RHINO - ENVIRONMENTAL IMPACT ASSESSMENT REPORT

Various Farms in the Free State Province

Prepared for: Rhino Oil and Gas Exploration South Africa (Pty) Ltd

Authority References:

PASA Reference: 12/3/318

RHINO RESOURCES

SLR

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Theo Wicks
(Project Manager)

Matthew Hemming
(Reviewer)

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EXECUTIVE SUMMARY

[Separate Document]

Rhino - Environmental Impact Assessment Report

1. INTRODUCTION

This chapter describes the purpose of this report, briefly describes the project, summarises the legislative authorisation requirements, provides the terms of reference for the Scoping and Environmental Impact Assessment process (S&EIA), and describes the structure of the report.

1.1 PROJECT BACKGROUND

In 2019, Rhino Oil and Gas Exploration South Africa (Pty) Limited (Rhino) was granted an Environmental Authorisation (EA) and Exploration Right (ER), permitting their exploration for natural gas using non-invasive techniques on various farms in the Magisterial District of Bultfontein, Wesselsbron, Welkom, Odendaalsrus, Wolmaransstad, Bothaville, Viljoenskroon, Kroonstad, Koppies & Heilbron, Free State and North-West Provinces (ER reference: 12/3/318). The extent of ER 318 as approved in 2019 is shown in Figure 1-1. Exploration was to be undertaken in terms of an approved Exploration Work Programme (EWP), over an initial period of three (3) years.

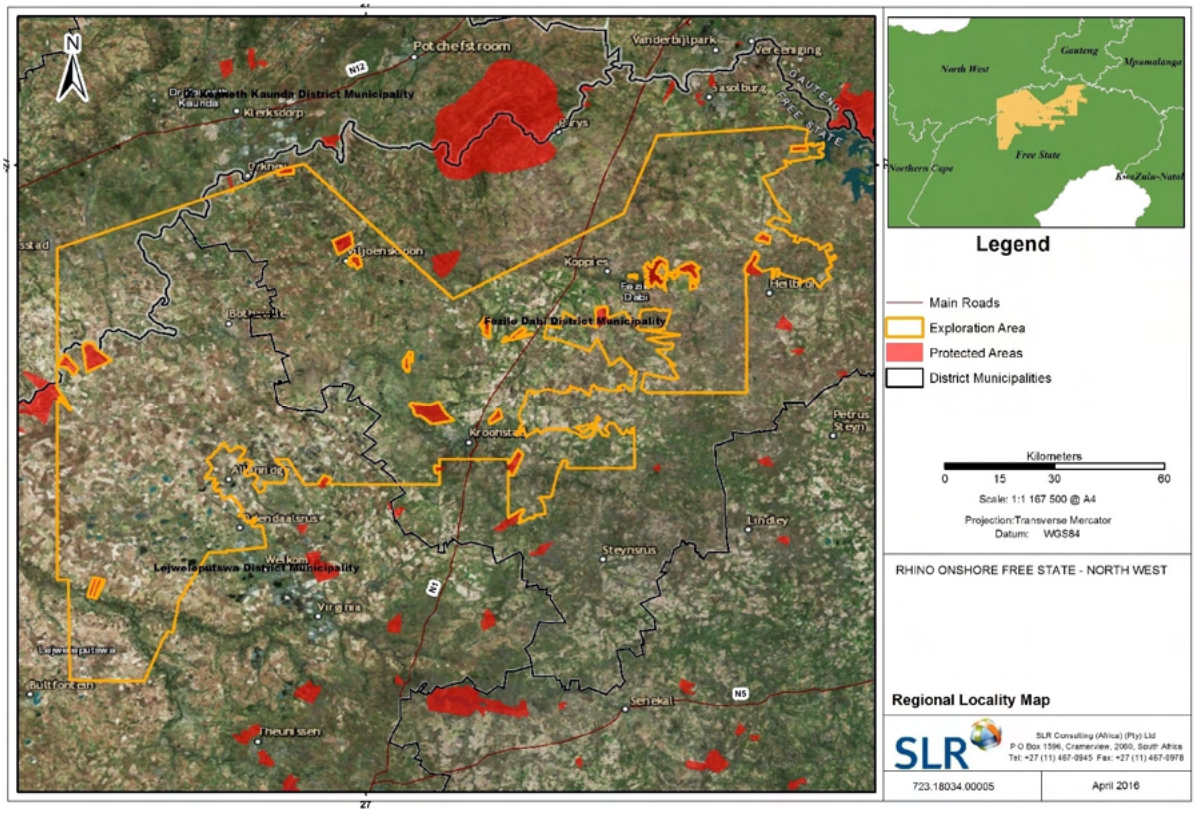

Figure 1-1: Original locality map showing extent of ER 318 (prior to any relinquishments)

Natural gas is found in underground rock formations, either in the naturally occurring fractures or in reservoir units, such as sandstones or coal beds, found within the formations. The gas generally consists primarily of methane (CH_4), but commonly includes varying amounts of other higher alkanes and sometimes

(usually a lesser percentage of) carbon dioxide, nitrogen, and/or hydrogen sulfide. Once extracted, natural gas is a versatile source of energy and one of the cleanest fossil fuels.

Rhino's initial EWP included for:

- The review of existing literature such as the positions of mapped hydrocarbon seeps (where hydrocarbon leaks to the surface through natural fissures and other geological features or exposed reservoir zones) and hydrocarbon shows, found during the drilling campaigns of SOEKOR and other exploration companies in the 1960-1980's (Year 1);
- Review of existing legacy geological, geophysical and geochemical datasets (Year 2);
- Procurement of geological core samples from the Council for Geoscience (Year 3);
- Acquisition of airborne geophysical data.

Over the course of the previous three years, the exploration and analysis undertaken by Rhino has furthered confidence regarding the presence of natural gases within the ER 318 area. Their intention is therefore to continue the exploration activities by renewing the ER for a further two (2) year duration and updating the EWP. The proposed addition to the EWP is for the drilling of several exploration wells to test for the presence, quantity and quality of gas within specific Target Areas within the current ER area (see Figure 1-2).

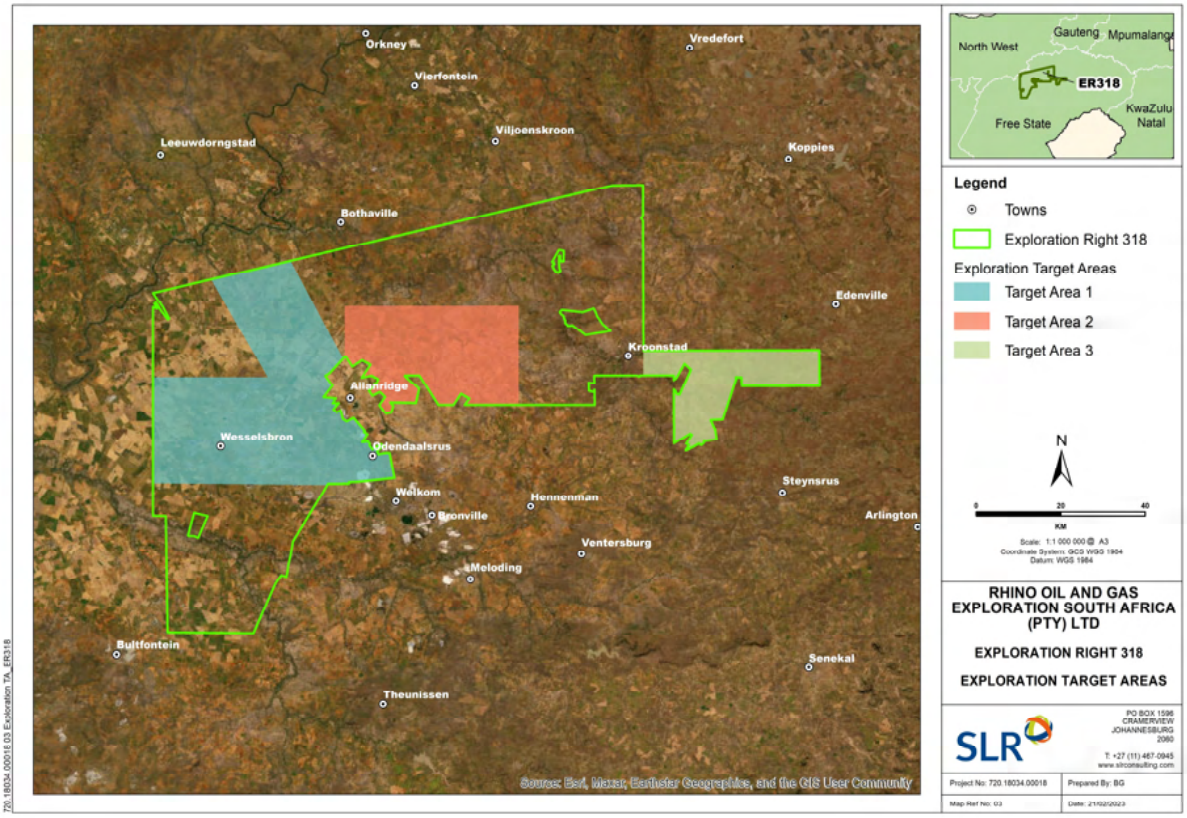

Figure 1-2: Locality of Rhino Oil and Gas's exploration well Target Areas within ER 318

Although Rhino holds an EA for exploration in the ER 318 area, the current EA is limited to the use of non-intrusive techniques as the drilling of wells was not considered in the previous EWP. In order to include well drilling in an updated EWP, it is necessary for Rhino to apply for, and obtain, further Environmental Authorisation in terms of Chapter 5 of the National Environmental Management Act, 1998 (No. 107 of 1998) (NEMA). As exploration activities conducted in terms of an ER are listed in Environmental Impact Assessment (EIA) Regulations Listing Notice 2, 2014 (Government Notice (GN) No. R984) an application for EA is required to be informed by a Scoping and Environmental Impact Assessment (S&EIA) process.

SLR Consulting (South Africa) (Pty) Ltd (SLR) has been appointed by Rhino as the independent Environmental Assessment Practitioner to compile an application for EA, to undertake an S&EIA process and to prepare the necessary reporting. Further detail regarding SLR is provided in Section 3.1.

1.2 OBJECTIVE AND PURPOSE OF THIS REPORT

This draft Environmental Impact Assessment (EIA) Report has been prepared as part of the S&EIA process that is being undertaken for the application by Rhino Oil and Gas for the proposed exploration well drilling activities in the ER 318 area. This report has been prepared in compliance with Appendix 3 and 4 of the EIA Regulations 2014 and is based on the Plan of Study presented in the final Scoping Report, which was accepted by the Department of Mineral Resources and Energy (DMRE) on 16 February 2023.

In accordance with Appendix 3 of the EIA Regulations 2014, *"the objective of the environmental impact assessment process is to, through a consultative process:*

- *a) determine the policy and legislative context within which the activity is located and document and how the proposed activity complies with and responds to the policy and legislative context;*
- *b) describe the need and desirability of the proposed activity, including the need and desirability of the activity in the context of the development footprint on the approved site as contemplated in the accepted scoping report;*
- *c) identify the location of the development footprint within the approved site as contemplated in the accepted scoping report based on an impact and risk assessment process inclusive of cumulative impacts and a ranking process of all the identified development footprint alternatives focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects of the environment;*
- *d) determine the -*
  - *i. nature, significance, consequence, extent, duration and probability of the impacts occurring to inform identified preferred alternatives; and*
  - *ii. degree to which these impacts—*
- *e) (aa) can be reversed; (bb) may cause irreplaceable loss of resources, and (cc) can be avoided, managed or mitigated;*
- *f) identify the most ideal location for the activity within the development footprint of the approved site as contemplated in the accepted scoping report based on the lowest level of environmental sensitivity identified during the assessment;*
- *g) identify, assess, and rank the impacts the activity will impose on the development footprint on the approved site as contemplated in the accepted scoping report through the life of the activity;*
- *h) identify suitable measures to avoid, manage or mitigate identified impacts; and*
- *i) identify residual risks that need to be managed and monitored."*

Interested and Affected Parties (I&APs) are invited to comment on this draft EIA Report (see Section 1.3).

The draft report will then be updated into a final version, giving due consideration to the comments received. The final EIA Report will then be submitted to the delegated authority, the Petroleum Agency of South Africa (PASA), for consideration and review. PASA will then make a recommendation on the granting or refusal of the Environmental Authorisation application to the DMRE, who will make the final decision.

1.3 OPPORTUNITY TO COMMENT AND ATTEND PUBLIC MEETINGS

This EIA Report is being distributed for a 30-day comment period from 24 April 2023 to 26 May 2023 to provide I&APs with an opportunity to comment on any aspect of the proposed project and the findings of the S&EIA process to date. Copies of the full report are available electronically on the SLR website (at **https://slrconsulting.com/za/slr-documents**) and in hard copy at the following locations:

Table 1-1: Location of facilities to access the draft Report.

Name of Facility	Physical Address and telephone number
Kroonstad Public Library	Address: Steyn Street, Kroonstad, 9499. Tel: 056 216 9911
Kroonstad Local Co-operative Senwes	Address: 9 10th Lane, Industria, Kroonstad. Tel: 056 216 0700
Steynsrus Public Library	Address: Matlwangtlwang, Steynsrus, 9515. Tel: 056 471 0006
Steynssrus: Moqhaka Local Municipality	Address: Van Riebeeck Street, Steynsrus, 9515. Tel: 056 216 9600
Welkom Public Library	Address: C/O Tulbagh and Reinett Street, Welkom, 9460 Tel: 057 391 3359
Welkom Local Co-operative Senwes	Address: 151 Jan Hofmeyer Road, 9460. Tel: 053 355 1731
Wesselsbron Public Library	Address: Erwee St, Wesselsbron, 9680. Tel: 057 899 1818
Wesselsbron Local Co-operative Senwes	Address: 10 Louis Kotze Street, 9680. Tel: 057 899 1851

Please send your comments to SLR at the address, telephone number or e-mail address shown below by no later than **26 May 2023** for them to be included in the final EIA Report. All comments received during the review process will be included in the final EIA Report.

SLR Consulting (South Africa) (Pty) Ltd
Attention: Theo Wicks or Amishka Mothilal
PO Box 1596, Cramerview 2060 (if using post please call SLR to notify us of your submission)
Tel: (011) 467 0945 / (067) 393 4496
E-mail: RhinoER318@slrconsulting.com

1.4 OVERVIEW OF ENVIRONMENTAL AUTHORISATION REQUIREMENTS

Rhino's exploration activities are being undertaken in terms of a series of sequential approval and authorisation processes based on the activities included in their EWP (see Figure 1-3):

- Further non-intrusive works (e.g. aerial surveys) will be undertaken in terms of the existing EA and approved Environmental Management Programme (EMPr) granted in 2019, via the pending ER renewal application made in terms of Section 81 of the MPRDA in January 2022; and
- Exploration well drilling and testing would be undertaken in terms of an EA and EMPr, which are the subject of the current EA application, made in terms of NEMA and submitted to PASA on 30 September 2022.

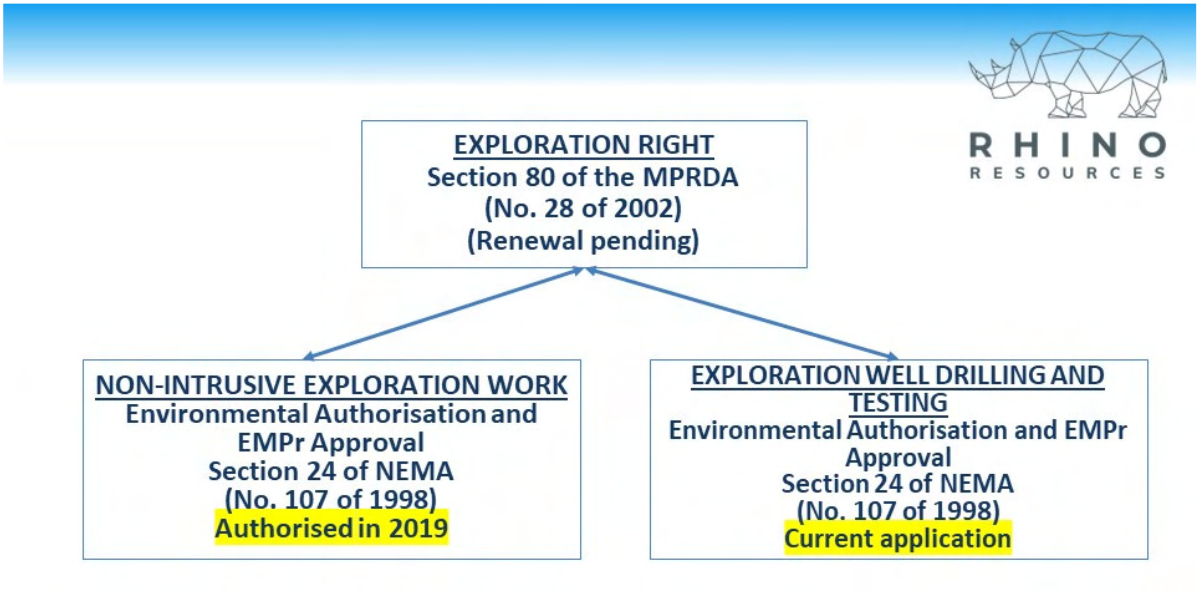

Figure 1-3: Overview of Rhino's Environmental Authorisation requirements

1.5 RELATED APPLICATIONS

Rhino is also the holder of ER 294, which is located to the east of ER 318. As with ER 318, Rhino has made application for the renewal of ER 294 and is also applying for a further EA in order to undertake well drilling. SLR is undertaking the S&EIA process for the ER 294 concurrently with the application in ER 318.

The drilling program proposed by Rhino would see activities being undertaken in both ERs concurrently.

1.6 TERMS OF REFERENCE

SLR, as the independent Environmental Assessment Practitioner (EAP), is responsible for undertaking the environmental regulatory process and conducting the public participation process. The terms of reference for the environmental regulatory process are to:

- make an application for Environmental Authorisation of the project in terms of NEMA;
- ensure the S&EIA is undertaken in accordance with the requirements of NEMA and the EIA Regulations 2014;
- ensure the S&EIA is undertaken in an open, participatory manner to ensure that all potential impacts are identified;
- undertake a formal public participation process, which includes the distribution of information to I&APs and provides the opportunity for I&APs to raise any concerns/issues, as well as an opportunity to comment on all S&EIA documentation; and
- integrate all the information into an Environmental Impact Assessment Report (EIAR) to allow the authorities to take an informed decision on the Environmental Authorisation.

1.7 STRUCTURE OF THIS REPORT

The structure and content of this report is summarised or set out in Table 1-2 below.

Table 1-2: Structure and Content of the EIA Report

Section	Contents
Executive Summary	Provides a synopsis of the EIAR.
Chapter 1	**Introduction** Provides a description of the project background and location, and describes the objectives, purpose and the structure of this report.
Chapter 2	**Administrative and Legal Framework** Outlines the key South African administrative authorities and legislative framework, international regulations and conventions, and Rhino standards and policies applicable to the proposed project and EIA-related guidelines considered in the compilation of the report.
Chapter 3	**Scoping & Environmental Impact Assessment Approach and Process** Presents the EIA Project Team, EIA assumptions and limitations, and outlines the approach and process followed during the EIA.
Chapter 4	**Public Participation Process** Presents and describes the public consultation process undertaken during the S&EIA process.
Chapter 5	**Need and Desirability** Provides an overview of the national and international policies informing the need and desirability for the project.
Chapter 6	**Project Description** Provides general project information and a detailed description of the proposed activities and associated project alternatives.
Chapter 7	**Description of Affected Environment** Describes the existing physical, biological, socio-economic and cultural environment that could potentially be affected by the proposed exploration activities.
Chapter 8	**Impact Description and Assessment** Describes and assesses the potential impacts of the proposed project on the affected environment. It also presents mitigation or optimisation measures that could be used to reduce the significance of any negative impacts or enhance any benefits, respectively.
Chapter 9	**Conclusion and Recommendations** Provides conclusions to the EIA and summarises the recommendations for the proposed project.
Chapter 10	**References**
Appendices	Appendix A: EAP undertaking Appendix B: Curricula Vitae (including registrations) of the Project Team Appendix C: Public Participation Process documentation Appendix D: Petroleum Exploration Well Drilling Application Area Appendix 4.1: Regulation 2(2) plan of the Well Drilling ER Application Area Appendix 4.2: List of properties within the Target Areas/Areas of Interest Appendix 4.3: Corner points of the Target Areas

Section	Contents	
	Appendix E:	Exploration Locality Plan
	Appendix F:	Specialist aquatic ecological impact assessment
	Appendix G:	Specialist terrestrial ecological impact assessment
	Appendix H:	Specialist cultural heritage impact assessment
	Appendix I:	Specialist palaeontological impact assessment
	Appendix J:	Specialist geohydrological impact assessment
	Appendix K:	Environmental Management Programme
	Appendix L:	Closure and Rehabilitation Plan

2. ADMINISTRATIVE AND LEGAL FRAMEWORK

This chapter outlines the South African administrative framework, key legislative requirements and other relevant local legislation and international conventions applicable to the proposed exploration activities and the S&EIA process.

2.1 SOUTH AFRICAN INSTITUTIONAL AND ADMINISTRATIVE FRAMEWORK

2.1.1 Overview of the "One Environmental System"

The "One Environmental System" commenced on 8 December 2014 removing the environmental regulation of prospecting, mining, exploration and production and related activities from the MPRDA and transferring it to NEMA. Under the "One Environmental System", the Minister of Mineral Resources (or delegated authority) is the competent authority responsible for issuing Environmental Authorisations in terms of NEMA for mining and petroleum related activities. The Minister of Environmental Affairs, however, remains the appeal authority for these authorisations.

2.1.2 Department of Mineral Resources and Energy

The DMRE is the public trustee of South Africa's mineral and petroleum resources. According to the MPRDA, read with the NEMA, the Minister of Mineral Resources (or designated authority) is responsible for the following:

- Approving or refusing an Environmental Authorisation on the basis of environmental reporting prepared in terms of Chapter 5 of the NEMA as part of Exploration or Production Right applications;
- Granting or refusing Exploration Rights and Production Rights; and
- Prescribing and levying any fee, in consultation with the Minister of Finance, payable in terms of the MPRDA.

The Minister is required to consider environmental policy, norms and standards, while promoting economic and social development, in order to ensure that the development of South Africa's mineral and petroleum resources is undertaken in a sustainable manner.

2.1.3 Petroleum Agency of South Africa

In terms of Section 70 of the MPRDA, the Minister of Mineral Resources and Energy in June 2004, designated various duties pertaining to petroleum exploration and production to PASA. Section 71 of MPRDA deals with the functions of the designated agency. Functions include the receipt of applications for different types of permits and rights (Section 71i), some of which require Environmental Authorisations. Section 71(i) provides that the designated agency must review and make recommendations to the Minister with regards to the acceptance of environmental reports and the conditions of Environmental Authorisations and amendments thereto.

PASA is responsible for promoting the exploration of oil and gas resources (Section 71a) and the optimal development thereof on behalf of the South African government. As such, PASA deals with the regulation and monitoring of exploration and production activities and endeavours to make sure that all such activities have long-term economic benefit for South Africa. In addition, PASA is the custodian of the national exploration and production database for petroleum.

2.1.4 Department of Forestry, Fisheries and the Environment

Department of Forestry, Fisheries and the Environment (DFFE) is the custodian of environmental matters and is tasked with ensuring protection of the environment and conservation of natural resources in the context of sustainable development. DFFE is responsible for the administration of applications for and the issuing of Environmental Authorisations in terms of NEMA and the EIA Regulations 2014, excluding applications related to mining and petroleum for which DMRE is the competent authority. The Minister of Forestry, Fisheries and the Environment, however, remains the competent authority for dealing with appeals in respect of environmental authorisation decisions for mining and petroleum applications and serves as the appeals administrator.

2.1.5 South African heritage Resources Agency

The South African Heritage Resources Agency (SAHRA) is a statutory organisation established under the National Heritage Resources Act, 1999 (No. 25 of 1999), and serves as the national administrative body responsible for the protection of South Africa's cultural heritage.

SAHRA is responsible for establishing national principles, standards and policy for the purposes of identifying, recording and managing the national estate. SAHRA also manages South Africa's national cultural heritage, identifies and keeps record of nationally significant heritage resources and provides expertise to provincial and local heritage authorities where required.

2.2 SOUTH AFRICAN LEGISLATION

2.2.1 Constitution of the Republic of South Africa

In terms of Section 24 of the Constitution of South Africa, 1996 (No. 108 of 1996) (the Constitution), *"everyone has the right:*

- *a) to an environment that is not harmful to their health or well-being; and*
- *b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that;*
  - *i. Prevent pollution and ecological degradation;*
  - *ii. Promote conservation; and*
  - *iii. Secure ecologically sustainable development and use of natural; resources while promoting justifiable economic and social development".*

The NEMA was gazetted to give specific effect to these rights and provides for the incorporation of environmental considerations in decision-making. It applies alongside the State's responsibility to respect, protect, promote and fulfil the social and economic rights in Chapter 2 of the Constitution, together with the basic needs of categories of persons disadvantaged by unfair discrimination.

The MPRDA gives effect to Section 24 of the Constitution by ensuring that South Africa's mineral and petroleum resources are developed in an orderly and ecologically sustainable manner while promoting justifiable social and economic development.

The above Acts and other laws listed below are the statutes in terms of which authorisation / approval is required in order for Rhino to undertake the proposed exploration activities. These laws govern the legal

requirements, the application processes to be followed and stipulate where exploration activities may or may not occur.

2.2.2 Minerals and Petroleum Resources Development Act, 2002

The MPRDA is the principal legislation governing prospecting and mining and the exploration and production of oil and natural gas. The Act provides for the equitable access to and sustainable development of mineral and petroleum resources. The MPRDA Regulations (GN R527 of 2004) provide for the application for and issuing of Reconnaissance Permits, Prospecting Rights, Exploration Rights, Mining Rights and Production Rights.

In addition to providing for the application for and issuing of rights and permits, the MPRDA provides for the renewal of rights and permit. Exploration Right are valid for a period not longer than 3-years and are then renewable through Section 81 of the MPRDA for a maximum of three periods not exceeding two years each. In terms of Section 102 of the MPRDA, an ER, EWP, EA or EMPr, may not be amended without the approval of the Minister (of Minerals and Energy).

Since 8 December 2014, environmental regulation of prospecting, mining, exploration and production and related activities was removed from the MPRDA and transferred to NEMA, as set out in Section 2.2.3 below. As stated above, the Minister of the DMRE is the competent authority that authorises an application for an Environmental Authorisation, while the Minister of Forestry, Fisheries and the Environment remains the appeal authority for such an authorisation.

As noted previously, Rhino currently hold Exploration Right 12/3/318 (see Section 1.1) and have made application to renew the ER in terms of Section 81 of the MPRDA (see Section 1.4).

2.2.3 National Environmental Management Act, 1998

Chapter 2 of NEMA sets out a range of environmental and social principles that are to be applied by all organs of state when taking decisions that significantly affect the environment. Included amongst the key principles is that all development must be socially, economically and environmentally sustainable. It requires that environmental management must place people and their needs at the forefront of its concern, and must serve their physical, psychological, developmental, cultural and social interests equitably. NEMA also provides for the participation of I&APs and stipulates that decisions must consider the interests, needs and values of all of them.

Chapter 5 of NEMA outlines the general objectives and implementation of Integrated Environmental Management (IEM), which provides a framework for the integration of environmental issues into the planning, design, decision-making and implementation of plans and development proposals. Section 24 of the NEMA provides a framework for the granting of an Environmental Authorisation. In order to give effect to the general objectives of IEM, the potential impacts on the environment of listed activities must be considered, investigated, assessed and reported on to the competent authority. Section 24(4) provides the minimum requirements for procedures for the investigation, assessment and communication of the potential impact of activities.

The EIA Regulations 2014 (as amended) promulgated in terms of Chapter 5 of NEMA and published in Government Notice (GN) No. R982, provide for the control of certain listed activities. These activities are listed in GN No. R983 (Listing Notice 1), R984 (Listing Notice 2) and R985 (Listing Notice 3) of 4 December

2014 (as amended) and are prohibited until an Environmental Authorisation has been obtained from the competent authority. The Minister of Mineral Resources and Energy (the Minister) is responsible for the granting or refusing of an Environmental Authorisation for the application to undertake exploration activities in terms of the NEMA. Such Environmental Authorisation, which may be granted subject to conditions, will only be considered once there has been compliance with GN No. R982. For oil and gas exploration, the responsibility for processing applications has been delegated to PASA (see Section 2.1.2). However, DMRE remains the competent authority for the Environmental Authorisation decision-making.

The EIA Regulations, 2014 sets out the procedures and documentation that need to be complied with when applying for an Environmental Authorisation. A Basic Assessment process must be undertaken if the authorisation applied for is in respect of an activity or activities listed in Listing Notice 1 and/or 3, while an S&EIA process (scoping and impact assessment) must be undertaken if the authorisation applied for is in respect of an activity or activities listed in Listing Notice 2.

The proposed exploration project triggers activities contained in both Listing Notice 1 and 2 (see Table 2 1), thus an S&EIA process must be undertaken for PASA and DMRE to consider the application. As noted previously, Rhino have made application for an EA in terms of Section 24 of the NEMA (see Section 1.4).

Table 2-1: List of applicable activities in terms of Listing Notice 1 and 2

No	Activity Description	Applicability in relation to the proposed project
Listing Notice 1 (as amended by GN No. 327 of April 2017)		
21D	Any activity including the operation of that activity which requires an amendment or variation to a right or permit in terms of section 102 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity contained in this Listing Notice or in Listing Notice 3 of 2014, required for such amendment.	Rhino currently holds an exploration right for ER 318 which limits their work programme to non-invasive and desktop exploration activities. To undertake the proposed well exploration and to further the EWP, it is necessary for Rhino to amend their existing ER in terms of Section 102 of the MPRDA.
Listing Notice 2 (as amended by GN No. 325 of April 2017)		
18	Any activity including the operation of that activity which requires an exploration right as contemplated in section 79 of the Mineral and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002), including - (a) associated infrastructure, structures and earthworks; or (b) the primary processing of a petroleum resource including winning, extraction, classifying, concentrating or water removal; but excluding the secondary processing of a petroleum resource, including the	Rhino is proposing to drill several exploration wells within identified Areas of Interest. Since the activity (namely drilling) requires an Exploration Right (although Rhino already holds an Exploration Right for ER 294) and drilling was not previously authorised, this activity is deemed applicable.

No	Activity Description	Applicability in relation to the proposed project
	beneficiation or refining of gas, oil or petroleum products in which case activity 5 in this Notice applies.	

In terms of Section 24P of NEMA, where prescribed, an applicant for an Environmental Authorisation relating to exploration, must, before the Competent Authority issues an Environmental Authorisation, determine the financial provision, which is required for undertaking progressive rehabilitation, decommissioning, closure and post-closure activities. Financial Provisions were previously determined in terms of Section 41 the MPRDA, and post implementation of the 'One Environmental System' in terms of NEMA. The Regulations pertaining to Financial Provision (GNR No. R1147 of 2015, as amended) set out the methods for determining and making Financial Provision to guarantee the availability of sufficient funds to undertake rehabilitation and remediation of the adverse environmental impacts caused by exploration.

Transitional arrangements in the Financial Provision Regulations provide various time extensions for compliance to the applicants and holders of rights in respect of petroleum. A financial provision, calculated in terms of the MPRDA, is in place for ER 318 and the previously approved EWP. This will require review and update to provide for the proposed exploration well drilling. Refer to Section 8.2.1 for further detail on the Financial Provision for this project.

2.2.4 National Environmental Management: Waste Act, 2008

The National Environmental Management: Waste Act, 2008 (No. 59 of 2008) (NEM:WA) regulates all aspects of waste management and has an emphasis on waste avoidance and minimisation. NEM:WA creates a system for listing and licensing waste management activities which may have a detrimental effect on the environment. Residues arising from petroleum exploration and production are regulated in terms of the NEM:WA.

Listed waste management activities (GN R 921, November 2013) above certain thresholds are subject to an impact assessment and licensing process prior to being commenced, undertaken or conducted. The assessment and reporting process in support of a Waste Management Licence application must be undertaken in accordance with the EIA Regulations, 2014. These Regulations define the requirements for the submission; processing, consideration and decision of applications authorisation of listed activities (refer to Section 2.2.3). Activities listed in Category A require a Basic Assessment process, while activities listed in Category B require a S&EIA process in order for authorities to consider an application in terms of NEM:WA.

While waste material (e.g. drill cuttings/muds) will be generated and stored during well drilling, the updated EWP does not trigger any activities listed in Category A or B and thus there is no requirement for a Waste Management Licence. This interpretation is based on the operating protocol that drill cuttings/muds would be placed into above-ground skips (i.e. not excavated sumps) and that wastes would be removed from site in less than 90 days from generation. Wastes removed from site would be directed to appropriately licensed waste managed facilities.

2.2.5 National Environmental Management: Air Quality Act, 2004

The National Environmental Management: Air Quality Act, 2004 (No. 39 of 2004)(NEM:AQA) regulates all aspects of air quality, including: prevention of pollution and environmental degradation; providing for national norms and standards (through a National Framework for Air Quality Management) regulating air quality monitoring, management and control; and licencing of activities that result in atmospheric emissions and have or may have a significant detrimental effect on the environment.

In terms of Section 22 of NEM:AQA no person may conduct a listed activity (as per GN R 893, 22 November 2013) without an Atmospheric Emission Licence (AEL).

The proposed well drilling activities in the updated EWP do not trigger any activity set out in the listing notice and thus there is no requirement for an Atmospheric Emissions Licence.

2.2.6 National Heritage Resources Act, 1999

The National Heritage Resources Act, 1999 (No. 25 of 1999) (NHRA) provides for the identification, assessment and management of the heritage resources of South Africa. The NHRA requires that a person who intends to undertake a listed activity notify the relevant provincial heritage authority at the earliest stages of initiating such a development. The relevant provincial heritage authority would then, notify the person whether a Heritage Impact Assessment (HIA) should be submitted.

Section 38(1) of the NHRA lists development activities that would require authorisation by the responsible heritage resources authority. The proposed well drilling activities in the updated EWP do not trigger any activity set out in this section of the NHRA and thus there is no requirement for approval from the heritage authority.

2.2.7 National Water Act, 1998

The National Water Act, 1998 (No. 36 of 1998) (NWA) provides a legal framework for the effective and sustainable management of water resources in South Africa. It serves to protect, use, develop, conserve, manage and control water resources as a whole, promoting the integrated management of water resources with the participation of all stakeholders. This Act also provides for national norms and standards, and the requirement for authorisation (either a Water Use Licence or General Authorisation) of water uses listed in Section 21 of the Act. This includes uses such as abstraction, storage, discharge and disposal amongst others for which a Water Use Licence must be obtained. The Department of Water and Sanitation (DWS) has published Regarding the Procedural Requirements for Water Use Licence Applications and Appeals which set out the process and reporting requirements where a water use licence (WUL) is required. The Minister has published various General Authorisations (GA), which replace the need for a water user to apply for a licence in terms of the NWA, provided that the water use is within the limits and conditions of GA.

Section 37 of the NWA lists controlled activities for which authorisation is required. The Minister of Water and Sanitation declared "*the exploration and or production of onshore naturally occurring hydrocarbons that requires stimulation, including but not limited to hydraulic fracturing and or underground gasification, to extract, and any activity incidental thereto that may impact detrimentally on the water resource*" (GN No. 999 of 2015) as a controlled activity in terms of section 38(1) of the NWA. The proposed well drilling activities in the updated EWP do not include for stimulation of naturally occurring hydrocarbons and as a result do not trigger this water use activity as set out in Section 21 of the NWA, nor a controlled activity.

The proposed well drilling will require the use and storage of water for specific activities. Such water will be obtained commercially, or if taken from a water resource limited to volumes less than the regulated limits. Storage of input water for the activities would be in water bowsers or tanks. The water abstraction and storage activities proposed as part of the exploration process would be subject to controls on the volumes, quality and activities. Dirty water generated during drilling would be in the form of drilling muds which would be contained in skips and removed for disposal to an appropriately licensed facility. Well testing may generate produced water which would be temporarily contained in tanks prior to management. Disposal of produced water would be at an appropriately licensed facility. These activities are not anticipated to constitute water uses as set out in Section 21 of the NWA.

Certain of the proposed exploration activities could be located within the "regulated area of a watercourse" as defined in the GA (GN. 509 of 2016) thereby necessitating consideration of Section 21 (c) and (i) water uses. A 21(c) use requires the impedance or divergence of the instream flow of a watercourse. A 21(i) use requires alteration of the "*bed, banks, course or characteristics of a watercourse*". The proposed well drilling activities would, by design, be located >200m from watercourses and could not alter instream flow nor the bed, banks or course of any watercourse. Given the nature and method, location, limited extent and short duration of the proposed well drilling activities it is considered unlikely that there would be a detectable influence on the characteristics of a watercourse. Thus there is no requirement for a Water Use Licence.

2.2.7.1 REGULATIONS ON USE OF WATER FOR MINING AND RELATED ACTIVITIES AIMED AT THE PROTECTION OF WATER RESOURCES

The Regulations (GN. 704 of 1999) prescribe the minimum requirements to fulfil the goals of the protecting, using, developing, conserving, managing and controlling water resources of around mines on a sustainable basis. Key requirements include restrictions on the locality of residue facilities (1:100 year flood line or > horizontal 100 m from watercourses, borehole or well), restrictions on the use of residue materials likely to cause pollution, provide systems for the separation of clean and dirty water and taking reasonable measures to protect water resources. Activities to implement the EWP would be undertaken with due consideration of GN 704.

2.2.8 National Environmental Management: Protected Areas Act, 2003

The National Environmental Management: Protected Areas Act, 2003 (No. 57 of 2003) (NEM:PAA), as amended, provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. Section 48 of the NEM:PAA sets out that "despite other legislation, no person may conduct commercial prospecting, mining, exploration, production or related activities –

a) in a special nature reserve, national park or nature reserve;
b) in a protected environment without the written permission of the Minister and the Cabinet member responsible for minerals and energy affairs; or
c) in a protected area referred to in section 9(b), (c) or (d)."

The ER, and the proposed target areas within the ER, exclude all areas protected in terms of NEM:PAA (in so far as the available information is accurate). See Sections 5.2.2.1 and 6.9.1 for further information on protected areas.

2.2.9 National Environmental Management: Biodiversity Act, 2004

National Environmental Management: Biodiversity Act, 2004 (No. 10 of 2004) (NEM:BA) provides for the management and conservation of South Africa's biodiversity and the protection of species and ecosystems that warrant national protection.

NEM:BA regulates restricted activities that may harm listed threatened or protected species or activities that encourage the spread of alien or invasive species. NEM:BA also makes provision for the publication of bioregional plans and the listing of ecosystems and species that are threatened or in need of protection. Within the published bioregional (spatial) plan, terrestrial and aquatic features that are critical for conserving biodiversity and maintaining ecosystem functioning are indicated as Critical Biodiversity Areas (CBAs). Bioregional plans provide the guidelines for avoiding the loss or degradation of natural habitat in CBAs with the aim of informing EIAs and land-use planning, including Environmental Management Frameworks (EMFs), Spatial Development Frameworks (SDFs) and Integrated Development Plans (IDPs).

Chapter 3 of the "Guideline regarding the determination of bioregions and the preparation of and publication of bioregional plans" requires environmental decision-makers who are required by NEMA to apply the NEMA Section 2 principles in their decision-making to consider, amongst other things, sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands and similar systems, which require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure. CBAs identified in a bioregional plan should be considered to be such areas and should, therefore, be considered by decision-makers in the course of the decision-making process. Thus, bioregional plans should be considered by competent authorities in their decision-making regarding an application for Environmental Authorisation.

Proposed exploration well sites would be sited outside of indigenous vegetation when located within defined CBA areas. The requirements of NEM:BA are not applicable to the well drilling application as no activities are proposed that trigger NEM:BA obligations.

Alien and Invasive Species Regulations (GN R 598 of 2014) as well as the Alien and Invasive Species List (GN R 864 of 2016) have been published to regulate the monitoring, control and eradication for listed invasive species. The Regulations are effective from 1 October 2014 and it is therefore necessary for all land owners on whose land alien and invasive species occur to make the necessary arrangements to be compliant with these Regulations. This may include studies to identify the existence of alien and invasive species, the determination of the category in the Alien and Invasive Species List and the implementation of programmes to combat or control such species. During site rehabilitation cognisance would be given to the management of alien and invasive species.

2.2.10 World Heritage Convention Act, 1999

The World Heritage Convention Act, 1999 (No. 49 of 1999) (WHCA) provides for the incorporation of the World Heritage Convention into South African law, enables the establishment of World Heritage Sites and provides for the management thereof to safeguard the integrity of World Heritage Sites.

World Heritage Sites are recognised as a protected area in terms of Section 9 of the NEM:PAA (refer to Section 2.2.8) and are therefore excluded from the Well Drilling ER application area.

2.3 OTHER LEGISLATION CONSIDERED IN THE PREPARATION OF THIS SCOPING REPORT

Table 2-2 below provides a summary of the additional legislative with potential relevance to the project.

Table 2-2: Legal Framework

Applicable legislation and guidelines	Relevance or reference
National Forests Act, 1998 (No 84 of 1998)	This Act provides for the sustainable management and development of forests for the benefit of all, including providing special measures for the protection of certain forests and trees. Licensing is required for the destruction of certain indigenous trees. The proposed project would not entail any activities to which the Act applies.
Mountain Catchment Areas Act, 1970 (No 63 of 1970)	This Act provides for the conservation, use, management and control of land situated in mountain catchment areas. The proposed project would not entail any activities to which the Act applies.
Conservation of Agricultural Resources Act (No. 43 of 1983) (CARA) and the Conservation of Agricultural Resources Act Regulations, 1984 (GN No. 1048)	The CARA provides for control over the utilization of the natural agricultural resources in order to promote the conservation of the soil, water sources, vegetation and the combating of weeds and invader plants. Landowners on whose land declared weed species occur must make the necessary arrangements to be compliant with the CARA Regulations.
Occupational Health and Safety Act, 1993 (No. 85 of 1993) and Major Hazard Installation Regulations	This Act provides for the health and safety of persons at work and the protection of persons other than persons at work against hazards to health and safety arising out of or in connection with the activities of persons at work. Every employer shall provide and maintain, as far as is reasonably practicable, a working environment that is safe and without risk to the health of his employees. The applicant will need to ensure compliance with the requirements of the Act during both construction and operations. Such requirements are not considered in the EIA.
The Spatial Planning and Land Use Management Act, 2013 (No. 6 of 2013) (SPLUMA)	SPLUMA aims to develop a new framework to govern planning permissions and approvals, sets parameters for new developments and provides for different lawful land uses in South Africa. SPLUMA is a framework law, which means that the law provides broad principles for a set of provincial laws that will regulate planning. SPLUMA also provides clarity on how planning law interacts with other laws and policies. Such requirements are not considered in the EIA.
Subdivision of Agricultural Land Act, 1970 (No. 70 of 1970)	The Subdivision of Agricultural Land Act, 1970 critically defines the zoning of agricultural land and the restricts the subdivision of land parcels subject to approval.

2.4 GUIDELINES, POLICIES, PLANS AND FRAMEWORKS

The guidelines, polices, plans and frameworks listed below (Table 2-3) have been or will be taken into account during the S&EIA process.

Table 2-3: Guideline and Policy Framework

Guideline	Governing body	Applicability
Specialist Studies, Integrated Environmental Management, Information Series 4 (2002)	DFFE	This guideline was consulted to ensure adequate development of terms of reference for specialist studies.
Impact significance, Integrated Environmental Management, Information Series 5 (2002)	DFFE	This guideline was consulted to inform the assessment of significance of impacts of the proposed project.
Cumulative Effects Assessment, Integrated Environmental Management, Information Series 7 (2004)	DFFE	This guideline was consulted to inform the consideration of potential cumulative effects of the proposed project.
Criteria for determining Alternatives in EIA, Integrated Environmental Management, Information Series 11 (2004)	DFFE	This guideline was consulted to inform the consideration of alternatives.
Environmental Management Plans, Integrated Environmental Management, Information Series 12 (2004)	DFFE	This guideline was consulted to ensure that the Environmental Management Programme (EMPr) is adequately compiled.
Environmental Impact Reporting, Integrated Environmental Management, Information Series 15 (2004)	DFFE	This guideline was consulted to inform the approach to impact reporting.
Guideline on Need and Desirability (2017)	DFFE	This guideline informed the consideration of the need and desirability aspects of the proposed project.
Public Participation Guideline in terms of NEMA (2017)	DFFE	The purpose of this guideline is to ensure that an adequate public participation process is undertaken during the S&EIA process.
National Development Plan 2030	National Planning Commission	The National Development Plan 2030 (NDP) is the overarching development planning policy for the country, to which all other development planning, in particular spatial planning, must be aligned. The NDP outline South Africa's Vision and provides the Framework for eliminating poverty and reducing inequality by 2030.

Guideline	Governing body	Applicability
Medium-Term Strategic Framework (MTSF) 2019-2024	National Planning Commission	Provides Government's Strategic Plan for the 2019-2024 electoral term.
Integrated Development Plans and Spatial Development Frameworks (various dates) for the District Municipalities.	District Municipalities	The IDP and SDFs of the relevant municipalities will be examined and relevant information will be included in the EIA report.

2.5 RHINO ESG AND OPERATIONAL STATEMENT

Hydraulic fracturing, also called fracking, hydrofracking, and hydrofracturing, is a technique typically used for the exploitation of shale oil and gas resources, involving the fracturing of formations by a pressurized liquid. The process involves the high-pressure injection of "fracking fluid" (primarily water, containing sand or other proppants suspended with the aid of thickening agents) into a wellbore to create new cracks in the deep-rock formations through which natural gas, petroleum, and brine can flow more freely.

While South Africa continues to explore the use of hydraulic fracturing through the development of policy and specific regulations, Rhino has publicly confirmed that their corporate strategy will not include exploring for shale oil or gas and therefore will not use hydraulic fracturing as part of their planned exploration.

Rhino Oil and Gas Exploration South Africa (Pty) Ltd.

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8000

Cell: +27 82 337 0804
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Website: www.rhinoresourcesltd.com

Vrystaat Landbou
4 Nobel Straat,
Brandwag, Bloemfontein,
9300

11 February 2022

RE: Hydraulic Fracture Completion of Wells

Dear Mr Wilken,

This statement is made in relation to the exploration activities of Rhino Oil & Gas Exploration South Africa under Exploration Rights 294, 318 and 350 within South Africa.

Rhino Oil & Gas Exploration South Africa has no ambition or interest in undertaking shale gas exploration and/or the associated use of hydraulic fracture stimulation as a completion methodology to extract resources, a position reinforced by our values and punctuated by the lack of benefit that activity would create. The directors and management have set a clear mandate for the company to pursue strategic growth aligned with the UN Sustainable Development Goals. This is consistent with the ESG position of the entire Rhino corporate structure including the ultimate parent Rhino Holdings SCSp and their investors and shareholders. Technically, we believe there is no benefit to hydraulic fracturing, as the shallow target intervals are unlikely to isolate and contain an induced fracture set. In addition, the low-pressure gas held in any potential target would be unattractive to monetize thereby making the activity pointless.

We are excited to play a role in South Africa's transition towards affordable and reliable low-carbon energy, while contributing to the economic development of communities and protecting the environments in which we are privileged to operate.

Please do not hesitate to reach out to Mr. Smithard for any further information that you may require at this time.

Yours faithfully,

Travis Smithard
Director
Rhino Oil & Gas Exploration South Africa

Cornelis Timmermans
Director
Rhino Holding SCSp Limited

Figure 2-1: Copy of Rhino corporate statement

3. SCOPING AND ENVIRONMENTAL IMPACT ASSESSMENT APPROACH AND PROCESS

This chapter outlines the assessment methodology and I&AP consultation process that has and will be followed in the S&EIA process.

3.1 DETAILS OF THE EIA PROJECT TEAM

SLR has been appointed as the independent EAP to undertake the S&EIA for the activities proposed by Rhino. The details of the EAP project team that are undertaking this S&EIA are provided in Table 1-1.

SLR has no vested interest in the proposed project other than fair payment for consulting services rendered as part of the S&EIA process and has declared its independence as required by the EIA Regulations, 2014. An undertaking by the EAP is provided in Appendix A.

Table 3-1: Details of the EIA Project Team and Specialists

Company	Name	Qualifications and Registrations	Years of Experience	Role
EIA Project Team				
SLR Consulting	Matthew Hemming	M.Sc. (Conservation Biology) University of Cape Town SACNASP – (Professional Natural Scientist) EAPASA (1107), IWMSA, Member IAIAsa	17	**Principal Environmental Consultant** Management of the S&EIA process, including public consultation, process review, specialist study review and report compilation.
	Theo Wicks	M. Phil. (Environmental Management). University of Stellenbosch Member IAIAsa	14	**Associate Environmental Consultant** Management of the S&EIA process, including public consultation, process review, specialist study review and report compilation.
	Amishka Mothilal	BSc Hons (Environmental Management). University of South Africa Member IAIAsa SACNASP - Certificated Natural Scientist	6	**Senior Environmental Consultant** Assisting with the management of the S&EIA process, including public consultation, process review, specialist study review and report compilation.
	Michael Van Niekerk	M.Sc. (Geography). University of KwaZulu-Natal Member IAIAsa	15	**Associate Climate Change Specialist** Inputs into the evaluation of impacts

Company	Name	Qualifications and Registrations	Years of Experience	Role
	Londeka Zulu	BSc Hons (Geography and Env Management) Member IAIAsa	1	**Environmental Consultant** Assisting with the management of the S&EIA process, including public consultation, process review, specialist study review and report compilation.
Specialist Team				
Eco-Pulse	Ryan Kok	Wetland & Terrestrial Scientist M.Sc. (Biological & Ecological Science) SACNASP – Certificated Ecological Science	6	**Wetland & Terrestrial Scientist** Design and management of the impact assessment, field investigations and survey, impact assessment, report compilation.
	Shaun McNamara	Wetland & Aquatic Scientist M.Sc. (Geography and Fluvial Geomorphology)	6	**Wetland & Aquatic Scientist** Design and management of the impact assessment, field investigations and survey, impact assessment, report compilation.
	Angelique Lazarus	Terrestrial Ecologist	3	**Terrestrial Ecologist** Design and management of the impact assessment, field investigations and survey, impact assessment, report compilation.
PGS Heritage	Wouter Fourie	Professional Archaeologist and accredited with the Principal Investigator; Accredited Professional Heritage Practitioner with the Association of Professional Heritage Practitioners (APHP).	25	**HIA Project Coordinator** Design and management of the impact assessment, desktop research and investigation, survey supervisor, impact assessment, report compilation.
	Nikki Mann	MSc (Archaeology) University of Cape Town. Professional Archaeologist with the Association of Southern African Professional Archaeologists (ASAPA).	5	**HIA Specialist** Desktop research and investigation, impact assessment, report compilation.
	Matt Lotter	Geoarchaeologist based at the University of Johannesburg	12	**Field technician** Desktop research and field investigation

Company	Name	Qualifications and Registrations	Years of Experience	Role
JG Afrika	Robert Schapers	BSc Hons (Geohydrology) University of the Free State SACNASP – Certificated Pr.Sci.Nat 400041/12 Ground Water Division – Professional Member (59/23)	27	**Geohydrological lead** Design and management of the impact assessment, desktop research and investigation, survey supervisor, ground water modelling, impact assessment, report compilation.
	Bheki Sibande	N6 - Central Johannesburg College Health & Safety Officer – Action Training Academy Certificate in SASS training (Groundtruth Aquatics)	11	**Field technician** Field investigation, water quality sampling and hydrocensus.
Marion Bamford Consulting	Marion Bamford	PhD (Palaeontology) University of the Witwatersrand. FRSSAf, mASSAf	34	**Palaeobotanist** Desktop research and investigation, impact assessment, report compilation.
GCS Environmental	Magnus van Rooyen	M. Phil. (Environmental Management). University of Stellenbosch SACNASP - Professional Natural Scientist) EAPASA Member IAIAsa	18	**Closure planning** Preparation of the closure plan, including preliminary rehabilitation plan and calculation of the required financial provision

Profiles of the key EIA project team members are provided below:

Matthew Hemming holds a Master's Degree in Conservation Biology and has over 17 years of experience in a range of environmental disciplines, including EIAs, EMPs, Environmental Auditing and Monitoring in South Africa. He has expertise in a wide range of projects, including oil / gas, mining and infrastructure. Matthew is a Registered Professional Natural Scientist and a registered Environmental Assessment Practitioner and is also a member of the International Association of Impact Assessment, South Africa (IAIAsa).

Theo Wicks holds a Master's Degree in Environmental Management and has more than 15 years of cross cutting experience including the preparation of assessments for the oil and gas industries, the power sector, civil infrastructure developments, waste management, private sector commercial development and the mining sector. Theo is a member of the IAIAsa.

Amishka Mothilal is a Senior Environmental Consultant at SLR with over 6 years of experience in environmental consulting, project management and community engagement. She holds an Honours Degree in Environmental Management and has experience in a range of sectors including upstream and downstream oil and gas, infrastructure, mining and power. Amishka is a Registered Certificated Natural Scientist and is a member of the IAIAsa.

Relevant curricula vitae of the EIA Project Team (including proof of registrations) are attached in Appendix B.

3.2 ASSUMPTIONS AND LIMITATIONS

The assumptions and limitations pertaining to this S&EIA are listed below:

- SLR assumes that it has been provided with all relevant project information and that it was correct and valid at the time it was provided;
- Gas exploration is a dynamic and responsive process which is not easily accommodated within the framework of an S&EIA process. To facilitate integrated environmental management of the activities, while accommodating the iterative nature of exploration, the EIA has assessed the impacts of wells, both at defined locations and generic well sites. It is assumed that the assessment of the defined locations has resulted in sufficiently representative information, such that the assessment of generic well sites can reasonably be considered representative. This assumption is supported and caveated by the application of the same specified criteria to determine future well locations as was used to select current well locations (see Section 5.2).
- The indicative technical specifications for well drilling are based on generic industry information and previous drilling campaigns and may vary slightly from well to well. It is assumed that the technical specifications on which this EIA is based are roughly equivalent to that which will be used during the proposed future drilling campaign;
- There will be no significant changes to the project description or surrounding environment between the completion of the S&EIA process and implementation of the proposed project that could substantially influence findings and recommendations with respect to mitigation and management, etc.
- The S&EIA considers the assessment of activities proposed as part of the additional exploration activities, but does not aim to identify or assess the impacts or benefits of possible future exploration or production activities or outcomes; and
- The EIA Regulations, 2014 require the consideration of the “cumulative impact”, which includes the ‘reasonably foreseeable future impact of an activity’. Cumulative impacts of the proposed activities, in the context of other exploration activities, will be considered in the S&EIA, to the extent that this is feasible and 'reasonably foreseeable'. While it is foreseeable that further exploration and future production activities could arise from the proposed exploration activities (if granted), there is not currently sufficient information to make reasonable assertions as to nature of any future activities due to the current lack of relevant geological information.

These assumptions and limitations, however, are not considered to have any negative implications in terms of the credibility of the results of the S&EIA process.

3.3 SCOPING AND ENVIRONMENTAL IMPACT ASSESSMENT PROCESS

The S&EIA process consists of two phases: Scoping Phase and Impact Assessment Phase. A flowchart indicating the entire S&EIA process is presented in Figure 3-1. The process is currently in the Impact Assessment Phase.

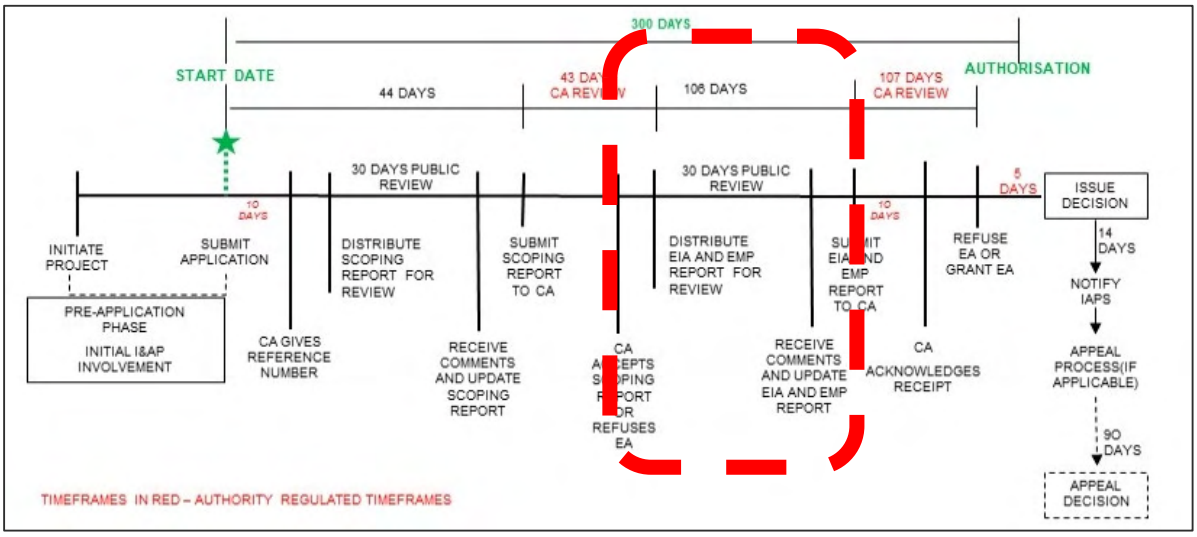

Figure 3-1: Flow Diagram showing the S&EIA Process

3.3.1 Scoping Phase

The Scoping phase complied with the requirements of NEMA and the EIA Regulations 2014. This involved a process of notifying I&APs of the proposed project and S&EIA process and providing them with the opportunity to make comment in order to ensure that all potential key environmental impacts, including those requiring further investigation, were identified.

The Scoping phase included a pre-application public participation process. Although this is not a legislated requirement of the EIA Regulations 2014, it provided an opportunity to notify I&APs of the proposed project and to raise any initial issues or concerns regarding the proposed exploration activities. The steps / tasks undertaken for public participation during the pre-application and Scoping phases are summarised in Box 3 (below).

The key issues and concerns identified by the project team, with I&AP input, during the Scoping phase are summarised in Table 3-2. This information provided formed the basis on which the Plan of Study for EIA and terms of reference for specialist studies were determined. The process and outcomes of the Scoping phase were documented in Scoping Report, which was made available for review and comment by I&APs prior to its submission to PASA.

The Scoping Report was accepted by the DMRE on 17 February 2023. The DMRE's acceptance of the Scoping Report confirmed that the EIA phase may proceed as outlined in the Plan of Study for EIA as submitted and in accordance with Appendix 4 to the EIA Regulations 2014. Specific conditions to the acceptance prescribed by PASA include the following:

- Submission of the Environmental Impact Assessment Report (EIAR) inclusive of specialist assessments and EMPR to PASA and the DMRE;
- Public participation must be undertaken in accordance with Chapter 6 of the EIA Regulations, 2014;
- Inclusion of an A3 locality map;

- The potential environmental liabilities associated with the proposed activity must be quantified by a specialist and the method of provision must be indicated, in line with the Financial Provision Regulations, 2015 (GN R No 1147)

BOX 3: TASKS UNDERTAKEN DURING THE PRE-APPLICATION PUBLIC PARTICIPATION PROCESS

- **I&AP identification**

  In addition to landowners (see below), a preliminary I&AP database of authorities (including State Departments with jurisdiction in the area, municipal offices and ward councillors), Organs of State, Non-Governmental Organisations, Community-based Organisations, adjacent landowners and other key stakeholders with a potential interest in the proposed project has been compiled. A letter and Background Information Document (BID) for the project were sent to all of these parties.

  Additional I&APs were added to the database following responses to the advertisements and notification letter and attendees at Public Information Meetings. To date ~5 000 I&APs have been registered on the project database.

- **Notification to Land owners**

  All landowners for whom contact details were obtained were notified of the application and S&EIA process by means of a letter and BID which was circulated on 22 August 2022. This was sent via email, post or fax. An SMS was sent to those landowners for whom only a cell number was available.

  To date the percentage of landowners in the supplied database (with contacts) who have been sent a notification by SLR is ~ 60-70 % of all landowners in the well drilling target areas, but 100% of the well site property owners were notified.

  Landowner details will be included in the final EIR Report.

- **Background Information Document (BID)**

  All identified I&APs were notified of the application for a well drilling ER, the application for Environmental Authorisation and the S&EIA process by means of a BID. The purpose of the BID was to convey information on the proposed project and environmental regulatory process, as well as to invite I&APs to register on the project database and provide initial comment. The BID was available, in English, SeSotho and Afrikaans at all of the public meetings.

- **Site notices and advertisements**

  Press advertisements providing notification of the proposal by Rhino and the S&EIA process, SLRs contact information and details of the public meetings to be hosted were placed in the following newspapers:

  - Vrystaat Kroon – 24 August 2022 in English, Afrikaans and SoSotho;
  - Heilbron Hereld – 26 August 2022 in English, Afrikaans and SoSotho;

  A total of 14 site notices, with the same information as the adverts, were placed on 24 August 2022 in Edenville, Steynsrus, Petrus Steyn, Heilbron, Frankfort and along major arterial routes within the ER area

  The EIA Regulations provides that a person conducting a public participation process must give notice to all IAPs of an application which is subjected to a public participation process by inter alia giving notice in the manners provided for in section 47D of the NEMA. Section 47D(c) of the NEMA provides that a notice may be issued to a person where an address is unknown despite reasonable enquiry, by publishing it once in the Government Gazette and once in a local newspaper circulating in the area of that person's last known residential or business address. For this project a notice of the application and EIA process was placed in the Government Gazette (4 March 2016) in English and Afrikaans.

- **Public information sharing meetings**

  Two public information sharing meeting were held at:

  Steynsrus and Edenville on 7 and 8 September 2022 respectively. Potential I&APs and the public were notified of the meetings via the advertisements, site notices and BIDs. At each meeting SLR introduced the Scoping and S&EIA process and Rhino Oil and Gas provided an overview of the well drilling ER application and the proposed programme. Opportunity was provided to stakeholders to raise any issues or concerns.

- **Register of I&APs**

  All landowners for whom SLR have contact details are considered as registered I&APs. All identified stakeholders as well as those parties whom attended the public meetings, registered with the project or returned the response sheet are registered as I&APs. The database of registered I&APs will continue to be updated during the course of the Scoping and EIA phase. All registered I&APs will receive all further information regarding the project and the S&EIA process.

- **Compilation and I&AP review of Scoping Report**

  The Scoping Report was prepared in compliance with Appendix 2 of the EIA Regulations 2014 and has been informed by all comments received during the pre-application public participation process and during the draft Scoping Report review and comment period.

  The draft version of the Scoping Report was distributed for a 30-day review and comment period from 10 October to 9 November 2022. Steps undertaken during this phase include:

  - Reports (in English) and Executive Summaries (in English, Afrikaans and Sesotho) were made available on the SLR website and a corresponding data free website (which can be accessed via an internet-capable device without incurring any data costs);
  - Hard copies of the draft Scoping Report were made available at:
    i. Kroonstad Public Library Address;
    ii. Kroonstad Local Co-operative Senwes;
    iii. Steynrus Public Library;
    iv. Moqhaka Local Municipality;
    v. Welkom Public Library Address;
    vi. Welkom Local Co-operative Senwes;
    vii. Wesselsbron Public Library; and
    viii. Wesselsbron Local Co-operative Senwes.

  A total of 30 written submissions were received during this review and comment period. All written comments received have been collated, and responded to, in a Comments and Responses Report.

3.3.2 EIA Phase

3.3.2.1 Objectives

In accordance with Appendix 3 of the EIA Regulations, 2014 the key activities of the EIA phase are to:

- Determine the policies and legislation relevant to the activity and document how the proposed activity complies with and responds to the policy and legislative context;
- Describe the need and desirability of the proposed activity in the context of the development footprint on the approved site as contemplated in the accepted Scoping Report;
- Identify feasible alternatives related to the project proposal;
- Ensure that all potential key environmental issues and impacts that would result from the proposed project are identified;
- Assess potential impacts of the proposed project alternatives during the different phases of project development;
- Identify the most ideal location of the activity within the development footprint of the approved site based on the lowest level of environmental sensitivity identified during the assessment;
- Present appropriate mitigation or optimisation measures to avoid, manage or mitigate potential impacts or enhance potential benefits, respectively;
- Identify residual risks that need to be managed and monitored; and

- Provide a reasonable opportunity for I&APs to be involved in the S&EIA process.

Through the above, ensure informed, transparent and accountable decision-making by the relevant authorities.

3.3.2.2 Impact Assessment Methodology

This assessment methodology enables the assessment of biophysical, cultural, and socio-economic impacts including cumulative impacts and impact significance through the consideration of intensity, extent, duration, and the probability of the impact occurring. Consideration is also given to the degree to which impacts may cause irreplaceable loss of resources, be avoided, reversibility of impacts and the degree to which the impacts can be mitigated.

3.3.2.3 Methodology used in determining the significance of impacts

Part A provides the definition for determining impact consequence (combining intensity, extent, and duration) and impact significance (the overall rating of the impact). Impact consequence and significance are determined from Part B and C. The interpretation of the impact significance is given in Part D. This methodology is utilised to assess both the incremental and cumulative project related impacts.

PART A: DEFINITIONS AND CRITERIA		
Definition of SIGNIFICANCE		**Significance = consequence x probability**
Definition of CONSEQUENCE		**Consequence is a function of intensity, extent, and duration**
Criteria for ranking of the INTENSITY of environmental impacts	**VH**	Severe change, disturbance, or degradation. Associated with severe consequences. May result in severe illness, injury, or death. Targets, limits, and thresholds of concern continually exceeded. Habitats or ecosystems of high importance for maintaining the persistence of species or habitats that meet critical habitat thresholds. Substantial intervention will be required. Vigorous/widespread community mobilization against project can be expected. May result in legal action if impact occurs.
	H	Prominent change, disturbance, or degradation. Associated with real and substantial consequences. May result in illness or injury. Targets, limits, and thresholds of concern regularly exceeded. Habitats or ecosystems which are important for meeting national/provincial conservation targets. Will definitely require intervention. Threats of community action. Regular complaints can be expected when the impact takes place.
	M	Moderate change, disturbance, or discomfort. Associated with real but not substantial consequences. Targets, limits, and thresholds of concern may occasionally be exceeded. Habitats or ecosystems with important functional value in maintaining biotic integrity. Occasional complaints can be expected.
	L	Minor (Slight) change, disturbance, or nuisance. Associated with minor consequences or deterioration. Targets, limits, and thresholds of concern rarely exceeded. Habitats and ecosystems which are degraded and modified require only minor interventions or clean-up actions. Sporadic complaints could be expected.
	VL	Negligible change, disturbance, or nuisance. Associated with very minor consequences or deterioration. Targets, limits, and thresholds of concern never exceeded. Species or habitats with negligible importance. No interventions or clean-up actions required. No complaints anticipated.

	VL+	Negligible change or improvement. Almost no benefits. Change not measurable/will remain in the current range.
	L+	Minor change or improvement. Minor benefits. Change not measurable/will remain in the current range. Few people will experience benefits.
	M+	Moderate change or improvement. Real but not substantial benefits. Will be within or marginally better than the current conditions. Small number of people will experience benefits.
	H+	Prominent change or improvement. Real and substantial benefits. Will be better than current conditions. Many people will experience benefits. General community support.
	VH+	Substantial, large-scale change or improvement. Considerable and widespread benefit. Will be much better than the current conditions. Favourable publicity and/or widespread support expected.
Criteria for ranking the DURATION of impacts	**Very Short term**	Very short, always less than a year or may be intermittent (less than 1 year). Quickly reversible.
	Short term	Short-term, occurs for more than 1 but less than 5 years. Reversible over time.
	Medium term	Medium-term, 5 to 10 years.
	Long term	Long term, between 10 and 20 years. Likely to cease at the end of the operational life of the activity or because of natural processes or by human intervention.
	Very long term/ permanent	Very long, permanent, +20 years. Irreversible. Beyond closure or where recovery is not possible either by natural processes or by human intervention.
Criteria for ranking the EXTENT of impacts	**Site**	A part of the site/property. Impact is limited to the immediate footprint of the activity and within a confined area.
	Whole site	Whole site. Impact is confined to within the project area and its nearby surroundings.
	Beyond site	Beyond the site boundary, affecting immediate neighbours.
	Local	Local area, extending far beyond site boundary.
	Regional/ national	Regional/National. Impact may extend beyond district or regional boundaries with national implications.

PART B: DETERMINING CONSEQUENCE – APPLIES TO POSITIVE OR ADVERSE IMPACTS						
		EXTENT				
		Site	**Whole site**	**Beyond the site, affecting neighbours**	**Local area, extending far beyond site**	**Regional/ National**
INTENSITY = VL						
DURATION	**Very long term /permanent**	**Low**	**Low**	**Medium**	**Medium**	**Medium**
	Long term	**Very Low**	**Low**	**Low**	**Medium**	**Medium**
	Medium term	**Very Low**	**Low**	**Low**	**Low**	**Medium**
	Short term	**Very low**	**Very Low**	**Low**	**Low**	**Low**
	Very short term	**Very low**	**Very Low**	**Very Low**	**Very Low**	**Low**
INTENSITY = L						
DURATION	**Very long term /permanent**	**Low**	**Medium**	**Medium**	**High**	**High**

	Long term	Low	Medium	Medium	Medium	High
	Medium term	Low	Low	Medium	Medium	Medium
	Short term	Very low	Low	Low	Medium	Medium
	Very short term	Very low	Very low	Low	Low	Low
INTENSITY = M						
DURATION	Very long term /permanent	Medium	Medium	High	High	Very High
	Long term	Low	Medium	Medium	High	High
	Medium term	Low	Medium	Medium	Medium	High
	Short term	Low	Low	Medium	Medium	Medium
	Very short term	Very low	Low	Low	Low	Medium
INTENSITY = H						
DURATION	Very long term /permanent	Medium	High	High	Very High	Very High
	Long term	Medium	Medium	High	High	Very High
	Medium term	Low	Medium	Medium	High	High
	Short term	Low	Medium	Medium	Medium	High
	Very short term	Very low	Low	Low	Medium	Medium
INTENSITY = VH						
DURATION	Very long term /permanent	Medium	High	Very High	Very High	Very High
	Long term	Medium	High	High	Very High	Very High
	Medium term	Medium	Medium	High	High	Very High
	Short term	Low	Medium	Medium	High	High
	Very short term	Low	Low	Medium	Medium	Medium

PART C: DETERMINING SIGNIFICANCE - APPLIES TO POSITIVE OR ADVERSE IMPACTS							
PROBABILITY (of exposure to impacts)	Definite/ Continuous	VH	Very Low	Low	Medium	High	Very High
	Probable	H	Very Low	Low	Medium	High	Very High
	Possible/ frequent	M	Very Low	Very Low	Low	Medium	High
	Conceivable	L	Insignificant	Very Low	Low	Medium	High
	Unlikely/ improbable	VL	Insignificant	Insignificant	Very Low	Low	Medium
			VL	L	M	H	VH
			CONSEQUENCE				

PART D: INTERPRETATION OF SIGNIFICANCE		
Significance		Decision guideline
Very High	Very High +	Represents a key factor in decision-making. Adverse impact would be considered a potential fatal flaw unless mitigated to lower significance.
High	High +	These beneficial or adverse impacts are considered to be very important considerations and must have an influence on the decision. In the case of adverse impacts, substantial mitigation will be required.
Medium	Medium +	These beneficial or adverse impacts may be important but are not likely to be key decision-making factors. In the case of adverse impacts, mitigation will be required.

Low	**Low +**	These beneficial or adverse impacts are unlikely to have a real influence on the decision. In the case of adverse impacts, limited mitigation is likely to be required.
Very Low	**Very Low +**	These beneficial or adverse impacts will not have an influence on the decision. In the case of adverse impacts, mitigation is not required.
Insignificant		Inconsequential, not requiring any consideration.

3.3.2.4 Additional Assessment Criteria

Additional criteria that are taken into consideration in the impact assessment process to further describe the impact and support the interpretation of significance in the impact assessment process include:

- the degree to which impacts may cause irreplaceable loss of resources;
- the degree to which impacts can be avoided;
- the degree to which impacts can be reversed;
- the degree to which the impacts can be mitigated; and
- the extent to which cumulative impacts may arise from interaction or combination from other planned activities or projects is tabulated below.

ADDITIONAL ASSESSMENT CRITERIA		
Criteria for DEGREE TO WHICH AN IMPACT CAN BE REVERSED	**IRREVERSIBLE**	Where the impact cannot be reversed and is permanent.
	PARTIALLY REVERSIBLE	Where the impact can be partially reversed and is temporary.
	FULLY REVERSIBLE	Where the impact can be completely reversed.
Criteria for DEGREE OF IRREPLACEABLE RESOURCE LOSS	**NONE**	Will not cause irreplaceable loss.
	LOW	Where the activity results in a marginal effect on an irreplaceable resource.
	MEDIUM	Where an impact results in a moderate loss, fragmentation or damage to an irreplaceable receptor or resource.
	HIGH	Where the activity results in an extensive or high proportion of loss, fragmentation or damage to an irreplaceable receptor or resource.
Criteria for DEGREE TO WHICH IMPACT CAN BE AVOIDED	**NONE**	Impact cannot be avoided and consideration should be given to compensation and offsets.
	LOW	Impact cannot be avoided but can be mitigated to acceptable levels through rehabilitation and restoration.
	MEDIUM	Impact cannot be avoided, but the significance can be reduced through mitigation measures.
	HIGH	Impact can be avoided through the implementation of preventative mitigation measures.
Criteria for the DEGREE TO WHICH IMPACT CAN BE MITIGATED	**NONE**	No mitigation is possible or mitigation even if applied would not change the impact.
	LOW	Some mitigation is possible but will have marginal effect in reducing the impact significance rating.
	MEDIUM	Mitigation is feasible and will may reduce the impact significance rating.
	HIGH	Mitigation can be easily applied or is considered standard operating practice for the activity and will reduce the impact significance rating.
	UNLIKELY	Low likelihood of cumulative impacts arising.

Criteria for POTENTIAL FOR CUMULATIVE IMPACTS	**POSSIBLE**	Cumulative impacts with other activities or projects may arise.
	LIKELY	Cumulative impacts with other activities or projects either through interaction or in combination can be expected.

3.3.2.5 Specialist Studies

Five (5) specialist studies were commissioned to address the key issues that required further investigation and detailed assessment, namely an Aquatic Ecology (including wetlands), Terrestrial Ecology, Geohydrology, Cultural Heritage and Palaeontology.

The specialist studies involved the gathering of data (desktop and site visits) relevant to identifying and assessing environmental impacts that may occur as a result of the proposed project. These impacts have been assessed according to pre-defined rating scales (see Section 7) and prepared in terms of the prescribed protocols and/or Appendix 6 of the EIA Regulations, 2014.

Specialists have provided recommendations regarding appropriate mitigation or optimisation measures to minimise potential impacts or enhance potential benefits, respectively.

3.3.2.6 Landowner and Stakeholder notification

Landowner and stakeholder notification is an ongoing activity throughout the S&EIA process and is being undertaken by Rhino as they continue to engage with landowners with whom Rhino have arranged access and as they engage with new landowners within the Target Areas. In parallel, SLR continues to engage with potential I&APs to notify them of the project and S&EIA process which is underway. Details of the opportunities for SLR to engage with I&AP are detailed in Box 4 below.

BOX 4: TASKS BEING UNDERTAKEN DURING THE EIA PHASE PUBLIC PARTICIPATION PROCESS

- **I&AP identification**

  Rhino and SLR will continue to source contact information for and notify landowners and potential I&APs of the well drilling ER application and the S&EIA process.

- **Electronic and hard copy publication of the EIA Report**

  A complete copy of the Draft EIAR, including appendices, will be published on SLR's website. The Report will be available for a 30-day period and will be made available as a data free download.

  The publication includes the publication of a Non-Technical Summary in English, Afrikaans and Sesotho

  Venues hosting hard copies of the Draft EIA Report include:

  - Kroonstad Public Library Address;
  - Kroonstad Local Co-operative Senwes;
  - Steynrus Public Library;
  - Moqhaka Local Municipality;
  - Welkom Public Library Address;
  - Welkom Local Co-operative Senwes;
  - Wesselsbron Public Library; and
  - Wesselsbron Local Co-operative Senwes.

- **Notification to EIA Report's availability for review**

  Registered I&AP's will be notified of the availability of the Draft EIAR and invited to review and provide comment. Email and by written notice will include the Non-Technical Summary for ease of reference.

  Where contact details are limited to mobile phone numbers, SLR will provide a text message notifying the recipient of the Draft EIAR and a link to the electric copy of the Report.

- **Updating the Comments and Responses Report**

  The Comments and Responses Report remains an active document throughout the S&EIA process. Any comment on the EIAR will be captured in this Report and addressed by responding to the comment or, where applicable, referencing where the comment has accommodated in the EIAR.

- **TASKS BEING UNDERTAKEN FOLLOWING DECISION-MAKING**

  Registered I&APs are entitled to notification of the outcome of the Competent Authority's decision-making. Following the DMRE issuing a decision on the Application for EA, SLR will provide notice (email/text/written) notice to I&APs of the Departments decision and the opportunity to appeal the decision.

3.3.2.7 Completion of the EIA Phase

After closure of the comment period, all comments received on the EIAR will be incorporated and responded to in a Comments and Responses Report. The EIAR will be updated to a final report, inclusive of the Comments and Responses Report, and will be submitted to PASA for consideration and decision-making.

After the DMRE has reached a decision, and PASA has advised the EAP of the decision, all I&APs registered on the project database will be notified of the outcome of the application and the reasons for the decision.

A statutory appeal period in terms of the National Appeal Regulations, 2014 (GN No. R993) will follow the issuing of the decision. In terms of Regulation 4(1)(a), an appellant must submit an appeal to the appeal administrator, and a copy of the appeal to the applicant, any registered I&AP and any organ of state with

interest in the matter within 20 days from the date that the notification of the decision for an application for an Integrated Environmental Authorisation was sent to the registered I&APs by the applicant.

3.3.3 Summary of the issues and concerns raised by through the S&EIA Process

The public participation process has resulted in more than 50 comments from various I&APs being received to date. As part of the S&EIA process, SLR is managing a Comments and Responses Report which captures comments received and provides a response or provides a cross reference to how the comment has been addressed in this EIAR (see Appendix C).

A summary of the key issues raised to thus far is provided in Table 3-2.

Table 3-2: Summary of the issues and concerns raised by I&APS during the Scoping Phase

#	Key Issues Raised	High-level response
1.	**Fracking** Will the proposed project entail hydraulic fracturing (fracking)? If not, how will the proposed process differ from the process of fracking?	Rhino has confirmed that they will not use hydraulic fracturing. Details regarding their corporate position regarding hydraulic fracturing can be found in Section 2.5 of this report.
2.	**Environmental Impacts** Groundwater contamination - What impact will the drilling of the wells have on groundwater? Surface water contamination - What impact will the proposed activity have on the contamination of surface water such as the Vaal River, which traverses certain parts of the proposed project area. Soil contamination – What impact will the drilling of the wells have on surrounding soils? Air quality/ gas flaring - Which mitigation measures will be implemented to ensure the that the flare is not defective to prevent the flare from releasing hydrocarbons into the atmosphere? Commercial agriculture - What impact will the proposed activity have on commercial agriculture? Archaeological and Paleontological impact - What archaeological and paleontological impacts will the proposed project have? Biodiversity impacts – The flora and fauna of the project area needs to be considered.	Detailed assessment of the potential impacts on these aspects is provided in Section 7 of the EIAR.

#	Key Issues Raised	High-level response
	Waste management - How will waste (drilling fluids, flowback water, etc) be managed during the drilling activities?	
3.	**Monitoring and rehabilitation** How often will the water around the wells be sampled and tested and in what radius? How would groundwater be rehabilitated in case of contamination? When the project is decommissioned, what will the monitoring process and requirements be and for how long?	Section 5.4 and Section 5.5 provides a detailed description of the exploration process and the sampling process. Risks regarding contamination of groundwater resources have been assessed as part of the EIA (See Section 7). Measures to mitigate any risks to groundwater and the associated monitoring frequency and parameters are detailed in Section 7.
4.	**Safety and security** How will the safety and security of the landowners be ensured throughout the life of the proposed project?	Rhino has committed to ongoing discussions with landowners and the farming communities within the Target Areas. Additionally, the EMPr includes for ongoing engagement with relevant landowner. Particular safety and security measures to cater for land owner requirements will be negotiated by Rhino as part of any access agreement.
5.	**Benefits for landowners and the community** What benefits will the proposed project have for landowners and the community at large?	The proposed project is restricted to the exploration phase where Rhino carry the financial risks. Apart from the generation of data to inform further exploratory work there is limited financial benefit from this phase. Potential indirect benefits to the local communities are beneficiation through the operation of the logistics base (See Section 5.4.7.3) and lease/rental agreements between Rhino and the landowner of the target drill sites.
6.	**Employment opportunities** What employment opportunities will the proposed project bring for the locals?	Exploration work is reliant upon designated skilled contractors and, as a result, employment opportunities outside of these are limited.
7.	**Separation of Exploration Risks and Production Risks** While impacts regarding gas exploration are provided, there is no consideration of risks associated with production if a commercially viable resource is identified	Exploration and Production, while sequential in nature, are defined as distinct activities in the MPRDA. The MPRDA and NEMA both recognise the distinction and provide for a separation of application, assessment, and authorisation processes which applicants must follow when

#	Key Issues Raised	High-level response
		seeking permission to undertake either Exploration or Production activities. This application, and thus the S&EIA, is specifically limited to the exploration activities.
8.	**Contributions toward climate change** How does the proposed gas exploration project contribute toward climate change	Risks to climate change as a result of the proposed exploration is discussed in Section 7.

4. NEED AND DESIRABILITY

This chapter provides an overview of the "need and desirability" of the proposed project, and essentially considers the strategic context of a project proposal within broader societal needs and the public interest. The DFFE guideline on need and desirability (GN No. R891 of 20 October 2017) notes that while addressing the growth of the national economy through the implementation of various national policies and strategies, it is also essential that these policies take cognisance of strategic concerns such as climate change, food security, as well as the sustainability in supply of natural resources and the status of our ecosystem services. The guideline further notes that at a project level (as part of an ESIA process), the need and desirability of the project should take into consideration the content of regional and local plans, frameworks and strategies.

4.1 SOUTH AFRICA'S NEED FOR GAS

South Africa's National Development Plan 2030 recognises 'Constructing infrastructure to import liquefied natural gas and increasing exploration to find domestic gas feedstock' as one of eight key national 'infrastructure investments [which] should be prioritised'.

This imperative is underpinned by multiple analyses[1] of South Africa's pathway of sustainable development, which recognise the extensive and important role of gas in delivering to the economic, social and environmental triple-bottom-line. Some of the key potential contributions of gas in the South African context are highlighted below (though a thorough exposition is not the purpose of this document):

- **Reliable energy:** gas is an abundant resource with dependable availability, which can be managed and utilised at scale with relative ease and flexibility.
- **Enablement of renewable electricity:** gas-to-electricity can form the requisite foundation of robust reserve, reactive backup, and grid stabilisation needed by intermittent renewables.
- **Reduced emissions:** Gas and LNG would directly offset coal and diesel in power and industry sectors. Burning gas releases less CO^2 per unit energy and much fewer particulates.
- **Increased efficiency:** investment in modern efficient gas-fired plant would lead to much more efficient fuel usage, especially compared to legacy South African coal-fired plants
- **Broad based economic growth:** reliable energy and power would act as an economic multiplier and underpin greater efficiency, economic activity and job creation across all sectors[2].

[1] See, *inter alia*:
Gas Master Plan 2022, Base Case Report, Stakeholder Consultation, September 2021, Dept of Mineral Resources & Energy
The Role of Gas in South Africa's Path to Net-Zero, Just Transition & Climate Pathways Study for South Africa, NBI
Decarbonising South Africa's Power System, Just Transition and Climate Pathways Study for South Africa, NBI, August 2021
Annual Report of the Industrial Gas users Association – Southern Africa 2021
National Development Plan: Vision for 2030, South African Government
Integrated Resource Plan, IRP 2019 Department: Energy, Republic of South Africa
Feasibility Study for the LNG Importation and Gas-to-Power Project, Delphos International Ltd, November 2019
LNG Importation: Evaluating the risks, Western Cape Department of Economic Development and Tourism, PWC, June 2016
South Africa Hydrogen Valley, Final Report, Science & Innovation Department, Republic of South Africa, October 2021
Hydrogen society roadmap for South Africa 2021, Science & Innovation Department, Republic of South Africa, February 2022

[2] KPMG estimate each R1M of gas sales could add R1.3M to the South African economy, and directly or indirectly create 4 jobs [Onshore benefits report, KPMG, 2016, for Rhino Oil and Gas Exploration South Africa]

- **Economic independence:** avoid dependency on imported energy supplies (e.g., methane or hydrogen / ammonia) that are likely to dominate the fuel mix in low-carbon power generation in the coming decades.

4.1.1 Domestic vs Imported Gas

Furthermore, there would be significant advantages for South Africa if such gas can be found and produced domestically rather than imported via pipelines or as LNG. Domestic gas production would yield tax and royalty receipts while also avoiding imports and therefore a debit on the balance of payments, providing economic insulation against foreign currency fluctuations. Substantial gas projects are likely to attract foreign investment and trigger follow-on investment in infrastructure, skills development and local support services. Improving energy independence for South Africa is a key strategic consideration, especially if gas-to-electricity enables and underpins the high-potential renewable electricity sector. Such independence would also cushion shocks to domestic gas prices as international LNG prices vary with global conditions. Hence, the NDP sets out in Action 16: '…If gas reserves are proven and environmental concerns alleviated, then development of these resources and gas-to-power projects should be fast-tracked.'

4.1.2 Project Proximity to Gas Need

Much of South Africa's current gas demand is located within and around the Gauteng province, including Sasolburg, which is fed by the ROMPCO pipeline from Mozambican gas fields at Pande and Temane. The production of these fields has reached decline with cessation of production expected within several years. Replacing this gas supply with imported LNG trucked from the coast, or building new gas trunk pipelines, or re-supplying ROMPCO would all come with enormous challenges. This project seeks to explore for gas in regional proximity to the demand, specifically in the Free State. Any discoveries would not only supply this critical latent demand but would be well placed to further supply other strategically important power plants. Twenty-eight GW of South Africa's 45 GW baseload power fleet is located in the region, as is Sasol's CTL plant; offsetting old coal-driven plants with gas would have advantageous environmental benefits including significant reductions in CO2 emissions[3], acid mine drainage and surface water contamination, mining-related health hazards, and particulate pollution.

4.1.3 Local Economic Benefits

The geographical synergies extend beyond infrastructure, much of which has been developed to support mining activities, to the skills sets of the people and service providers who have historically been employed in that sector. Gas developments in the Free State would re-invigorate local business and spur employment in the provision of services. It is envisioned that most of the work to be carried out in support of the proposed activity would be contracted to local suppliers, since they are likely to be the most locally experienced, flexible and efficient bidders, and therefore most cost-effective options. Whilst initially this is likely to have a relatively modest impact, the resource which could potentially be unlocked from this activity

[3] Bituminous coal releases 93 KgCO2/mmbtu combusted, around twice as much as methane which releases 53 KgCO2/mmbtu. The relative efficiency of new-build CCGT (55-60% HHV) versus old South African coal plants (~34%) means coal-to-gas switching could reduce related CO2 emissions by two-thirds from 930-990 tCO2/MWh to 300-330 tCO2/MWh [https://www.eia.gov/environment/emissions/co2_vol_mass.php; https://fffcarbon.co.za/conferences/2016/IPP/Falcon-Rosemary.pdf]

could have a very significant long-term impact on the economic prospects of the region and South Africa as a whole.

4.1.4 Project Environmental Context – Greenhouse Gases

The proposed activity is an investigation into the relatively new field of biogeochemistry – the study of the ongoing generation of biogenic methane in geological formations by archaea at geographical scale – not shale gas, coal seam gas, or any other gaseous fossil fuel. The biogenic gas is understood to be produced by archaea metabolising modern organic matter, with the gas leaking to the atmosphere from natural fissures and other geological features. The following image shows increased atmospheric concentrations of methane above the areas of geologic interest.

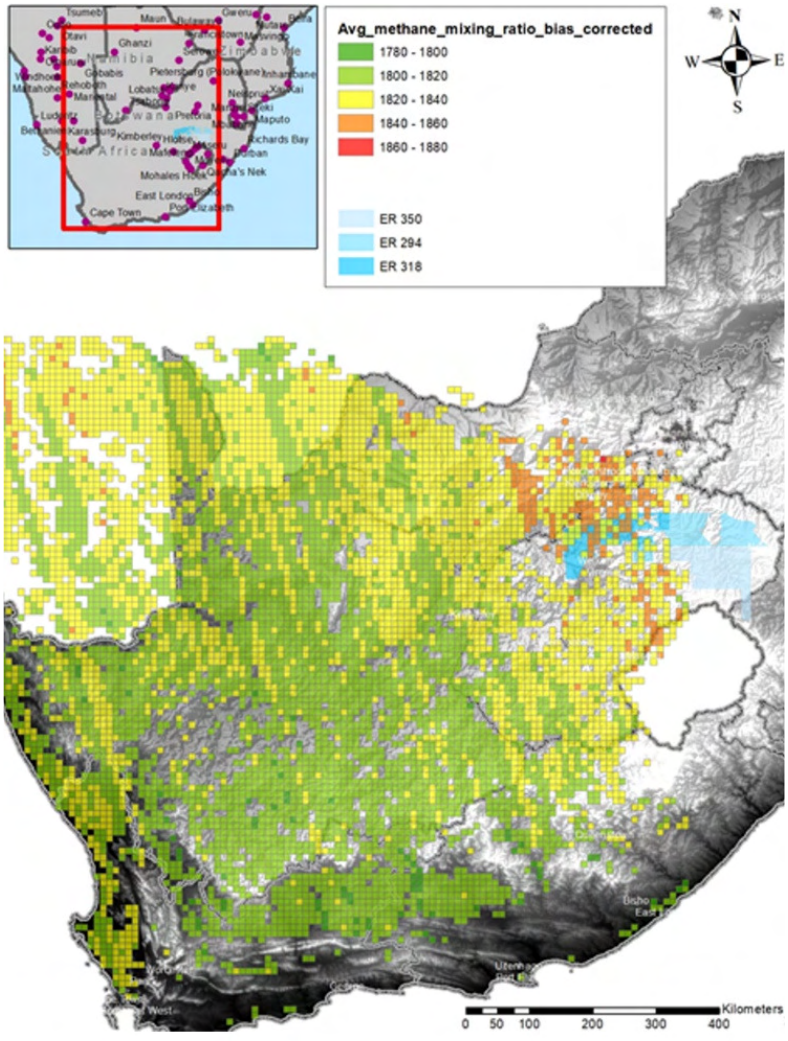

Figure 4-1: Atmospheric methane concentrations over South Africa,
Source: ESA Sentinel 5P satellite, 17th January 2021

Methane is 25x more potent than CO_2 as a greenhouse gas over a 100-year period, and up to 80x over a 20-year period[4], so simply capturing and combusting leaking biogenic gas would reduce the associated greenhouse gas liability by a factor of respectively nine-fold and thirty-fold[5]. If such combustion was instead utilised to displace fuels more commonly used in South Africa such as coal or diesel, the greenhouse gas liability could reduce another two- to three-fold. To put this in more tangible terms, each kilogram of methane captured and combusted for power generation, offsetting current coal-fired power generation, would release approx. 3 kilograms of CO2e, whereas the status quo releases approx. 36 or 89 kilograms of CO2e[6]. Instead, replacing the coal-fired generation with renewables and continuing to allow the methane to leak would release approx. 25 or 80 kilograms of CO2e.

4.1.5 Project Environmental Context – Local

A key difference between the proposed project and domestic gas as considered in the NDP is the NDP considers potential reserves of shale and coal seam gas, and therefore caveats the benefit by the then-ongoing environmental impact investigations into shale gas production techniques – particularly hydraulic fracturing or "fracking". Hydraulic fracturing of shales does not apply to the proposed project, which is centred on understanding the naturally fissured geology, and biogenic gas production, pooling and migration pathways.

The area of interest for the project is predominantly sparsely populated farmland, and proposed drilling activity would be limited to open farmland and away from water sources. Rhino have engaged closely with the Free State Farming Union to represent farming interests as they have developed their proposals, and Rhino appreciate their expressed support. The farmers would be generally familiar with the proposed activity as it analogous to the drilling of water wells. Rhino continues to engage with the communities to ensure informed consent in respect of every proposed activity. Additionally, the improved understanding of local geology and especially water tables could be of material benefit to farmers and landowners.

The exploration of gas is a well-regulated activity, and with strict compliance, local engagement and due care, much of the benefits and desirability of the activity can be realised and the risks and disruptions minimised.

In addition to natural gas, the exploration activity would also test for possible helium reserves. This high-value strategic resource is in high global demand, and discovery of material reserves could further add to the strategic and economic advantages of this project to South Africa.

4.2 GAS MASTER PLAN 2022

To highlight the alignment of the proposed Project with the overall objectives of the Government of South Africa, and to contextualise and emphasise the value of the proposed exploration activities, this section considers certain extracts from the Gas Master Plan 2022 (Sept 2021, Department of Mineral Resources and Energy).

[4] https://climate.mit.edu/ask-mit/why-do-we-compare-methane-carbon-dioxide-over-100-year-timeframe-are-we-underrating

[5] Combustion of 1kg of methane (CH4) in air produces 2.75kg of CO2

[6] Depending on period used to determine CO2e potency of methane (100 years or 20 years): 1 kilogram of methane to atmosphere = 25 or 80 kilograms of CO2e; coal-fired power generator = approx. 9 kilograms of CO2e for equivalent electricity production

Background:

"The economy of South Africa can capture real benefit from developing natural gas resources, generating employment (directly and indirectly), increasing GDP (directly and indirectly), increasing foreign direct investments and with potential future exports, increase the inflow of foreign currency, stemming both from the extraction and utilization of natural gas."

"The National Development Plan (NDP) envisions that by 2030 South Africa will have an energy sector that promotes economic growth and development through adequate investment in energy infrastructure. At just 2.6% of the country's total energy mix, South Africa's natural gas market is small, but with all its inherent benefits, it has the potential to completely change the economy by stimulating economic growth and development, stability, and job creation. The meaningful addition of natural gas to the country's energy mix will rejuvenate an overburdened, out-dated energy infrastructure and reduce cyclical energy shortfalls. Perhaps even more importantly, it will stimulate the economy by allowing business and industry to lower their energy and operational spend while also creating significant numbers of new jobs and skills development opportunities. Considering that nearly 90% of South Africa's existing natural gas demand is supplied by a single entity, namely Sasol Gas, the associated economic and employment risks of limited supply options, development and sourcing of alternative natural gas resources are high."

"It is imperative to ensure economic and employment stability within the natural gas sector by introducing more suppliers. Southern Africa's gas potential has been revealed by major discoveries that, when developed, widen options for greater regional energy trade. South Africa's unconventional gas potential remains to be quantified but raises the prospect of possible domestic production in the longer term. Globally the natural gas industry has moved into a supply surplus, favouring a larger role for gas as a clean fossil fuel in many countries' energy policies. A challenge in developing the gas sector is to bring gas demand and supply on stream at the same time and spread geographically to stimulate broader localized demand through South Africa. Without such localized gas demand, it is difficult to develop distributed gas supply and without such distributed gas supply it is difficult to develop localized gas demand. One way of breaking this impasse is to create significant "anchor" gas demand through the development of a gas-to-power programme. In pursuit of adding generating capacity, lowering carbon emissions, enhancing energy security and supporting industrial development, South Africa has taken the first steps in a gas-to-power programme to be executed under the Integrated Resource Plan 2019, aiming to increase the national energy mix natural gas contribution from 2.6% to 15.7% by 2030."

The global gas supply/demand balance has changed significantly since the date of the publication of the Gas Master Plan as a result of the Russia/Ukraine conflict, with several implications on the global gas market. Such volatility in gas market dynamics highlights the importance of diversified supply options, whether from a large-scale offshore gas development, importation via pipeline, LNG regasification or onshore domestic gas production close to a major demand centre.

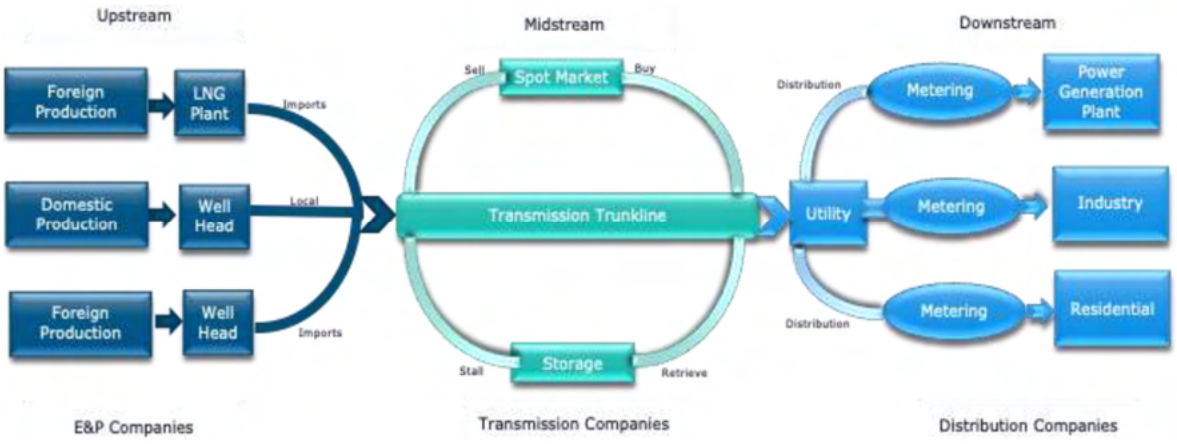

Figure 4-2: Gas Value Chain: Natural Gas Business

Source: Gas Master Plan 2022, Base Case Report, September 2021.

The current South African natural gas value chain structure, and associated dominant players, is depicted below. Tetra4 CNG production is noted as a domestic supply source and immediately neighbours the proposed Project.

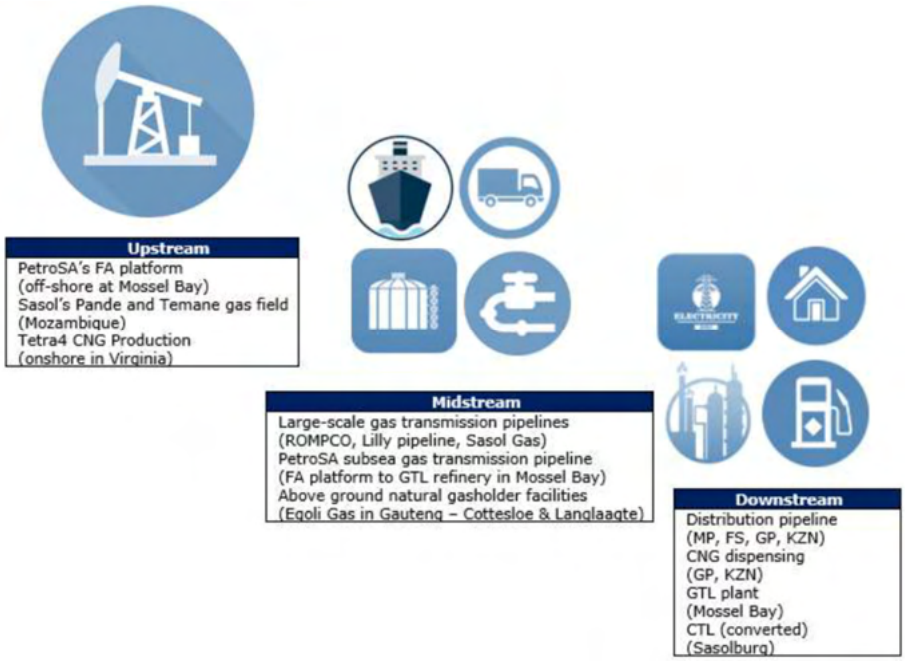

Figure 4-3: South African natural gas value chain structure

Source: Gas Master Plan 2022, Base Case Report, September 2021. Figure 3-2: South African Natural Gas Value Chain

4.2.1 Domestic Gas Reserves and Resources

"Ten countries hold more than two-thirds of the world's total proven natural gas reserves according to the latest publications by US EIA, OPEC and BP. Although South Africa does not currently feature on any of the published proven natural gas reserve lists, the country has the potential to rank amongst the top 30 countries, provided the initial gas estimates, specifically unconventional natural gas reserves, hold true (BP Statistical Review of World Energy, 2020) (EIA, 2019) (OPEC, 2019). South Africa has several natural gas opportunities for local natural gas production, either from conventional (onshore/offshore) or unconventional (shale gas/coal bed methane) sources. Refer to Figure 4-4f or a simplified graphical representation of the domestic gas fields and their quantified reserve volumes."

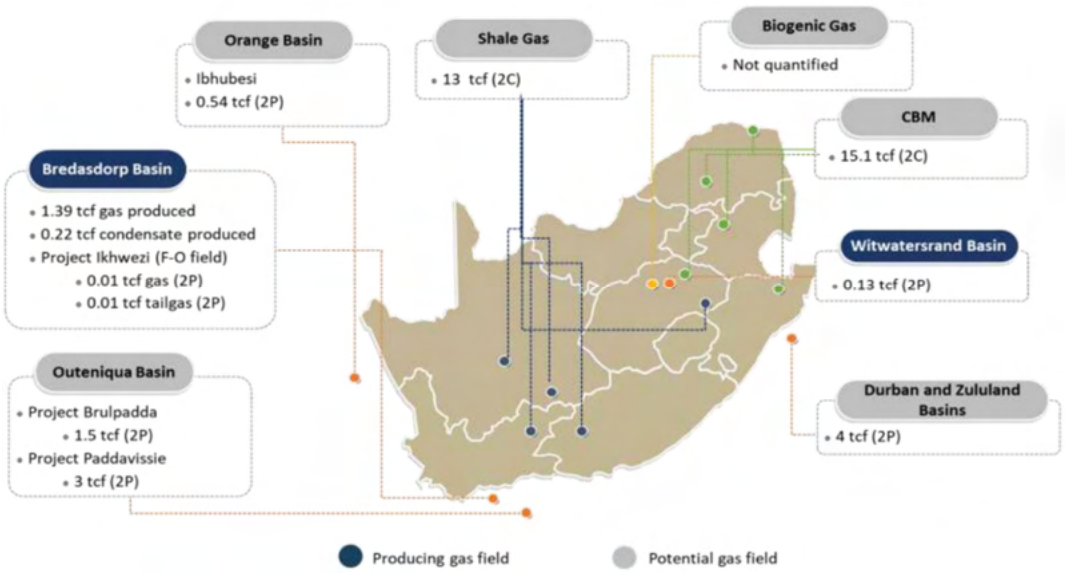

Figure 4-4: Domestic Gas Reserves

Source: Gas Master Plan 2022, Base Case Report, September 2021.

"Gas encountered within the coal-bearing Karoo strata in the region is believed to have migrated from the underlying Witwatersrand Basin, which is biogenic in origin and is thus constantly replenished. Given the unusual nature of this unconventional biogenic play, the volume of technically recoverable gas resource has not yet been quantified."

The above extract from the Gas Master Plan 2022 recognises the potential scale of South African Biogenic Gas production has not yet been quantified, and the role this resource could play in alleviating the tight domestic gas supply balance it not yet well understood. The Project proposes to contribute to that understanding by conducting exploration activities over a significant geography to determine the Biogenic Gas volume in place, the replenishment and leakage rates, and hence how much is potentially recoverable.

4.2.2 Contribution to the Power Sector:

"More than 90% of South Africa's electricity is generated from coal and it is anticipated to remain the main fuel source for power generation. Power generation has been clearly identified as the priority sector for gas utilisation in the draft IEP and approved IRP2019, aiming to increase the national energy mix's natural gas contribution from 2.6% to 15.7% by 2030 (Department of Energy, 2019). The existing Open Cycle Gas Turbine

(OCGT) peaking plants present an ideal opportunity for conversion to natural gas, with the potential to realize substantial cost savings of more than 30% from fuel source perspective. Nationally, there are six OCGT plants currently utilising diesel as fuel source. These OCGT plants, with a combined installed capacity of nearly 4 GW, could be powered by natural gas and potentially be converted to closed cycle operations, presenting both a cheaper and cleaner source of energy with potentially higher energy output. Further opportunities exist in converting mothballed coal fired power plants to run on natural gas. This opportunity will save substantial time and capital expenditure when compared with building new generation facilities and present the opportunity of recovering previously lost jobs when facilities were closed. The power sector presents an immediate source of secure and growing natural gas demand, with attractive margins at low-risk as existing OCGT plants are ready to convert to Combined Cycle Gas Turbine (CCGT) plants, in addition to new gas-based thermal plants at various stages of development."

"The National Development Plan (NDP) identifies natural gas as a viable alternative to coal. The NDP further provides as one of the infrastructure priorities the construction of infrastructure to import LNG and increasing exploration to find domestic gas feedstock. Conventional and unconventional natural gas should play a more prominent role in South Africa's future energy mix, both in the electricity sector and in the liquid fuel sector (National Planning Commission, 2012). In support of the vision for the South Africa gas programme, the Department of Mineral Resources and Energy has started developing, through its Independent Power Producer Office (IPPO), a gas-to-power IPP procurement programme. This programme will serve as an anchor for the gas market infrastructure development in South Africa. Furthermore, the RMIPPPP could serve as a catalyst for early LNG development. The introduction of large-scale gas in the South African economy will lower the country's carbon emissions, not just from electricity generation but also from other energy sectors, including the transport sector."

4.2.3 USE OF NATURAL GAS

Petroleum (oil and gas) products have a wide range of uses (e.g. energy, road building, chemical, plastic and synthetic material manufacture) and remain a key source of energy across the globe. They are produced from the refining of oil and gas extracted from beneath the earth's surface.

In this exploration project the primary target is natural gas, although other petroleum products cannot be discounted. Natural gas is a fossil fuel which comprises mostly methane. It is used globally as a source of energy for heating, cooking, electricity generation and vehicles. It is also used in the manufacturing of plastics and other commercially important chemicals. Once extracted, gas can be contained, transported and safely used in many applications. The type of downstream use is entirely dependent on the commercial scale of the resource.

The fastest growing sector for the use of natural gas is for the generation of electric power (Union of Concerned Scientists). Natural gas power plants usually generate electricity in gas turbines, directly using the hot exhaust gases from the combustion of the gas. Of the three fossil fuels used for electric power generation (coal, oil and natural gas), natural gas emits the least carbon dioxide per unit of energy produced. When burnt, natural gas emits 30% and 45% less carbon dioxide than burning oil and coal, respectively. Burning natural gas also releases lower amounts of nitrogen oxides, sulphur dioxide, particulates and mercury when compared to coal and oil.

As economic growth is dependent on the availability of energy, ensuring a sustainable and reliable supply of electricity with sufficient capacity is a key aspect to growing the economy of South Africa in the future. The electricity shortages experienced in South Africa over the past decade were a contributing factor to the significant slowdown in economic growth rate. To enable economic growth within the target rate of between 6% and 8% (Accelerated and Shared Growth Initiative, 2004) to be achieved, it will be necessary for Government to continue increasing electricity generating capacity in the country.

The use of natural gas for electricity generation is identified in national policy, together with renewable energy technologies, as an alternative in diversifying the domestic energy supply away from its current reliance on coal. In 2013, the total natural gas supply in South Africa (domestic production and import) equated to approximately 2.5% of total primary energy supply for the country (Bischof-Niemz, Carter-Brown, Wright & Zinaman, 2016). Gas is identified in the Integrated Resources Plan (October 2019) as significant contributor to South Africa's energy mix in the period up to 2030. According to the Plan, gas fired power generation should account for 8.1% of installed generation capacity, requiring 3 000 MW of new generation capacity. The feasibility of using natural gas for domestic power generation is considered to be dependent on the extent of available domestic reserves of natural gas, as well as the financial cost of importing natural gas should those reserves be insufficient.

Domestic resources are limited to gas fields close offshore of Mossel Bay (F-A field), which are in decline. Other proven offshore reserves include the Ibhubesi Gas Field off the West Coast of South Africa. The development of this field to supply gas to the existing Ankerlig Power Station is currently being considered. Neighbouring countries (Mozambique and Namibia) and regional African nations (Angola and Tanzania) have substantial gas reserves. Presently, gas is imported to South Africa through the Republic of Mozambique Pipeline Company (ROMPCO) pipeline from Mozambique. This gas is mostly used for chemical processes in Sasol's coal-to-liquid (CTL) process in Secunda (Bischof-Niemz, Carter-Brown, Wright, & Zinaman, 2016). In Johannesburg, Egoli Gas supplies industry and households in some suburbs with reticulated natural gas that is sourced from Sasol.

Identification and use of domestic natural gas reserves could enable South Africa to take steps to secure the country's energy supply (through diversification), assist in reducing the emissions of greenhouse gases (by reducing the country's reliance on coal for electricity generation) and reduce the need for the importation of gas. As such, exploration for additional domestic hydrocarbon reserves is consistent with the Integrated Resource Plan (IRP) (2019).

4.3 NATIONAL POLICY AND PLANNING FRAMEWORK

This section aims to provide an overview of the national and regional policy and planning context relating to the promotion of development in general within South Africa, developing the energy sector (with specific reference to natural gas and renewable energy) and response to climate change. Further details on the need and desirability of the project, with consideration of relevant National policy documents, will be provided in the EIA Report.

4.3.1 White Paper on the Energy Policy of the Republic of South Africa (1998)

The White Paper on the Energy Policy (1998) is the overarching policy document which guides future policy and planning in the energy sector. The policy objectives include the stimulation of economic development,

management of energy related environmental and health impacts and diversification of the country's energy supply to ensure energy security.

The paper states that the government will, inter alia, "promote the development of South Africa's oil and gas resources…" and "ensure private sector investment and expertise in the exploitation and development of the country's oil and gas resources". The successful exploitation of these natural resources would contribute to the growth of the economy and relieve pressure on the balance of payments. Before the development of the country's oil and gas resources can take place, there is a need to undertake exploration activities to determine their extent and the feasibility of utilising these resources for production.

4.3.2 White Paper on the Renewable Energy Policy (2003)

The White Paper on Renewable Energy supplements the White Paper on Energy Policy (described above) and sets out Government's vision, policy principles, strategic goals and objectives for promoting and implementing renewable energy in South Africa. The paper is based on the integrated resource planning criterion of "ensuring that an equitable level of national resources is invested in renewable technologies, given their potential and compared to investments in other energy supply options". The White Paper affirms Government's commitment to develop a framework within which the renewable energy industry can operate, grow, and contribute positively to the South African economy and to the global environment.

The White Paper indicated that due to the limited availability of domestic gas reserves, gas was unlikely to form any major component of primary energy supply over any extended period when compared with coal, even though natural gas is considered to be a "cleaner fuel" in comparison with coal and oil. The IRP (2019) indicates a bigger contribution from gas, due presumably to the significant gas discoveries in Mozambique.

4.3.3 National Gas Infrastructure Plan (2005)

The National Gas Infrastructure Plan is Government's strategy for the development of the natural gas industry in South Africa so as to meet the energy policy objectives set out in the White Paper on Energy Policy (1998). The plan sets out the outlook for gas consumption and production globally and within South Africa and aims to articulate Government's broad policy and development aims. The plan outlines four main phases of gas infrastructure development (each with sub-phases) and following the completion of these projects, it is envisaged that there will be a fully integrated network linking the major economic centres to the upstream supplies of gas.

4.3.4 New Growth Path (2011)

The New Growth Path (NGP) reflects the commitment of Government to prioritise employment creation in all economic policies and sets out the key drivers and sectors for employment which will be the focus of Government. These focus sectors are infrastructure, agriculture, mining, manufacturing, tourism and the green economy.

The NGP targeted 300 000 additional direct jobs within the green economy sector by 2020, with 80 000 in manufacturing and the rest in construction, operations and maintenance of new environmentally friendly infrastructure. The potential for job creation rises to well over 400 000 by 2030. The additional jobs are envisaged to be created by expanding the existing public employment schemes to protect the environment and the production of biofuels. The NGP notes that renewable energy provides new opportunities for investment and employment in manufacturing new energy technologies as well as in construction.

The NGP further identifies the need to develop macroeconomic strategies and microeconomic measures to achieve sustainable expansion of work opportunities and output. The NGP states that one microeconomic measure is South Africa being the driving force behind the development of regional energy, transport and telecommunications infrastructure. Priorities in this regard include strengthening the regional integration of energy by undertaking urgent improvements in electricity interconnectors, and exploring other opportunities for enhancing clean energy across central and southern Africa, including natural gas.

4.3.5 National Development Plan 2030 (2013)

The National Development Plan (NDP) 2030 provides the context for all growth in South Africa, with the overarching aim of eradicating poverty and inequality between people in South Africa through the promotion of development. The NDP provides a broad strategic framework, setting out an overarching approach to confronting poverty and inequality based on the six focused and interlinked priorities. One of the key priorities is "faster and more inclusive economic growth". To transform the economy and create sustainable expansion for job creation, an average economic growth exceeding 5% per annum is required. The NDP supports transformation of the economy through changing patterns of ownership and control.

Meeting the development initiatives goals represent a challenge, as the NDP emphasises, at the same time, the need to:

- protect the natural environment;
- enhance the resilience of people and the economy to climate change;
- reduce carbon emissions in line with international commitments;
- make significant strides toward becoming a zero-waste economy; and
- reduce greenhouse gas emissions and improve energy efficiency.

The NDP makes numerous mentions of the need to act responsibly to mitigate the effects of climate change. Diversification of the energy mix away from fossil fuels will be key as energy generation makes up 48% of South Africa's GHG emissions. The NDP indicates that "*the country will explore the use of natural gas as a less carbon intensive transitional fuel*" and that there is a requirement for "*increasing exploration to find domestic gas feedstock… to diversify the energy mix and reduce carbon emissions*". Thus, the ongoing exploration of local natural gas reserves is a key action required to ensure that natural gas is a viable transitional fuel for use in the national electricity generation mix.

4.3.6 National Climate Change Response White Paper (2014)

The National Climate Change Response Paper presents the South African Government's vision for an effective climate change response and the long-term, just transition to a climate-resilient and lower-carbon economy and society. South Africa's response to climate change has two objectives:

- Effectively manage inevitable climate change impacts through interventions that build and sustain South Africa's social, economic and environmental resilience and emergency response capacity.
- Make a fair contribution to the global effort to stabilise greenhouse gas (GHG) concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system within a timeframe that enables economic, social and environmental development to proceed in a sustainable manner.

The Paper acknowledges that South Africa has relatively high emissions for an emerging economy. The energy intensity of the South African economy, largely due to the significance of mining and minerals processing in the economy and the coal-intensive energy system, means that South Africa is a significant emitter of GHGs. The majority of South Africa's energy emissions arise from electricity generation.

The Paper sets out South Africa's overall response strategy though strategic priorities, leading to a series of adaption, mitigation, response measures and priority flagship programmes. Policy decisions on new infrastructure investments must consider climate change impacts to avoid the lock-in of emissions intensive technologies into the future. In the medium-term, the Paper indicates that a mitigation option with the biggest potential includes a shift to lower-carbon electricity generation options. The Renewable Energy Flagship Programme is identified as possible driver for the deployment of renewable energy technologies. Renewable energy and not fossil fuel gas is ultimately recommended for climate change mitigation.

4.3.7 Paris Agreement - United Nations Framework Convention on Climate Change (2015)

The Paris Agreement is an international agreement / treaty, in terms of the UNFCCC, on climate change, which was adopted in 2015. It addresses mitigation, adaptation and finance and was adopted at the 2015 United Nations Climate Change Conference (CoP21), which was held in Le Bourget near Paris, France. The Paris Agreement was opened for signature on 22 April 2016. The agreement aims to improve upon and replace the Kyoto Protocol by committing countries to keeping the long-term rise of global temperatures below 2°C, above pre-industrial levels, and to pursue efforts to limit the increase to 1.5°C, thereby recognising that this would substantially reduce the risks and impacts of climate change.

South Africa signed the Paris Agreement and submitted its pledge in 2016. The pledge is also known as the 'Nationally Determined Contribution' or NDC. According to the pledge, South Africa adopted a 'peak, plateau and decline' approach, whereby it is anticipated the greenhouse gas emissions will peak by 2025, plateau for a decade and then start to decline. By signing the agreement, countries are required to adopt the conditions of the agreement into their own legal systems through ratification, acceptance, approval, or accession. The agreement will become enforceable when ratified / approved by at least 55 countries, which together account for at least 55 % of the global greenhouse gas emissions.

4.3.8 Integrated Energy Plan (2016)

The Integrated Energy Plan (IEP) (2016) considers how current and future energy needs can be addressed. The plan considers security of supply, increased access to energy, diversity in supply sources and primary sources of energy, and minimising emissions. The plan indicates that projected demand for natural gas between 2010 and 2050 would be second only to petroleum products, primarily due to increased growth in the industrial sector.

The IEP states that given South Africa is a net importer of oil, the liquid fuels industry and its economy is vulnerable to fluctuations in the global oil market. Current natural gas consumption exceeds production, with the majority of demand being met through imports from Mozambique.

The plan states that the use of natural gas as an alternative electricity generator must be considered in moderation due to limited proven reserves, but that it has significant potential both for power generation, as well as direct thermal uses. The use of natural gas for power generation is considered as an option to

assist South Africa to move towards a low carbon future given that natural gas has a lower carbon content than coal.

The role of renewable energy to deliver the intended policy benefits of improved energy security and reduced greenhouse gas emissions is also acknowledged in the plan. The availability of untapped renewable energy resources within the country is highlighted. DoE has implemented the RE IPPs procurement process to increase the share of renewable energy technologies in the energy mix but, due to the intermittent nature of renewable energy systems and the variability in electricity load requirements, storage remains the most important challenge to the widespread use of renewable energy. Thus, the IEP notes the need to incorporate fossil fuels and nuclear power to ensure that there is both sufficient base-load electricity generating power to meet the minimum needs and peak-load power to meet the needs during peak periods.

4.3.9 Strategic Environmental Assessment for Shale Gas Development (2017)

The South African government commissioned a Strategic Environmental Assessment (SEA) for Shale Gas Development in the Central Karoo in order to provide an initial scientific assessment of the potential trade-offs between economic opportunity and environmental protection that the development of a medium to large shale gas resource might require. The key objective of the scientific assessment was to provide society with an evidence base, at a strategic level, which will assist South Africa in developing a better understanding of the risks and opportunities associated with Shale Gas Development. The SEA includes 18 chapters of scientific assessment that were drafted and peer reviewed by many authors and experts. The SEA considered three hypothetical development scenarios with the spatial context of the Karoo. The full report is publicly available at http://seasgd.csir.co.za/scientific-assessment-chapters/. The “Summary for Policy Makers” chapter provides an overview of the scientific report. The SEA also considers the risks of drilling within the development scenarios.

The SEA for Shale Gas Development in South Africa (CSIR) indicates that “Including more natural gas in South Africa’s energy mix would make the energy system more efficient, cheaper and more reliable. Natural gas, regardless of its source, has a desirable set of qualities that coal and oil do not possess. Gas can be used in almost all subsectors (e.g. power generation, heat, transport, manufacture of chemicals); is easily transported once gas infrastructure is in place; is supported by a growing international market; is a more consistent fuel than coal (thus more flexible and easier to handle); is less CO_2 intensive when burnt than coal (if leakage during production and transport is minimised); can be more efficiently used for power generation (more kWh per GJ); has high operational flexibility; and has an end-use cost structure that is capital- light and fuel-intensive, making it economically flexible” (Summary for Policy Makers, 2017).

4.3.10 Integrated Resources Plan (2019)

The Integrated Resource Plan, 2019 was gazetted in October 2019. The National Development Plan envisages that, by 2030, South Africa will have an energy sector that provides reliable and efficient energy service at competitive rates, is socially equitable through expanded access to energy at affordable tariffs and environmentally sustainable through reduced pollution. The IRP provides a path to meet electricity needs over a 20-year planning horizon to 2030 and will be used to roll out electricity infrastructure development in line with Ministerial Determinations. The plan aims to balance a number of objectives, namely to ensure security of supply, to minimise cost of electricity, to minimise negative environmental impact (emissions) and to minimise water usage.

Gas is documented in the Integrated Resources Plan (2019) as a low gas utilization scenario due to constraints on gas availability. According to the IRP, gas fired power generation should account for 8.1% of installed generation capacity in the period up to 2030, requiring 3 000 MW of new generation capacity and the conversion of diesel-fired plants to gas. The IRP notes that unconstrained gas would be a 'no regret option' as the power system calls for additional gas volumes if there were no constraints.

4.3.11 South African Economic Reconstruction and Recovery Plan (2020)

South African Economic Reconstruction and Recovery Plan's interventions are in pursuit of the National Development Plan goals of reducing unemployment, poverty and inequality. This document sets out a reconstruction and recovery plan for the South African economy that is aimed at stimulating equitable and inclusive growth. For the past decade, the South African economy has experienced stagnation which has put a strain in the effort to tackle the historical structural inequalities, unemployment and poverty. There is consensus that there needs to be substantial structural change in the economy that would unlock growth and allow for development. Government's conviction is that South Africa has to massively mobilise all its resources and efforts in economic activities to put the economy in a sustainable recovery trajectory. The Covid-19 pandemic deepened the economic crisis in South Africa with many people losing their jobs. As a result, inequality is expected to widen and poverty to deepen.

One of the priority intervention areas is Energy Security, which is critical for the maintenance of a stable economy and is also important in ensuring growth. Specific interventions in the energy sector include creating and securing additional supply, including gas, and finalising the Petroleum Resources Development Bill and related fiscal measures to enable Upstream Sector Investments.

The proposed project could support meeting this priority intervention in Energy Security, through the ongoing exploration to determine the nature and extent of potentially viable offshore resources, which could include gas finds.

4.3.12 South Africa's Low-Emission Development Strategy (SA-LEDS) 2050 (2020)

South Africa's Low-Emission Development Strategy (SA-LEDS) was prepared in response to Article 4 of the Paris Agreement and presents South Africa's first low-emissions development strategy. The Strategy sets out the path going forward to place the country on a low-carbon trajectory towards ultimately reaching a net zero carbon economy by 2050, while at the same time ensuring broader socio-economic development. The strategy acknowledges that as one of the top 20 global emitters, with a high dependency on fossil fuels, substantial emission cuts will be required. It also acknowledges that the rapid transition that will be required presents a potential risk to economic growth and sustainable development if not managed properly.

The strategy centres on measures currently being implemented to address mitigation across the four key sectors of the economy, namely energy; industry; Agriculture, Forestry and Land Use (AFOLU); and waste. With regards to energy supply, the decarbonisation will largely be driven through, *inter alia*:

- the Integrated Energy Plan, which analyses current energy supply and demand trends within the different sectors of the economy, and projects the country's future energy requirements under a variety of different scenarios,

- the Integrated Resource Plan (see Section 4.3.9), which guides the South African electricity supply sector, by identifying the preferred electricity generation technologies to meet projected electricity demand. It, thus, provides a mechanism for Government to drive the diversification of the country's electricity generation mix and promote the use of renewable energy and other low-carbon technologies.

The Strategy recognises that many of the current measures address only the short-term and are not considered to be transformational. Thus, the Strategy also presents planned cross sectoral measures that will contribute to driving mitigation action. It acknowledges that a broad range of structural changes will be necessary, in order to ensure the global economy achieves carbon neutrality within the second half of the century. Changes will be required in terms of service demand, technology fleet, infrastructure, operating practice, and energy sources, for all sectors of activity.

4.3.13 South Africa's Draft Nationally Determined Contribution (2021)

On 31 March 2021 the Minister of Forestry, Fisheries and the Environment officially launched South Africa's updated draft Nationally Determined Contribution (NDC) for public consultation. The updated draft NDC is the cornerstone of South Africa's climate change response and expresses South Africa's commitment to the Paris Agreement and a statement as to how South Africa will address the climate challenge. South Africa remains committed to addressing climate change based on science, equity and sustainable development. Similarly, the present draft updated NDC seeks to balance the three structural components of mitigation, adaptation and means of implementation / support requirements.[7]

The Intergovernmental Panel on Climate Change (IPCC) indicates that more urgent and rapid reductions in emissions are required by all countries. The updated mitigation NDC proposes a significant reduction in GHG emissions target ranges up to 2030, with the 2025 target range allowing time to fully implement the national mitigation system, including those elements contained in the Climate Change Bill (see Section 4.3.17). It will also allow space for the implementation of IRP 2019 and other key policies and measures, as well as the national recovery from COVID-19. The 2030 target range (398 - 440 Mt $CO_{2\text{-eq}}$) is consistent with South Africa's fair share, and also an ambitious improvement on South Africa's current NDC target. The upper range of the proposed 2030 target range represents a 28% reduction in GHG emissions from the 2015 NDC targets. South Africa's updated NDC targets are aligned with planned policies and measures to provide opportunities for accessing large-scale international climate finance to fund low carbon infrastructure and also to fund the just transition.

The Presidential Climate Commission (PCC) was established in order to advise government and its social partners on the climate transition and viable pathways to a climate resilient net-zero economy and society. The PCC believe that the NDC should give expression to the need for a "just transition", to which Government and its social partners are committed. It is important to protect those most vulnerable to climate change, including women, children, people with disabilities, the poor and the unemployed, and protect workers' jobs and livelihoods as the economy shifts to cleaner, more sustainable production.
In reviewing the draft NDC, the PCC recommends that (PCC 2021):

[7] Source: https://www.environment.gov.za/mediarelease/ creecy_indc2021draftlaunch_climatechangecop26.

- The upper and lower bounds of the emissions trajectory in the NDC should be compatible with South Africa's 'fair share' of emission reductions, taking into account common but differentiated responsibilities and respective capabilities.
- The NDC should reaffirm South Africa's commitment to reaching 'net-zero' carbon emissions by 2050.
  A net-zero target will be consistent with the direction other countries are taking and will set the context for evaluating the 2025 – 2030 emission trajectory.
- Since current policies will result in emissions below the draft updated NDC trajectory, the implementation of these current policies and programmes allows for increased ambition in the updated NDC.
- Further ambition beyond existing policies is possible by adopting least-cost measures to accelerate emissions reductions, provided that the required investment is supported by scaled up climate finance.
- South Africa should maximise the employment opportunities and other co-benefits associated with higher levels of and more rapid decarbonisation mitigation, at the same time as addressing negative local employment effects.
- The NDC should note the sensitivity of tradable sectors of South Africa's economy to global carbon measures as trading partners embark on net-zero targets and seek to be competitive in low-carbon goods and services.
- The NDC should lower South Africa's emissions target range to at least 350 – 420 Mt $CO_{2\text{-eq}}$ by 2030. This will be consistent with South Africa's fair share contribution to a 2°C global target.

In addition, the NDC should indicate South Africa's long-term emissions target of achieving net-zero carbon emissions by 2050, as set out in SA-LEDS. In arguing for a proactive stance, it is important to be mindful of the enormous challenges South Africa faces in terms of unemployment, poverty and inequality. South Africa is committed to a just transition to a net-zero and climate resilient society. The process of transition to a decarbonised economy has to be carefully managed, and the social and economic cost of the transition for vulnerable groups must be factored into the planning process, while the economic opportunities of the transition should be fairly distributed.

4.3.14 South African Gas Masterplan Base Case Report (2021)

The NDP envisions that by 2030 South Africa will have an energy sector that promotes economic growth and development through adequate investment in energy infrastructure (See Section 4.3.5). At just 2.6% of the country's total energy mix, South Africa's natural gas market is small, but with all its inherent benefits, it has the potential to change the economy by stimulating economic growth and development, stability and job creation.

The meaningful addition of natural gas to the country's energy mix will rejuvenate an overburdened, out-dated energy infrastructure and reduce cyclical energy shortfalls. It will also stimulate the economy by allowing business and industry to lower their energy and operational spend, while also creating significant numbers of new jobs and skills development opportunities.

A challenge in developing the gas sector is to bring gas demand and supply on stream at the same time and spread geographically to stimulate broader localised demand through South Africa. Without such localised gas demand, it is difficult to develop distributed gas supply and without such distributed gas supply it is

difficult to develop localised gas demand. In pursuit of adding generating capacity, lowering carbon emissions, enhancing energy security and supporting industrial development, South Africa has taken the first steps in a gas-to-power programme to be executed under the IRP 2019, aiming to increase the national energy mix natural gas contribution from 2.6% to 15.7% by 2030.

The purpose of the Gas Masterplan Base Case Report is to establish baseline information for the natural gas sector in South Africa and to outline the Gas Master Plan roadmap. Such baseline information includes an overview of the gas value chain and regulatory framework. The report also sets the scene for the Gas Master Plan development process.

4.3.15 International Energy Agency: Net Zero by 2050 - A Roadmap for the Global Energy Sector (2021)

The International Energy Agency (IEA) is a Paris-based autonomous intergovernmental organisation established in the framework of the Organisation for Economic Co-operation and Development (OECD) in 1974. Today the IEA acts as a policy adviser to its member states, as well as major emerging economies, such as South Africa (which is an association country to the IEA), to support energy security and advance the clean energy transition worldwide. The IEA's mandate has broadened to focus on providing analysis, data, policy recommendations and solutions to help countries ensure secure, affordable and sustainable energy for all. In particular, it has focused on supporting global efforts to accelerate the clean energy transition and mitigate climate change. The IEA has a broad role in promoting rational energy policies and multinational energy technology co-operation with a view to reaching net zero emissions. In response to the growing number of pledges by countries and companies around the world to limit their emissions to net zero by 2050 or soon after, IEA announced in January 2021 that it would produce a roadmap for the global energy sector to reach 2050 net zero. The report maps out a pathway in line with preventing global temperatures from rising above 1.5°C[8].

The global pathway to net-zero emissions by 2050 detailed in this report requires all governments to significantly strengthen and then successfully implement their energy and climate policies. The proposed pathway calls for scaling up solar and wind so that the energy sector is dominated by renewables with a significant decline in fossil fuels (reducing from four-fifths of total energy supply to slightly over one-fifth by 2050). Although the proposed pathway still recognises the need for fossil fuels in the energy mix, it does not provide for the approval of new oil and gas fields for development due to the projected drastic reduction in oil and gas demand (IEA, 2021).

The report, however, recognises that the route mapped out is a path, not necessarily the path, and so it examines some key uncertainties, including the speed with which demand and behaviours adapt, the real level of energy efficiency, the pace at which new decarbonisation technologies (such as hydrogen and carbon capture and storage) scale up, etc. The report thus concludes that the proposed pathway to net-zero emissions is just one possible pathway to achieve net-zero emissions by 2050.

[8] Source: https://www.iea.org/reports/net-zero-by-2050

4.3.16 Just Transition and Climate Pathways Study for South Africa (NBI, 2021[9])

While gas is set to play a major role in South Africa's path to net-zero emissions, this report by the National Business Initiative, Business Unity South Africa and the Boston Consulting Group shows that a lack of supply threatens the country's decarbonisation strategy. This report unpacks the impact of including gas in the country's plans to reduce emissions from carbon-heavy sectors such as electricity, transport and industrial. It is envisioned that natural gas replaces coal and diesel fuel sources, which are more emissions-intensive. Eventually, gas would be phased out by 2050 and replaced by greener alternatives like green hydrogen once the latter is developed and becomes more affordable.

According to this report, the country's current gas consumption comes to 180 petajoules (180 trillion kilojoules) per annum. The majority of gas is used in the synfuels sector, followed by the industrial sector. Most of the country's gas is sourced from the Pande-Temane gas fields in Mozambique, which supplies approximately 160 petajoules to Gauteng, KwaZulu-Natal and Mpumalanga. Energy and chemicals company Sasol provides about 20 petajoules of gas to KwaZulu-Natal via the Lilly pipeline. However, the Pande-Temane reserves are declining and will be constrained from 2025, which "*poses a risk to the decarbonisation ambitions of key sectors in the South African economy, which will rely on gas as a transition fuel or low carbon feedstock*".
South Africa's potential future gas demand will be driven by four key sectors with proven use cases for gas as a transition fuel or lower emission feedstock:

1. **Power:** Use gas in gas-to-power (GTP) plants to enable a high penetration of renewable energy in the power system by providing the flexible capacity to manage the long-duration intermittency, which battery storage cannot currently address.
2. **Synfuels:** Introduce additional gas to enable the phase-out of significantly more carbon-intense coal feedstock in the production of liquid fuels.
3. **Industry:** Phase out higher emitting coal, and to a lesser extent diesel, with additional gas as an energy source for industrial heat generation and other processes.
4. **Transport:** Use gas as an alternative to diesel, albeit at a small scale, for heavy-duty commercial road transport in the short- to mid-term, while alternative greener technologies mature and become economically viable.

The study warns that without additional gas, there would be more emissions in the long run because the synfuels, power and industrial sectors would rely on carbon-intensive fuels like coal and diesel for longer.
The report, however, does highlight other potential sources of South Africa's gas supply over the short, medium and long term.

- In the short term (2021 to 2024), the country can supplement the Pande-Temane reserves by relying on LNG. LNG mainly would be supplied from floating storage regasification units or gas-carrying ships stationed at ports like Matola in Mozambique and South African ports such as Richards Bay, Coega and Saldanha.
- In the medium term (2024-2030), the supply from Pande-Temane could be maximised through "technical work" on the reserves. For example, this is possible through regional cooperation between South Africa and Mozambique to achieve a "win-win" for both parties. The report,

[9] Report summarised, in part by, by https://www.news24.com/fin24/economy/shortage-of-gas-could-derail-sas-plans-to-decarbonise-20220221

however, notes that the additional gas available from Pande-Temane is not fixed and depends on contractual and other technical uncertainties.

- In the long term (beyond 2030), other supply options include LNG and piped gas from Rovuma and other gas fields from Mozambique. Gas can also be sourced from South Africa's exploration activities like TEEPSA's Brulpadda and Luiperd gas fields.

The study warned against unconstrained gas demand - as the goal is to ultimately move away from using the fuel in favour of green alternatives. The report encourages research into repurposing gas infrastructure for green synfuels and green hydrogen.

4.3.17 Climate Change Bill (2022)

On 18 February 2022, the Climate Change Bill was formally introduced to the National Assembly by the Minister of Forestry, Fisheries and the Environment. The aim of the Bill is to enable the development of an effective climate change response and a long-term, just transition to a low-carbon and climate-resilient economy and society for South Africa in the context of sustainable development.

The objects of this Act are to:

(a) "provide for a coordinated and integrated response by the economy and society to climate change and its impacts in accordance with the principles of cooperative governance;
(b) provide for the effective management of inevitable climate change impacts by enhancing adaptive capacity, strengthening resilience and reducing vulnerability to climate change, with a view to building social, economic and environmental resilience and an adequate national adaptation response in the context of the global climate change response;
(c) make a fair contribution to the global effort to stabilise greenhouse gas concentrations in the atmosphere at a level that avoids dangerous anthropogenic interference with the climate system;
(d) to ensure a just transition towards a low carbon economy and society considering national circumstances;
(e) give effect to the Republic's international commitments and obligations in relation to climate change; and
(f) protect and preserve the planet for the benefit of present and future generations of humankind".

When promulgated, the Bill will form the legislative foundation for the climate change adaptation and mitigation response. With respect to the mitigation response, the Bill provides for future review and determination of the national greenhouse gas emissions trajectory; determination of sectoral emissions targets for emitting sectors and subsectors; and allocation of carbon budgets (Source: SA-LEDS).

4.3.18 UN IPCC Report II (February 2022) and Report III (March 2022)

The IPCC released a new climate report in March 2022, building on the findings of a previous report released in February 2022. This provides the IPCC's guidance on what the world can do to avoid the consequences of climate change. The report outlines the most up-to-date science regarding current emissions levels and mitigation strategies in order to transition from fossil fuels. In order to ensure that the 1.5°C degree target can be fulfilled, the report notes that alternative fuels need urgent investment and scaling up to combat the rising global warming margins.

The latest IPCC report shows greenhouse gas emissions continue to rise and that current policies to address climate change are not ambitious enough to limit warming to 1.5°C above pre-industrial levels. The report

notes that without a strengthening of policies beyond those that are implemented by the end of 2020, GHG emissions are projected to rise beyond 2025, leading to a median global warming of 3.2°C by 2100.

Although growth in emissions has slowed, global GHG emissions remain at their highest level ever. Global GHGs must peak around 2020 and before 2025 at latest in order to remain below 1.5°C with no or limited overshoot. To achieve the 1.5°C degree target, global GHGs must fall by 43 % below 2019 by 2030 and 84% by 2050, while CO_2 emissions must fall by 48% by 2030 and to net-zero in early 2050s and methane must fall by 4% by 2030. If the world cuts emissions quicker, then there is slightly more time before CO_2 has to reach net-zero.

Current and historical GHG emissions are not evenly distributed, with the top 10 % of households being responsible for 34 - 45% of emissions today. Least-developed countries have contributed to less than 0.4 % of historical CO_2 emissions.

The report notes that cutting emissions requires a "substantial reduction in overall fossil fuel use", energy efficiency, low-emission energy sources, such as renewables and alternative energy carriers, such as hydrogen.

4.4 REGIONAL AND LOCAL POLICY AND PLANNING FRAMEWORK

This section aims to provide an overview of the regional and local policy and planning context relating to the proposed development.

4.4.1 Free State Provincial Spatial Development Framework

The Free State Provincial Spatial Development Framework (PSDF) aims to align the province's strategies, proposals and guidelines for future spatial development with the Free State Development Strategy (FSGDS) 2005 – 2014 and the NDP (refer to Section 4.3.2). Like the NDP, the PSDF identifies key challenges to be addressed through plans and strategies. Four categories have been identified, each with its own challenges and plans and strategies to address the challenges. The four categories identified include:

- Context - Lack of international and national cooperation as it relates to biodiversity conservation and efficient bioregional planning.
- The Place - Addressing the space-related aspects that represent the environmental capital of the Free State.
- The People - Towards enhancing of well-being of the people of the province as an imperative for sustainable development.
- The Economy - Towards promoting the economy and ensuring efficient use of monetary and infrastructural capital for the benefit of all (Van der Merwe, 2013).

The fundamental principle of the PSDF is sustainability of the resource base and supporting environment which would enable long-term viability of economic activity. Although The Free State PSDF doesn't currently specify any details on gas developments, there have been various media stories (2016 to 2020) pointing to the presence of local gas, supply to Sasol's Sasolburg operations in the northern part of the Free State and the development of Liquefied Natural Gas (LNG) facilities. Renergen is currently developing the Virginia Gas Project, which will produce LNG and liquid helium. According to Renergen, the Free State natural gas field contains one of the richest helium concentrations recorded globally. The plant is expected to be operational

within the first half of 2021. Within this context the proposal by Rhino to explore for petroleum products could contribute to the establishment of a gas-based economy in the Free State Province.

4.4.2 District Municipality Integrated Development Plans and Spatial Development Frameworks

The Local Government: Municipal Systems Act, (Act 32 of 2000) stipulates that all Municipalities are required to prepare an Integrated Development Plan (IDP) and that a Spatial Development Framework (SDF) be a component of the IDP. The IDP outlines the municipality's strategic plans for achieving its long-term goals and acts as a connection between its long-term strategic planning and its yearly operational plans. It takes into account national and provincial government priorities, emerging trends, and other relevant issues to create a framework that ensures developmental local government. The Spatial Planning and Land Use Management Act (SPLUMA) provides a framework for spatial planning and land use management and Chapter 4 addresses the preparation requirements and content of an SDF.

4.4.2.1 Nketoana Local Municipality Integrated Development Plan (2022 – 2027)

Nketoana Local Municipality forms part of the Thabo Mofutsanyana District Municipality in the Free State province. It is one of the six local municipalities within the district; other five local municipalities are, Maluti a Phofung, Dihlabeng, Phumelela, Mantsopa and Setsoto. The Municipal vision is to create a Municipality that will care for its residents and provide a safe and crime-free environment conducive for sustainable development. The key performance areas (KPAs) of the municipality include:

- KPA 1: Good Governance & Public Participation;
- KPA 2: Basic Service Delivery & Infrastructure Investment;
- KPA 3: Local Economic Development (including job creation)
- KPA 4: Institutional Transformation and Organizational Development; and
- KPA 5: Financial Viability & Management.

According to the IDP, the municipality had approximately 5 855 unemployed residents and 18 070 economically inactive residents as per the 2011 census. However, due to COVID-19 and the declining economy, the unemployment rate has increased. Nevertheless, the proposed project's construction and operation phases will create economic opportunities for unemployed residents within the municipality, thereby contributing to the local economy.

The municipality's primary economic activities are agriculture and retail businesses, with about 19% of the economically active population employed in agriculture. The proposed project will align with KPA 2 of the NLM IDP and contribute to economic growth and development in the region. Considering the high unemployment rate, the project's implementation will enable the municipality to achieve some of its critical objectives as outlined in the IDP. Consequently, the project is consistent with the IDP's goals, aims, and objectives for the Nketoana Local Municipality.

4.4.2.2 Nketoana Local Municipality Spatial Development Framework (2022 – 2027)

The Nketoana Local Municipality Spatial Development Framework (SDF) was developed with the assistance of the Department of Cooperative Governance and Traditional Affairs (COGTA) to ensure that the SDF is SPLUMA compliant. The Municipality’s SDF focuses on several key elements, namely:

- Job creation
- Identify and develop economic development landmarks

- Develop Reitz as an economic development hub for manufacturing (industrial zones)
- To create a business environment conducive for investment, with specific reference to ensuring that basic services are available to support such expansion
- Promotion of targeted economic sectors, such as BBBEEs, SMMEs, local purchasing and Tourism
- Provide and improve educational opportunities to combat unemployment specifically amongst the youth in Nketoana.
- Strategy related to Cooperatives
- Cooperatives must be community driven

4.4.2.3 Moqhaka Local Municipality Integrated Development Plan (2022 – 2027)

The Moqhaka Local Municipality (MLM) is a category B municipality, comprising of Kroonstad, Maokeng, Viljoenskroon, Rammulotsi, Steynsrus, Matlwangtlwang in the Fezile Dabi District. The mission of the municipality is to maintain and enhance quality of life by providing effective, efficient quality and affordable services equitably and facilitating sustainable socio-economic growth through active community participation. The KPAs of the municipality include:

- KPA 1: Basic Service Delivery
- KPA 2: Good Governance and Public Participation
- KPA 3: Local Economic Development
- KPA 4: Municipal Financial Viability and Management
- KPA 5: Municipal Transformation and Institutional Development
- KPA 6: Social and Community Development

According to the IDP, COVID-19, negative economic growth, and recent international political tensions are responsible for unemployment, particularly among young people. In 2011, the municipality had around 19,554 unemployed residents and 51,074 discouraged jobseekers. Despite being minimal, the proposed project's construction and operation phases will create job and business opportunities for unemployed residents within the municipality, thereby boosting the local economy.

The MLM IDP's goal is to create a conducive environment that fosters local economic development and facilitates job creation. The proposed project is in line with KPA 3 of the MLM IDP and will contribute to economic growth and development in the region. The project aligns with the IDP's objectives for the Moqhaka Local Municipality and will help the municipality achieve some of its key goals, given the high unemployment rate.

4.4.2.4 MLM Spatial Development Framework (2022 – 2027)

The current MSDF translates the current and the upcoming municipal IDP vision, namely, “Moqhaka Local Municipality strives to be a Municipality that creates an enabling environment for socio economic growth and sustainable development”. The MSDF long term spatial vision, 2030 states “Moqhaka, as an integrated spatial unit, responsibly catering for all community development needs”. The municipal spatial framework is based on the six identified spatial strategies:

- Cross Cutting Goals
    - Continuous community consultation prior to any spatial framework changes should be adopted as a principle.

- Revitalisation and re-population of the rural areas are considered as significant to enhance development of the region.

- Core and Buffer
  - Developments aligned with environmental legislation and policy and cognisant of protecting the environment and the optimisation of natural resources.
  - To promote the optimal development and utilisation of the unique tourism potential.
- Agricultural Areas
  - Enhancement of current predominant agri-industrial development focus, with access to agricultural land, commonage and all urban agriculture endeavours to the benefit of the broader community.
  - Responsible utilisation and control measures (carrying capacity) of commonage and agricultural resources and the protection of high potential agricultural land.
- Urban related
  - Meeting SPLUMA requirements for spatial justice.
  - Employing norms and standards in ensuring the availability of amenities in all urban areas; restricting conversion thereof into other land uses.
  - Inclusionary housing developments must ensure differentiation in typologies and provide for densification and infill planning intercepting sprawl.
  - An integrated and efficient land use management system to be implemented, ensuring unhindered progression of the development processes.
- Industrial Areas
  - Continual expansion of the industrial zones must procure preference.
- Surface Infrastructure and Buildings
  - Development should be feasible; especially in relation to the availability of infrastructure services.
  - Access to services must be ensured to the broader community.
  - Infrastructure and bulk service delivery

4.4.2.5 Ngwathe Local Municipality Integrated Development Plan (2021 – 2026)

The IDP (2021-2026) of the Ngwathe Local Municipality (NLM) is a category B municipality with agriculture, mining and tourism as the economic drivers. The mission of the municipality is to provide affordable and quality municipal services and address triple challenges of poverty, unemployment and inequality, and promote sustainable development through cooperative, strategic partnerships and innovation. The KPAs of the municipality include:

- KPA 1: Basic Service Delivery and Infrastructure Investment
- KPA 2: Local Economic Development
- KPA 3: Financial Viability and Financial Management
- KPA 4: Municipal Transformation and Institutional Development
- KPA 5: Good Governance and Community Participation

The IDP indicates that as per the 2011 census results, the municipality had a 35 % unemployment rate, which is equivalent to approximately 19 643 residents. The IDP indicates that the unemployment rate has since increased due to Covid-19 related impacts. Although negligible, the employment and socio-economic opportunities associated with the construction and operation phases of the proposed project will contribute

towards the stimulation of the local economy, through the creation of employment and business opportunities for unemployed residents within the municipal area.

The overarching direction of the NLM, IDP articulates a vision for economic growth and development, provision of basic services (service delivery improvement) and infrastructure development. The proposed Project will contribute to economic growth and development in the region, which will be in line with the KPA 2 of the NLM IDP. Taking into consideration the high unemployment rate, the implementation of the Project will enable the municipality in reaching some of its key objectives, as outlined in the IDP. As a result, the project is considered to be aligned with the goals / aims / objectives of the IDP for the Ngwathe Local Municipality.

4.4.2.6 Ngwathe Local Municipality Spatial Development Framework (2021 – 2026)

The Ngwathe Local Municipality Spatial Development Framework (SDF) aims to provide guidance for land development planning, serve as a reference for decision-makers during unusual situations, establish a spatial logic to direct private sector investment, ensure social, economic, and environmental sustainability, identify public sector developmental priorities and spatial priorities, and identify areas where public-private partnerships are feasible. The SDF emphasizes the need to address specific issues, such as natural resource management, land rights and tenure arrangements, land capability sub-division and consolidation of farms, and protection of prime agricultural land.

Moreover, the SDF recognizes that there are various developmental constraints in the district, such as poorly defined urban concentrations, slow land reform, high unemployment, poverty, HIV/AIDS infection, crime, and illiteracy rates, underutilized tourism potential, and the need for improved housing, sanitation, and infrastructure. On the other hand, the district presents opportunities for development, such as high agricultural and tourism potential, the requirement for supporting services to complement the primary sectors, utilization of natural resources for job creation, good internal and external linkages through efficient road networks, good electricity supply, and availability of industrial stands.

4.4.3 District Environmental Management Frameworks

An Environmental Management Framework (EMF) is a document that aims to ensure that environmental limits to development are included in spatial planning documents. EMFs provide a compilation of information and maps, illustrating attributes of the environment for a specific geographical area that becomes useful in a diverse field of environmental applications, including S&EIA processes, but also other planning processes, such as the development of IDPs, SDFs and other open space planning applications.

While the development of IDPs and SDFs is a mandatory district and municipal requirement, the development of EMFs is not and as a result the Ngwathe Local Municipality is the only municipality with an adopted EMF within Rhino's ER area.

4.5 CONSISTENCY WITH POLICY AND PLANNING CONTEXT

The previous sections have considered the policy and planning context at national, regional and local level, which are relevant to the proposed amended EWP. There is a drive from national and provincial Government to stimulate development and grow the economy of South Africa with a strong focus on job creation in all sectors, whilst protecting the environment. In order to facilitate this economic growth, there is a need to ensure that there is sufficient capacity in the country's electricity supply by diversifying the

primary energy sources within South Africa. Exploration for domestic gas has been identified as a potential driver of economic growth, energy supply and job creation.

The proposed well drilling exploration activities would allow for the determination of whether or not domestic gas resources are located within the proposed ER area. By gaining a better understanding of the extent, nature and economic feasibility of extracting these potential resources, the viability of developing indigenous gas resources would be better understood.

The promotion of the oil and gas sector could also be considered in contradiction with some of the other plans and policies, which identify the need to reduce the reliance on fossil fuels in order for South Africa to reduce GHG emissions and meet commitments in this regard. Nevertheless, the current limitations of renewable energy technologies are such, that there is still a need to include fossil fuels (notably natural gas) within the energy mix of the country.

4.6 CONSISTENCY WITH NEMA PRINCIPLES

The national environmental management principles contained in NEMA serve as a guide for the interpretation, administration and implementation of NEMA and the EIA Regulations. In order to demonstrate consistency with the NEMA principles, a discussion of how these principles are taken into account during the S&EIA process is provided in Table 4-1 below.

Table 4-1: Consideration of the NEMA Principles in relation to the Proposed Project

National Environmental Management Principles	Comment
(2) Environmental management must place people and their needs at the forefront of its concern, and serve their physical, psychological, developmental, cultural and social interests equitably.	The proposed project aims to determine the presence of petroleum resources within the ER area. Confirmation of the presence of such resources would enable the country to refine its long-term planning for the development of the oil and gas sector within the country. The gas sector is known to have economic benefits and environmental risk which need to be balanced. The S&EIA process will also serve to identify the needs and interests of potentially affected parties and to address issues and concerns raised through the course of the study.
(3) Development must be socially, environmentally and economically sustainable.	Government has indicated that there is a need for the country to reduce its reliance on coal-based electricity. The use of natural gas is being considered to assist in reaching this goal. By determining the presence (and extent) of such resources, the sustainability of developing the petroleum sector within the country can be better considered.
(4)(a) Sustainable development requires the consideration of all relevant factors including the following:	The S&EIA process will consider potential social, economic, biophysical impacts that could result through

National Environmental Management Principles	Comment
(i) That the disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied; *(ii) that pollution and degradation of the environment are avoided, or, where they cannot be altogether avoided, are minimised and remedied;* *(iii) that the disturbance of landscapes and sites that constitute the nation's cultural heritage is avoided, or where it cannot be altogether avoided, is minimised and remedied;* *that waste is avoided, or where it cannot be altogether avoided, minimised and re-used or recycled where possible and otherwise disposed of in a responsible manner;* *that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;* *that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised;*	the implementation of the proposed amended exploration work programme. Measures will also be identified to avoid, minimise and/or remedy potential pollution and/or degradation of the environment that may occur as a result of the proposed project.
(4)(a)(vii) that a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and	Assumptions, uncertainties and limitations associated with the compilation of the EIA Report are discussed in Section 3.2. Compliance with the various legislative requirements is presented in Section 2.3.
(4)(a)(viii) that negative impacts on the environment and on people's environmental rights be anticipated and prevented, and where they cannot be altogether prevented, are minimised and remedied.	The S&EIA process will consider and assess the identified potential social, economic and biophysical impacts of the project (refer to Section 7). The EMPr will provide the recommended management measures to mitigate the significance of identified impacts.
(4)(b) Environmental management must be integrated, acknowledging that all elements of the environment are linked and interrelated, and it must take into account the effects of decisions on all aspects of the environment and all people in the environment by pursuing the selection of the best practicable environmental option.	The S&EIA process that is being followed recognises that all elements of the environment are linked and interrelated. PASA/DMRE, as the decision-making authority, will be responsible for taking all aspects of the environment, including whether or not the potential impacts of the project would unfairly discriminate against

National Environmental Management Principles	Comment
(4)(c) Environmental justice must be pursued so that adverse environmental impacts shall not be distributed in such a manner as to unfairly discriminate against any person, particularly vulnerable and disadvantaged persons.	any person, into consideration when making a decision regarding the proposed project.
(4)(d) Equitable access to environmental resources, benefits and services to meet basic human needs and ensure human well-being must be pursued and special measures may be taken to ensure access thereto by categories of persons disadvantaged by unfair discrimination.	The S&EIA process includes undertaking a geohydrological assessment which is scoped to assess whether the proposed amended exploration work programme will present any risk to ground water quality or quantities (See Section 7)
(4)(e) Responsibility for the environmental health and safety consequences of a policy, programme, project, product, process, service or activity exists throughout its life cycle.	Rhino is committed to comply with environmental health and safety consequences of the proposed well drilling exploration process.
(4)(f) The participation of all interested and affected parties in environmental governance must be promoted, and all people must have the opportunity to develop the understanding, skills and capacity necessary for achieving equitable and effective participation, and participation by vulnerable and disadvantaged persons must be ensured.	The public participation process has been undertaken in accordance with the requirements of the EIA Regulations 2014 (see Section 3.3). In addition, a pre-application Public Participation Process was undertaken for the project, which included public information meetings and distribution of a BID for comment (see Box 3 and Box 4).
(4)(g) Decisions must take into account the interests, needs and values of all interested and affected parties, and this includes recognizing all forms of knowledge, including traditional and ordinary knowledge.	The S&EIA process will take into the account the interests, needs and values of I&APs, through the submission of comments on the proposed project, during the Scoping and EIA phases of the project. Thus, the decision-makers will have the necessary information before them on which to base an informed decision.
(4)(h) Community wellbeing and empowerment must be promoted through environmental education, the raising of environmental awareness, the sharing of knowledge and experience and other appropriate means.	The Scoping Report and EIAR prepared for the proposed project will be made available to communities for review and comment.
(4)(i) The social, economic and environmental impacts of activities, including disadvantages and benefits, must be considered, assessed and evaluated, and decisions must be appropriate in the light of such consideration and assessment.	The S&EIA process will consider identified potential social, economic, biophysical impacts of the project in an integrated manner. The significance of these impacts will be assessed in the EIA phase according to pre-defined rating scales.
(4)(j) The right of workers to refuse work that is harmful to human health or the environment	Rhino (and its appointed contractors) would be required to comply with the requirements of the Mine Health and Safety Act. An Environmental Awareness Plan will also be

National Environmental Management Principles	Comment
and to be informed of dangers must be respected and protected.	prepared to inform staff about any aspects of their work that may pose a danger to the environment.
(4)(k) Decisions must be taken in an open and transparent manner, and access to information must be provided in accordance with the law.	The public consultation process is being undertaken in accordance with the requirements of the EIA Regulations 2014 (as amended) and will allow for the distribution of the Scoping Report and EIAR for public review and comment. This information will be provided in an open and transparent manner.
(4)(l) There must be intergovernmental co-ordination and harmonisation of policies, legislation and actions relating to the environment.	The public participation process for the proposed project provides an opportunity for the Organs of State to provide comment on the proposed project and address any potential conflicts between policies or other developmental proposals administered by them that may be in conflict with the proposed project before decision-making.
(4)(m) Actual or potential conflicts of interest between organs of state should be resolved through conflict resolution procedures.	It is not anticipated that the proposed project would result in any conflicts between organs of state.
(4)(n) Global and international responsibilities relating to the environment must be discharged in the national interest.	PASA/DMRE, as the decision-making authority, will be responsible for taking cognisance of any international obligations that could have an influence on the project.
(4)(o) The environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage.	The S&EIA process will consider and assess the identified potential social, economic, biophysical impacts of the project (refer to 7).
(4)(p) The costs of remedying pollution, environmental degradation and consequent adverse health effects and of preventing, controlling or minimizing further pollution, environmental damage or adverse health effects must be paid for by those responsible for harming the environment.	As the applicant, Rhino will be responsible for the implementation of the measures included in the EMPr.
(4)(q) The vital role of women and youth in environment management and development must be recognised and their full participation therein must be promoted.	The public participation process for the proposed project has been and will continue to be inclusive of women and the youth.
(4)(r) Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands and similar systems require specific attention in management and planning	The S&EIA process undertaken for the proposed project will identify relevant sensitive and/or vulnerable areas and assess potential impacts if applicable. Appropriate mitigation measures will be proposed if required.

National Environmental Management Principles	Comment
procedures, especially where they are subject to significant human resource usage and development pressure.	

4.7 SECURING ECOLOGICAL SUSTAINABLE DEVELOPMENT AND USE OF NATURAL RESOURCES

The biophysical impacts of the proposed project have been investigated and are documented in section 7 of the EIAR. Measures to enhance the benefits and mitigate the impacts to these resources are included in the EMPR .

4.8 PROMOTING JUSTIFIABLE ECONOMIC AND SOCIAL DEVELOPMENT

The socio-economic impacts of the proposed project have been assessed in the EIA (see Section 7). Measures to enhance the benefits and mitigate the impacts to these resources are included in the EMPR.

5. PROJECT DESCRIPTION

This chapter describes the sequence of the proposed project phases, provides technical information, and describes the proposed exploration activities and alternatives.

5.1 DETAILS OF THE APPLICANT

Rhino is a South African registered subsidiary of Rhino Resources Ltd. Rhino Resources Ltd is a technology driven, independent oil and gas exploration and development company focused on Africa. Company details for Rhino are detailed in Table 5-1.

Table 5-1: Details of the applicant

Applicant details	
Company name	Rhino Oil and Gas Exploration South Africa (Pty) Ltd
Registration no:	2013/096757/07
Contact person	Travis Smithard
Postal address	3rd Floor, Icon Building, 24 Hans Strijdom Avenue, Foreshore, Cape Town
E-mail	info@rhinoresourcesltd.com
Web address	http://www.rhinoresourcesltd.com/

5.2 PROJECT LOCATION

5.2.1 Target areas

The extent of ER 318 includes ~ 3 000 properties (farms and portions) over an area of approximately 600 000 ha (Figure 1-2).

Rhino has identified three (3) Target Areas within which they intend to focus well drilling as per the updated EWP . The Target Areas include (Figure 1-2):

- **Target Area 1** is approximately 200 km^2 in extent and is located approximately 4 km west of Allanridge and 5 km north of Welkom. The Target Area includes ~ 680 properties;
- **Target Area 2** is approximately 450 km^2, approximately 4 km northeast of Allanridge and 20 km west of Kroonstad. The Target Area includes ~ 324 properties;
- **Target Area 3** is approximately 138 km^2 in extent in the eastern portion of ER 318, with Steynsrus located 38 km south and Kroonstad to 2 km west. The target Area includes ~ 228 properties.

The corner co-ordinates of the Target Area boundaries and a list of the properties included in the Target Areas are provided in Appendix D. Given the large number of properties included, it was not feasible to include a cadastral description of every property in this document.

While the updated EWP focuses on the three Target Areas, the balance of the area remains under ER to Rhino and is not being relinquished. These remaining areas are available to Rhino to undertake further exploratory work subject to compliance with the MPRDA, NEMA and any other statute as required.

5.2.2 Drill site locations

As part of the updated EWP, Rhino is proposing to drill a total of up to 40 wells. Siting of the proposed wells is based on:

- Prospective geological and geophysical formations or features;
- Accessibility and agreement with affected landowners, and
- Accommodation of environmental and social/socio-economic constraints.

As discussed in Section 1.1, during their initial 3-year exploration campaign, Rhino undertook an appraisal of available historical geological and geophysical data as well as commissioned an airborne survey to acquire additional project specific geophysical data (See Figure 5-1 for example). Based on this desktop information, Rhino identified the three Target Areas shown in Figure 1-2.

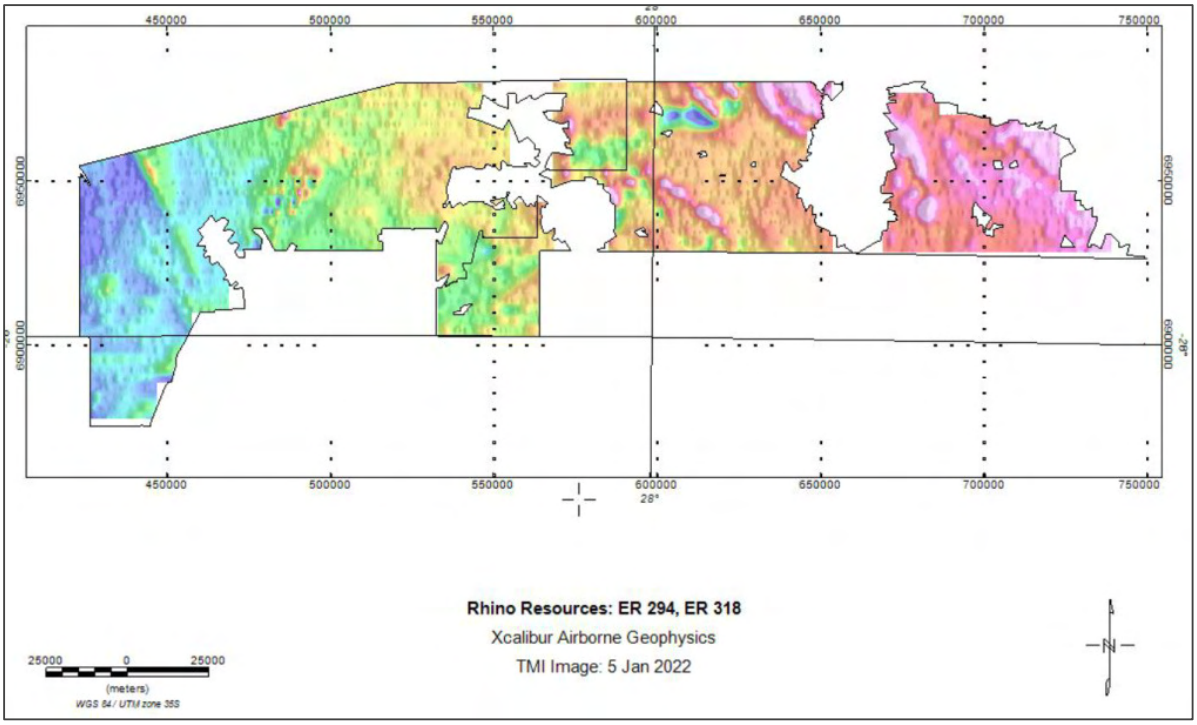

Figure 5-1: Example of results from airborne geophysical survey

(Shows both ER 318 and ER 294 – refer to Section 1.5)

Each of the Target Areas were then screened for environmental and social sensitivities utilising a defined set of constraints. Details of the constraints used to screen the Target Areas are provided Table 5-2.

Table 5-2: Drill site locality constraints

Constraint	Criteria
Lawful entitlement	Located within full extent of Rhino's ER.
Resource availability	Located within prospective geology/ gaseous structure.
Environmental sensitivity	Protected areas under NEM:PAA are excluded.

Constraint	Criteria
	All areas within the 1:100-year flood line or 100 m from a wetland are excluded.
	All areas identified as “irreplaceable” (CBAs) or “highly significant” (ESAs) in the provincial biodiversity conservation plan are excluded.
	All areas identified as “critically endangered” or “endangered” ecosystems are excluded.
	Biodiversity importance from the Mining and Biodiversity Guideline (which incorporates river and wetland FEPAs) are excluded.
	All Focus areas for protected area expansion strategy are excluded.
	All areas of biosphere reserves are excluded.
Social/socio-economic sensitivity	All areas within 200 m of a water supply borehole are excluded.
	Areas and sites of cultural heritage or archaeological/Paleontological significance are excluded (including a 100 m buffer).
	Areas within 200 m from residences are excluded.
	Areas within 500 m from urban areas are excluded.
	Areas withing 50 m of linear infrastructure are excluded.
	Landowner agreement to access to the sites must be granted.

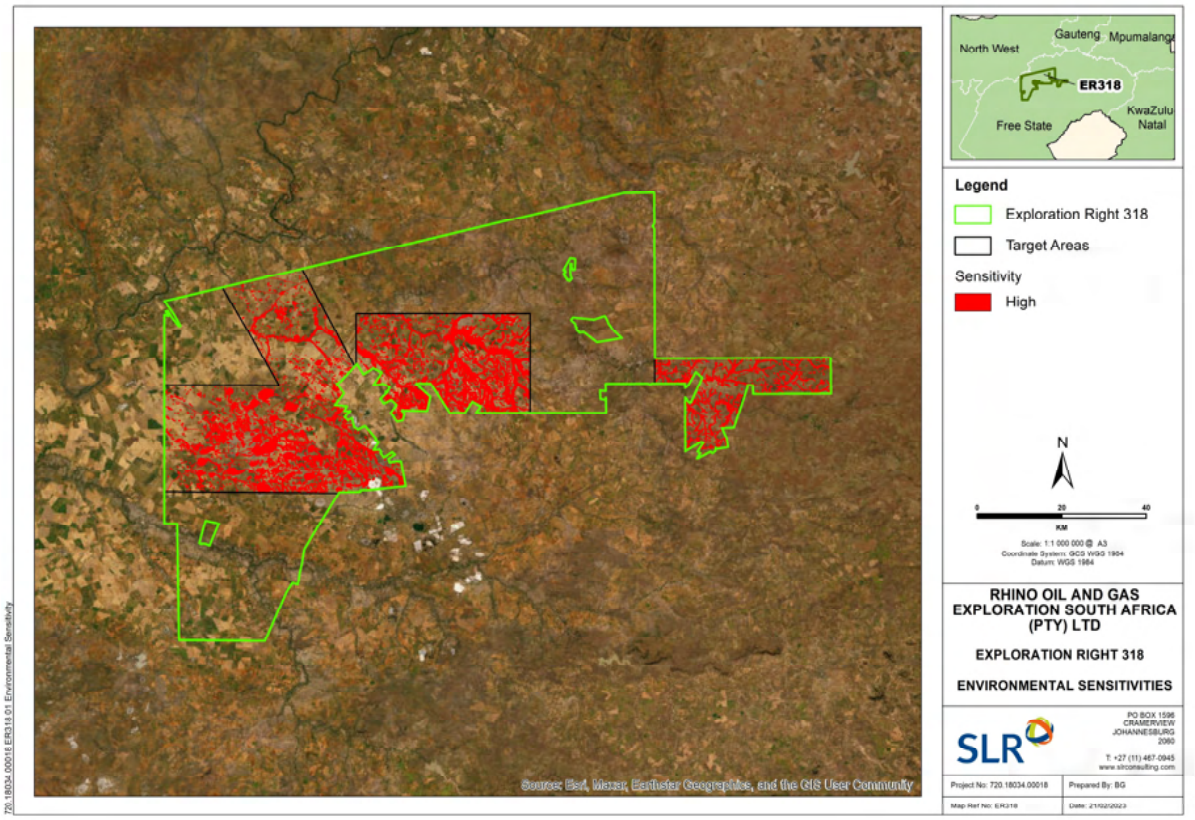

Figure 5-2: Environmental sensitives

The screening process was designed to de-risk the project by accommodating these sensitivities into the drill site identification and was carried out in a phased approach which included:

- A **Preliminary phase** where areas of potential environmental and social sensitivities, identified at a desktop level from publicly available GIS datasets, were combined into a 'sensitivity layer' (see Figure 5-2) and removed from consideration as drill sites. The screening used spatial databases such as the National Freshwater Ecosystem Priority Areas, the Free State Province Biodiversity Plan etc. Based on these sensitivities Rhino identified an initial database of prospective well sites and negotiated agreements with the owners of the underlying properties;
- A **Desktop Assessment phase** was then undertaken to evaluate the initial database of prospective wells sites. This assessment was undertaken by SLR in association with ecological, groundwater, and heritage specialist (including palaeontology) using available GIS datasets and aerial photography. Where additional sensitivities were identified, the proposed well site was adjusted to accommodate this constraint.
- A **Site Assessment phase** was then undertaken in November-December 2022 to ground-truth the sensitives identified in the Preliminary and Desktop phases, to survey the site and surrounds and to collect samples.

Through the screening process, Rhino were able to identify 15 potentials well sites as listed in Table 5-3.

Table 5-3: Proposed Drill Site Locations

Target Area	Site Name	Surveyor General Code
Target Area 1	Drill Site - 01	F00500000000010200000
	Drill Site – 02	F00500000000024100000
	Drill Site – 03	F04100000000025200000
	Drill Site – 04	F04100000000021300000
	Drill Site – 05	F04100000000015600000
	Drill Site – 06	F04100000000032800000
	Drill Site – 07	F04100000000022000000
	Drill Site – 08	F04100000000033300000
	Drill Site – 09	F04100000000008900000
	Drill Site – 10	F02400000000015400000
	Drill Site – 11	F04100000000021000000
	Drill Site – 12	F02400000000011500000
Target Area 2	Drill Site – 01	F02400000000045800000
	Drill Site – 02	F02400000000004600000
Target Area 3	Drill Site – 01	F02000000000074800000

The locality of the 15 'identified well' sites is provided as an A3 diagram included in Appendix E. Site plans for each of the 'identified well' sites are included as Figure 5-3 to Figure 5-17 below and show an area within which the drill site might be established as well as any identified environmental sensitivities (refer to Section 5.5.1 for details of the drill site layout).

It is noted that the extent of the well sites is subject to final negotiations with the respective landowner provided that no sensitive areas are encroached into.

As mentioned, the 15 'identified well' sites target specific geological features or formations of primary interest to Rhino. The balance of the exploration wells included in the EWP remain "unseen" and are designed for use if Rhino confirm a resource when drilling the 15 'identified wells'. Deploying any of the 'unseen wells' provides flexibility and efficiency to the exploration programme. If, through the course of drilling the 15 'identified wells', Rhino is able to confirm a gas resource, they would be able to explore in the vicinity of the resource using one (or several) of the remaining 'unseen wells'. Deployment of any of the 'unseen wells' would be subject to compliance with the EMPr which includes, amongst other, adhering to the environmental constraints used to identify the initial 15 'identified well' sites (refer to Table 5-2).

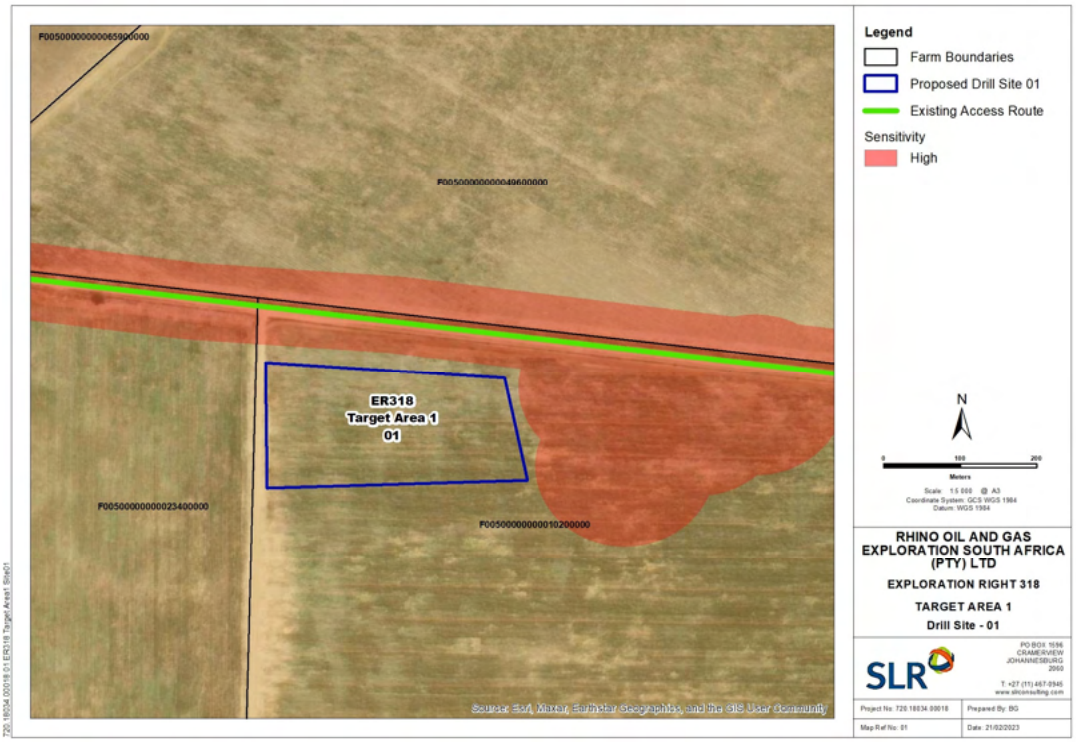

Figure 5-3: ER318 – Target Area 1 – Drill Site 01

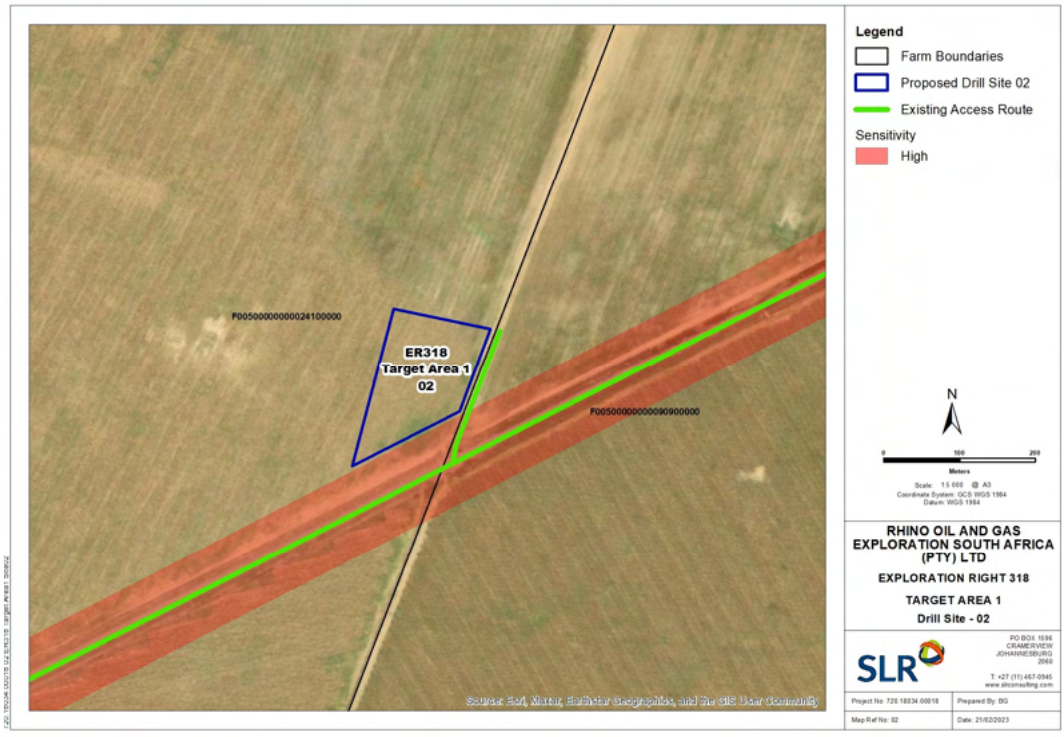

Figure 5-4: ER318 – Target Area 1 – Drill Site 02

Figure 5-5: ER318 – Target Area 1 – Drill Site 03

Figure 5-6: ER318 – Target Area 1 – Drill Site 04

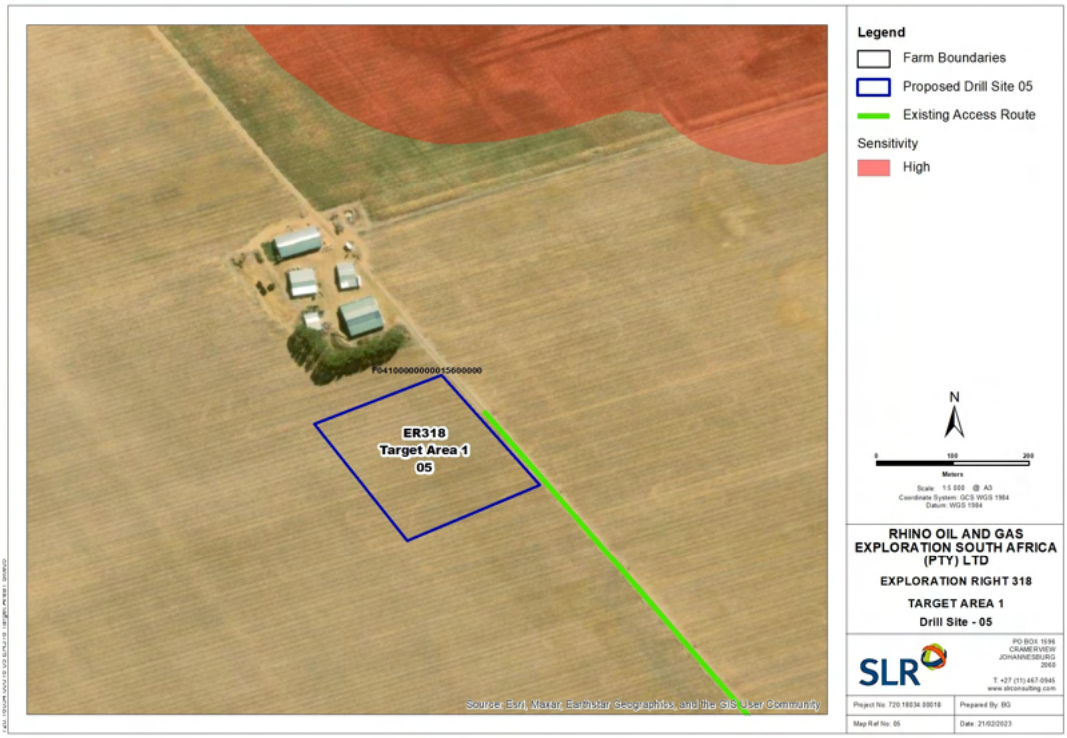

Figure 5-7: ER318 – Target Area 1 – Drill Site 05

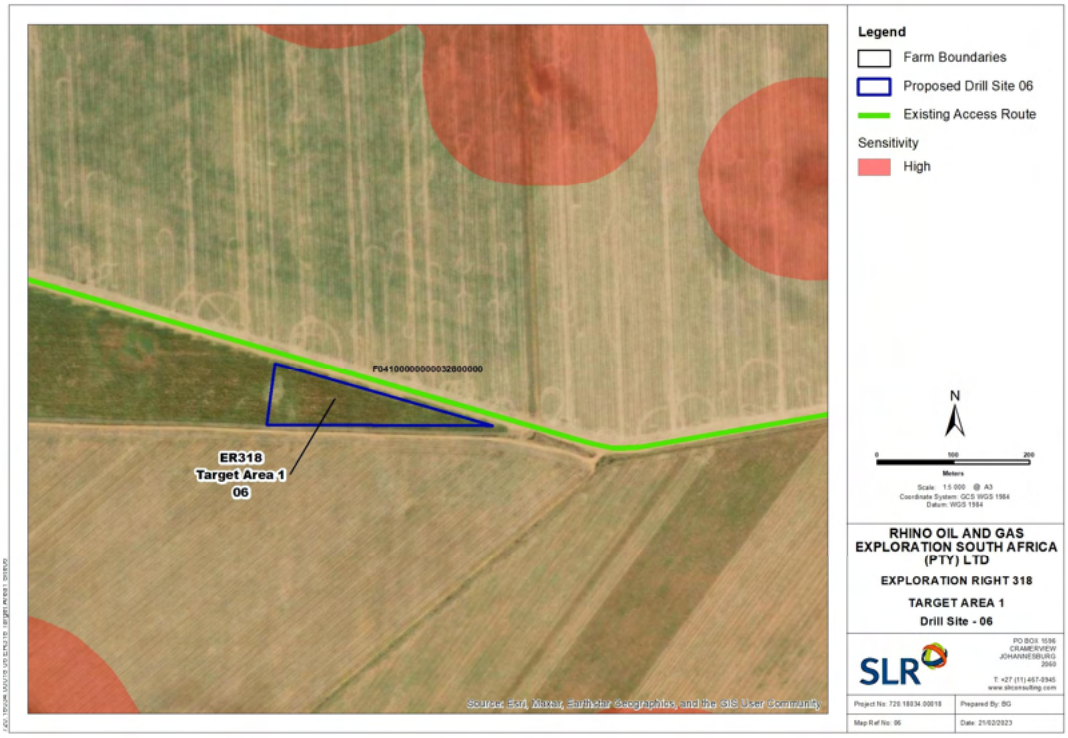

Figure 5-8: ER318 – Target Area 1 – Drill Site 06

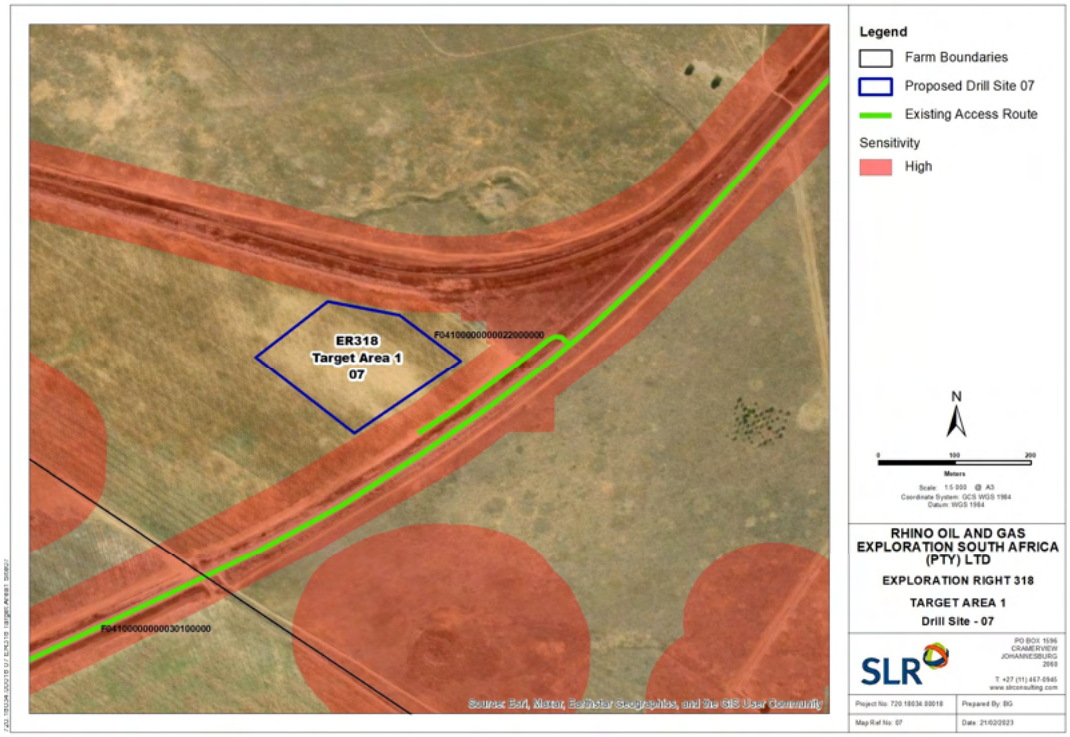

Figure 5-9: ER318 – Target Area 1 – Drill Site 07

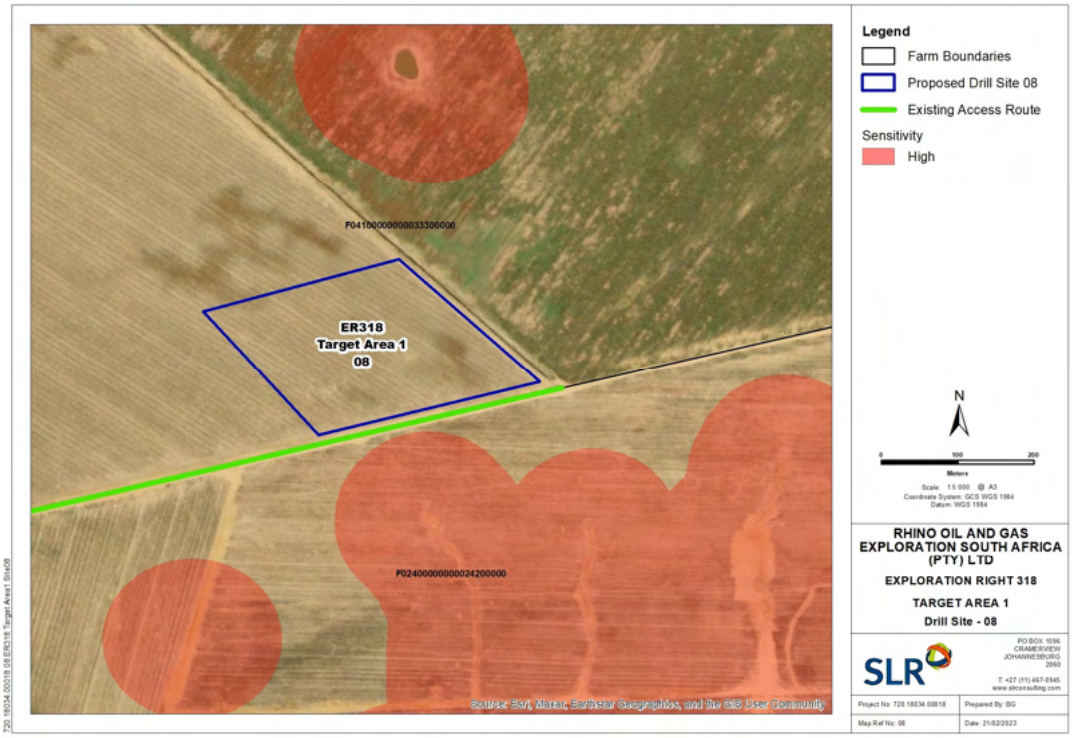

Figure 5-10: ER318 – Target Area 1 – Drill Site 08

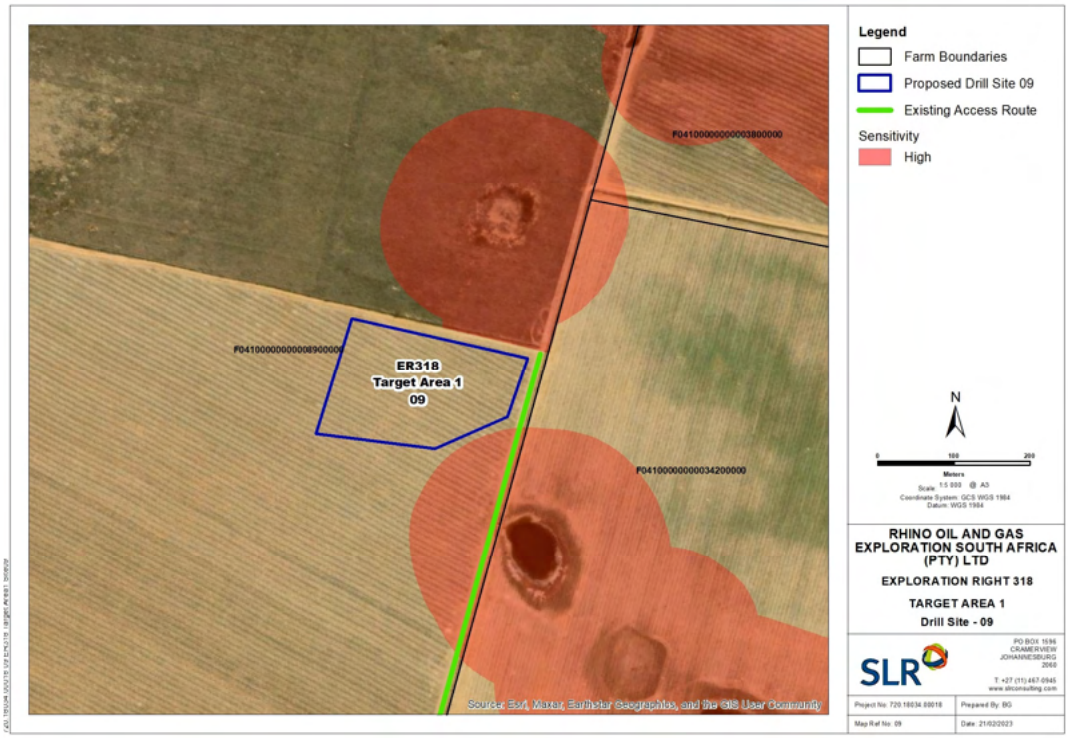

Figure 5-11: ER318 – Target Area 1 – Drill Site 09

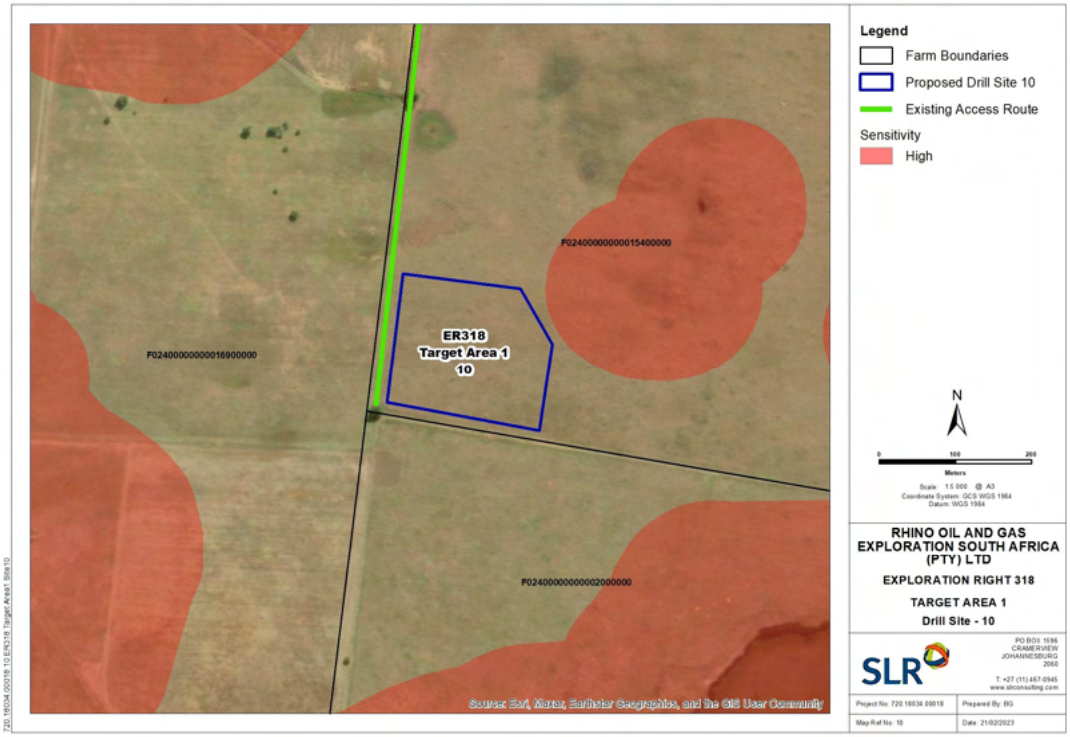

Figure 5-12: ER318 – Target Area 1 – Drill Site 10

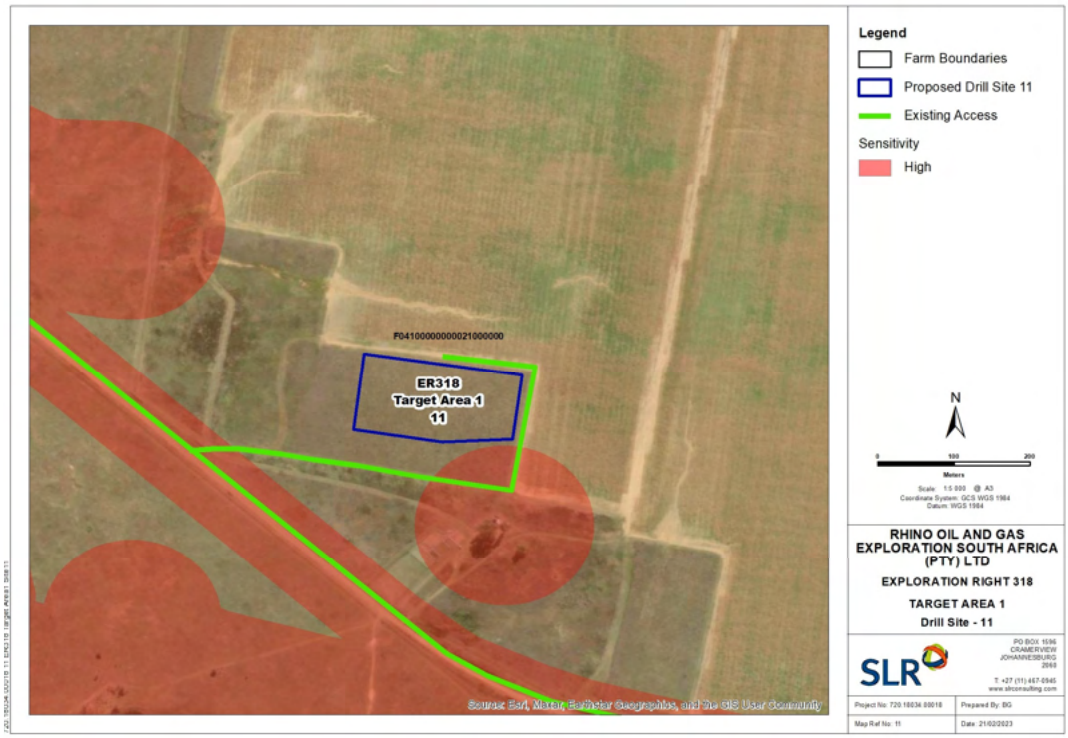

Figure 5-13: ER318 – Target Area 1 – Drill Site 11

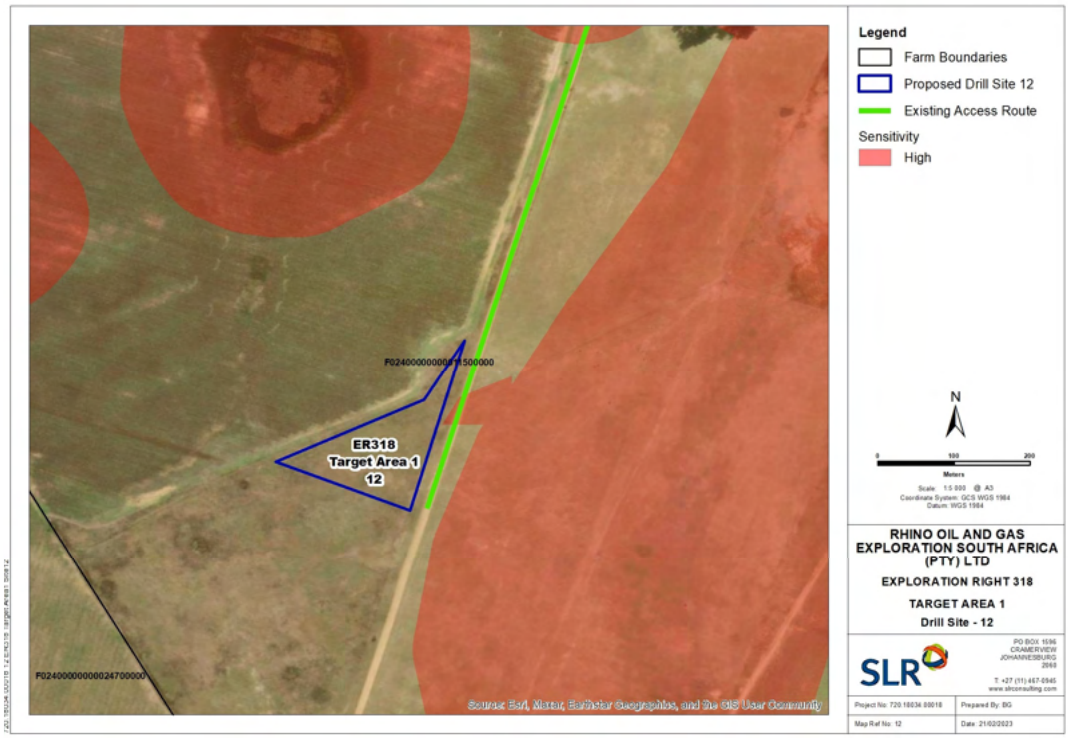

Figure 5-14: ER318 – Target Area 1 – Drill Site 12

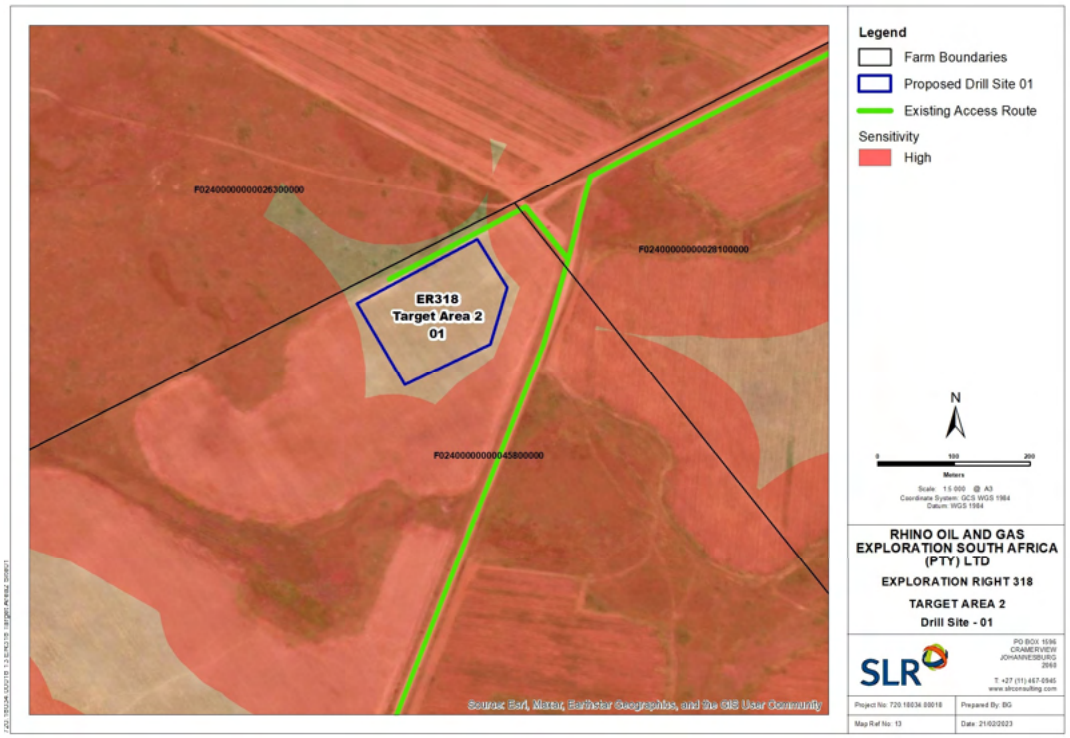

Figure 5-15: ER318 – Target Area 2 – Drill Site 01

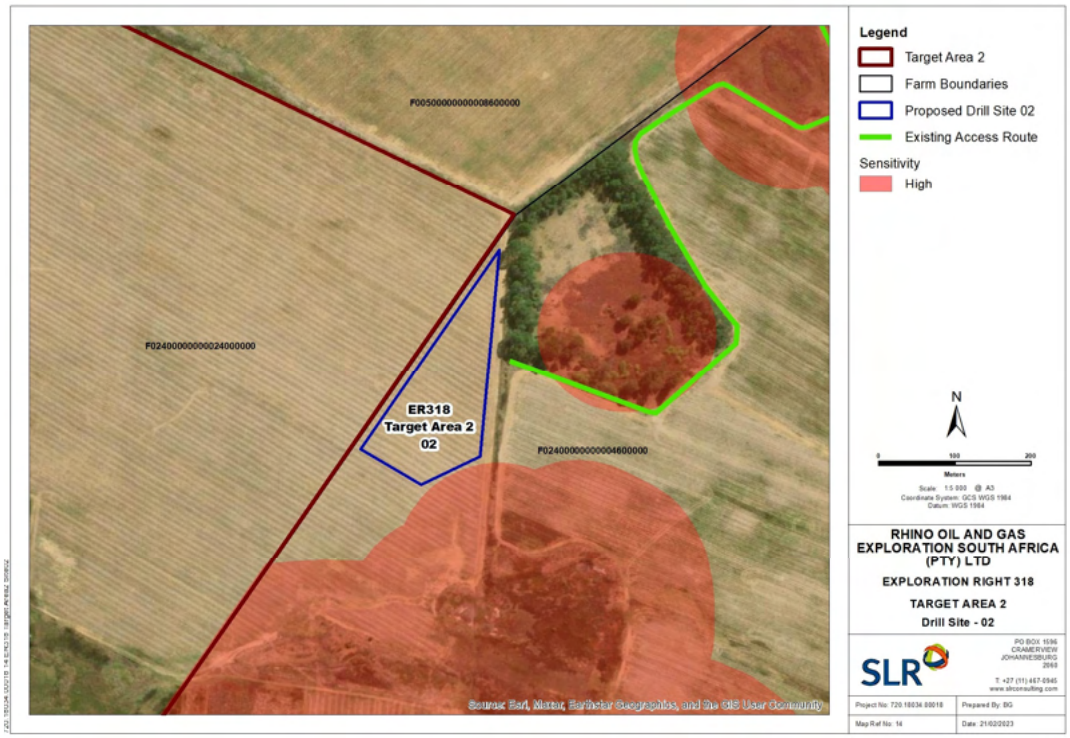

Figure 5-16: ER318 – Target Area 2 – Drill Site 02

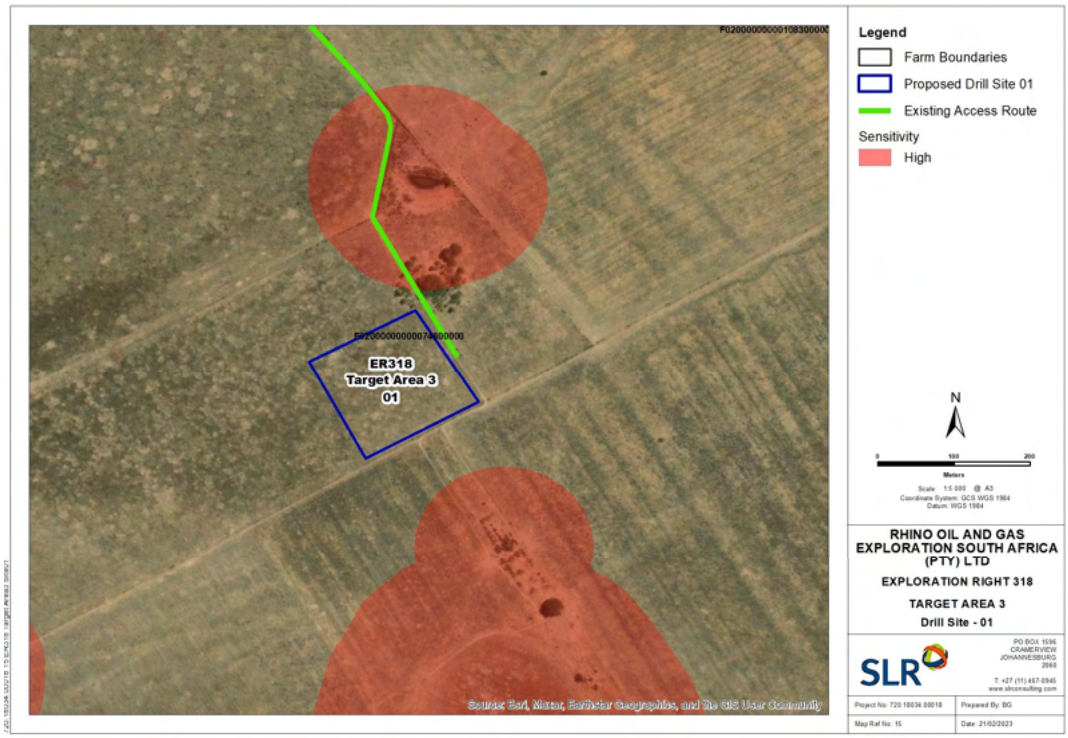

Figure 5-17: ER318 – Target Area 3 – Drill Site 01

5.3 EXPLORATION DRILLING PROGRAM AND PROJECT SCHEDULE

The Drilling Program and Time Schedule proposed by Rhino is to start drilling at least five (5) exploration wells within the Target Areas in 2023.

If any of the first ten exploration wells result in the identification of commercially viable commodities (hydrocarbons, helium, or hydrogen), Rhino's Drilling Program and Project Schedule would be updated to include the drilling of additional exploration wells at the identified locations within the Target Areas.

Completed exploration wells will be tested to evaluate their commerciality, as described further in Section 5.5.3. The drilling of the exploration wells will likely be undertaken over the course of one or two campaigns. At the end of operations, unsuccessful wells will be abandoned (refer to Section 5.5.4). Successful wells will have their ability to produce preserved but be capped and secured for possible future field development (subject to a receipt of the requisite approvals including, amongst others, Environmental Authorisation by means of a separate S&EIA process for Production Rights (PR)).

The drilling time to complete one well is estimated to take approximately 3 to 4 weeks. The results of the first few wells drilled within the Target Areas will influence the positioning and pace of the rest of the drilling campaign based on the interpretation of the geological, geophysical, and fluid sampling data. The sequencing of the drilling campaign will be dynamic and influenced by the learnings of each completed well.

The drilling rig will be mobilised from within South Africa. The likely drilling service provider already operates in the vicinity of Renergen's development (Virginia field) located approximately 15 km south of the ER; as such the longest mobilisation will take only a couple of days.

5.4 MAIN PROJECT COMPONENTS

This section describes the main project components, including the following:

- Onshore Drill Rig;
- Exclusion Zone;
- Local logistics base;
- Supply trucks;
- Personnel;
- Crew transfer; and
- Infrastructure and services.

5.4.1 Onshore Drill Rig

Various types of drilling rigs are used worldwide in onshore drilling operations, with the type of unit typically dependent on the depths to which it needs to reach and the hardness of rocks it needs to penetrate. The alternative drilling rig types considered are discussed further in Section 5.9. Based on the overall subsurface rock in each Target Area, it is anticipated that exploratory drilling would be conducted using a truck mounted drilling rig with air and mud drilling capabilities.

An example of truck mounted drilling rig specifications is presented in Table 5-4 below. The truck mounted drilling rig has relatively small area of disturbance due to its compact footprint (See Figure 5-18 for an example of a typical drill rig). A significant benefit to using a truck mounted drilling rig is the ease of mobility as it is a self-propelled vehicle with the flexibility to move from location to location without the need of additional truck support.

Figure 5-18: Example of a drill rig,
(Source: Torque Africa)

Table 5-4: Example of onshore drill rig specifications parameters,

(Source: thordrill.co.za)

Thor Drill Rig

MINE EXPLORATION RC RIG

RC 8000

TECHNICAL DESCRIPTIONS

DECK ENGINE	140 HP
FUEL TANK CAPACITY	1000 L
STANDARD COMPRESSOR	Different option available
DRILLING CAPACITY	@36,8 T 1177 meters with 4" rods & 981 meters with 4,5" rods
COOLING	Hydraulic cooler fitted
CONTROL SYSTEM	Easy accessible Control panel with clear view for operator
STEEL TRACK MOUNTING	45 tons trackOne under carriage, with manual hydraulic tramming system and wireless remote control option
TRUCK MOUNTING	6x4/6x6 or 8x4/8x8 truck
TOP HEAD DRIVE /ROTATION HEAD	Reduction gearbox type (grease filled) reduction 3,25:1 spindle hole 80 mm , RPM 0-80, MAX TORQUE 18000 Nm, spindle thread -102 ARD, Head can be used for RC/DTH/Air core
HYDRAULIC HEAD TILT	Hydraulic head tilt for safe and easy rod & casing handling
OUTRIGGERS	4 x steel boxed hydraulic outriggers bore size 100mm, stoke 1m, double fitted double pilot operated check valves in case of hose failure
FEED SYSTEM	Mast tubular construction working with 2 cylinders (no chains or cables)
PULL BACK	36,8 T @ 300 bar
PULL DOWN	21,7 T @ 300 bar
ROD LENGTH	6 M
MAST LENGTH	11 M
OVERALL DEPTH	400 mm
OVERALL WIDTH	600 mm
TOP HEAD TRAVEL /STROKE	7,4 M
DUMP MAST SLIDE TRAVEL	1,8M
BREAKOUT SYSTEM	Manual keeper spanner, Conventional hydraulic assisted breaker spanner, or hydraulic hands free option.
WINCHES	Worm Drive gearbox type hydraulically driven, max weight capacity 1000kg/1m/sec. Optional wire line winches available.
HYDRAULIC SYSTEM	Open loop hydraulic system, with Poclain piston pump @ 300 bar, gear pumps for auxiliary functions and cooling.
HAMMER LUBRICATOR	In line venturi type with 15 L capacity
FOAM PUMP	Hydraulic driven piston pump 21 L/min @ 200bar
ELECTRIC SYSTEM	12 & 24 volts with options of working lights, emergency stops, and lock out depending on customer needs.
AIR LINES	All air lines are rated at 80 bar with whip safety socks on all ends with booster line as option
SHIPPING DIMENSIONS LxWxH (track mounted rigs)	10480 x 2500 x 4020 mm
GROSS WEIGHT (track mounted rigs)	27 T
DEPTH CALCULATION EXPLANATION	All depth calculations are theoretical based on different rod/m weight with 20% safety margin worked in. 4" RC rods 25KG/m, 4,5" RC rods 30KG/m. These capacities are based on the hydraulic capacities of the drilling rigs.

THOR DRILL RIG CC MANUFACTURERS OF DRILLING EQUIPMENT
Plot 78 Vaalbank, R104 rd to Bronkhorstspruit,1055. PO Box 1881 Rayton, 1001
South Africa. Tel :+ 27 12 736 2345. marianna@thordrill.co.za len@thordrill.co.za

@thordrill
https://www.thordrill.co.za/

5.4.2 Safety Zone

During the drilling operations, there will be a fenced safety zone of about 20 to 25 m around the drill site. No traffic will be allowed to enter the safety zone for the duration of drilling operations. The purpose of the safety zone is to prevent accidents with the high-powered equipment used during operations. In addition, drilling may liberate flammable gases that require a standoff distance for safe handling.

5.4.3 Local Logistics Base

A local logistics base will be in close vicinity of Target Areas since it will be shared with other ongoing drilling activities undertaken by the drilling contractor for Renergen, who are developing and producing the Virginia field in the Free State.

That logistics base will be on an existing brownfield site (previously developed land) most likely used by farming communities to store and maintain heavy duty machinery. A final decision will be undertaken after a logistic survey in the identified areas. This base will include the following facilities:

- An open storage area partially equipped with pipe racks for drilling tubular material storage;
- A covered warehouse for drilling material and other minor equipment;
- Temporary offices for logistic base personnel;
- Area for storage (less than 90 days per well activity) for general waste and hazardous waste at any one time.

Wastes arising will be transported to a licensed waste disposal facility by an appropriately permitted waste management contractor and will not be stored within the base except for the time strictly necessary for unloading from the drill site and loading on the trucks for transport to the disposal site. The following maximum potential space requirements have been identified:

- Open area/pipe yard: up to 1000 m^2; and
- Warehouse: up to 500 m^2.

Rhino's drilling contractor plans to use existing infrastructure within the Free State to provide the transport, storage and bunkering facilities for the project. Based on regional experience, the drilling contractor anticipate that the drilling will be done by air drilling thus not requiring mud plant. However, for safe operations and well control backup options, a small temporary mud plant will be available at the well site.

5.4.4 Supply trucks

For the duration of the drilling operation, each drill site will be supported by supply trucks, which are general purpose trucks designed to carry a variety of equipment and cargo. These trucks will supply the drill site two to four times a week with cement, mud and equipment such as casing, drill pipe and tubing. They will also remove waste that must be appropriately disposed of. The number of supply trucks has not yet been defined but will be provided by the drilling contractor.

5.4.5 Personnel

The logistics base will be located within around 120 km reach and all personnel will reside locally. The local staff employed by the South African drilling contractor is experienced local South Africans in drilling in the Free State region. Some external advisors might be internationally sourced if required by the project. Rhino representatives will also be located in the Cape Town office and travel to well sites during the drilling campaign. The drilling operation will see around 5 to 10 personnel on site. The number of personnel on the

supply trucks will vary based on the types of activities they support. The trucks will be local trucks and staff, where possible, for drilling operations service. All workers will be provided with health and safety training and Personal Protective Equipment (PPE) suitable for the types of activities by the drilling contractor.

5.4.6 Crew Transfers

Transportation of personnel to and from the drill site will most likely be provided by road. The drill site can operate during day and night shifts. However, if timeline permits, it is anticipated to mainly operate during day shifts only. Crews will generally work in 8-to-12-hour shifts in 2-to-4-week cycles. Crew changes will be staggered, and in combination with *ad hoc* personnel requirements and will be managed by Rhino's drilling contractor.

5.4.7 Infrastructure Support and Services

5.4.7.1 Freshwater

The project will require water for making water-based drilling muds to be used as backup for safe measure to maintain well control and for rig cleaning. This industrial water will be sourced by Rhino's drilling contractor from authorized sources. The drinking (potable) water for the personnel on the drill site will be bottled water.

5.4.7.2 Fuel

The estimated total fuel consumption per well during the mobilization and drilling phase (approximately 2 days mobilisation and 25 days drilling, 1000 m drilled) by all the project equipment's and truck is on average 7 to 15 m^3 of gasoil.

5.4.7.3 Food Supplies and Local Services

The bulk of food and local services will be purchased locally near the logistics base.

5.5 PROJECT ACTIVITIES PER PHASES

Project activities associated with drilling include the following phases, described further in the following sections:

- Mobilisation of the truck mounted rig and supply trucks from drilling contractor base located near Pretoria to the Rhino Target Area in the Free State Province;
- Well drilling;
- Well execution (logging, completion) options;
- Well testing for successful well options;
- Well abandonment for unsuccessful well (Plug and Abandonment "decommissioning"); and
- Demobilisation of the drill rig, supply truck and local logistics base.

5.5.1 Mobilisation Phase

The drilling locations will be identified prior to mobilisation of the drill rig based on the results of the analysis of airborne geophysical data, regional geological analysis, historical data integration, landowner consultation and environmental sensitivities.

During mobilisation, the drill rig and supporting equipment will arrive directly on location from previous jobs (probably from Renergen drill sites) or from Rhino's drilling contractor main yard near Pretoria.

Once on location, the well site will be prepared by drilling contractor. A typical drill site schematic is provided as Figure 5-19. Should any obstacles/sensitivities be identified at the drilling location, the well site location and layout would be relocated/adjusted to a nearby location where no obstacles/sensitivities are located.

These activities will be followed up with safety checks, drills, communication tests. This will take approximately 2 to 4 days to complete.

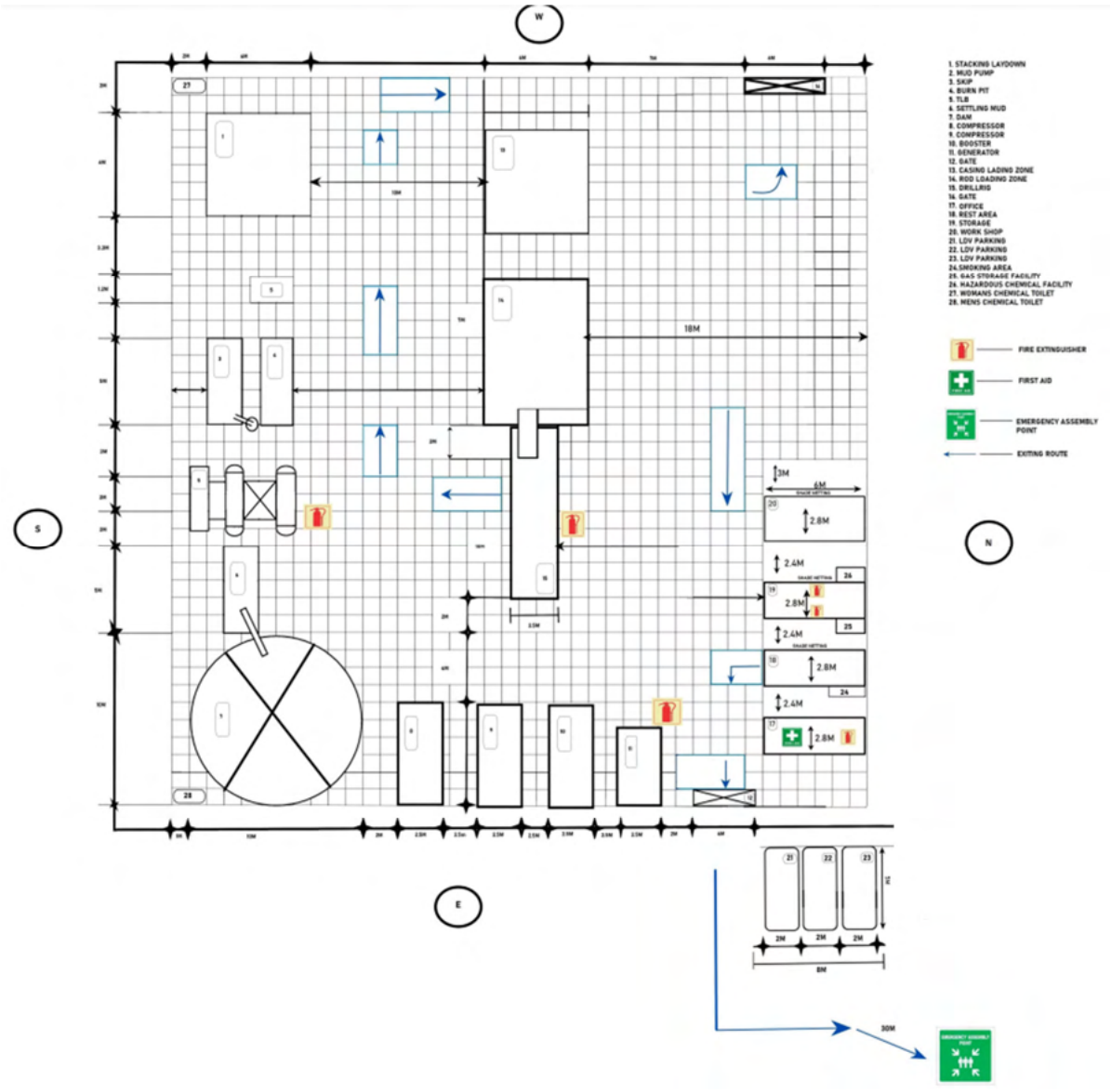

Figure 5-19: Drill site layout
(Source: Torque Africa)

5.5.2 Drilling Phase

The drilling sequence for the exploration drilling campaign is not yet defined as it will depend on the first exploration well results. However, it is currently planned that each Target Area will have at least 1 well drilled in the initial 10 exploration well campaign.

To evaluate and confirm the commercial viability of the reservoir, a vertical or slanted well will be drilled to a total depth of approximately 1 000 m below surface. The expected valuable fluid for these wells is biogenic gas, helium or geological hydrogen. A standard well design and programme for onshore wells is described below. This will be updated after the completion of seismic interpretation and stratigraphy evaluation by the geologists and petroleum engineers. The final well path will be defined according to the reservoir target and final location of the wellhead at surface. Rhino's preference for drilling exploration wells is a slanted well profile allowing maximum chance to intersect naturally occurring faults in the basement rocks.

During the drilling phase, different drilling bit sizes are used to drill a series of telescoping holes, from the surface to the total depth of the planned well. The first hole, whose outer diameter is the biggest, is called the top hole, while the next inner holes are progressively smaller and smaller as the well depth increases. This continues until the final hole, which is the smallest, reaches the reservoir level. Further details regarding the section diameters, depths and planned profile of the well are provided in Figure 5-20 to Figure 5-22.

During the drilling process, drilling fluids such as compressed air or muds are pumped down the inside of the drill pipe and exit at the drill bit to optimise drilling operations. For the first section (top hole) of the well, a conductor pipe will be installed by hammering it down to around 50 mbgl to isolate from any ground water. In the bottom sections of the well, air drilling (i.e., with compressed air injected) will be mainly carried out. A water-based mud drilling programme will only be deployed if high rock formation pressure is encountered. The main functions of drilling fluids (air or mud) include the following:

- Removal of drilled rock cuttings from the bottom of the well and from the well bore and transportation of these cuttings to the surface;
- Control of formation pressures and managing of formation fluids (i.e., 'primary well control');
- Transmission of power to the drill bit;
- Provision of hydrostatic pressure as well as chemical stability to the rock to maintain the integrity of the hole and prevent hole collapse;
- Lubrication and cooling of the drill bit.

The drill bit is connected to surface by a string of hollow tubulars referred to as the drill string. On the rig floor, drill pipes are attached, one by one, to the top of the string as the drill bit advances into the borehole. The action of drilling (creating a hole in the rocks stratigraphy) is obtained by applying weight and percussion to the bit. The top drive, installed in the truck mounted drill rig, advances the drill string into the well, and provides the rotation/percussion and weight on bit required to drill. The drill string goes through a Rotating Control Device (RCD) to provide physical barrier with wellbore and allow flow back diversion to flare in case of hydrocarbon intersection. Once each hole section has been drilled, casing (steel tubulars) is run into the well and cemented in place to secure/seal the hole interval just drilled and to allow for the drilling of the next (smaller) hole section. The cementing operation consists of pumping cement down the drill string to the bottom. The cement flows, out the bottom of the casing shoe and back up into the annular space around

the casing, sealing the space between the cased tube and open hole. Casing plus cement is a tested barrier that facilitates the drilling of the next section, allowing to reach the target final depth in the safest way.

During the drilling stage, fluid (mainly air) and dust/cuttings are discharged in the immediate proximity of the well after going through a cyclone separator. The fluids and cuttings are contained in a series of skips. The physical and chemical properties of the drilling fluid are constantly monitored and adjusted to suit varying down-hole conditions. These conditions are, in part, due to the variation in formation pressure within the well bore at different depths. If water-based mud is in use, fluid density (or mud weight) is adjusted with mud additives. The three (3) main mud additives likely to be used by the drilling contractor are AMC EzeeMix (classified non-hazardous), AMC Aerofoam and AMC Rotafoam (classified non to moderate hazardous). The mud additives details are displayed on AMC website (**www.amcmud.com**).

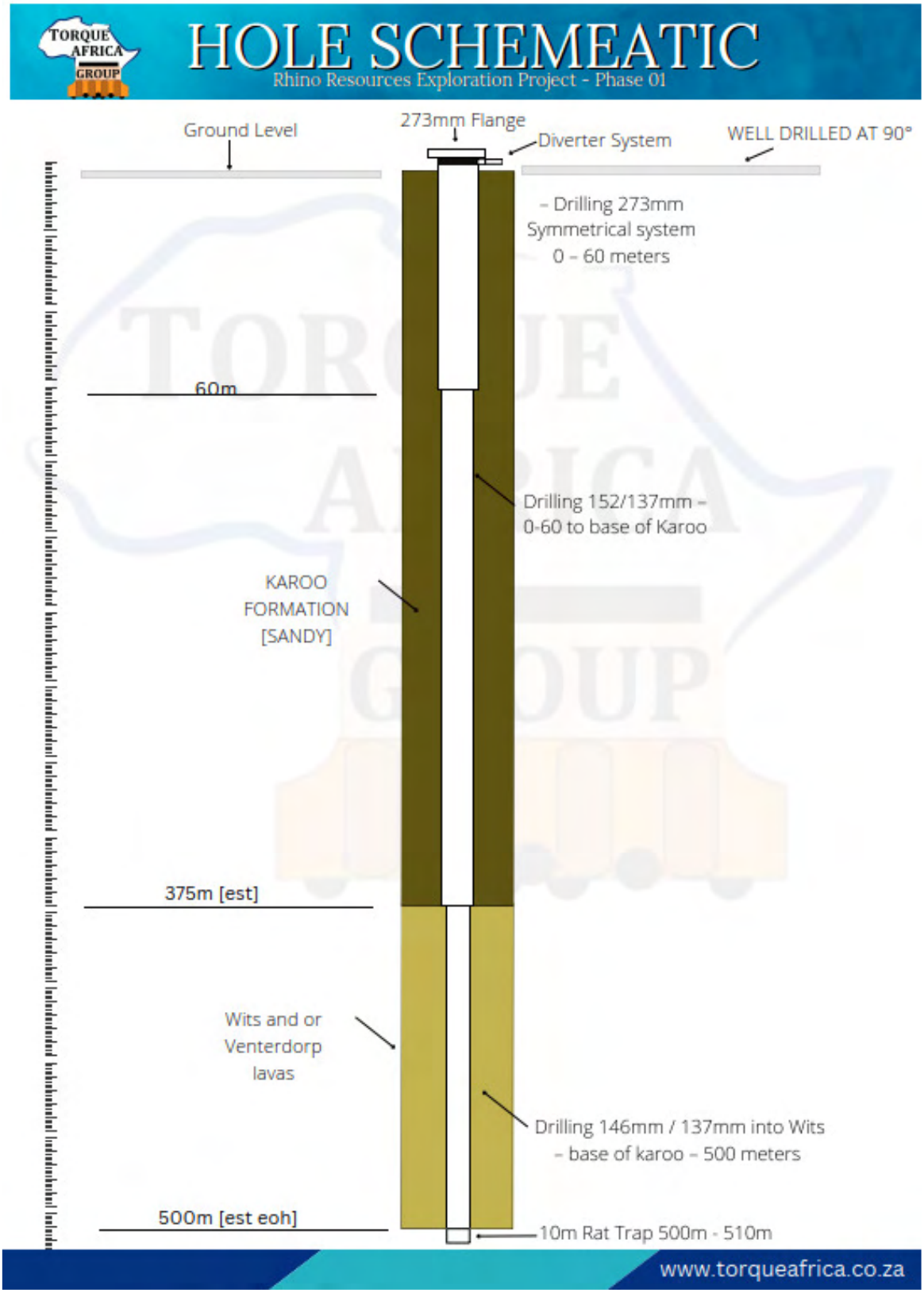

Figure 5-20: Well schematic (prior to casing)
(Source Torque Africa)

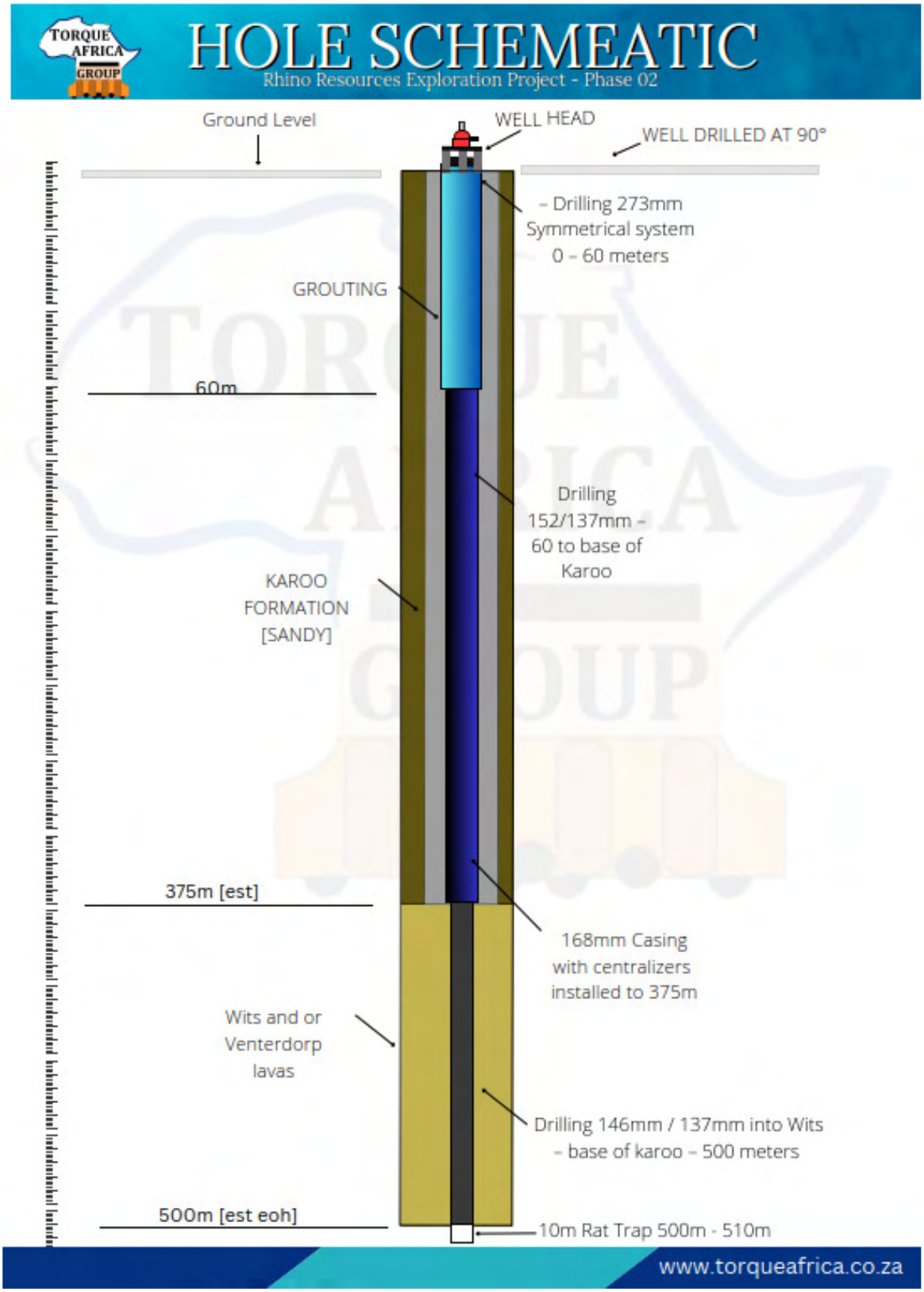

Figure 5-21: Well schematic (cased and grouted to ~375 m)
(Source: Torque Africa)

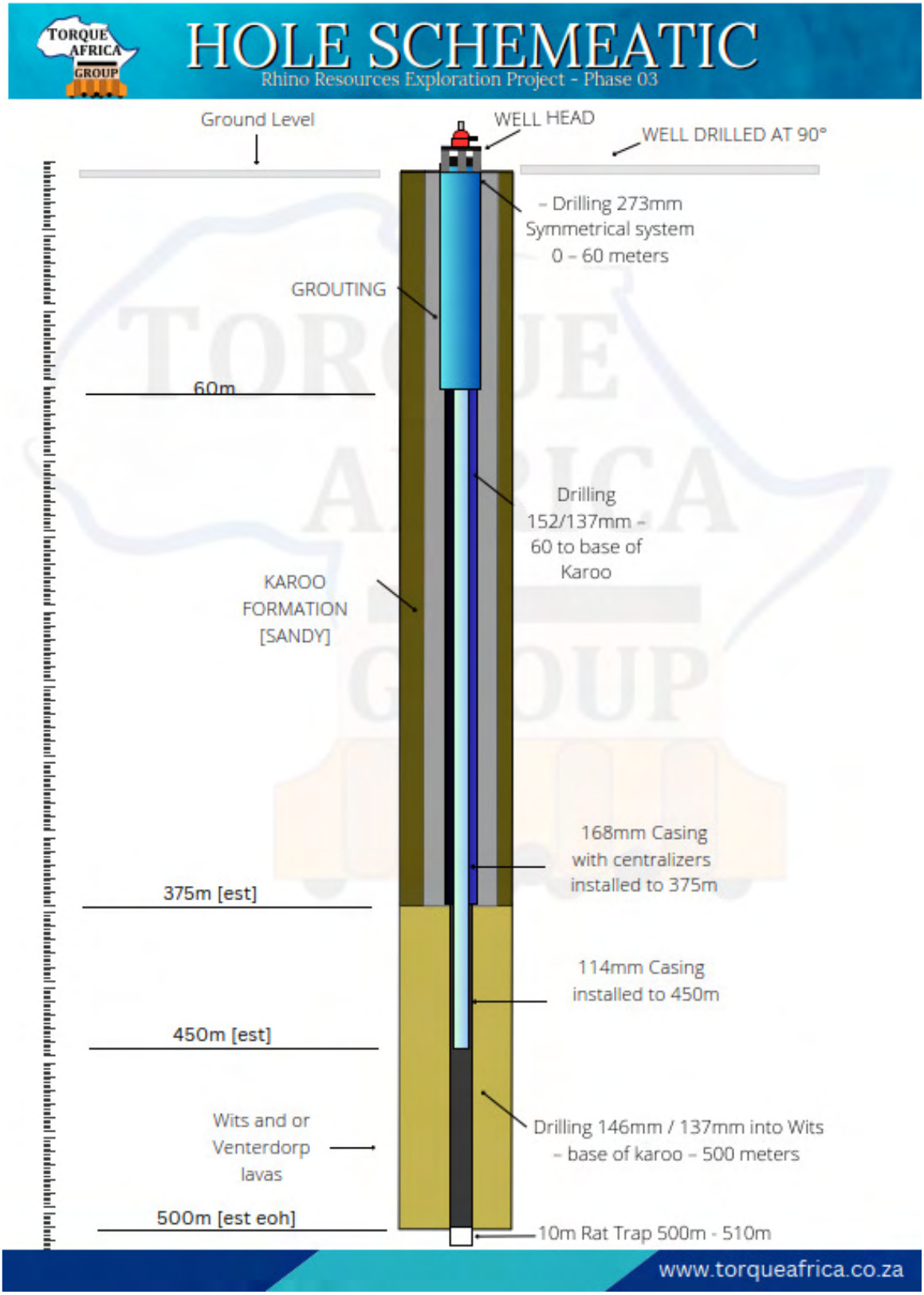

Figure 5-22: Well schematic (final casing installed to depth)
(Source: Torque Africa)

5.5.3 Well Execution Options

5.5.3.1 Redrill

In case of any issues related to stratigraphy (e.g., permeable zones with different pressure gradient, hole instability, necessity to increase the inclination of the well to achieve the reservoir target) or problem during the drilling activities (e.g. bottom hole assembly stuck) it would be easier to redrill the well in a nearby location. The initial open hole will be cemented up and abandoned.

5.5.3.2 Well Logging

Different sensors are used throughout the drilling operation to measure several parameters such as quality of cement job, lithology, fluid types.

A dedicated run to measure/log the cement bond and consistency in the annuli is performed at the end of each cement job, prior to start drilling operations in the next phase.

Further detailed information is obtained on the physical properties of the rock formations and fluids (water, oil, gas) by means of an open and cased hole logging using sensors introduced down- hole with a wireline cable, or coiled tubing unit.

This operation is usually performed at the end of the drilling phase, after the bottom hole final clean up. The logging plan is developed in accordance with standard industry best practices. In the case of unsuccessful wells, once a full log of the reservoir section might have been undertaken, the well will be plugged and abandoned. The completion phase, if confirmed in case of discovery, will be performed.

5.5.3.3 Well Completion

Well completion and well testing operations will be conducted during drilling of successful exploration wells. The completion phase of a successful well takes place after the reservoir formation has been drilled and maintained open hole.

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

The selection of salt and brine composition will be defined once the hydrocarbon has been discovered in the exploration well and reservoir lithology completely logged although simple industrial water is expected to be adequate considering low pressure encountered in regional analogue exploration or production wells.

The successful well will be capped with a well head valve connected to metering equipment with a flare stack at the end of it. In most circumstances the fenced safety zone will be reduced to a smaller footprint and the surface profile reinstated to match the surrounds. An interim rehabilitation plan will be implemented to stabilise the wellhead area and to fully restore the disturbed area outside of this, to a condition as close as possible to pre-disturbance conditions, and as agreed with the landowner.

5.5.3.4 Well Testing Option for Successful Wells

As stated previously, well testing may be conducted on the successful wells if they present potential commercial quantities of hydrocarbon. A well test is a temporary completion of a well to acquire dynamic

rate through time, pressure, and fluid property data. The well test often indicates how the well will perform when it is subjected to various flow conditions. An analysis is usually performed on the data to determine reservoir parameters and characteristics including pressure, volume, and temperature. Current testing practices are carried out using modern testing equipment and high-resolution pressure data acquisition system, getting the reservoir evaluation objectives depends on the behaviour of the formation fluid properties, well completion, and flow assurance situations are only known when testing is carried out.

The well test objectives are to:

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

While testing, hydrocarbons are sent to a flare boom with a burner to ensure as complete combustion of fluids (including hydrocarbons) as possible. To ensure that burning can be done safely from the drill site, a flare pit can be installed in order to prevent fire propagation.

The flow periods and rates will be limited to the minimum necessary to obtain the required reservoir information during the well test. It is anticipated that a maximum well test time for this project will be approximately 30 days.

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

The following key well testing preventative measures will be implemented during the well testing programme:

- Monitor flare performance to maximise efficiency of flaring operations;
- Flare equipment appropriately inspected, certified and function tested prior to operations;
- Flare equipment appropriately maintained and monitored throughout well testing operations;
- The appropriate emergency stop mechanisms (Emergency Shut Down devices) are in place to halt testing in case of emergency

5.5.3.5 Well Control and Blowout Prevention

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

Well control during well operations is a routine function, with each well designed and executed to minimise risk of developing a well control incident. Down-hole conditions, such as shallow gas and high-pressure zones can cause control measures as a sudden variation in well pressure. A well kick can occur if there is an influx of formation fluids with sufficient pressure to displace the well fluids.

The drilling will be done through a Rotative Control Device (RCD) that creates a pressure tight barrier against drilling hazards and allows safe diversion to the side flare stack (Figure 5-23). RCD must be pressure rated to the expected pressure to be encountered in the regional subsurface conditions.

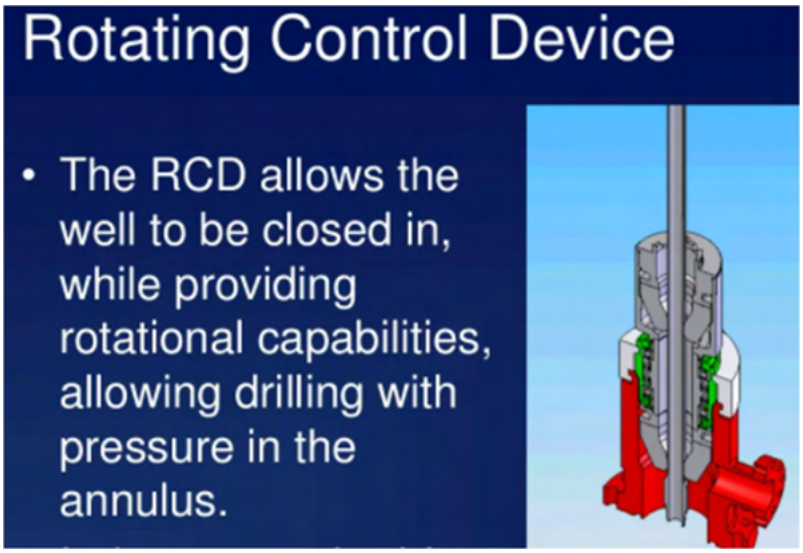

Figure 5-23: Rotating Control Device,
(Source: Slideshare.net/SPE)

5.5.4 Well Abandonment (Plug and Abandonment "decommissioning")

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

For unsuccessful wells, a cement plug setting job will be performed (Figure 5-24). The plugging and abandonment job will be final, in that no re-entry of the well is planned. The cement plugs are suitable to guarantee the effectiveness and integrity of the seal and are configured so that no future intervention and monitoring is required.

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

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

in case of failure of the first well barrier. The RCD will be then retrieved, and the wellbore will be flanged and capped.

In most circumstances the standpipe will be cut off below ground level and the surface profile reinstated to match the surrounds. A rehabilitation process in support of closure will be implemented (refer to Section 5.5.6).

The final program for well plugging and abandonment will be finalized after the end of drilling phase and log evaluation, in order to maximize the number and composition of plugs sealing in the single or multiple permeable zones discovered.

At the end of the plug and abandonment operations, the well schematic and wellhead location (including casings dimension, length, cement plug dimension and composition, pressure and inflow test results etc.) will be included in a final report submitted to PASA.

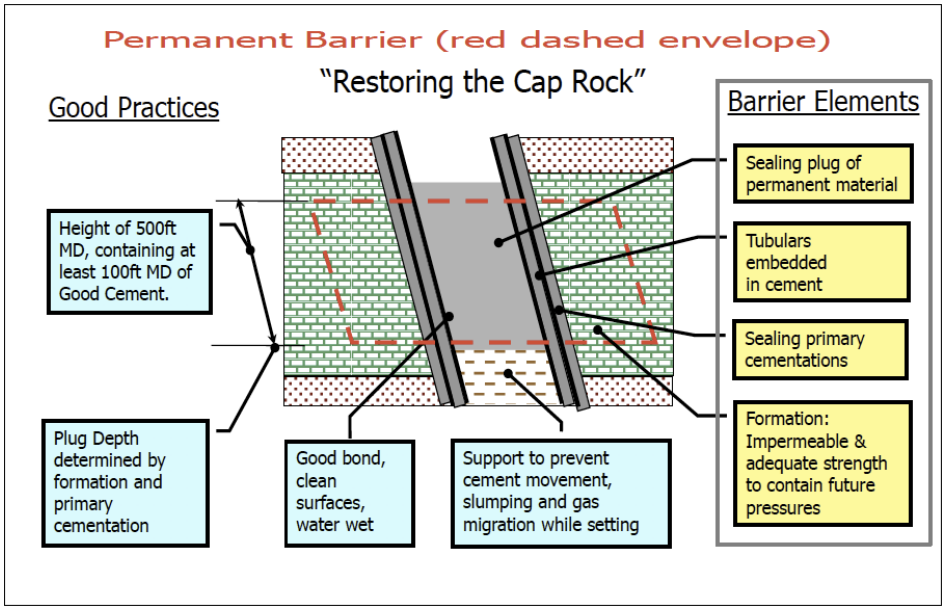

Figure 5-24: Schematic of cement plug at bottom hole
(Source: Guidelines for the abandonment of Wells, p12 OGUK, 2015)

5.5.5 Demobilisation

On completion of drilling and/or testing, the drill rig and support trucks will leave the wellsite location. All drilling equipment and introduced materials, as well as remaining wastes, will be removed and the site will be restored to a condition as close as possible to pre-disturbance conditions, and as agreed with the landowner. A final well site verification survey will be performed to check the condition of the wellsite and included in a report submitted to PASA.

5.5.6 Closure planning and rehabilitation

Following demobilisation on abandoned wells (refer to Section 5.5.4) and for areas outside of the well head footprint on completed wells (see Section 5.5.3.3) each site will be rehabilitated in support of closure.

The overall objective of the rehabilitation process is to reinstate all aspects of each site to a condition as close as possible to pre-disturbance conditions, and as agreed with the landowner. A detailed closure plan is included in Appendix L which details the activities to occur during the closure including Preparation (Phase 1), Making safe (Phase 2), Rehabilitation (Phase 3), and Monitoring and Maintenance (Phase 4)

5.6 HSE RISK MANAGEMENT DURING OPERATIONS

Rhino Oil & Gas's HSE (health, safety, environment) risk management will be implemented by the drilling contractor during operations. Rhino Oil & Gas is committed to protecting the health, safety and security of its employees and those of its contractors, to ensure that all activities are conducted in a manner that protects the environment and people who are potentially impacted by its operations.

5.7 PLANNED EMISSIONS, CUTTINGS HANDLING AND WASTE MANAGEMENT

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

Waste management will follow South African regulations. Appropriately licenced waste disposal sites and waste management facilities will be identified prior to commencement of drilling.

5.7.1 Emissions to air

The principal sources of emissions to air from the proposed drilling campaigns could be from three (3) main sources:

- Exhaust emissions from diesel fuel used to generate power on the drill site. The power will be used for operating truck mounted drill rig, air compressors, miscellaneous equipment;
- Exhaust emissions from diesel fuel used by the supply trucks. The local logistics base will be in the vicinity and will minimise commute length and emissions;
- Flaring activities during well testing. Based on regional analysis and analogue wells, mainly biogenic gas (CH_4) with traces of Helium (He) and geologic hydrogen (H_2) will be encountered. This gas will burn clean emitting mainly carbon dioxide (CO_2) and water (H_2O). No other polluting contaminants are expected such as Hydrogen sulphide (H_2S) or Mercury (Hg).

The emissions from diesel fuel will essentially be carbon dioxide (CO_2), sulphur oxides (SOx), nitrogen oxides (NOx) and carbon monoxide (CO). Relative to these pollutants, smaller quantities of non-methane volatile organic compounds (VOCs), methane (CH_4) and particulate matter (PM_{10}/$PM_{2.5}$) will also be released. These emissions are released during the normal operation of a diesel engine and have the potential to result in a minor short-term localised increase in pollutant concentrations. They also contribute to regional and global atmospheric pollution.

It is estimated that the operations of each well will consume between 7 m^3 to 15 m^3 of diesel fuel. It was calculated that diesel consumption at each well will result in 19 and 40 tonnes carbon dioxide equivalent (tCO_2e)[10] being emitted. The total emissions associated with diesel consumption at all 20 wells was calculated to be 376 to 807 tCO_2e.

[10] Calculated in accordance with the American Petroleum Institute 2021 Compendium of Greenhouse Gas Emissions Methodologies for the Natural gas and Oil Industry (https://www.api.org).

The main gaseous emissions from flaring activities are likely to be carbon dioxide (CO_2), methane (CH_4), helium (He) and water vapour (H_20). At this stage, it is difficult to predict the flow performance of the exploration wells. However, based on regional analogues, it is estimated that 116 565 m^3 of natural gas will be flared at each well over a three-week period. It was calculated that 243 tCO_2e will be emitted at each well. This calculation assumes that the flare would have a combustion efficiency of 98%.

5.7.2 Cutting handling

For the first section (top hole) of the well, around 3 m^2 of topsoil will be picked up and stockpiled for use in rehabilitation. Once reaching deeper sections, the drilled rock formation will come back at surface in dust format while air drilling. If mud drilling, the drilled rock formation will come back as cuttings. The overall volume is highly dependent on subsurface layering, overall depth to be drilled and the use or not of mud while drilling. In air drilling configuration, the volume of dust rock is estimated to be anywhere between 20 m^3 for 600 m deep well and 40 m^3 for 1200 m deep well. Dust and cuttings will be collected by Rhino's drilling contractor in adequate containers and then transported for disposal as directed by South African regulations. All materials designated as hazardous wastes will be transported to appropriately licensed landfill sites for safe disposal.

In the case of dusts these would be deposited on tarpaulins and/ or into skips. In the case of drill muds these would be deposited into skips. A series of skips are typically connected in sequence to allow for the split/decant of solids and liquids for reuse and disposal.

5.7.3 Water management

To be prepared for water/liquid management, each well site will be provided with a series of bowsers, tanks and skips. The skips will be used to temporarily manage subsurface water or drilling mud (if any). In the skips, the water and mud will split/decant, and the solids will fall to the bottom. The volumes of liquid will largely be recovered with sub aqueous pumps for future drilling use, the small remainder naturally evaporating over a certain period of time with the hot ambient temperatures experienced in the Free State. This efficient dehydration process allows to handle smaller residual quantities. The remaining material will then be removed and handled by a hazardous waste management company identified by Rhino's drilling contractor.

If water is intersected down hole, the hole will be reamed, casing installed, and grouting completed to seal off the water. The water in the hole will follow the same process as above.

5.7.4 Waste management

A number of other types of wastes generated during the drilling activities be transported for disposal.

These wastes will be recycled or re-used if possible or transported and disposed of at an appropriate licensed municipal landfill facility or at an alternative approved site.

5.7.5 Noise emissions

The main sources of noise from the proposed drilling programme include noise produced by the power generator and air compressor at the drill site. The noise characteristics and level will vary between 80 and 180 dB. The particular activity being conducted changes the noise characteristics, for example, if it is at idle, or providing full power to the truck mounted drill rig.

5.8 UNPLANNED EMISSIONS AND DISCHARGES

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

5.8.1 Hydrocarbons and chemical spills

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

Loss of well containment is a continuous release (in worst situation, with no control and massive release, it is called “well blowout”) which could last for a measurable period of time, while a single-event spill is an instantaneous or limited duration occurrence. Rhino is not expecting to find any liquid hydrocarbon (oil) but only to find dry biogenic gas (already covered in the emissions section). The downhole pressures recorded in regional analogue wells do not indicate any risk for potential long-term release.

Rhino is committed to minimising the release of hazardous chemical discharge into the environment and avoiding unplanned spills.

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

1. Incorporating chemical spill prevention into the drilling plans, and
2. Ensuring that necessary contingency planning has taken place to respond effectively to an incident.

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

5.9 PROJECT ALTERNATIVES

In relation to a proposed activity “alternatives” means different ways of meeting the general purposes and requirements of the proposed activity. Appendix 2 Section 2 (h)(i) of the EIA Regulations, 2014 (as amended), requires that all S&EIR processes must identify and describe alternatives to the proposed activity that are feasible and reasonable. Different types or categories of alternatives can be identified, e.g., location alternatives, type of activity, design or layout alternatives, technology alternatives and operational alternatives. The ‘No-Go’ or ’No project’ alternative must also be considered.

Not all categories of alternatives are applicable to all projects. The consideration of alternatives is inherent in the detailed design and the identification of mitigation measures, and therefore, although not specifically assessed, alternatives have been and will continue to be considered in the design and S&EIA processes. Despite many advances in geophysical data acquisition and analysis, currently no alternatives exist to definitively establish the presence of hydrocarbon reserves other than through exploration drilling. No activity alternatives have therefore been assessed.

The internationally accepted mitigation hierarchy (Figure 5-25) was considered and applied when analysing and selecting preferred alternatives in line with Good International Industry Practise.

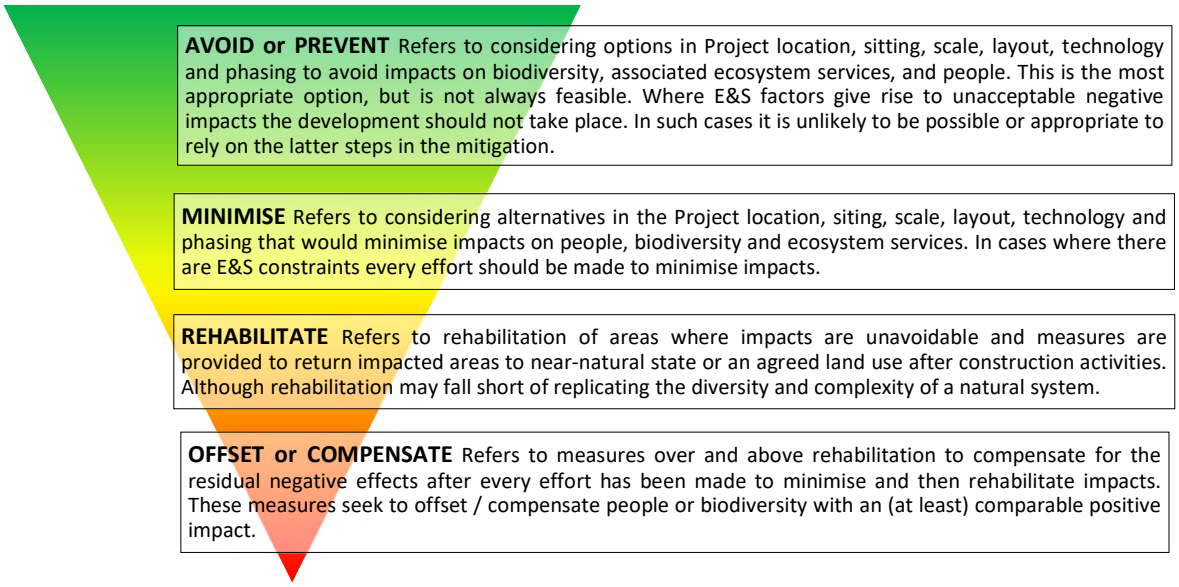

Figure 5-25: Mitigation Hierarchy

5.9.1 Review of available alternatives

Key criteria for consideration when identifying alternatives are that they should be "practicable", "feasible", "relevant", "reasonable" and "viable". A range of alternatives exists, not all of which are necessarily appropriate for each project under consideration. The different categories of alternatives that can typically be identified include: (1) activity alternatives; (2) location alternatives; (3) process alternatives; (4) demand alternatives; (5) scheduling alternatives; (6) input alternatives; (7) routing alternatives; (8) site layout alternatives; (9) scale alternatives; and (10) design alternatives.

Alternatives considered as part of this S&EIA process are outlined in the table below (Table 5-5).

Table 5-5: Review of available alternatives

No.	Alternative	Discussion
1.	**Activity alternative** Activity alternatives are sometime referred to as the Project Alternative and refers to a fundamental change in the nature of the proposed activity. One of the key issues raised as part of the ongoing public participation process is Rhino's pursuit of fossil fuel activities rather than developing renewable energy projects.	As discussed in the projects "Need and desirability" section (Section 4), South Africa has recognised that a gas economy plays a role in the country's planning. To inform this planning, it is necessary for Rhino (and others) to undertake exploration to confirm whether indigenous resources are available and, if found, are commercially available for recovery. Adopting an activity alternative is similar to the No-Go alternative as it implies forgoing exploration (See discussion below).

No.	Alternative	Discussion
2.	**Location alternatives** Location alternatives refer to both alternative properties as well as alternative sites on the same property. Through the screening process Rhino were able to identify and reach agreement with landowners for a total of 15 sites.	The basis for the proposed well sites is compliance with a defined screening criteria (See Table 5-2). While changes to this criterion could have resulted in alternative locations being identified, the guiding principle is to avoid environmental and social risks. The screening process implemented has provided for the selection of identified well sites of relatively lower sensitivity than possible alternatives. Given the extent of available areas to sight potential well sites, it was considered unnecessary to amend this criterion.
3	**Technology alternative** Consideration of such alternatives is to include the option of achieving the same goal by using a different method or process There is a range of drilling rigs available to conduct the drilling of a shallow onshore well. There are essentially four (4) possible rigs to be considered: • Coring drilling rig • Percussion air drilling rig; • Rotating mud drilling rig; • Hybrid air/mud drilling rig	• Review of the available technologies by Rhino confirmed: Coring drilling rig: usually used in mining type activities, not very efficient in handling hydrocarbons; • Percussion air drilling rig: usually used in drilling water wells, can be used in very low pressure hydrocarbons exploration but with limited ability to control well in un-expected kick situation; • Rotating mud drilling rig: usually used in traditional hydrocarbon drilling activities, can handle high pressure reservoir but totally inefficient in low pressure naturally fractured reservoir (mud circulation losses and reservoir clogging) • Hybrid air/mud drilling rig: usually use for drilling water wells, can be used in very low pressure naturally fractured reservoir and ability to handle unexpected higher pressure with mud injection for well control Rhino's preference is to use the hybrid air/mud drilling rig provided by the local South Africa experienced drilling contractor.
4.	**Scheduling alternative** These are sometimes known as sequencing or phasing alternatives. In this case an activity may comprise a number of components, which can be	The drilling of the first exploration well, is planned for 2023, dependent on drill rig availability, amongst several other planning requirements. The drilling of one well is estimated to take approximately 25 to 30 days to complete. The time sequence and the number

No.	Alternative	Discussion
	scheduled in a different order or at different times and as such produce different impacts.	of additional wells will be dependent on the results of the first exploration well and the interpretation of its results. Where possible, Rhino will ramp up the EWP to expedite the programme where possible. Other scheduling considerations relevant to Rhino's application is the accommodation of crop production and rainy season constraints. Management of these constraints are included in the attached EMPr (See Appendix K).
5.	**No-Go Alternative** The No-Go assumes that the EWP does not go ahead, implying a continuation of the current situation or the status quo.	The impact of the No-Go alternative is assessed, in accordance with the requirements of the EIA Regulations, 2014 (as amended). The No-Go alternative entails no change to the status quo, in other words the proposed exploration drilling activities will not be conducted in ER 318. The option not to proceed with exploration drilling will leave the areas of the potential drilling sites in their current environmental state, with the biogenic gas, helium and geological hydrogen potential remaining unknown. This alternative is in contravention of South Africa's overall strategic objectives with a No-Go (assuming a viable hydrocarbon source would be discovered) resulting in: • No improved security of gas/power supply for both businesses and households; • Not being able to make competitively priced locally produced natural gas available; • No in-country investments in a development project with associated job creation, increased government revenues and general contribution to economic growth; • Not being able to help with the transition to a low carbon economy to meet South Africa's Paris Agreement obligations, and

No.	Alternative	Discussion
		• Increased dependence on imported Liquified Natural Gas and coal for baseload power and industrial heat.

6. DESCRIPTION OF AFFECTED ENVIRONMENT

This chapter is aimed at providing the reader with general information on relevant environmental (geographical, physical, biological, social, economic, heritage and cultural) aspects associated with the proposed well drilling Target Areas. This assessment thus identifies environmental sensitivities within the Well Drilling ER application area, at a high-level and using currently available information.

6.1 INTRODUCTION

Baseline information for this Report was sourced through a desktop review and draws extensively on information contained in studies that have been conducted by various government departments and non-government environmental organisations responsible for relevant environmental aspects. Several data sources were used for this section, including:

- Provincial Biodiversity Conservation Plans;
- Data held by the South African National Biodiversity Institute (SANBI), World Wildlife Fund (WWF), BirdLife SA, Animal Demography Unit (ADU) and provincial conservation bodies etc;
- National Freshwater Priority Areas project;
- The International Union for the Conservation of Nature (IUCN) Red Data List of species;
- Available internet information on environmental issues related to exploration and production;
- Mining and Biodiversity Guideline;
- Available internet information on the baseline environment within the Well Drilling ER application area;
- Topocadastral and geological maps covering the Well Drilling ER application area at scales ranging from 1:50 000 to 1:250 000;
- Previous reports undertaken by SLR for the project area; and
- Municipality Integrated Development Plans and/or Municipality Spatial Development Frameworks

Details regarding specific environmental aspects have been sourced from specialist assessments commissioned as part of this S&EIA Process.

6.2 CLIMATE

According to the Köppen-Geiger Climate Classification system, the western portions of Block ER 318 are located within an area classed as cold semi-desert climate (BSk), while the eastern portions are classed as subtropical highland climate (Cwb) (source: **https://climateknowledgeportal.worldbank.org**). Areas with a cold desert climate are typically found in continental interiors, away from the moderating effects of large water bodies. Summers are generally warm and dry, while winters are generally cold and possibly freezing in some places. Areas with a subtropical highland climate are typically found in elevated areas, within either the tropics or subtropics. Summers are generally warm with noticeably cooler winters.

Rainfall across the Target Areas is limited to the summer months and is mostly in the form of thunderstorms. Regional Mean Annual Precipitation (MAP) can vary between 544 mm to 668 mm per annum. Day temperatures reach a maximum of up to 28°C in the months of January and December (the hottest months of the year), whilst the lowest night temperatures can drop to a minimum of -5°C. The wettest six months of the year are between October and March, with maximum precipitation occurring in December at an

average of 112mm and approximately 19.5 days of precipitation. On average 10 days of frost are experienced in the winter month of July, which is also the driest month of the year (Source: https://www.meteoblue.com/).

Mean annual temperatures in the Free State province have increased from 1901 to 2021, with an increase in the rate of change towards the present (source: **https://climateknowledgeportal.worldbank.org**). In contrast, there has been no statistically significant change in precipitation over the same period.

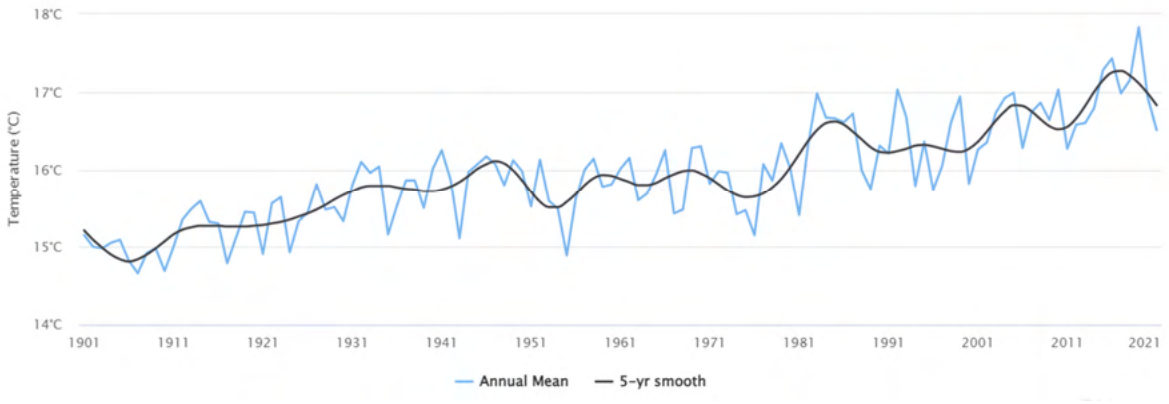

Figure 6-1: Observed change in mean annual temperature of the Free State province for the period 1901 to 2021

In the near future (2020-2039), mean annual temperatures are projected to increase by 3.3% in a low emissions climate scenario (SSP1-1.9)[11] and 4.9% in a high emissions scenario (SSP5-8.5) (source: **https://climateknowledgeportal.worldbank.org**). During the same period, the maximum daily temperature is projected to increase by 5.2% in SSP1-1.9 and 4.9% in SSP5-8.5. In the near future, mean annual precipitation is projected to increase by 2% in SSP1-1.9 and a 1% decrease in SSP5-8.5. During the same period, the maximum daily rainfall is projected to increase by 12.6% in SSP1-1.9 and 19.3% in SSP5-8.5.

It is highly unlikely that climate change will have a significant effect on the proposed exploration activities given the relatively small scale, nature, and short duration of the activities. The potential effects of climate change on the proposed exploration activities will therefore not be considered any further in this assessment.

[11] SSP1-1.9 is described as the sustainability narrative with low challenges to climate change mitigation and adaptation. This is pathway is the most closely aligned with the desired outcomes of the Paris Agreement. SSP5-8.5 is described as the fossil-fuelled development pathway with high challenges to climate change mitigation and low challenges to adaptation. This pathway is most closely aligned with business-as-usual.

6.3 GEOLOGY

6.3.1 Regional Setting

The proposed Target Areas lie in the east and northeast of the Karoo Basin (see Figure 6-2 and Figure 6-3). The main Karoo Basin in South Africa formed as a result of compression predominantly associated with flexural subsidence, characteristic of foreland basins, during the assembly of the Gondwana super-continent. Consensus on the tectonic setting of the basin, however, remains debated (Tankard et al., 2012; Schreiber-Enslin et al., 2014). The Karoo Basin represents a diverse and complex suite of rock units with an aerial extent of roughly 600 000 square kilometres that attains a maximum sedimentary thickness of 12 kilometres. The northeast of the basin is host to several distinct facies of rocks that vary between shore face, fluvial and lacustrine sediments, deposited between the Permian and Triassic.

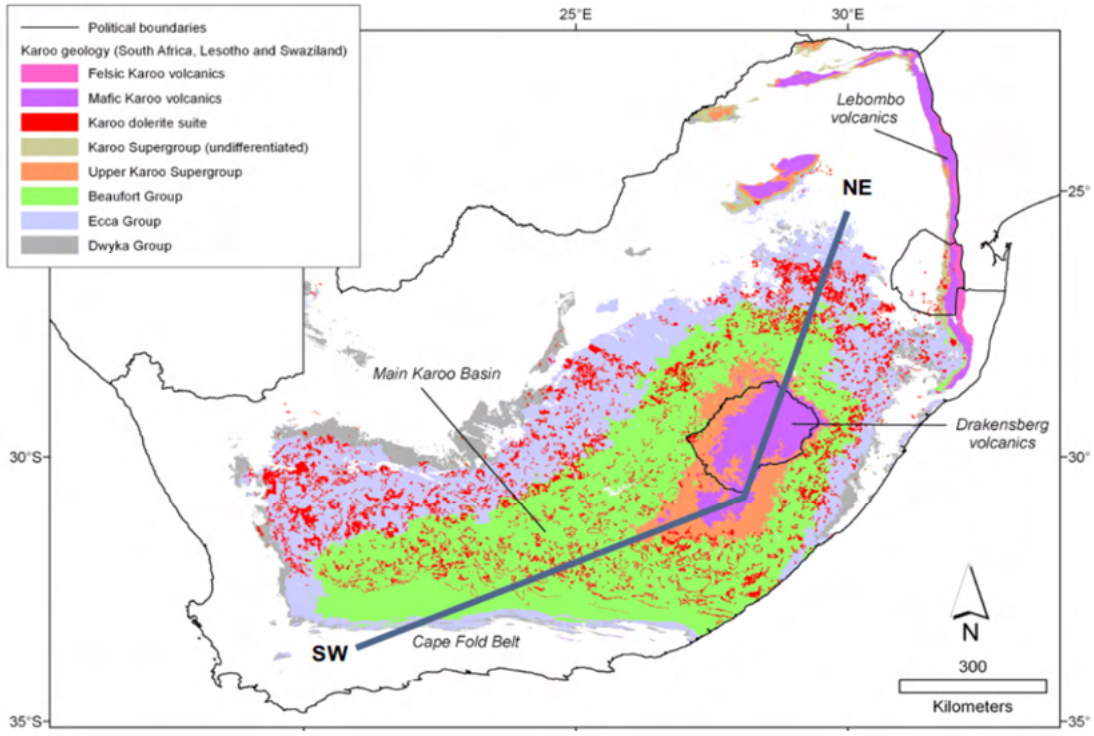

Figure 6-2: Karoo Basin Geology

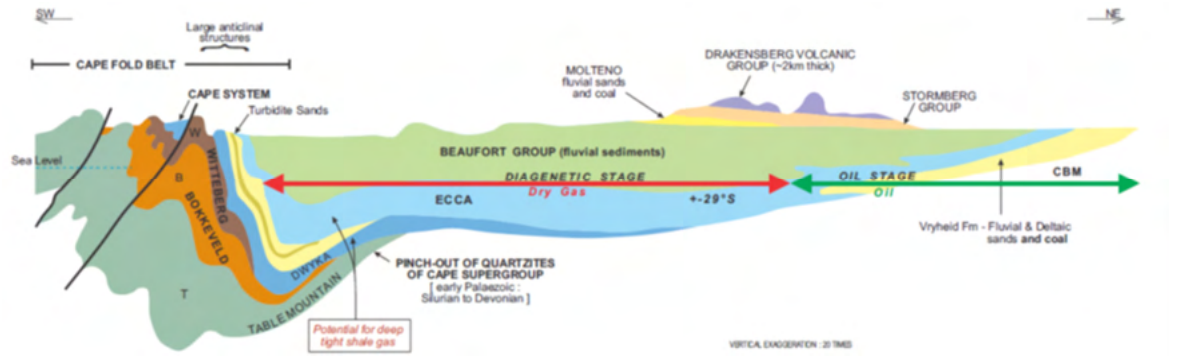

Figure 6-3: Simplified Geology of the Karoo Basin
Source: PASA Brochure

6.3.2 Resource assessment

Resource assessments of the Karoo Basin have historically emphasised the world-class coal reserves that have dominated the energy history of South Africa. Some limited onshore exploration for hydrocarbon occurrences was undertaken in the 1960s, but no commercial hydrocarbon occurrences were discovered. However, it is expected that the north-east Karoo Basin has potential for a tremendous diversity of hydrocarbon resources including helium and biogenic gas.

One of the complications recognised during the initial resource exploration effort undertaken in the 1960s was the widespread occurrence of dolerite dykes, especially in the north-east Karoo Basin. The thermal effects of these dykes led some early researchers to state that the dykes were required for distillation of hydrocarbons from adjacent coal and shale beds. The complexity of these dyke intrusions, well documented in the shallow north-east Karoo coal fields, makes it difficult to understand the geometry of any possible reservoir horizons in the adjacent sediments. As a result, there is poor understanding of the relationship between the observed non-commercial oil and gas occurrences and any structural control. Further compounding the perception of an absence of commercial hydrocarbons in the Karoo Basin was the documentation of low-permeability conditions in most drill holes. This led many researchers to conclude that the rocks possessed too low a permeability to produce hydrocarbons and porosities too low to trap them.

6.3.3 Seismicity

The Southern African region is considered to be relatively stable from a seismic perspective. South Africa is located on the African tectonic plate, which includes the African continent and parts of the floor of the Atlantic and Indian Oceans. In general earth tremors and quakes are infrequent and generally of low magnitude. The largest ever recorded earthquake to occur in South Africa was the Ceres-Tulbagh Earthquake, which occurred in September 1969, and had a magnitude of 6.3 on the Richter Scale.

There are areas in South Africa with higher peak ground acceleration which indicates a greater likelihood of earthquakes. These are found in the Western Cape region and in parts of the northern and western Free State, as well as the Witwatersrand. In general, the proposed Target Areas are not located in a region with high levels of seismicity although minor earth tremors have been recorded in the recent past.

6.4 SOILS AND LAND CAPABILITY

Soils across the proposed Target Areas are extremely diverse, ranging in structure and composition from light sandy soils to heavy swelling clays; leached soils that are high in organic matter to virtually unweathered rocky materials. The soil types are related to the parent rock from which the material was derived, climate and the landform on which they exist (position in the landscape). To the east of the escarpment soils are generally red-yellow apedal types. Above and immediately west of the escarpment soils are generally plinthic with some prismacutanic soils.

Land capability of the region is largely tied to topography (slope), rainfall and altitude. Regions with steeper gradients and higher altitudes generally have lower agricultural potential. Mean annual rainfall increases with elevation, and once over the escarpment decreases to the west, with land capability declining in a similar pattern.

6.5 LAND USE AND COVER

6.5.1 Land Cover

Land cover across large parts of the region comprises natural rangeland. The majority of the ER area consists of grassland (see Figure 6-4). Cultivated areas are evident across the region, except in the areas of high altitude and steep slope.

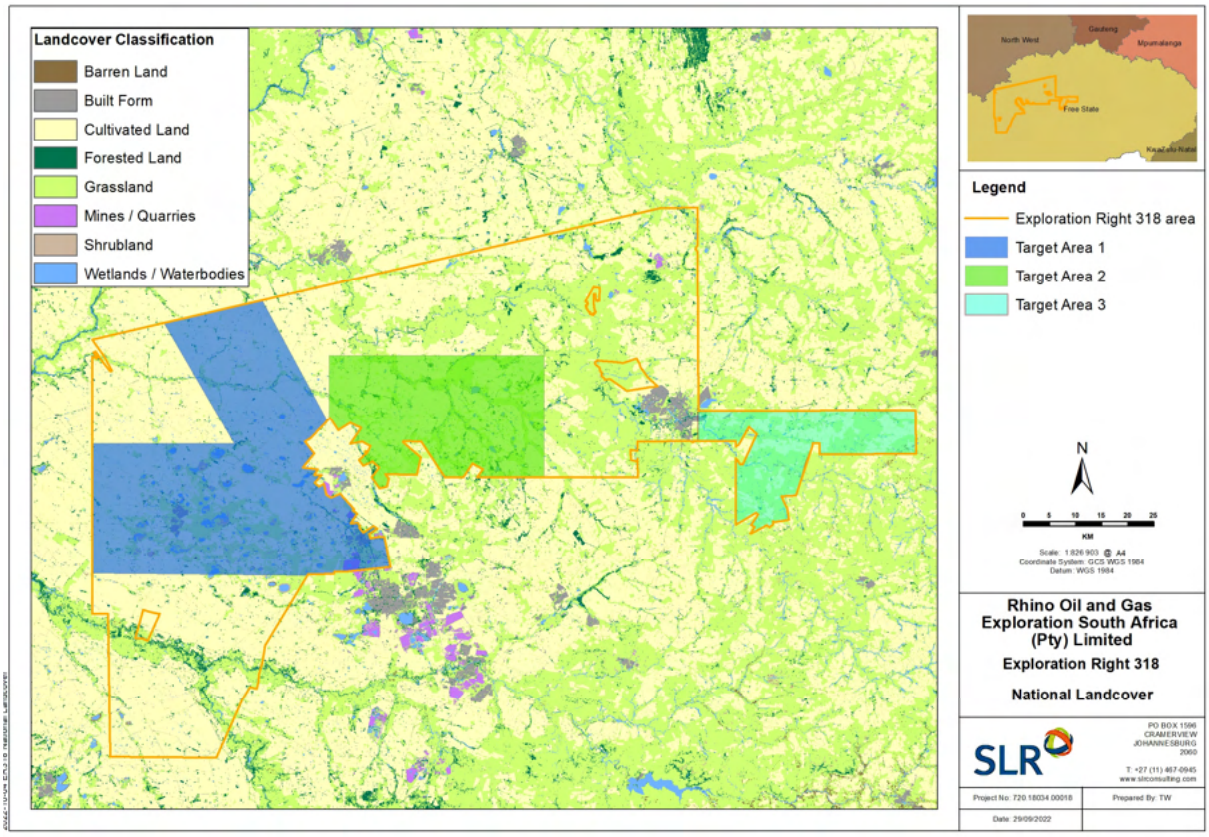

Figure 6-4: National Landcover database (2020)

6.5.2 Agricultural activities

The area is home to significant commercial agriculture. Agricultural activities associated with the area include a combination of crop production, animal production, horticulture, dairy farming, game farming, aquaculture, fruit production and agro-processing. Major crops are maize, soybeans, wheat, sorghum, sunflowers, potatoes, groundnuts and wool. Much is dryland but there are areas of irrigated crops. The main vegetable is asparagus, both of the green and white varieties. The large majority of the land is used for extensive livestock grazing (cattle and sheep). Subsistence farming is mostly associated with the towns where residents run livestock on the townlands.

6.5.3 Main towns

The main towns located within the proposed Well Drilling exploration area include the following:

- Kroonstad;
- Wesselsbron; and
- Odendaalsrus.

These towns comprise numerous buildings such as schools, sports facilities, hospitals/clinics, shops, local farm co-operations and designated residential areas.

6.5.4 Local road network

Numerous tarred provincial roads are located within the proposed exploration area. These include the following:

- The R76 that runs between Kroonstad and Steynsrus
- The R30 from Bothaville to Odendaalsrus and Welkom; and
- The R719 between Bultfontein and Wesselsbron.

That national tarred road (N1) also traverses a portion of the proposed exploration area connecting Kroonstad to Johannesburg. Further to this, numerous gravel roads are located within the Target Areas predominately associated with access to farms.

6.5.5 Existing Mineral Rights

The Regional Office of the DMRE is included as an I&AP and, as part of this S&EIA process, SLR has submitted a request for information on properties on which there are existing prospecting or mining rights (for non-petroleum minerals), and/or for which applications for prospecting or mining rights have been submitted. If there are overlapping rights, Rhino will engage with the holders prior to the undertaking of any well drilling.

6.5.6 Land Claims

The provincial office of Commission on Restitution of Land Rights is included as an I&AP and, as part of this S&EIA process, SLR has submitted a request for information regarding properties within the Target Areas on which existing Land Claims have been registered.

6.5.7 Core Astronomy Areas

To date no Core or Central Astronomy Advantage Areas have been declared within the Target Areas.

6.6 HYDROLOGY

6.6.1 Catchments and River Systems

The well drilling ER area falls within the Middle Vaal Water Management Area (WMA). The Vaal River is the only main river in the Middle Vaal WMA. It flows in a westerly direction from the Upper Vaal water management area, to be joined by the Skoonspruit, Rhenoster, Vals and Vet Rivers as main tributaries from the Middle Vaal water management area, before flowing into the Lower Vaal water management area and then into the Orange River. The Middle Vaal WMA covers a catchment area of approximately 44 803 km^2. The total water requirements in the Middle Vaal WMA is 872 million m^3/annum.

The Middle Vaal WMA consists of numerous quaternary catchments. The characteristics of the quaternary catchments located within the well drilling ER area are included in Table 6-1 below. Figure 6-4 illustrates the distribution of the quaternary catchments within the Well Drilling ER area.

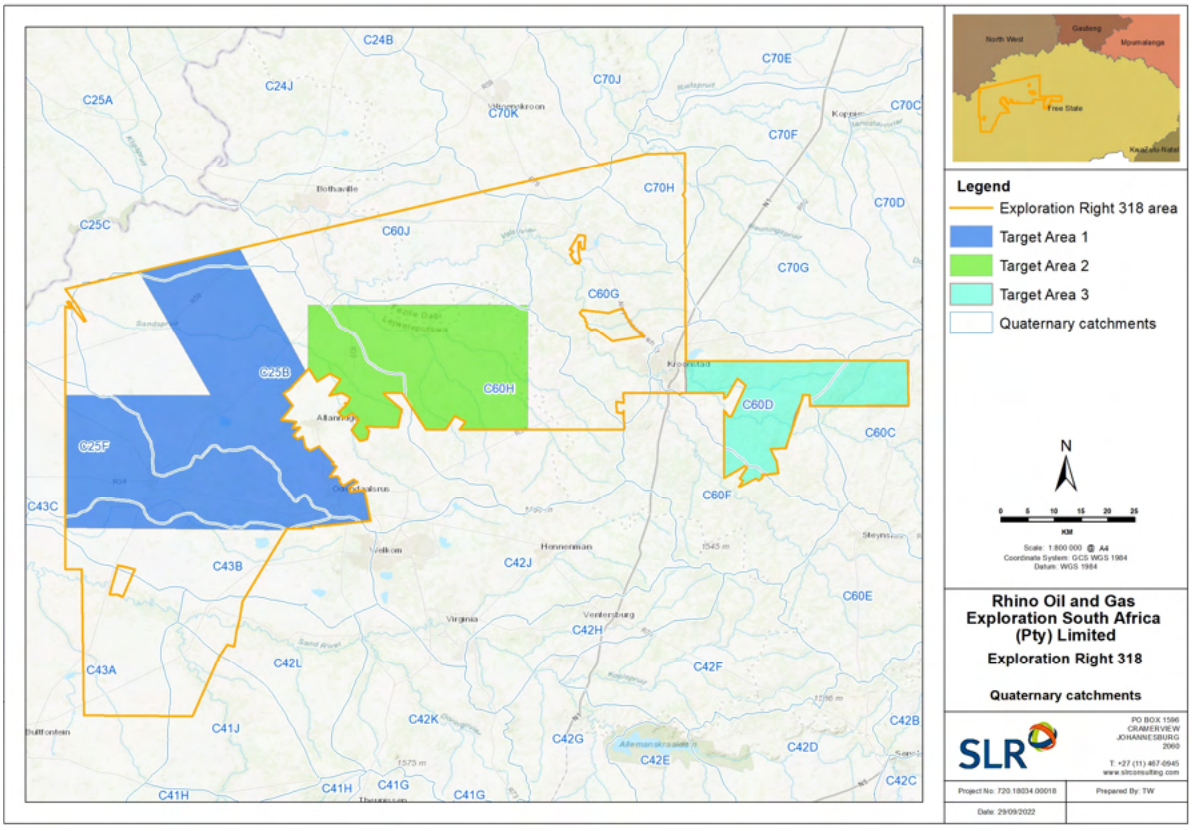

Figure 6-5: Water management areas and catchments

Table 6-1: QUATERNARY CATCHMENT CHARACTERISTICS (SLR, 2015)

Water management area	Quaternary catchment	Mean annual Runoff (mcm)	Catchment area (km^2)
Middle Vaal WMA	C25B	9.4	1888
	C25C	6.6	1210
	C25F	8.1	2219

Water management area	Quaternary catchment	Mean annual Runoff (mcm)	Catchment area (km^2)
	C43A	6	1491
	C43B	3.3	723
	C60F	17.87	659
	C60D	16.66	645
	C60C	28.63	1048
	C60G	16.4	782
	C60H	4.2	1232
	C70H	3.99	251
	C70K	10.9	891

6.6.2 Major Dams

The Vaal River is located within the ER and is one of South Africa's strongest-flowing rivers (see Figure 6-6). The Vaal dam itself falls outside of the ER. Several other small dams and numerous farm dams are located within the proposed Well Drilling ER area, which are largely used for livestock and domestic purposes.

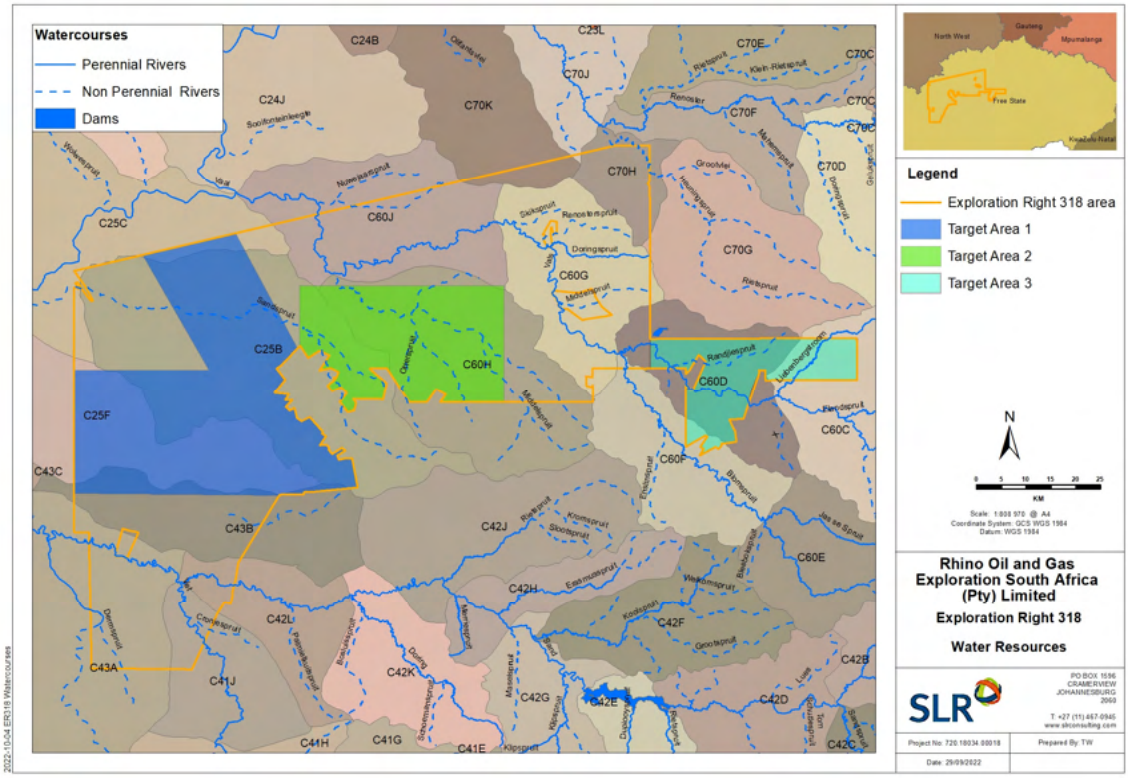

Figure 6-6: Water resources

Based on the National Freshwater Ecosystem Priority (NFEPA) wetland database (2011) the Target Areas include a significant number of wetlands ranging in hydrogeomorphic classification, including:

- Channelled valley-bottom wetlands;
- Depressions;
- Flat;
- Floodplain wetlands;
- Seep;
- Unchannelled valley-bottom wetlands; and
- Valleyhead seeps.

For reference, the location of the NFEPA wetlands within the Target Areas are illustrated in Figure 6-7. A quantitative and qualitative description of wetlands within the Target Areas is provided in Section 6.9.1 .

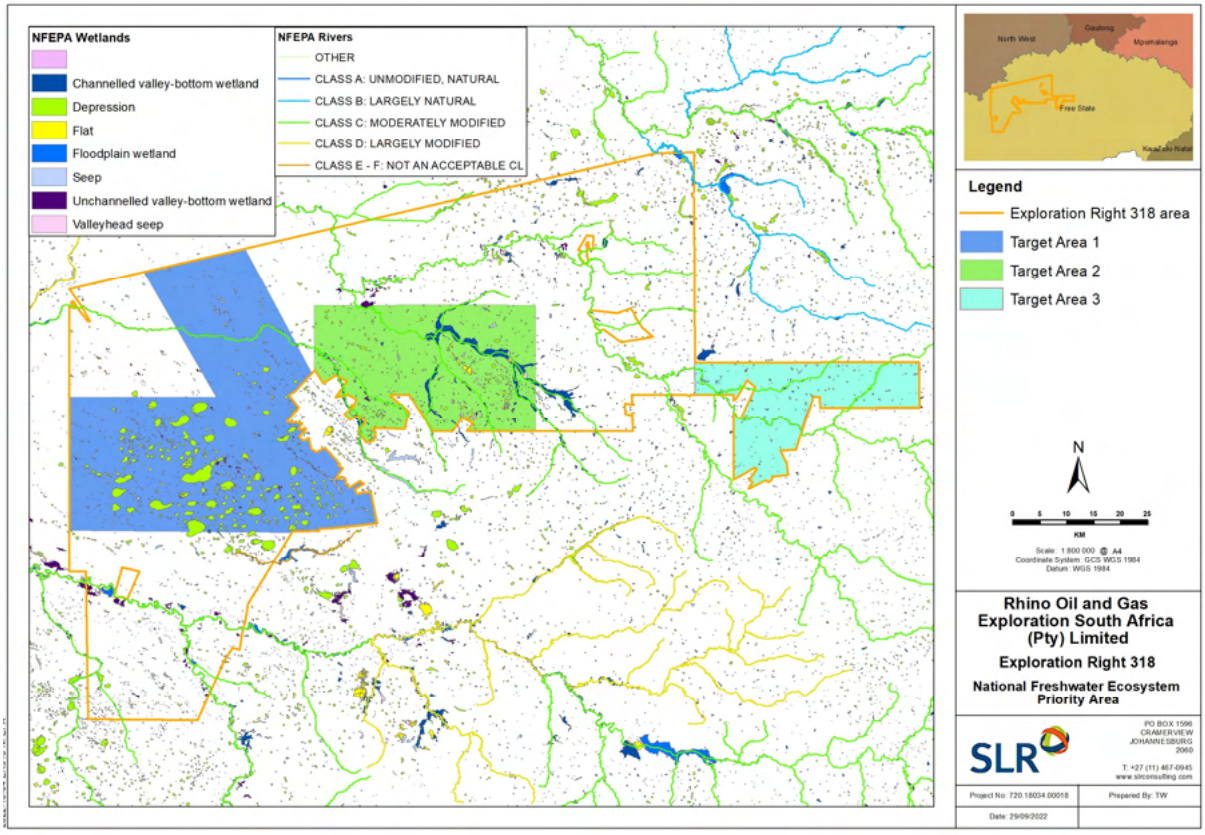

Figure 6-7: NFEPA Wetlands within the Target Areas

6.6.3 Surface Water Use

Surface water use consists of a combination of domestic, livestock use and irrigation for crop production on farms. Rivers within the Target Areas are tributaries of the Vaal Dam which is utilised for domestic, industrial and recreational purposes such as water sports and fishing. The Vaal Dam is a vital resource for water supply to Gauteng.

6.7 GROUNDWATER

JG Afrika (Pty) Ltd was appointed to undertake a specialist geohydrological impact assessment of the proposed exploration well drilling application (JG Afrika, 2023, See Appendix J)

6.7.1 Aquifer Classification

The regional geohydrology of the northern half of the project area can be broadly described as predominantly arenaceous rocks (d2) comprising sandstone. The principal groundwater occurrence is from an intergranular and fractured aquifer type, with median borehole yields in the range 0.1 to 0.5 l/s. The aquifer is characterised as a medium to low yielding Minor aquifer in terms of the South African Aquifer Classification System.

The regional geohydrology of the southern half of the project area can be broadly described as predominantly argillaceous rocks (d3) comprising shale and mudstone. The principal groundwater occurrence is from an intergranular and fractured aquifer type, with median borehole yields in the range 0.5 to 0.2 l/s. The aquifer is characterised as a medium to low yielding Minor aquifer in terms of the South African Aquifer Classification System.

North of the project area, the regional geohydrology can be broadly described as predominantly mafic intrusive rocks (d3) comprising dolerite. The principal groundwater occurrence is from an intergranular and fractured aquifer type, with median borehole yields in the range 0.5 to 0.2 l/s. The aquifer is characterised as a medium to low yielding Minor aquifer in terms of the South African Aquifer Classification System.
The regional geohydrology of the project area is presented Figure 6.

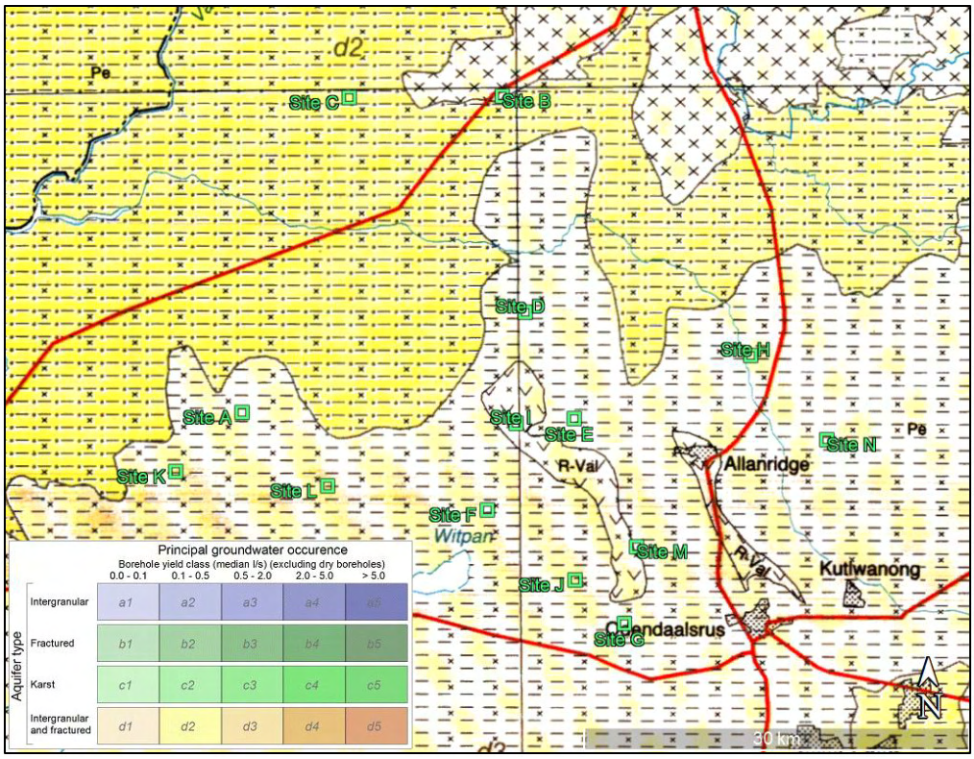

Figure 6-8: Regional Geohydrology

6.7.2 Groundwater Quality

Groundwater samples were collected by JG Afrika from boreholes identified and field verified during the site assessment, to establish the baseline groundwater quality status quo. Sampling was carried out from 29 November 2022 to 1 December 2022. Samples were submitted to EPL Laboratory for analysis of selected compounds of the Domestic Consumption SANS241 (2015) suite, to assess the potability and suitability of use. Samples were also submitted to iThemba labs for isotope analysis. The results of analysis were compared to the SANS241 (2015) Drinking Water Standards screening guidelines.

The results of analysis indicate that for the compounds analysed, nitrate and combined nitrate/nitrate regularly exceed the acute health screening limit. E.Coli occasionally exceeded the acute health limit. Aluminium, arsenic, iron and total organic carbon exceeded the chronic health limit in isolated samples. The operational and aesthetic limits were exceeded in numerous samples for total coliforms, colour, conductivity, total dissolved solids, turbidity and iron, with isolated exceedances for total plate counts, ammonia, chloride, sodium and manganese.

Typically the groundwater is unsuitable for potable use and the likely sources of compounds of concern are related to agricultural activities. For the isotope analysis, the results are presented in the common delta-notation, expressed as per mil deviation relative to the known mean ocean water (SMOW) standard. The δ^{180} versus δD space relative to the Global Meteoric Water Line (GMWL, Craig, 1961) is presented in Figure 6-9.

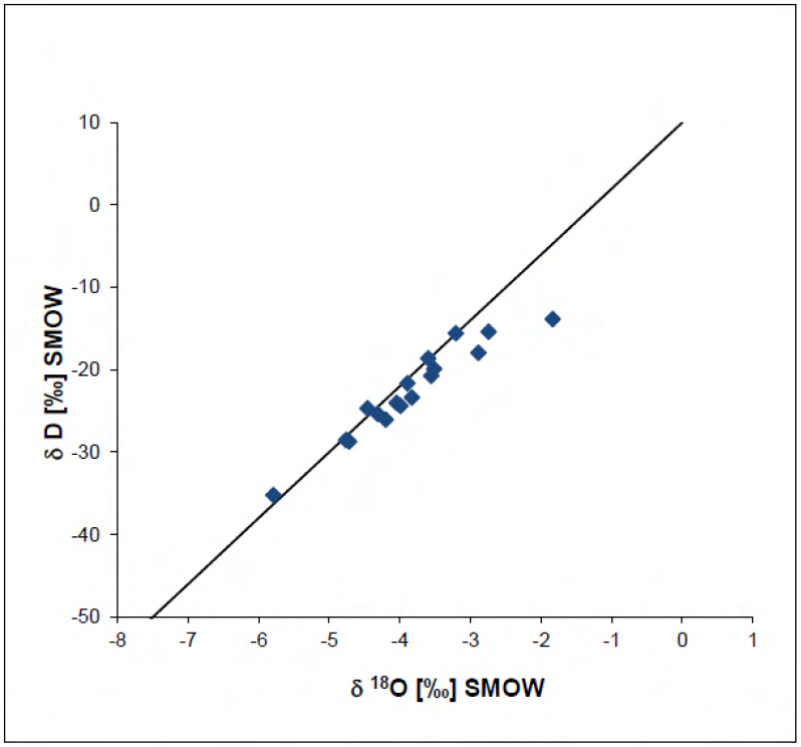

Figure 6-9: Stable Isotope Data Relative to Global Meteoric Water Line (Craig, 1961)
(Source: JG Afrika, 2023)

6.7.3 Groundwater Use

The National Groundwater Archive (NGA) and Water Allocation Resource Management System (WARMS) of the DWS were interrogated to establish the existence of any groundwater resources and groundwater use in proximity to the sites (See Figure 6-10)

Field verified resources identified during the site assessment noted shallow resources (where depth could be confirmed) ranging from 0.83 m to 7.21 m b.g.l. The majority of the verified water boreholes within the region are equipped for supporting livestock watering.

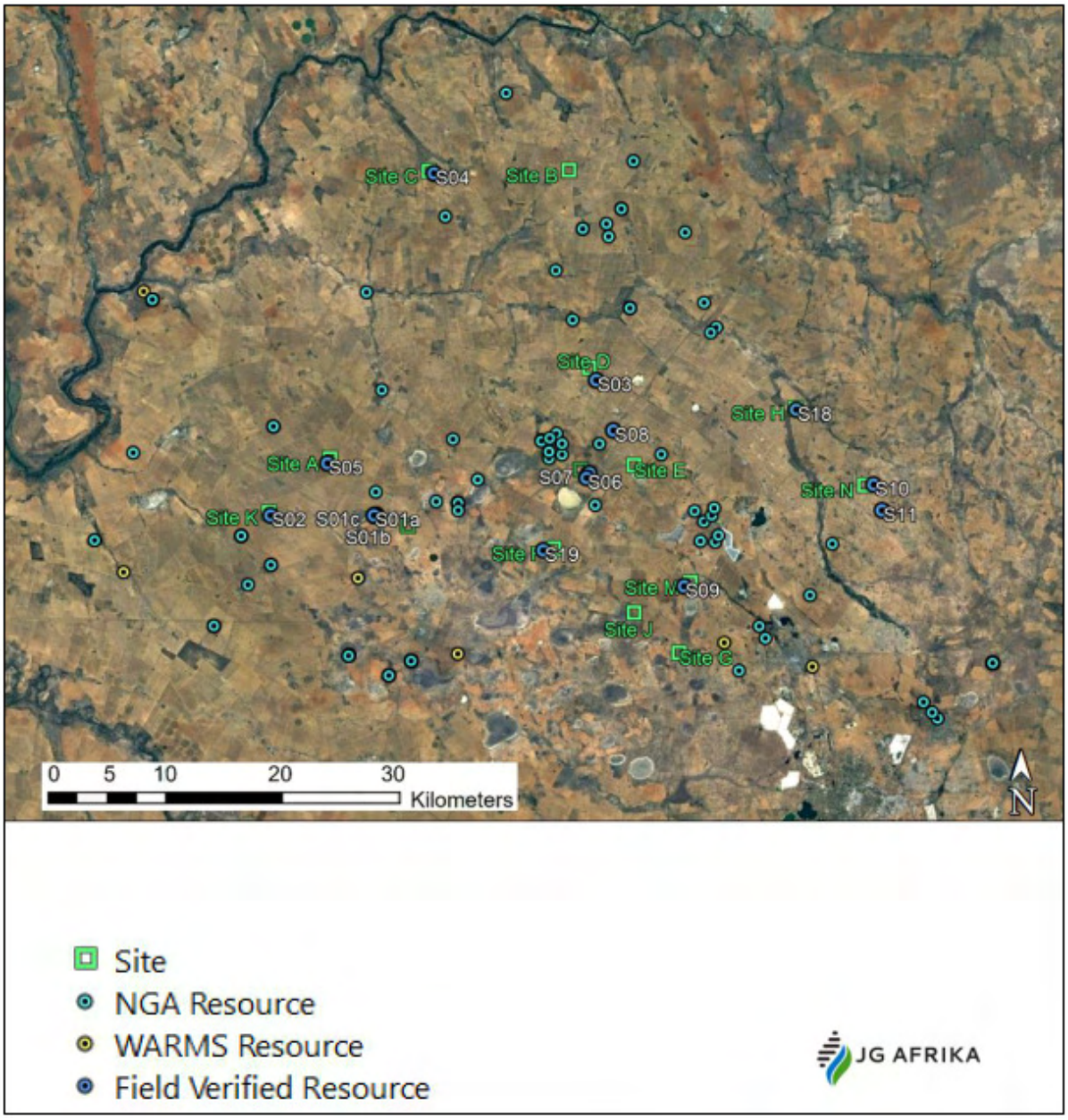

Figure 6-10: Groundwater hydrocensus
(Source: JG Afrika, 2023)

6.8 AIR QUALITY

The majority of the proposed well drilling Target Areas are rural in nature and is comprised mostly of small towns, isolated farmsteads, scattered communities and agricultural activities such as livestock grazing and crop cultivation. It follows that the air quality associated with majority of the area is expected to be good. The quality of air within and near to major towns is expected to be reduced due to various factors such as vehicle emissions and industrial operations. Existing emission sources within the well drilling Target Areas include fugitive dust from paved and unpaved roads, wind erosion from open areas, household fuel combustion (fuel and coal), vehicle exhaust emissions and smoke from veld fires in winter and stack emissions from industries.

6.9 BIODIVERSITY

Biodiversity refers to flora (plants) and fauna (animals). According to the International Union for Conservation of Nature (IUCN) (2011), biodiversity is crucial for the functioning of ecosystems which provide us with products and services which sustain human life. Healthy ecosystems provide us with oxygen, food, fresh water, fertile soil, medicines, shelter, protection from storms and floods, stable climate and recreation.

6.9.1 Aquatic biodiversity

To gather baseline data and inform the aquatic assessment and the S&EIA, a field survey was conducted during the early-summer months of November and December 2022. The survey involved a site visit and walkover of the identified well sites, which included Exploration Well 01 located in catchment C25C of the DWS quaternary division, near its boundary with catchment C25B, drained by the Vaal River about 14km east of the well site. Other well sites, including 02, 03, 07, 08, 09, 12, 13, and 14, were situated in catchment C25B, drained by the Sandspruit system, a tributary of the Vaal River. Catchment C25F, also drained by the Vaal, contained well sites 04, 05, and 06. ER318 was characterized by a mix of small to large wetlands, including pan/depression and seep wetlands with low longitudinal slope gradients.

The infield sampling of soil and vegetation, along with the recording of terrain indicators and features, helped identify four wetlands that may be impacted by the project (See Figure 6-11). The aquatic assessment report (refer to Appendix F) provides a summary of the key biophysical characteristics of each delineated watercourse unit.

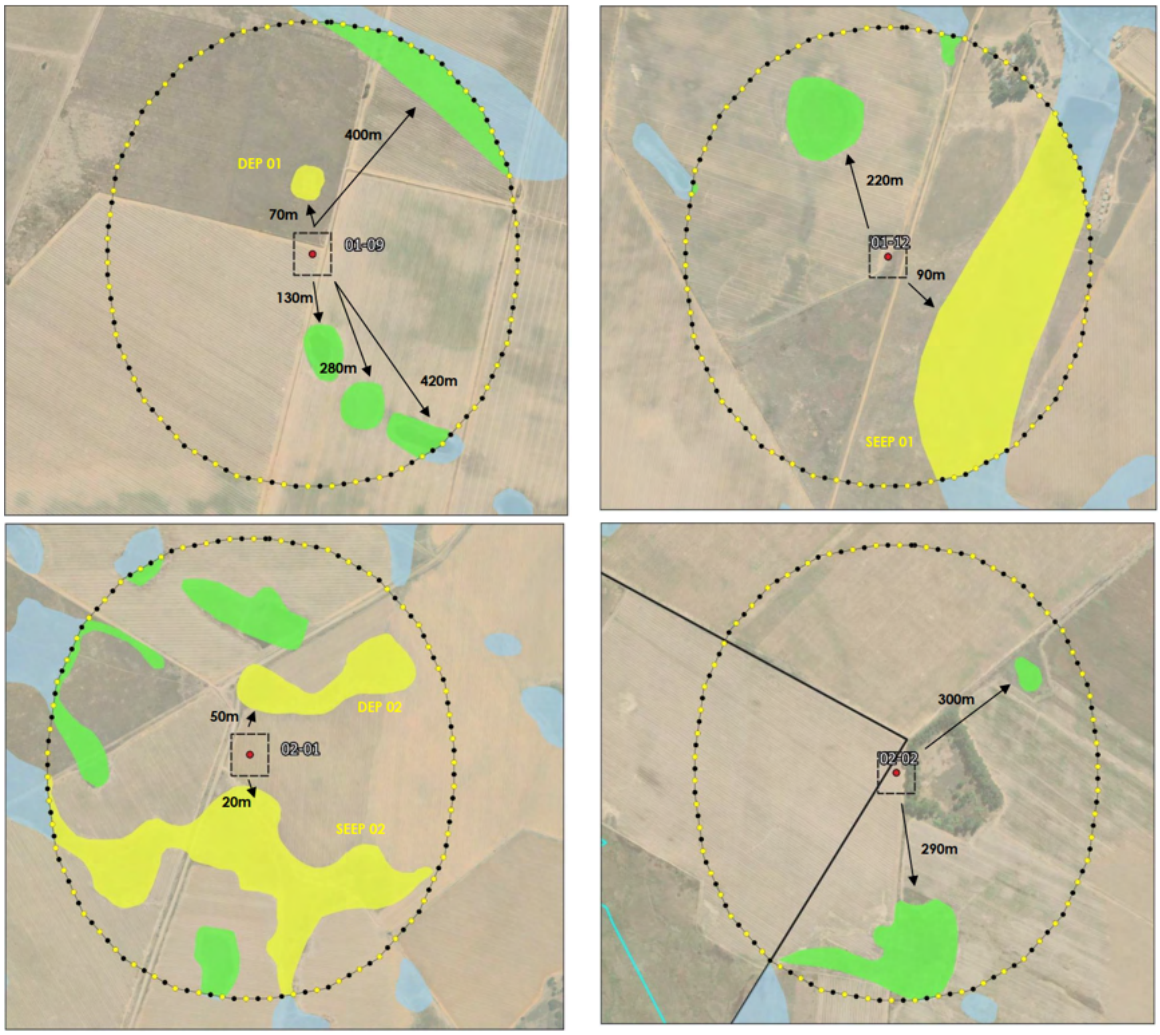

Figure 6-11: Outcomes of the watercourse impact likelihood assessment

The four assessed wetlands consisted of two depression units and two seep units. Depression 01 was classified as largely natural (B PES Category), while the other assessed wetland was moderately modified (C PES Category). The main impact affecting all assessed units was the altered hydrological and geomorphological processes in the catchment due to extensive cultivation. The depression wetlands were found to have low ecological importance and sensitivity (EIS), as they are small and not hydrologically linked to surrounding areas. Both seep wetlands were considered moderately important for the provision of regulating services. Seep 01, with a large upstream catchment, plays an important role in trapping sediment and processing excess nitrates and phosphates generated from surrounding cultivation activities. Seep 01 and Seep 02 are important for carbon storage due to the slow decomposition of organic matter in their saturated soils, making them effective carbon sinks.

6.9.2 Terrestrial biodiversity

A field survey was undertaken in November and December 2022 (early-summer) to collect baseline data and to inform the terrestrial biodiversity assessment and the S&EIA. The site visit and field survey entailed

undertaking a site walkover at each of the identified well sites. The site vegetation and habitat were surveyed on the 15 proposed drilling sites and within a 100 m buffer.

The national vegetation classification indicates that the reference terrestrial vegetation for the study area comprises Vaal-Vet Sandy Grassland, Kimberley Thornveld and Western Free State Clay Grassland (SANBI, 2018). According to the National Environmental Management: Biodiversity Act or NEMBA: revised national list of threatened terrestrial ecosystems (18 November 2022) Vaal-Vet Sandy Grassland is listed as 'Endangered', while Kimberley Thornveld and Western Free State Clay Grassland are listed as 'Least Concern'. Furthermore, according to the FSBP (Collins, 2019), Vaal-Vet Sandy Grassland is considered Critically Endangered (CR) at a provincial level (Table 6-2). In addition, the red list of threatened ecosystems classification – original extent and remnants – was consolidated. Vaal-Vet Sandy Grassland, Kimberley Thornveld and Western Free State Clay Grassland are considered endemic to the Free State.

Table 6-2 below indicates the extent of provincial vegetation types within the study area as contained in the FSBP (Collins, 2019). Vaal-Vet Sandy Grassland, Kimberley Thornveld and Western Free State Clay Grassland cover 10.2, 0.5 and 4 hectares of the study area respectively. Table 6-2 further provides an overview of the conservation targets, ecosystem status and level of protection based on 2019 accumulated transformation statistics of the Free State vegetation types that occur on-site (extracted from Collins, 2019), and the extent in hectares of the vegetation types that occur within the site.

Table 6-2: Conservation targets, ecosystem status and level of protection

Vegetation type	Conservation target (%)	Ecosystem status	Natural (ha)	Transformed (ha)	Extent on site (ha)
Vaal-Vet Sandy Grassland	24	Critically Endangered	475504.1	1797196	10.2
Kimberley Thornveld	16	Least Concern	1345758	567721.8	0.8
Western Free State Clay Grassland	24	Least Concern	402431.9	264294.8	4

The various terrestrial vegetation communities discussed in the terrestrial biodiversity assessment (Appendix G) were identified and classified according to topographic location, plant species composition, vegetation structure and level of degradation. A full list of the individual plant species identified within the study area as part of the terrestrial vegetation survey is provided in the terrestrial biodiversity assessment (Appendix G).

Table 6-3: Summary of the terrestrial vegetation communities and land use types identified

Vegetation Community Type	Threat Status[12]	Condition	Protected Plants Present?
Western Free State Clay Grassland	LC	Poor: moderately modified to degraded	No

[12] Threat Status (Collins, 2019): LC - Least Concern.

Vegetation Community Type	Threat Status[12]	Condition	Protected Plants Present?
Secondary Open Grassland	N/A	Poor: moderately modified to degraded	No
Dense Invasive Alien Plants	N/A	Lost: irreversibly modified	No
Cultivated land*	N/A	Lost: irreversibly modified	No
Transformed*	N/A	Lost: irreversibly modified	No

6.9.2.1 Western Free State Clay Grassland

This grassland community was observed to occur within untransformed areas of the drilling site areas and was found to be in a relatively 'poor' condition and was classified as a degraded Western Free State Clay Grassland community. The poor condition has likely resulted from an unnatural burning regime, disturbances linked to cattle grazing, and bush encroachment. The community was dominated by *Aristida congesta, Eragrostis curvula, Digitaria eriantha, Themeda triandra, Hyparrhenia hirta,* and *Helichrysum dregeanum*. No threatened plant species were found within the project footprint. The degraded grassland community had a particularly low diversity of indigenous forbs.

6.9.2.2 Secondary Open Grassland

This grassland community was observed within untransformed areas of the study area and was found to be in a relatively 'poor' condition and was classified as a secondary grassland community due to the high level of disturbance observed. The original vegetation was likely cleared in the past or severely disturbed by activities such as cattle grazing and other farming practices and human activities such as road building. The community was characterised by a high abundance of weeds, pioneer grasses and typical 'increaser' grass species that dominate under an unnatural disturbance regime linked primarily with over-grazing. The most common/abundant graminoid (grass) species occurring within the secondary open grassland type included a number of indigenous pioneer species and tolerant/increaser grasses such as: Cynodon dactylon and *Eragrostis plana*. Other grass species noted at low abundance levels were, *Digitaria eriantha, Panicum maximum and Hyparrhenia hirta.*

A number of ruderal, weed and Invasive Alien Plant (IAP) species were recorded within the grassland, including *Bidens Pilosa, Tagetes minuta* and *Verbena bonariensis.*

6.9.2.3 Dense Invasive Alien Community

The alien/exotic plant has essentially been created as a result of anthropogenic disturbance including plantations and removal of indigenous plants. As the name suggests, this community was found to be dominated with Invasive Alien Vegetation: *Pinus sp* and *Eucalyptus sp*.
Although indigenous vegetation was present, it constituted a small minority of the vegetation type, with mainly tolerant and locally common species (remnants of the former grassland communities that would have been present historically), including mainly of indigenous species of least concern, and mainly disturbance-tolerant and pioneer/increaser grasses such as *Panicum maximum* and *Cynodon dactylon*.

6.9.2.4 Protected Plant Species

No protected plants were recorded at any of the identified well sites.

6.9.2.5 Faunal Species

No faunal species of conservation importance were observed/ recorded at any of the identified well sites.

6.9.2.6 Site Ecological Importance

The results of the site ecological importance assessment are shown in Table 6-4. The ecological importance and sensitivity (EIS) of the various vegetation communities and habitat types assessed relates to the ability of the ecosystem to meet conservation targets and maintain important biodiversity features, as well as the ecosystem's sensitivity/resilience to ecological change and how significant such change would be.

Table 6-4: Summary of terrestrial habitat ecological importance ratings.

	Degraded Western Free State Clay Grassland	Secondary Grassland	Dense Invasive Alien Plants
Conservation importance	Low	Low	Very Low
Functional integrity	Low	Low	Low
Biodiversity importance	Low	Low	Very Low
Receptor resilience	High	High	Very High
Site ecological importance rating	Low	Low	Very Low

6.10 CONSERVATION SITES

6.10.1 Protected Areas

While several formally protected areas are located within close proximity to the Target Areas, all areas with protected status under the National Environmental Management: Protected Areas Act, 2003 (No. 57 of 2003); Biodiversity Act, 2004 (Act 10 of 2004); National Forests Act, 1998 (No. 84 of 1998) and Mountain Catchment Areas Act, 1970 (No. 63 of 1970) have been excluded from the extent of the ER 318 area (see Figure 6-12). Thus, no exploration activities will occur within these Protected Areas.

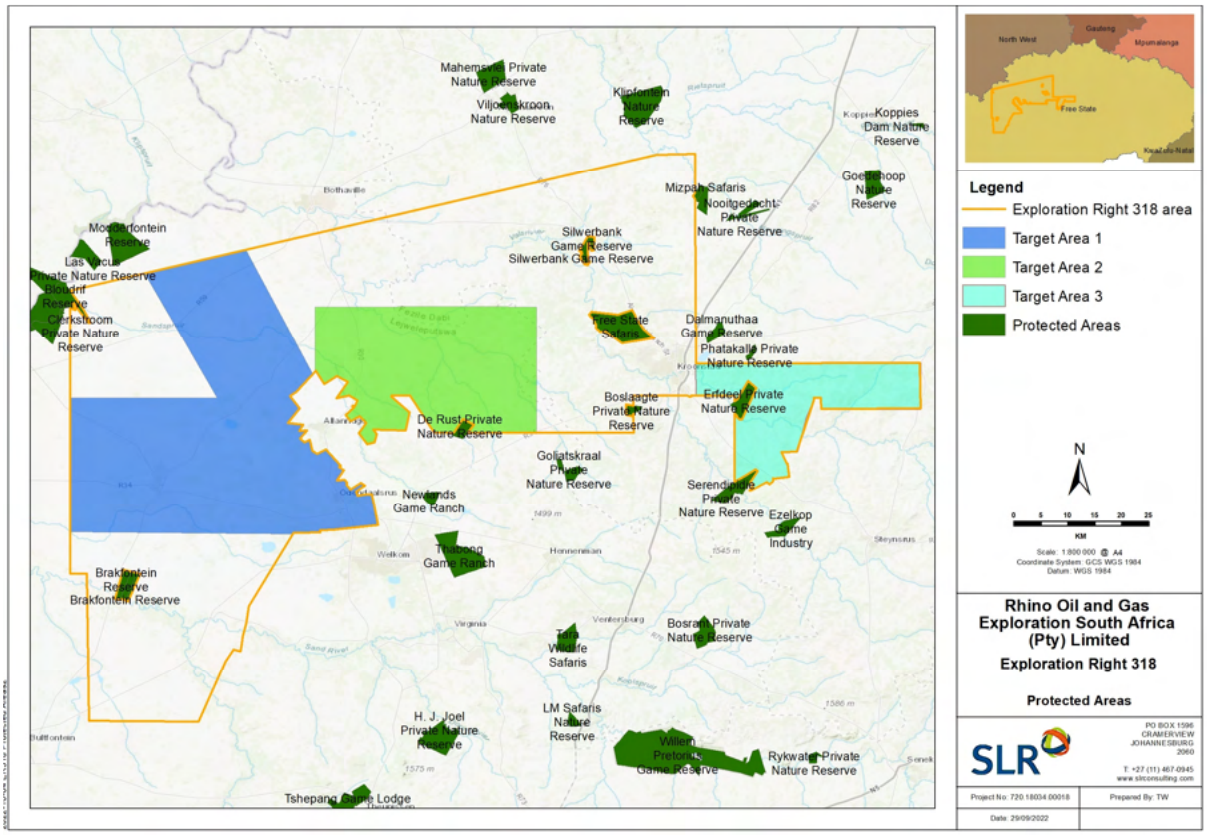

Figure 6-12: Location of Protected Areas outside of the proposed Target Areas

6.10.2 National Protected Area Expansion Strategy

The aim of the National Protected Area Expansion Strategy (NPAES) is to achieve cost effective protected area expansion for ecological sustainability and adaptation to climate change. The NPAES sets targets for protected area expansion, provides maps of the most important areas for protected area expansion, and makes recommendations on mechanisms for protected area expansion. It deals with land-based and marine protected areas across all of South Africa's territory (SANBI BGIS).

With reference to Figure 6-13, the ER area overlaps with the Freestate Highveld Grasslands NPAES focus area. Focus areas are important for the land-based protected area expansion network as these areas are large, intact and unfragmented areas which are suitable for creation or expansion of large, protected areas. However, it is noted that NPAES boundaries should never be literally interpreted as future protected area boundaries (DEA, 2016).

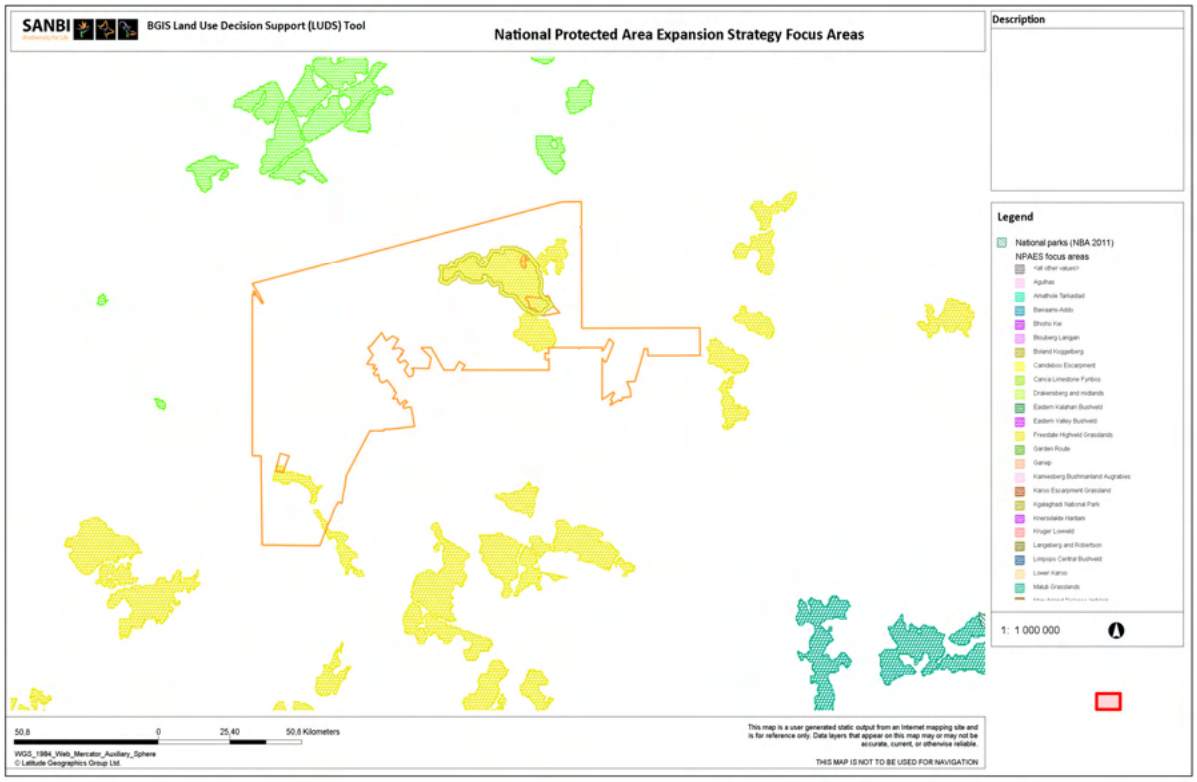

Figure 6-13: The ER Area in relation to the NPAES Focus Areas
Source: SANBI BGIS Map Viewer, 2022

6.10.3 National Threatened Ecosystems

Section 52 of the National Environmental Management: Biodiversity Act, 2004 (No. 10 of 2004) provides for the listing of threatened ecosystems at both national and provincial level. No critically endangered ecosystems are located within the proposed well drilling Target Areas (Mucina and Rutherford, 2006). The Vaal-Vet Sand Grassland is listed as endangered ecosystem and is found within the well drilling Target Areas

6.10.4 Freshwater ecosystems

The Water Research Commission and partners undertook the National Freshwater Ecosystem Priority Areas project (NFEPA). The NFEPA project produced several outcomes including the Atlas of Freshwater Ecosystem Priority Areas in South Africa, which provides strategic spatial priorities for conserving South Africa's freshwater ecosystems and supporting sustainable use of water resources. The NFEPA is supported by an implementation manual that provides guidance on the use of FEPA maps when planning and decision-making impacts on freshwater ecosystems. The manual provides ecosystem management guidelines for river FEPAs, wetland FEPAs, sub-quaternary catchments associated with river FEPAs, and Upstream Management Areas. The purpose of freshwater ecosystem management is to conserve biodiversity patterns and ecological processes and to maintain natural variability. Management should aim to prevent the occurrence of large-scale damaging events, as well as the repeated, chronic, persistent, subtle events.

There are numerous NFEPA Rivers and wetlands located within the proposed ER 318 area (refer to Figure 6-7 above). The present ecological state of the NFEPA Rivers located within the proposed exploration area are either classified as Class C (Moderately modified), Class D (Largely modified) and Class E (Seriously modified). It follows that all the NFEPA Rivers located within the proposed exploration area have been modified to some extent. No natural or unmodified NFEPA rivers are located within the proposed exploration area. The wetlands located within the proposed exploration area include a combination of Channelled valley-bottom wetlands, depressions, flat, floodplain wetlands, seeps, unchanelled valley-bottom wetlands and valley head seep.

According to the NFEPA implementation manual, mining in any form (including prospecting/exploration) should not be permitted in wetland FEPAs or within 1 km of a wetland FEPA buffer, or within 1 km of a riverine buffer (including all associated wetland systems and tributaries) within a FEPA catchment. It is noted that there is no legislation regarding buffers around rivers or wetlands in the NWA. The width of a buffer required around a river or wetland depends on many factors such as the risk the proposed development poses to the water resources, the sensitivity of receiving environment and the proposed mitigation measures. All water courses and wetlands (and 100 m buffer) were excluded from consideration during the well site selection process (refer to Section 5.2.2).

6.10.5 Critical Biodiversity Areas

The Free State Biodiversity Sector Plan, 2016 was developed with cognisance of the requirements for the determination of bioregions and the preparation and publication of bioregional plans (DEAT, 2009). To this end, the two main products of this biodiversity sector planning process includes:

- A map indicating the different terrestrial categories (Protected, Critical Biodiversity Areas (CBAs), Ecological Support Areas (ESAs), Other and Degraded)
- Land-use guidelines for the above-mentioned categories

The Free State Biodiversity Sector Plan represents the first attempt at collating all terrestrial biodiversity and ecological data for the province into a single system from which it can be interrogated and assessed. Biodiversity and ecological data included are:

- Land cover data;
- Inselbergs;
- Species distribution data (from records and expert mapping);
- Modelled species distribution;
- A range of national data sets (Vegetation types, NFEPA sub-catchments);
- The existing Ekangala spatial biodiversity plan;
- Biodiversity plans of neighbouring provinces; and
- Existing provincial plans that guide development within the Free State Province, most notably the Provincial Spatial Development Framework (PSDF).

Interrogation and assessment of the data was done according to national accepted biodiversity planning principles, i.e. classification of the landscape was done according to a systematic and a quantitative approach. Included in the assessment was the incorporation of edge matching principles to ensure that planning units across provincial boundaries have similar classifications (CBA, ESA, etc.) where appropriate.

Large portions of the Free State have been degraded and are not available for conservation. According to the 2009 land cover map of the Free State, portions of the province are degraded (18%) while 33.67% is transformed (urban development, agriculture). Only 1% of the Free State is covered by Formal Protected areas (Provincial Nature Reserves and SANParks).

The well drilling Target Areas proposed by Rhino include several areas classified as Critical Biodiversity Areas and Ecological Support Areas, however the majority of the Target Areas are mapped as Degraded or Other (see Figure 6-14). All CBA areas were excluded from consideration during the well site selection process (refer to Section 5.2.2).

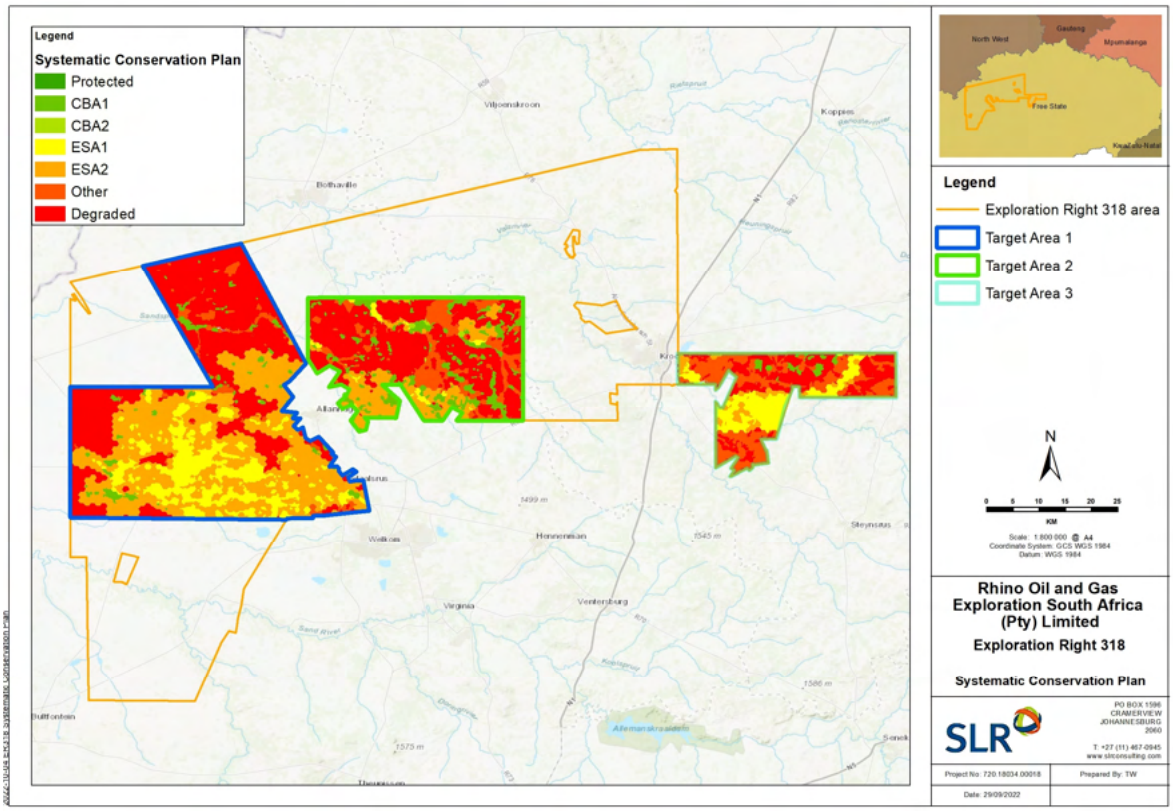

Figure 6-14: Mapped terrestrial categories of the Free State Biodiversity Sector Plan within the proposed Target Areas

6.10.6 Important Bird Areas

Important Bird Areas (IBAs) were initiated by BirdLife International to conserve a network of specific sites that are critical in the long-term survival avifaunal species. The following criteria was used in selecting the IBA's:

- Globally threatened species;
- Restricted range;
- Restricted to specific vegetation types or biomes; and
- Significant population numbers for a specific area.

No IBAs are located within the ER or proposed Target Areas (Figure 6-15).

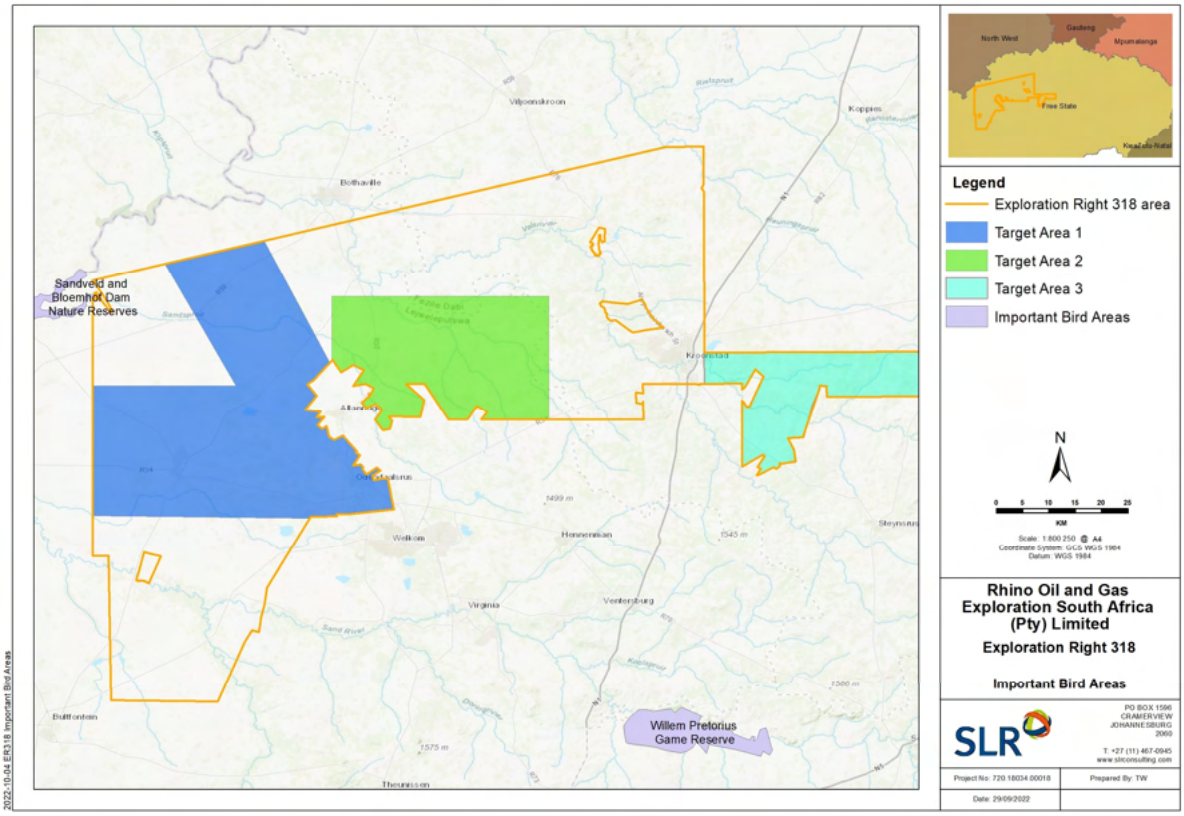

Figure 6-15: Location of the proposed Target Areas in relation to IBAs

6.11 HERITAGE/CULTURAL AND PALEONTOLOGICAL RESOURCES

Heritage (and cultural) resources include all human-made phenomena and intangible products that are the result of the human mind. Natural, technological or industrial features may also be part of heritage resources as places that have made an outstanding contribution to the cultures, traditions and lifestyles of the people or groups of people of South Africa.

The Target Areas are likely to include numerous heritage sites that are documented in the national and provincial heritage databases as well as many undiscovered sites. Towns associated with the Target Areas are likely to have buildings and graveyards of heritage significance. Many farms within the area will have graves and cemeteries while buildings of heritage significance are also likely on the older farms.

According to the SAHRIS database the Target Areas are located in a region that is generally regarded as having a very high to moderate palaeontological sensitivity. It follows that there is a high likelihood of fossil occurrence within most of the ER application area. As such, heritage and palaeontology specialist studies were undertaken to identify and assess any potential impacts on cultural heritage and palaeontological resources.

6.11.1 Cultural Heritage Baseline

The Free State has a rich archaeological and historical history going back millions of years and includes significant aspects such as Later Stone Age rock art, Battlefields and Iron Age stonewalled enclosures. The general surroundings of the study area became a melting pot of contact and conflict as it represents one of many frontiers where San hunter- gatherers, Nguni and Sotho-Tswana agro-pastoralists, Dutch Voortrekkers and British Colonists all came together. The ravages of war also swept across these plains, and in particular the South African War (1899-1902) as well as the Boer Rebellion (1914-1915).

The archaeological history of the area can broadly be divided into a Stone Age, Iron Age and Historic Period. Both the Stone and Iron Ages form part of what is referred to as the Pre-Colonial Period (Prehistoric Period) whereas the Historic Period is referred to as the Colonial Period (Historic Period).

It must be noted that such an overview, which is based on available literature and archival research, would necessarily reflect a bias toward a traditional white history of the region as this would have been the focus of publications and archival documents during the last 150 years.

6.11.1.1Fieldwork Findings

The fieldwork was conducted between November and December 2022 by a geoarchaeologist. During the fieldwork, a total of nine heritage features and resources where identified. These are described in Table 6-5 and demarcated in Figure 6-16.

Table 6-5: Heritage resources identified within the project site area

Label per Figure 6-16	Description
014	A burial ground
005	A multi-roomed house.
004	A stonewalled structure.
001 and 002	Two localities with abandoned farm buildings.
010 and 012	Two localities with sandstone fence markers.
011	A locality with old farm equipment.
018	An old farm entrance.

It must be noted that four alternative well locations were proposed based on various specialist observations. None of the identified heritage resources are located within proximity of the proposed well sites.

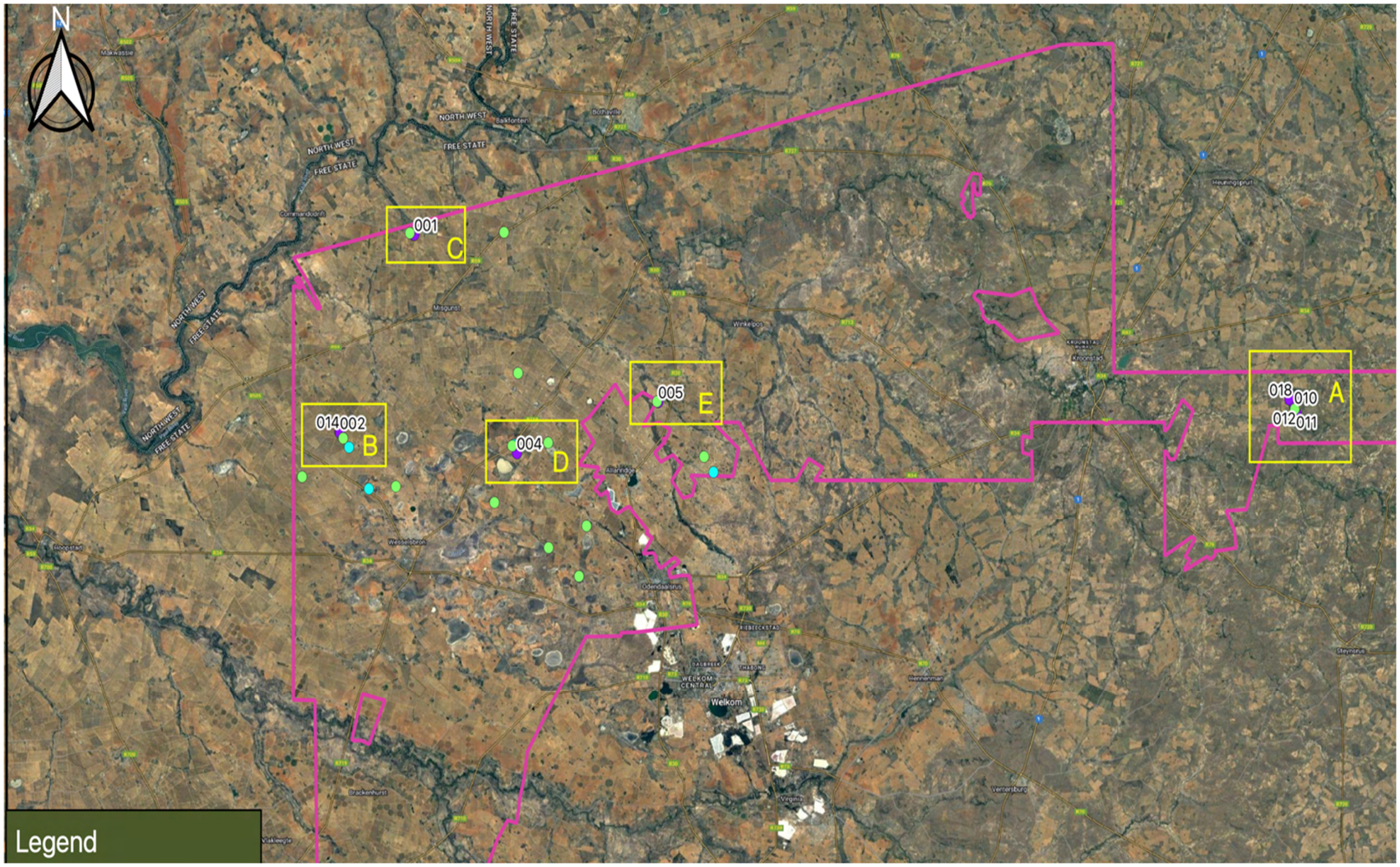

Figure 6-16: Identified heritage resources within the study area

(Per PGS, 2023)

6.11.2 Palaeontological Baseline

The project lies in the central part of the main Karoo Basin where the Ecca Group sediments are exposed. The Karoo Supergroup rocks cover a large part of South Africa, extending from the northeast to the southwest and almost to the KwaZulu Natal south coast. They are bounded by the Cape Fold Belt to the south and the Transvaal Supergroup rocks to the north. The rocks, which are between 183 and 300 million years old, contain a wide range of fossilized plants, insects, vertebrates, and invertebrates. In the Odendalsrus area, there are a few rare outcrops of the older Ventersdorp Supergroup lavas, while younger Quaternary sands and alluvium cover most of the Karoo Supergroup rocks that have not been eroded.

The Ecca Group, which is Early Permian in age, overlies the basal Dwyka Group rocks in the Karoo Basin. There are eleven formations in this group, but they are not present throughout the basin. In the central and eastern parts, the Pietermaritzburg, Vryheid, and Volksrust formations are present, which contain varying proportions of sandstones, mudstones, shales, and siltstones. These sediments were deposited in shallow to deep-water settings, including deltas, rivers, streams, and overbank environments. Overlying the Ecca Group are the rocks of the Beaufort Group, which are divided into the lower Adelaide Subgroup for Upper Permian strata and the Tarkastad Subgroup for Early to Middle Triassic strata. The formations of the Beaufort Group also vary across the Karoo Basin.

Minor exposures of Jurassic dolerite dykes occur throughout the area. These intruded through the Karoo sediments around 183 million years ago at about the same time as the Drakensberg basaltic eruption.

Quaternary Kalahari sands cover large parts of the rocks in this region, especially to the west. This is the largest and most extensive palaeo-erg in the world (Partridge et al., 2006) and is composed of extensive aeolian and fluvial sands, sand dunes, calcrete, scree and colluvium. Periods of aridity have overprinted the sands, and calcrete and silcrete are common. Most geological maps indicate these sands simply descriptively (aeolian sand, gravelly sand, calcrete) or they are lumped together as the Gordonia Formation because the detailed regional lithostratigraphic work has not been done, Nonetheless, these sands have eroded from the interior and have been transported by wind or water to fill the basin. Reworking of the sands or stabilisation by vegetation has occurred. Probable ages of dune formation are around 100 kya (thousand years), 60 kya, 27-23 kya and 17-10 kya (in Botha, 2021).

Along many of the rivers and watercourses are fluvially-transported sands and gravels that too are difficult to date. This sand is derived from the meandering channels and terraces and has been reworked in the past from rivers and re-captured rivers as the tectonic uplift has changed drainage patterns (de Wit, 1999; Botha, 2021). Human activities have also impacted the rivers and their sediment source.

Details of the palaeo-sensitivity coding and geology of each drill site is included in Table 6-6 below.

Table 6-6: Drill sites in the three Target Areas with (SAHRIS) palaeo-sensitivity coding and geology

Target Area	Drill Site No	Geology and palaeosensitivity
Target Area 1	Drill Site - 01	Quaternary sands Transported fragments
	Drill Site – 02	Quaternary sands Transported fragments

Target Area	Drill Site No	Geology and palaeosensitivity
	Drill Site – 03	Quaternary sands Transported fragments
	Drill Site – 04	Quaternary sands Transported fragments
	Drill Site – 05	Quaternary sands Transported fragments
	Drill Site – 06	Quaternary sands Transported fragments
	Drill Site – 07	Quaternary sands Transported fragments
	Drill Site – 08	Quaternary sands Transported fragments
	Drill Site – 09	Quaternary sands Transported fragments
	Drill Site – 10	Quaternary sands Transported fragments
	Drill Site – 11	Jurassic dolerite No fossils
	Drill Site – 12	Quaternary sands Transported fragments
Target Area 2	Drill Site – 01	Quaternary sands Transported fragments
	Drill Site – 02	Quaternary sands Transported fragments
Target Area 3	Drill Site – 01	Adelaide Subgroup Vertebrate fossils

Based on the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the overlying sands and alluvium of the Quaternary. There is a very small chance that features that trap fossils, such as palaeo-pans and palaeo-springs might be obscured by the sands. This is the case for all the drill sites in Target areas 1 and 2.

The drill site in Target Area 3 is on potentially very highly fossiliferous mudstones of the Adelaide Subgroup that might preserve fossil vertebrate bones, are on flat fields that have been cleared for agriculture (grazing or previously for crops) and no rocky outcrops remain on the surface. Therefore, no fossils would be visible on the surface.

6.12 SOCIO-ECONOMIC ENVIRONMENT

6.12.1 Districts

The ER 318 area is largely located within three Local Municipalities in the Free State Province, namely:

- Nala Local Municipality;
- Moqhaka Local Municipality; and

- Matjhabeng Local Municipality.

Details (predominately based on Census 2011 data) pertaining to the three local municipalities area are provided in the section below. The ER 318 area also has a small overlap with the Ngwathe (in the northeast corner) and Tswelopele (in the southwest corner) Local Municipalities. However, due to the limited overlap, these are not discussed in detail.

6.12.2 Population

The population of the Nala Local Municipality has decreased 3.3% from 81 220 in 2011 to 78 515 persons in 2016. The population of the Moqhaka Local Municipality has decreased by 4.4% from 167 892 in 2001 to 160 532 persons in 2011. The community survey conducted during 2016 indicated that the population once again decreased with 3.61% to 154 732.

The Matjhabeng Local Municipality experienced a 5.14% growth rate from 407 020 to 429 113 between 2011 to 2016.

6.12.3 Employment

In the Nala Local Municipality, there are 26 611 economically active (employed or unemployed but looking for work) people, and of these 35.9% are unemployed. Of the 12 357 economically active youth (15–35 years) in the area, 47.6% are unemployed.

Within the Moqhaka Local Municipality, there are 55 594 economically active (employed or unemployed but looking for work) people, and of these 35.2% are unemployed. Of the 27 349 economically active youth (15–34 years) in the area, 47.2% are unemployed.

In the Matjhabeng Local Municipality, A total of 99 650 people are employed while 13 290 are discouraged work-seekers. According to Census 2011, 58 524 people are unemployed, making the unemployment rate stand at 37%. Of the youth aged 15–34, 39 442 are employed and 38 975 are unemployed.

6.12.4 Households

In the Nala Local Municipality, there are 21 703 households in the municipality, with an average household size of 3.7 persons per household. 40.4% of households have access to piped water either in their dwelling or in the yard. Only 1.2% of households do not have access to piped water.

Within the Moqhaka Local Municipality, there are 45 661 households, 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.

There are 123 195 households in the Matjhabeng Local Municipality, with an average household size of 3.1 persons per household. Of those households, 36% have access to piped water inside the yard whereas

54.8% have access to piped water inside their dwelling. Only 2% of the households do not have access to piped water.

6.12.5 Basic Services

The percentage of the total population located within each of the local municipalities within the ER 318 area that have access to drinking water, sanitation and power is included in Table 6-7 below. Where access to sanitation is not available, alternative sources include pit toilets, bucket system, chemical toilets and other. Where access to power is not available, alternative sources such as wood, gas and paraffin are used.

Table 6-7: Demographics – Basic Services

Local municipality	Access to drinking water	Access to sanitation	Access to power
Nala Local Municipality	87.6%	97.3%	Lighting: 90. 4% Heating: 54.3% Cooking: 85.6%
Moqhaka Local Municipality	87.2%	98%	Lighting: 93.3% Heating: 65% Cooking:
Matjhabeng Local Municipality	95%	97.4%	Lighting: 91. 1%

Source: StatsSA, Census 2011 data

6.12.6 Education

Education information for each of the local municipalities located within the ER area is included in Table 6-8 below.

Table 6-8: Demographics - Education

Local municipality	No education	Completed grade 12	Higher education
Nala Local Municipality	7.9%	22.2%	5.6%
Moqhaka Local Municipality	5.3%	27.8%	8.6%
Matjhabeng Local Municipality	4.6%	28%	9%

Source: StatsSA, Census 2011 data

7. IMPACT DESCRIPTION AND ASSESSMENT

This chapter describes and assesses the significance of potential impacts associated with the proposed project. The impacts were identified by SLR and the team of specialist consultants and evaluated in terms of the methodology outlined in Section 3.3.2.2.

The Scoping phase identified several risks to physical, biological/biodiversity and socio-economic aspects and produced a Plan of Study to evaluate the significance of these risks. These risks were either assessed by SLR or, where necessary, by specialist consultants. Initially a comprehensive list of risks to each aspect was identified. Where risks were evaluated as "Insignificant" these were excluded from further assessment. Where impacts pre-mitigation ranged between "Very Low" and "Low" significance, the impacts are evaluated in detail, and mitigation and monitoring measures outlined.

No impact with a significance higher than "Low" (i.e Medium, High or Very High) were identified.

All recommended mitigation measures and monitoring requirements, regardless of impact significance, have been incorporated in the EMPr (Appendix K)

7.1 IMPACTS ON PHYSICAL ASPECTS

Potential risks to the physical environmental aspects include (Table 7-1):

Table 7-1: Risks to physical environmental aspects

Type of Impact	Impact Description	Pre-Mitigation Significance	Post-Mitigation Significance
Geology	Risk to underground geological formations and mine workings	Insignificant	Insignificant
Climate change	Contribution of Project-related GHG Emissions to Climate Change	**Very Low**	**Very Low**
	Accidental Escape or Release of GHG Emissions	**Very Low**	**Very Low**
Soils and Land Capability	Risk to soil through increased erosion/compaction	**Very Low**	Insignificant
	Risk to soils through contamination	**Very Low**	Insignificant

7.1.1 Climate change - Contribution of Project-related GHG Emissions to Climate Change

Description: Exploration activities will result in GHG emissions which contribute to atmospheric GHG concentrations and climate change. Significant sources of emissions include the fuel consumption of onsite generators for operating truck mounted drill rig, air compressors, miscellaneous equipment, the fuel consumption of supply trucks, and flaring activities (see Section 5.7). As project-related emissions are likely

to be below the 10 000 tCO_2e threshold of the European Bank of Reconstruction and Development (EBRD)[13], the impact is classed as very low.

Issue: Contribution of project-related GHG emissions to climate change		
Phases: Drilling phase		
Criteria	Without Mitigation	With Mitigation
Intensity	n/a	n/a
Duration	n/a	n/a
Extent	n/a	n/a
Consequence	n/a	n/a
Probability	n/a	n/a
Significance	**Very low -**	**Very low -**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Fully reversible**	
Degree to which impact may cause irreplaceable loss of resources	**None**	
Degree to which impact can be avoided	**High:**	
Degree to which impact can be mitigated	**High:**	
Cumulative Impacts		
Nature of cumulative impacts	Insignificant contribution to global GHG concentrations.	
Extent to which a cumulative impact may arise	**Unlikely**	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	**Insignificant**
Residual impacts	**None**	

[13] The EBRD has developed thresholds for determining the impact of project-related emissions (in the Methodology for Assessment of Greenhouse Gas Emissions). These thresholds have been used as the standard SLR impact assessment methodology tends to overestimate the significance of the impact due to the long-term duration, global extent, and high probability of occurrence, in contrast to the generally low intensity of the impact.

Mitigation measures: Mitigation measures include:

- Application of general international industry practice such as regular vehicle and equipment maintenance and servicing.

Monitoring: Monitoring will include:

- No monitoring required.

7.1.2 Climate change - Accidental Escape or Release of GHG Emissions

Description: Wells drilled to the target strata could create the opportunity for gas to escape to the surface. The accidental escape or release of gas from exploration wells is of concern as methane (one of the main constituents of natural gas) is a relatively powerful GHG with a high global warming potential (25 times that of CO_2 over a 100 year period), contributing to climate change. As the accidental escape or release of GHG emissions are likely to be below the 10 000 tCO_2e threshold of the EBRD, the impact significance is classed as "Very Low".

Issue: Accidental escape or release of GHG emissions		
Phases: Drilling phase		
Criteria	Without Mitigation	With Mitigation
Intensity	n/a	n/a
Duration	n/a	n/a
Extent	n/a	n/a
Consequence	n/a	n/a
Probability	n/a	n/a
Significance	**Very Low -**	**Very Low -**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Fully reversible:**	
Degree to which impact may cause irreplaceable loss of resources	**None**	
Degree to which impact can be avoided	**High:**	
Degree to which impact can be mitigated	**High:**	
Cumulative Impacts		
Nature of cumulative impacts	Insignificant contribution to global GHG concentrations.	
Extent to which a cumulative impact may arise	**Unlikely**	

Issue: Accidental escape or release of GHG emissions		
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	**Insignificant**
Residual impacts	**None**	

Mitigation measures: Mitigation measures include:

- No additional mitigation measures other than the application of general international industry practice (such as the use of standards or guidelines produced by the American Petroleum Institute, International Finance Corporation, International Association of Oil and Gas Producers etc).

Monitoring: Monitoring will include:

- No additional monitoring requirements.

7.1.3 Soils and Land Capability - Physical impact on soils (increased erosion / compaction)

Description: The exposure of soils through vegetation clearance and/or physical disturbance of exposed soils may increase the risk of erosion (by wind and water), while the repetitive movement of vehicles and machinery over such surfaces could compact soils. These impacts may collectively affect the surface hydrology, damage soil structure, reduce aeration, soil permeability, infiltration rates and water retention capacity, and retard the regeneration of vegetation. Reduced infiltration could also result in an increase in surface runoff, potentially causing increased sheet, rill, and gully erosion.

Issue: Risk to soil through increased erosion/compaction		
Phases: All Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Low
Duration	Short Term	Short Term
Extent	Whole Site	Site
Consequence	Low	Very Low
Probability	Conceivable	Unlikely
Significance	**Very Low**	**Insignificant**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Fully reversible**	
Degree to which impact may cause irreplaceable loss of resources	**None**	
Degree to which impact can be avoided	**High**	

Issue: Risk to soil through increased erosion/compaction		
Degree to which impact can be mitigated	**High**	
Cumulative Impacts		
Nature of cumulative impacts	The extent that the addition of this project will have on the overall soil and land capabilities.	
Extent to which a cumulative impact may arise	**Fully reversible**	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	**Insignificant**
Residual impacts	**None**	

Mitigation measures include:

- The placement of soil stockpiles will be identified prior to commencement of construction to minimise soil erosion.
- Site clearing should, where possible, be undertaken in the dry season to minimise the chance of erosion due to run-off.
- Land clearance will only be undertaken just prior to drilling of a particular activity and unnecessary land clearance must be avoided. Work areas will be clearly defined to avoid disturbance outside of the footprint.
- Vehicles to remain on designated prepared roads.
- Design site drainage and stormwater runoff to minimise risk of erosion.
- Hazardous substances stored on site should be contained in compatible, appropriately-labelled containers to prevent reaction with containers and spillage during handling.
- The relevant MSDS documents should be clearly displayed in the hazardous substance storage area.
- Relevant training should be provided to all employees/contractors on the correct storage and handling procedures and records of this training kept on site.
- All excess concrete and rubble shall be removed from site on completion of concrete works and disposed of appropriately.

Monitoring: Monitoring will include:

- Daily site inspections by the designated environmental/Safety, Health, Environmental and Quality Officer
- Monthly inspections by external Environmental Control Officer.

7.1.4 Soils and Land Capability – Soil contamination

Exploration drilling requires the use of vehicles and equipment driven by engines using hydrocarbons. Some of the equipment has hydraulic systems with lubricants. Certain hazardous chemicals may also be used and stored on site. Each of these systems can leak and spillages can occur from containers and during refuelling. Such materials would contaminate the soils. The overall volumes of the high risk materials on site during drilling is relatively low with no bulk containers (such materials are generally in 210L drums or smaller).

Issue: Soil contamination		
Phases: All Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Medium	Low
Duration	Short Term	Short Term
Extent	Whole Site	Site
Consequence	Low	Very Low
Probability	Conceivable	Unlikely
Significance	**Very Low**	**Insignificant**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Fully reversible**	
Degree to which impact may cause irreplaceable loss of resources	**None**	
Degree to which impact can be avoided	**High**	
Degree to which impact can be mitigated	**High**	
Cumulative Impacts		
Nature of cumulative impacts	The proposed exploration well drilling occurs within an agricultural landscape within which the use of similar equipment is common (i.e. use of tractors, harvesters, trucks).	
Extent to which a cumulative impact may arise	**Fully reversible**	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	**Insignificant**
Residual impacts	**None**	

Mitigation measures include:

- Hazardous substances stored on site should be contained in compatible, appropriately-labelled containers to prevent reaction with containers and spillage during handling.
- The relevant MSDS documents should be clearly displayed in the hazardous substance storage area.
- Relevant training should be provided to all employees/contractors on the correct storage and handling procedures and records of this training kept on site.

Monitoring: Monitoring will include:

- Daily site inspections by the designated environmental/Safety, Health, Environmental and Quality Officer
- Monthly inspections by external Environmental Control Officer.

7.2 IMPACTS ON BIOLOGICAL/BIODIVERSITY ASPECTS

Potential risks to the biological/biodiversity aspects include (Table 7-2):

Table 7-2: Risks to biological environmental aspects

Type of Impact	Impact Description	Pre-Mitigation Significance	Post-Mitigation Significance
Loss of fauna	Loss of or disturbance to vegetation and faunal habitats	Insignificant	Insignificant
Decrease or adverse changes in terrestrial biodiversity	Populations of species of conservation concern, disturbance to and mortality of fauna	Insignificant	Insignificant
Decrease in plant diversity	Establishment of alien and invasive species in disturbed areas	Insignificant	Insignificant
	Changes in vegetation structure and plant species composition	Insignificant	Insignificant
Loss of terrestrial ecosystem function	Overall Species and Ecosystem Diversity	Insignificant	Insignificant
	Ecological processes and ecosystem functionality	Insignificant	Insignificant
	Ecological connectivity	Insignificant	Insignificant
	Targets for threatened ecosystem are compromised	Insignificant	Insignificant
Impacts on aquatic ecosystems	Direct physical loss or modification of freshwater habitat	Insignificant	Insignificant
	Alteration of hydrological and geomorphological processes	**Very Low**	**Very Low**
	Impacts to water quality	Insignificant	Insignificant
	Ecological connectivity and / or ecological disturbance	**Very Low**	**Very Low**

7.2.1 Aquatic ecology - Alteration of hydrological and geomorphological processes

Description: Most of the wetlands in the study area are depressions. Whilst the small depression wetlands in the study area are unlikely to be associated with significant groundwater interactions , the large depression wetlands are expected to be hydrologically linked to groundwater resources. The proposed exploration wells will be drilled to a depth of approximately 1 000 m. The wells will therefore penetrate shallow and deep aquifers. Whilst the sealed and capped wells will be in place permanently, the localised nature of the interruption of groundwater processes by the drill hole means that the expected intensity of impacts to surface water wetlands because of the interruption is negligible. Should water-based mud be used as a drilling fluid, this will be contained within a series of waste skips within the vicinity of the drill site. The distance of each drill site from the study area wetlands means that it is unlikely that expelled fluid will impact upon watercourse hydrological regimes. Rather, discharged liquid is likely to infiltrate into the soil profile and move downslope away from the selected sites in a diffuse manner. Overall, the operation phase impact significance rating is 'Very Low'.

Issue: Alteration of Hydrological and Geomorphological Processes		
Phases: Establishment and drilling		
Criteria	Without Mitigation	With Mitigation
Intensity	Negligible	Negligible
Duration	Permanent	Permanent
Extent	Site	Site
Consequence	Low	Low
Probability	Conceivable	Conceivable
Significance	**Very Low**	**Very Low -**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Irreversible**.	
Degree to which impact may cause irreplaceable loss of resources	**None.**	
Degree to which impact can be avoided	**None.**	
Degree to which impact can be mitigated	**None.**	
Cumulative Impacts		
Nature of cumulative impacts	The study area is associated with existing mine prospecting cores from old coal and gold mine exploration missions. These cores would have penetrated groundwater resources causing potential impacts to surface water resources. Wetlands in the areas have also generally experienced notable catchment land use alterations due to the dominance of broad acre cropping in the study area.	

	Cropping therefore exists as an impact to watercourse hydrological and geomorphological processes. The drilling of the wells is however unlikely to cause any notable alterations to watercourse hydrological and geomorphological processes and there is not considered as a contributor to cumulative impacts of this nature.	
Extent to which a cumulative impact may arise	Unlikely.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	Insignificant
Residual impacts	**None**	

Mitigation measures include:
Refer to Section 7.3.6 for recommended mitigation measures

Monitoring will include:
Refer to Section 7.3.6 for recommended monitoring measures

7.2.2 Ecological connectivity and / or ecological disturbance

Description: During the drilling phase the presence of workers and vehicles in the general vicinity of onsite watercourses could create noise, vibrations and dust which have the potential to temporarily disturb and displace fauna that make use of watercourses for refuge. Additionally, the actual operation of the drill rig will be associated with significance temporary noise and vibrations. Faunal species that could be disturbed in nearby watercourses are likely to include amphibians, reptiles, birds, and small mammals. The presence and operation of the drill sites is however temporary with any dispersed fauna likely to return to the vicinity of the drill sites once well testing and logging is complete, and the drill contractor has moved off site. It is likely that areas where equipment and mobile infrastructure have been stored at the drill sites will be colonised by pioneer vegetation species including some invasive aliens. These can however easily be cleared and controlled. The overall operation phase ecological connectivity / disturbance impact significance is therefore very low.

Issue: Ecological connectivity and / or ecological disturbances		
Phases: Drilling and test phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Negligible	Negligible
Duration	Very short term	Very short term
Extent	Site	Site
Consequence	Very low	Very low
Probability	Possible	Possible
Significance	**Very Low**	**Very Low -**
Additional Assessment Criteria		

Degree to which impact can be reversed	**Full reversable.**	
Degree to which impact may cause irreplaceable loss of resources	**None.**	
Degree to which impact can be avoided	**Low**.	
Degree to which impact can be mitigated	**None.**	
Cumulative Impacts		
Nature of cumulative impacts	The establishment of the drill sites is unlikely to be associated with permanent ecological disturbances. This project is therefore not associated with the cumulative impacts of this nature.	
Extent to which a cumulative impact may arise	Unlikely.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	Insignificant
Residual impacts	**None**	

Mitigation measures include:

- Prohibit poaching or collection of plants and biota during the operational (drilling phase).
- Rehabilitate any erosion or vegetation clearing impacts as soon as practically possible.
- Temporary noise pollution should be minimized where possible.

Monitoring will include:

- Daily site inspections by the designated environmental/Safety, Health, Environmental and Quality Officer
- Monthly inspections by external Environmental Control Officer.

7.3 IMPACTS ON SOCIAL AND SOCIO-ECONOMIC ASPECTS

Potential risks to the social and socio-economic environmental aspects include (Table 7-3):

Table 7-3: Risks to social and socio-economic environmental aspects

Type of Impact	Impact Description	Pre-Mitigation Significance	Post-Mitigation Significance
Heritage (Cultural	Destruction or damage to previously unidentified archaeological resources and historical resources.	**Low -**	**Very Low** -

Type of Impact	Impact Description	Pre-Mitigation Significance	Post-Mitigation Significance
Heritage and Palaeontological Impacts)	Destruction of fossils that might be present in the drill site and laydown area.	**Low**	Insignificant
Social	Risk to land use	Insignificant	Insignificant
	Risk to public safety	Insignificant	Insignificant
	Farm safety and security	Insignificant	Insignificant
	Risk of veld fires	Insignificant	Insignificant
	Impacts on air quality because of dust	Insignificant	Insignificant
	Noise impacting residences more than 200 m from drill sites	Insignificant	Insignificant
Socio-economic	Disruption of agricultural practices	**Very Low**	Insignificant
	Employment	Insignificant	Insignificant
Groundwater	Groundwater contamination	**Low**	**Low**
	Reduction in groundwater availability	**Low**	**Low**
Surface water	Surface water contamination (spillages, chemical spills)	**Low**	**Low**
	Increased sediments loads affecting water quality	**Low**	**Low**

7.3.1 Heritage - Archaeological, cultural, and historical impacts

Description: Many farms and communities in rural areas have graveyards located near to the dwellings. There are also many buildings, infrastructure and sites of cultural or heritage importance across the Province. During mobilization and drilling operations, there is a chance of uncovering cultural artifacts that could be salvaged. Even though the construction of infrastructure and facilities around the site can cause

significant disruption, the boreholes can serve as a glimpse into the past, and it may be feasible to recover some of the data and materials.

Issue: Destruction or damage to previously unidentified archaeological resources and historical resources.		
Phases: All Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Very Low
Duration	Permanent	Permanent
Extent	Local	Site
Consequence	Medium	Low
Probability	Conceivable	Improbable
Significance	**Low -**	**Very Low -**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Low.**	
Degree to which impact may cause irreplaceable loss of resources	**Low**	
Degree to which impact can be avoided	**High.**	
Degree to which impact can be mitigated	**High.**	
Cumulative Impacts		
Nature of cumulative impacts	The extent that the addition of this project will have on the overall impact of developments in the region on heritage resources.	
Extent to which a cumulative impact may arise	Unlikely. However, until a regional detailed study is commissioned by SAHRA. No further mitigations measures can be proposed other than those already recommended for the site-specific mitigation of sites in this report.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	**Insignificant**
Residual impacts	Due to the nature of heritage resources, subsurface artefact deposits are possible and can be exposed during construction activities. However, with the implementation of the approved mitigation measures as confirmed by SAHRA such finds can be successfully mitigated.	

Mitigation measures include:

- While the exploration drill sites are located more than 100 m away from any cultural heritage resource (burial ground, structures, farm equipment, boundary markers), there remains a residual " Very Low" risk that resources may be unearthed during exploration. A chance find protocol is to be included in the EMPr for guidance should an artefact be discovered.

Monitoring will include:

- Inspection of the site's pre-establishment by the contractors SHEQ manager.

7.3.2 Heritage - Palaeontological Impacts

Description: Destruction of fossils that might be present in the drill site and laydown area.

Issue: Destruction of fossils that might be present in the drill site and laydown area.		
Phases: All Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	High	Low
Duration	Permanent	Permanent
Extent	Site	Site
Consequence	Medium	Low
Probability	Conceivable	Unlikely
Significance	**Low**	**Insignificant**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Irreversible.**	
Degree to which impact may cause irreplaceable loss of resources	Fossils are irreplaceable. However, the implementation of a Chance Finds Protocol will enable the monitoring and where required documentation of such resources.	
Degree to which impact can be avoided	**High**	
Degree to which impact can be mitigated	**High**	
Cumulative Impacts		
Nature of cumulative impacts	General loss of fossils and scientific knowledge to national palaeontological record.	
Extent to which a cumulative impact may arise	Negligible as each site is unique	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	**Insignificant**

Issue: Destruction of fossils that might be present in the drill site and laydown area.	
Residual impacts	**None**, with mitigation (removal of any fossils) the impact will be insignificant

Mitigation measures include:

- Implementation of a fossil chance find protocol which is included in the EMPr.
- If fossils are found by the contractor, environmental officer or other responsible person once drilling has commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample.

Monitoring will include:

- While logging, the geologist should search for fossil plants remains in the shales and attempt to photograph and recover them, although it is unlikely that any complete fossils will be retrieved given the 135 mm diameter of the core.
- The fossil heritage within the development footprint could be affected by surface activities due to the nature of the project. However, the geological structures indicate that the rocks are unsuitable (transported sands) for containing fossils. While there is a minute possibility that fossils from covered or obscured palaeo-pans or palaeo-springs underneath the quaternary sands may be present and disturbed, a Fossil Chance Find Protocol has been included in the EMPr.

7.3.3 Socio-economic – Disruption of agricultural practices

Description: Most of the proposed sites identified are located within agricultural landscapes (either crop production or dryland grazing). While the identification of drill sites typically targets the margins/outer edges of these areas so as to limit intrusion into productive lands, there is a potential for conflicting land uses to arise resulting in a nominal impact on production and, by extension, income generation.

The growing season for maize in the Free State extends for a period of approximately 7 – 9 months (from Oct/Nov until June/July), which in terms of Rhino planning only affords a period of 3 – 5 months to complete the exploration process (including rehabilitation). As a result, it is probable that an impact will result.

Despite the high probability of an impact resulting, the extent of any impact is limited and would only impact on a single growing season.

Issue: Disruption of agricultural practices		
Phases: All Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Very Low	n/a
Duration	Very short term	n/a
Extent	Site	n/a
Consequence	Very Low	n/a
Probability	Probable	n/a

Issue: Disruption of agricultural practices		
Significance	**Low**	**Insignificant**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Fully reversible.**	
Degree to which impact may cause irreplaceable loss of resources	**Low.**	
Degree to which impact can be avoided	**High**.	
Degree to which impact can be mitigated	**High.**	
Cumulative Impacts		
Nature of cumulative impacts	Cumulative impact may arise from several drilling rigs operating near one another.	
Extent to which a cumulative impact may arise	Operation of multiple drilling rigs increases the potential for an impact of Low significance occurring.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Low	**Low**
Residual impacts	**None**	

Mitigation measures include:

- The location, size and timing of any exploration drilling should be done to minimise disturbances to the current productivity of any area.
- Any siting of a drill site for exploration will have to be through an access agreement negotiated between the exploration right holder and the land owner/occupier. The land owner will thus have a direct say in where the exploration drill site is placed or not placed.
- Where interference with agricultural production cannot be avoided then compensation will have to be paid based on the current agricultural rates as agreed with the land owner/operator.
- All drill sites must be rehabilitated to ensure that there are no long-term effects on productivity.

Monitoring will include:

- Auditing compliance with EMPr which includes confirming written agreement between Rhino and the relevant landowner.

7.3.4 Social - Farm safety and security

Access without permission, poaching and security concerns (of stock theft and personal safety) are very real problems on farms in South Africa. The access created by exploration drilling and the many people coming and going from the site could provide opportunity and cover for criminals. The impact if a security occurred in such circumstances would be of high significance.

Concerns regarding site access, trespassing and farm security as a result of the drilling teams being on private land will be alleviated by developing relationships with individual farm owners.

Issue: Farm safety and security		
Phases: All Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Low	Very low
Duration	Very short term	Very short term
Extent	Beyond the site	Beyond the site
Consequence	Medium	Medium
Probability	Conceivable	Unlikely
Significance	**Low**	**Insignificant**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Fully reversible.**	
Degree to which impact may cause irreplaceable loss of resources	**Low.**	
Degree to which impact can be avoided	**High**.	
Degree to which impact can be mitigated	**High.**	
Cumulative Impacts		
Nature of cumulative impacts	Unfortunately, crime remains inherently part of South Africa.	
Extent to which a cumulative impact may arise	It is unlikely that contractor operations on the various farms will result in additional activities.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Low	**Insignificant**
Residual impacts	**None**	

Mitigation measures include:

- All access to land for exploration activities will have to be through an access agreement negotiated between the exploration right holder and the land owner/occupier.
- As discussed with various landowners, it is recommended that police clearance certificate be obtained for all contractor personnel
- It is recommended that all exploration personnel carry identification cards which can be produced on request.

- Exploration personnel must report unknown persons on the property to the land owner.
- Where appropriate the access points to a farm must be fitted with locks and these gates must be kept in the status as agreed with the land owner.
- Exploration personnel must contribute positively to security on the farm by informing the land owner of their activity schedules and reporting any suspicious activity to the land owner.
-

Monitoring will include:

- Auditing compliance with EMPr which includes confirming written agreement between Rhino and the relevant landowner.
- Auditing of the employment register against a register of police clearance certificates.

7.3.5 Groundwater - Contamination

Description: Most agricultural activities in the region use groundwater and may be partly or wholly dependent of groundwater. Many rural houses obtain potable water from groundwater. Most farmers abstract groundwater from multiple, relatively shallow boreholes across their properties. Groundwater can therefore be viewed as a critical resource. Any changes to the quality of water in near-surface aquifers may affect adjacent users who rely on groundwater for domestic and agricultural use.

In most areas it is expected that there is a near-surface aquifer which is the resource used by farmers and a deeper aquifer that is associated with the target geology. These two aquifers are understood to be separated by hundreds of metres of rock strata, which are anticipated to be largely impermeable with very low hydraulic conductivity between the aquifers. The deeper aquifers are seldom used and are mostly confined by low permeability dolerites or other aquacludes.

Impacts to groundwater could potentially result through the process of drilling the proposed exploration wells, contamination from decant from deeper aquifers or from incidental risks such as hazardous substance spills (leaks from standing plant, poor vehicle and machinery maintenance practices, sanitation facility leaks, spills during refuelling) and major events (See Sections 5.5 and 5.8.1).

During the drilling process, drilling fluids such as compressed air or muds are pumped down the inside of the drill pipe and exit at the drill bit to optimise drilling operations. The drilling fluids will mix with ground water encountered down the hole until such time as the hole is grouted. The upper aquifers will be exposed to the drilling fluids for the shortest periods as the hole is cased and grouted early in the drilling process. The assessment concludes that the drilling fluids are not very likely to have a significant effect on groundwater quality because:

- The drilling additives used are largely non-hazardous and/or are bio-degradable;
- The drilling additives are diluted in the drilling water;
- Fluids are designed to not move far from the drilling hole unless very poor formations or large cracks are encountered;
- A ‘mudcake’ of drill cuttings seals most of the drilled formations even during drilling;
- Drilling fluids are only used for a short period while the hole is being drilled; and
- The total volume of drilling fluids is very small in comparison with any aquifer volume.

The drilling of the exploration wells creates a conduit that potentially connects the shallower strata nearer the surface to the deeper strata. Small quantities of groundwater in different aquifers may flow via this conduit from one aquifer to another, potentially affecting the quality of water in these aquifers.

The upper section of the exploration wells includes a casing and grouting which will restrict interaction between these aquifers (See Figure 5-3 to Figure 5-5). A contamination plume model was developed part of JG Afrika's geohydrological impact assessment (Appendix J). based on the modelled results, JG Afrika concluded:

- The shallow groundwater conditions (<200 m depth) were considered most relevant for development of model scenarios as these aquifers are the source of many water supply boreholes in the project area and present the greatest risk. Deeper aquifers, as per those being targeted by the Rhino exploration programme, are lower risk and modelled plumes will have less lateral extent.
- The plume movement over 100 years does not extend far (Max 670 m). This is based on estimated aquifer parameters and not field verified aquifer test data
- In areas where a wetland or pan is in close proximity to the proposed site, the plume moves in the direction of the wetland or pan, as this is modelled as a groundwater discharge zone.

An example of a plume model results is provided as Figure 7-1 for further details see Appendix J

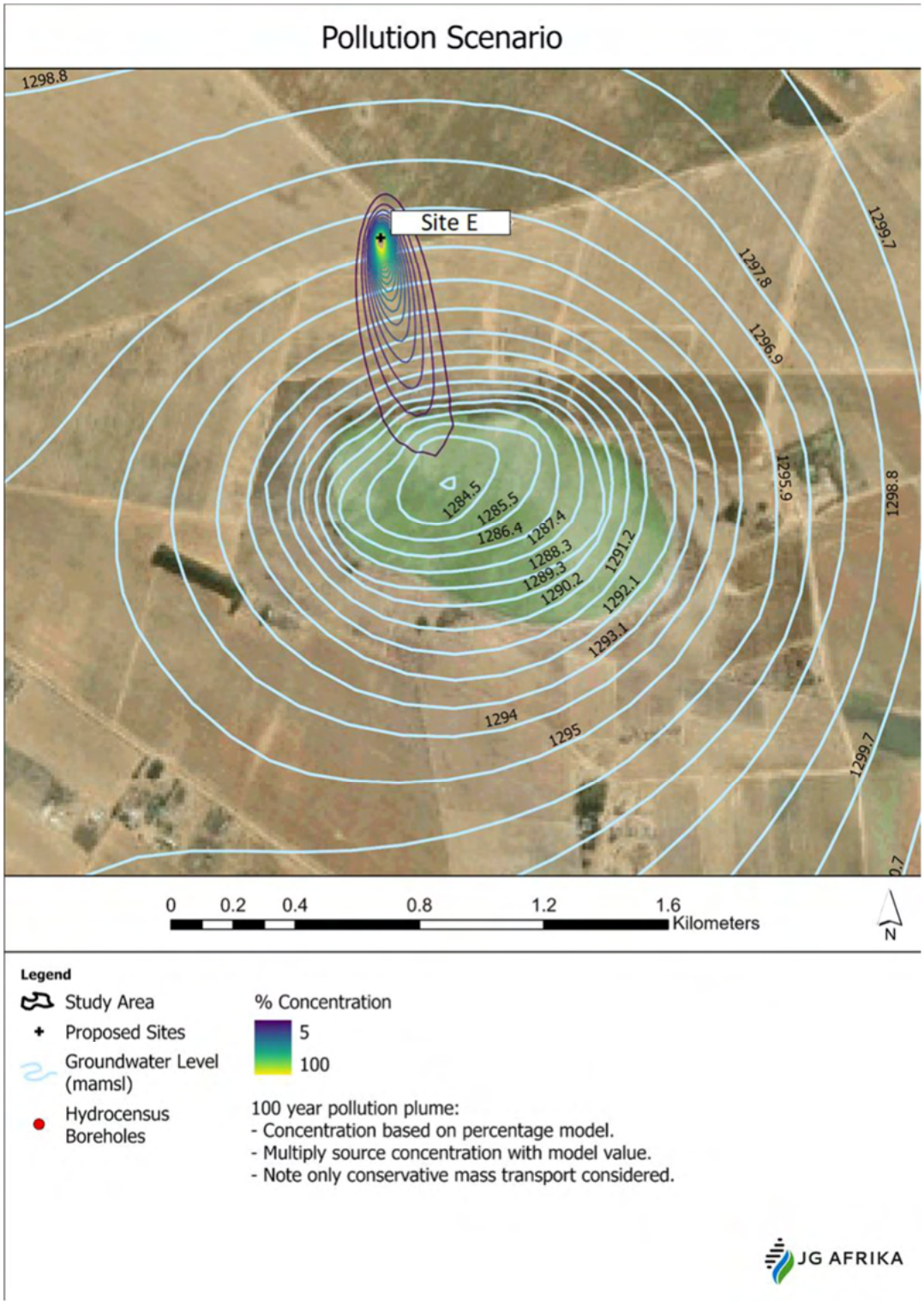

Figure 7-1: Modelled contamination plume
(JG Afrika, 2023)

Issue: Groundwater contamination		
Phases: All Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate	Low
Duration	Short term	Short term
Extent	Beyond site	Site
Consequence	Low	Low
Probability	Probable	Possible
Significance	**Low**	**Low**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Medium**.	
Degree to which impact may cause irreplaceable loss of resources	**Low.**	
Degree to which impact can be avoided	**High..**	
Degree to which impact can be mitigated	**High.**	
Cumulative Impacts		
Nature of cumulative impacts	Existing land practises and uses (agriculture) can result in contamination from incidental spillage as well as contamination from inappropriate use of agricultural chemicals. Cumulative impact may arise from several drilling rigs operating near one another.	
Extent to which a cumulative impact may arise	Operation of multiple drilling rigs increases the potential for an impact of Low significance occurring.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Low	**Low**
Residual impacts	**Low.** While best practise in terms of handling and storage of potential contaminants and well design may be utilised, there remains a residual risk of an emergency situation or incident which may occur.	

Mitigation measures include:

- Sanitation facilities are to be installed more than 100 m from any wetland, stream or water borehole;
- Sanitation facilities are to be sufficiently secured being blown over by wind or knocked over;

- Sanitation facilities are to be serviced regularly and safe disposal certificates obtained and retained on file;
- All vehicles, machinery and equipment is to be maintained in correct operating conditions as per the manufacturers specification;
- No washing of vehicles machinery or equipment is permitted within the drill sites;
- No spillage of hydrocarbons (petroleum, diesel, hydraulic fluids or oils) or chemicals is permitted. Drip trays are to be utilised under vehicles or earth moving equipment when not in use.
- Storage and use of chemicals and hydrocarbons may only take place on impermeable surfaces with bunds to contain any accidental spills.
- All spills, including contaminated soils, are to be recovered immediately and managed as hazardous waste.
- A designated representative is to be trained in the use of an emergency spill kit. Emergency spill kits are to be provided at all drill sites;
- Designated waste receptacles for general waste and hazardous waste are to be provided. Receptacles are to stored under a roof or lids provided to prevent windblown litter and rain water entering;
- Sufficient waste storage capacity is to be maintained at all times.
- Safe disposal certificates are to be recorded confirming the appropriate disposal of all hazardous and general wastes;
- Collection, transportation and disposal of all hazardous waste is to be done so by an appropriately licensed waste service provider.
- As outlined in the Project Description, the wells are to be appropriately cased and grouted. The integrity of the case and grouting to be verified.
- The specific types of drilling additives used must be recorded and Safety Datasheets (SDS) must be available for all drilling chemicals.
- The Contractor must use the minimum volume of drilling additives required and must record the daily use of drilling additives and drilling water.
- Where no existing water boreholes are present within 500 m downstream of a drill site, it is necessary for Rhino to install a groundwater monitoring well.

Monitoring will include:

- The site is to be inspected on a daily basis by the contractors designated representative/SHEQ manager;
- All sites are to be inspected and audited by an Environmental Control Officer.
- The quality and static water level of groundwater in active water boreholes within 500 m of any exploration drill site must be monitored- this includes drilling new exploration holes for monitoring. The monitoring should take place prior to exploration, during exploration and for at least one quarter after demobilisation. If a significant decline in water quality or quantity is detected then further work must be undertaken to determine the cause and remedial measures must be implemented.

7.3.6 Groundwater – Reduction in groundwater resource availability

Description: Most agricultural activities in the region use groundwater and may be partly or wholly dependent of groundwater. Many rural houses obtain potable water from groundwater. Most farmers

abstract groundwater from multiple, relatively shallow boreholes across their properties. Groundwater can therefore be viewed as a critical resource. Any changes to the quality or quantity of water in near-surface aquifers may affect adjacent users who rely on groundwater for domestic and agricultural use.

In most areas it is expected that there is a near-surface aquifer which is the resource used by farmers and a deeper aquifer that is associated with the target geology. These two aquifers are understood to be separated by hundreds of metres of rock strata, which are anticipated to be largely impermeable with very low hydraulic conductivity between the aquifers. The deeper aquifers are seldom used and are mostly confined by low permeability dolerites or other aquacludes.

The exploration wells are to be cased and grouted (see Figure 5-3 to Figure 5-5) so as to prevent the ingress of water from the near-surface aquifer. The relatively short exploration duration (~3 months) and anticipated low volume of any produced water further limits impacts to groundwater. The volume of water to be produced during well testing (if any) would be too little to have any material effect on the availability of groundwater in the near-surface aquifer. As indicated in the prior discussion on groundwater quality there are unlikely to be changes in groundwater quality that would prevent its use. In addition, the siting of wells away from active boreholes will ensure that there are relatively few users of groundwater in close proximity to the wells and so the risks are “Low”.

Issue: Reduction in groundwater resource availability		
Phases: All Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate	Low
Duration	Short term	Short term
Extent	Beyond site	Site
Consequence	Low	Low
Probability	Probable	Possible
Significance	**Low**	**Low**
Additional Assessment Criteria		
Degree to which impact can be reversed	**High.**	
Degree to which impact may cause irreplaceable loss of resources	**Low.**	
Degree to which impact can be avoided	**High**.	
Degree to which impact can be mitigated	**High.**	
Cumulative Impacts		

Issue: Reduction in groundwater resource availability		
Nature of cumulative impacts	While the Department of Water and Sanitation maintain a database of registered groundwater users, there is a remains a potential for unregistered water boreholes to be in operation.	
Extent to which a cumulative impact may arise	These operation of unregistered and registered water boreholes in combination with the short duration of the proposed exploration well is likely to result in a low risk, if any.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Low	**Low**
Residual impacts	**None**, correct installation of the casing and grouting during testing and safe closure will prohibit any reduction in available groundwater resources.	

Mitigation measures include:

- The exploration wells must not be located within 200 m of any farmers' active water production boreholes.
- The upper portion of the wells must be cased and grouted as per the project description.
- The production of water during well testing must be limited to the smallest volume necessary to produce the required test results.

Monitoring will include:

- The static water level of groundwater in active water boreholes within 500 m of any exploration drill site must be monitored- this includes drilling new groundwater boreholes for monitoring of exploration. The monitoring should take place prior to exploration, during exploration and for at least one quarter after demobilisation. If a significant decline in water quality or quantity is detected then further work must be undertaken to determine the cause and remedial measures must be implemented.

7.3.7 Surface water - Contamination (spillages, chemical spills)

Description: Exploration drilling requires the use of vehicles and equipment driven by engines using hydrocarbons. Some of the equipment has hydraulic systems with lubricants. Certain hazardous chemicals may also be used and stored on site. Each of these systems can leak and spillages can occur from containers and during refuelling.

Drilling fluids in skips may contain sediments, additives and hydrocarbons at concentrations not suitable for release to the environment. Produced water arising during well testing may be saline or contain contaminants at concentrations not suitable for release to the environment. Personnel operating at a drill site will generate limited volumes of sewage. If quantities of any of these are released then water contamination may occur.

The overall volumes of the high-risk materials on site during drilling is relatively low with no bulk containers (such materials are generally in 210 L drums or smaller). The potential contaminants on site for/from

exploration well drilling are to be contained in suitable containers, many on secondary bunding, and thus the risks to surface water resources are likely to be low. The relatively short duration of exploration (~3 months) and the siting of wells away from watercourses will ensure that the risks are low. Furthermore the operations procedures will include spill response and clean-up that would aim to contain any spillages before they could reach a surface water resource.

Issue: Reduction in groundwater resource availability		
Phases: All Phases		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate	Low
Duration	Short term	Short term
Extent	Beyond site	Site
Consequence	Low	Low
Probability	Probable	Possible
Significance	**Low**	**Low**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Medium.**	
Degree to which impact may cause irreplaceable loss of resources	**Low.**	
Degree to which impact can be avoided	**High.**	
Degree to which impact can be mitigated	**High.**	
Cumulative Impacts		
Nature of cumulative impacts	Existing land practises and uses (agriculture) can result in contamination from incidental spillage as well as contamination from inappropriate use of agricultural chemicals. Cumulative impact may arise from several drilling rigs operating near one another.	
Extent to which a cumulative impact may arise	Operation of multiple drilling rigs increases the potential for an impact of Low significance occurring.	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Low	**Low**
Residual impacts	**Low.** While best practise in terms of handling and storage of potential contaminants may be utilised, there remains a residual risk of an emergency situation or incident which may occur.	

Mitigation measures include:

- All drill sites must be located at least 100 m from a watercourse thus lowering the exposure risk.
- Contamination of surface water by hydrocarbon or chemical products should be prevented.
- Oils, greases and drilling fluids (or water contaminated with any of these) may not be released into the environment.
- Storage and use of chemicals hydrocarbons may only take place on impermeable surfaces with bunds to contain any accidental spills.
- Drip trays and or impermeable surfaces with bunds must be placed under machinery that could leak.
- All drilling fluids must be contained in skip receptacles. The sumps should operate at a level to prevent overflows and be bunded to prevent inflow of clean surface water.
- Mobile chemical toilets must be supplied unless access to a built-facility can be negotiated. The chemical toilet must be located more than 100 m from a watercourse. All toilets must be serviced by a reputable service provider and records of safe disposal provided.
- An Emergency Spill Procedure must be developed and the necessary equipment available to implement a response. Any spillages must be recorded as environmental incidents. Spillages should be cleaned up and the affected area remediated with a suitable product.
- Any wastes, spent clean up equipment, or remaining contaminated materials must be disposed as hazardous wastes.

Monitoring will include:

On-going monitoring of surface water resources downstream of drilling sites is required before, during and after drilling. The monitoring should take place prior to exploration, quarterly during exploration and for at least one quarter after the site is closed. If a significant decline in water quality is detected then further work must be undertaken to determine the cause and remedial measures.

7.4 NO-GO ALTERNATIVE IMPACTS

The “no-go” alternative is the non-occurrence of the proposed exploration activities. The potential positive implications of not going ahead with the proposed exploration are:

- No impacts resulting from the proposed intrusive exploration would occur within the exploration right area (refer to Sections 7.1 to 7.3) ; and
- No (reduced) chance of any risks arising from further exploration or future production.

The potential negative implications of foregoing the proposed exploration are as follows:

- South Africa would lose the opportunity to further establish the extent of indigenous oil or gas reserves in the Free State;
- Lost economic opportunities related to sunken costs (i.e. costs already incurred) of initial desktop investigations in the proposed exploration licence area;
- If economic oil and gas reserves do exist and are not developed, South Africa / Rhino would lose the opportunity to maximise the use of its own indigenous oil and gas reserves; and
- Other sources of energy would need to be identified and developed in order to meet the growing demand in South Africa.

As noted in the Need and Desirability section (see Section 4), there is a drive from national and provincial Government to stimulate development and grow the economy of South Africa. In order to facilitate this economic growth, there is a need to ensure that there is sufficient capacity in the country's power supply by diversifying the primary energy sources within South Africa. One of the proposals to meet this aim is to develop the oil and gas sector within the country.

No environmental or social fatal flaws have been identified as part of this S&EIA process. Where impacts have been identified, the significance of these has been limited (Insignificant to Low) and where necessary measures to mitigate, manage and monitor these impact can be undertaken.

7.5 CUMULATIVE IMPACTS

Cumulative impacts relates to the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with the activity when added to existing and reasonably foreseeable impacts from other activities.

Given that the assessed impacts of the Rhino's exploration are considered be of Insignificant to Low significance, there is a limited, if any, possibility of a cumulative impacts of any significance resulting.

The various oil and gas activities to be undertaken in terms of the separate applications for Exploration Rights that are currently approved or under consideration, could jointly result in cumulative impacts. Currently the majority of applications remain unapproved (see PASA's Hub Map showing all current applications - Figure 7-2), or are in the early stages of exploration.

With the exception of Renergen's Tetra 4 (Pty) Ltd Production Right 12/4/007, the majority of the applications that have been made to date are limited to early-phase exploration activities (aerial surveys, corehole drilling & seismic surveys etc). The nature, scale and duration of these activities, in the context of the large and widespread application areas, is such that a detectable cumulative impact is considered very unlikely. However, cumulative impacts could become significant in future if many of these applications proceed to include intrusive works such as well drilling, testing and then production

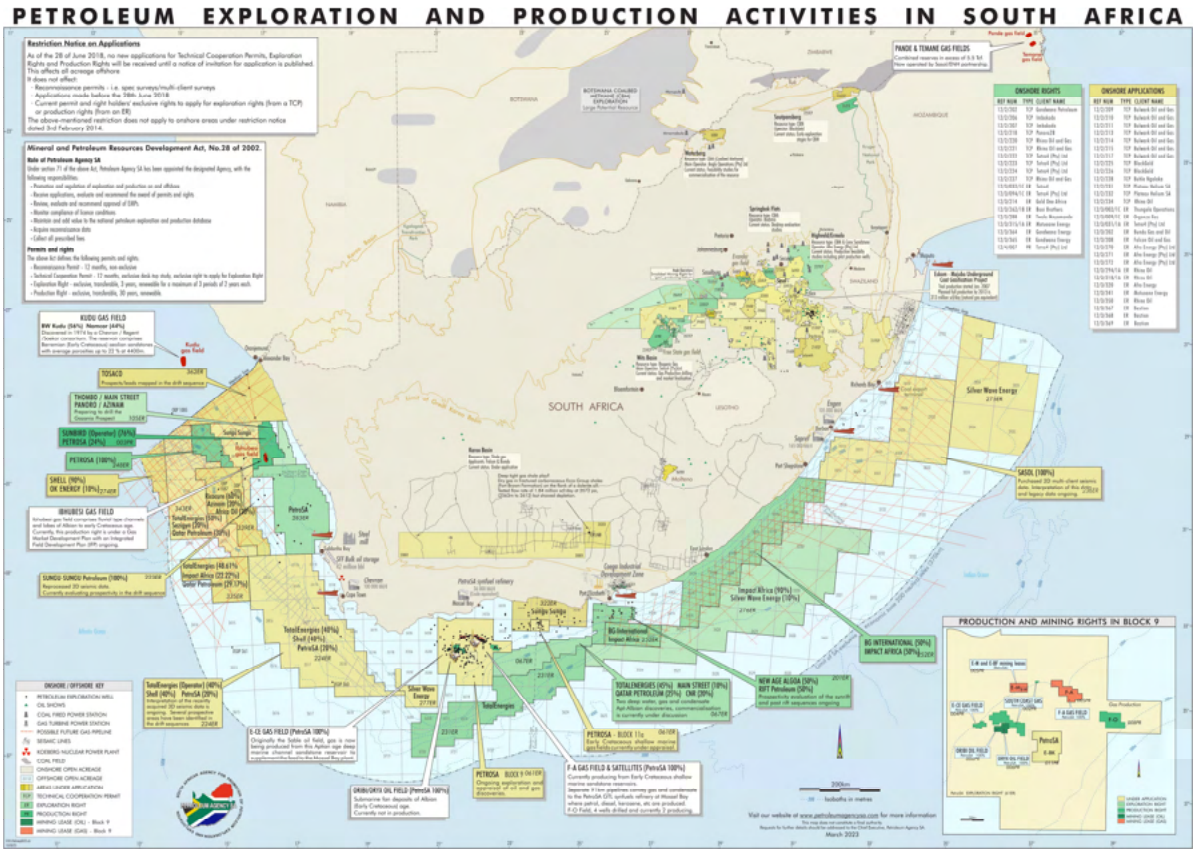

Figure 7-2: Petroleum Exploration and Production Activities in South Africa
Source: PASA, March 2023

I&APs continue to request that the impacts of potential further exploration and future production be assessed in EIAs for exploration, in order for them to have a full picture of the risk of the eventual project. Rhino maintains that it cannot yet, without conducting the early-phase exploration work, know what the future options entail. Without information on the scope, extent, duration and location of future activities it is not possible to undertake a reliable assessment of future impacts. To do so without this information would be speculative at best. Exploration and Production, while sequential in nature, are defined as distinct activities in the MPRDA. The MPRDA and NEMA both recognise the distinction and provide for a separation of application, assessment, and authorisation processes which applicants must follow when seeking permission to undertake either Exploration or Production activities. This application, and thus the S&EIA, is specifically limited to well drilling exploration activities

8. CONCLUSION AND RECOMMENDATIONS

This chapter concludes on the key impact assessment findings and makes a recommendation and conclusion regarding the issuing of an Environmental Authorisation for the proposed project.

8.1 ENVIRONMENTAL IMPACT STATEMENT

Rhino was initially granted an EA and ER for ER 318 in 2019, permitting the company to undertake non-intrusive exploration as part of their EWP. Following their review of available data and the successful acquisition and review of geophysical data, Rhino renewed their ER 318 and updated the EWP to include for the drilling of up to 40 exploration wells within three Target Areas.

Because the activity of drilling exploration wells was not included in Rhino's previous Application for EA in terms of Chapter 5 of NEMA, the risks and impacts associated were not previously assessed and, as a result it was necessary for Rhino to commence with the current S&EIA process.

8.1.1 Key Findings

The EIA process findings for the proposed exploration well drilling and testing are generally of very low significance impacts as the activities are few in number, extremely limited in extent, widely dispersed, of very short duration and of low intensity. The well drilling has been proposed using industry standard methods. The location for identified well sites were determined via a desktop screening to avoid mapped environmental and social sensitivities and the findings were confirmed via field visit by the EAP and specialists. Well locations are only proposed on the properties of consenting owners and access for drilling would be in terms of negotiated agreements. The process to site future 'unseen wells' would be subject to compliance with the EMPr which includes, amongst other, adhering to the environmental constraints used to locate the 'identified well' sites. There is therefore no environmental reason why the exploration activities should not be approved.

There remains somewhat of a contradiction between South Africa's plans and policies promoting the indigenous oil and gas sector versus those which identify the need to reduce the fossil fuel use in order for South Africa to reduce GHG emissions and meet commitments in this regard. Nevertheless, the currently adopted energy plan defines a need to include fossil fuels (notably natural gas) within the energy mix of the country. Thus, exploration for indigenous gas is supported by government.

There is some opposition from participating stakeholders to the proposed application and the undertaking of well drilling for exploration. The opposition is less against the merits of exploration activities as proposed, and more against the anticipated outcome and risks that could result from successful exploration and the subsequent production activities. The public perception is interpreted to be that issuing of an exploration right will lead to successful exploration; that would result in production which, would lead to widespread impacts on water and land causing devastation to local livelihoods. The stakeholder' approach is to 'close the door on exploration before it opens', thereby preventing any future risk, or potential benefit, from resulting.

8.1.2 Summary of Specialist Findings

To inform the S&EIA process, SLR commissioned five (5) specialist environmental assessments, namely

- A terrestrial ecological assessment;
- An aquatic (including wetlands) ecological assessment;
- A cultural heritage impact assessment;
- Palaeontological impact assessment; and
- Geohydrological impact assessment.

No project fatal flaws were identified through by any of the specialist assessments.

Where impacts were identified, these were assigned significances ranging from “Insignificant” to “Low”. No impacts of “Medium”, “High” or “Very High” were identified.

8.1.3 Summary of Impacts

The S&EIA process identified a total of 29 risks associated with the proposed exploration well drilling programme spread across the three environmental aspects (See Table 8-1).

Table 8-1: Summary of impacts identified

Type of Impact	Impact Description	Pre-Mitigation Significance	Post-Mitigation Significance
Impacts on physical aspects			
Geology	Risk to underground geological formations and mine workings	Insignificant	Insignificant
Climate change	Contribution of Project-related GHG Emissions to Climate Change	**Very Low**	**Very Low**
	Accidental Escape or Release of GHG Emissions	**Very Low**	**Very Low**
Soils and Land Capability	Risk to soil through increased erosion/compaction	**Very Low**	Insignificant
	Risk to soils through contamination	Insignificant	Insignificant
Impacts to biological/biodiversity aspects			
Loss of fauna	Loss of or disturbance to vegetation and faunal habitats	Insignificant	Insignificant
Decrease or adverse changes in terrestrial biodiversity	Populations of species of conservation concern, disturbance to and mortality of fauna	Insignificant	Insignificant
Decrease in plant diversity	Establishment of alien and invasive species in disturbed areas	Insignificant	Insignificant
	Changes in vegetation structure and plant species composition	Insignificant	Insignificant
Loss of terrestrial	Overall species and ecosystem diversity	Insignificant	Insignificant
	Ecological processes and ecosystem functionality	Insignificant	Insignificant

Type of Impact	Impact Description	Pre-Mitigation Significance	Post-Mitigation Significance
ecosystem function	Ecological connectivity	Insignificant	Insignificant
	Targets for threatened ecosystem are compromised	Insignificant	Insignificant
Impacts on aquatic ecosystems	Direct physical loss or modification of freshwater habitat	Insignificant	Insignificant
	Alteration of hydrological and geomorphological processes	**Very Low**	**Very Low**
	Impacts to water quality	Insignificant	Insignificant
	Ecological connectivity and / or ecological disturbance	**Very Low**	**Very Low**
Impacts on social and socio-economic aspects			
Heritage (Cultural Heritage and Palaeontological Impacts)	Destruction or damage to previously unidentified archaeological resources and historical resources.	**Low -**	**Very Low -**
	Destruction of fossils that might be present in the drill site and laydown area.	**Low**	Insignificant
Social	Risk to land use	Insignificant	Insignificant
	Risk to public safety	Insignificant	Insignificant
	Landowner security	Insignificant	Insignificant
	Risk of veld fires	Insignificant	Insignificant
	Impacts on air quality because of dust	Insignificant	Insignificant
	Noise impacting residences more than 200 m from drill sites	Insignificant	Insignificant
Groundwater	Groundwater contamination	**Low**	**Low**
	Reduction in groundwater availability	**Low**	**Low**
Surface water	Surface water contamination (spillages, chemical spills)	**Low**	**Low**
	Increased sediments loads affecting water quality	**Low**	**Low**

8.2 IMPACT MANAGEMENT OBJECTIVES AND OUTCOMES

The overall impact management objective for Rhino is to undertake exploration in a socially, environmentally and economically sustainable manner. The following are the key impact management objectives or outcomes:

- Design and Planning Phase
  - Locate wells on properties where the owner consents to access and on sites in areas of demonstrated low environmental and social sensitivity, preferentially with existing access and
  - Well planning and design to be by a qualified specialist in terms of applicable industry standards and regulation, with cognisance of the local context; and

- Consult with PASA and landowners.

- Exploration Phase
  - Drilling activities are to remain consistent with landowner agreements;
  - Minimise disturbance to the ecological environment;
  - Minimise disturbance on the biophysical environment including the protection of soils, surface water and groundwater during exploration operations;
  - Minimise disturbances to cultural and heritage sites;
  - Minimise disturbance to current land uses, landowners and neighbouring activities; and
  - Successful wells will be capped and the site reduced to manage the well head valve, the balance of the area will be reinstated and rehabilitated to a state equivalent to pre-disturbance levels and agreeable to the land owner.
  - Unsuccessful wells will be plugged and the site and surrounds reinstated and rehabilitated to a state equivalent to pre-disturbance levels and agreeable to the land owner.
  - Engage regularly with stakeholders to ensure transparent communication of relevant information and receipt of grievances
  - Gather environmental information relevant to monitor potential impacts and inform assessment and management of future activities.
- Decommissioning and rehabilitation
  - Successful wells will be capped and the site reduced to manage the well head valve, the balance of the area will be reinstated and rehabilitated to a state equivalent to pre-disturbance levels and agreeable to the land owner;
  - Unsuccessful wells will be plugged and the site and surrounds reinstated and rehabilitated to a state equivalent to pre-disturbance levels and agreeable to the land owner;
  - Decommissioning and rehabilitation activities are to remain consistent with landowner agreements;
  - Engage regularly with stakeholders to ensure transparent communication of relevant information and receipt of grievances; and
  - Gather environmental information relevant to monitor potential impacts and inform assessment and management of closure activities.

8.2.1 Rehabilitation and post closure

The primary closure objective is to ensure that exploration decisions and actions throughout operations, and specifically during closure, enable a condition approximating the pre-exploration condition or better to be achieved at any site impacted by an exploration activity.

8.2.1.1 Financial Provision

In terms of Section 24P of NEMA and associated regulations pertaining to the financial provision (GN. R1147), an applicant for Environmental Authorisation relating to exploration must, before the Minister of Mineral Resources and Energy issues the Environmental Authorisation, comply with the prescribed financial provision for the rehabilitation, closure and ongoing post decommissioning management of negative environmental impacts.

To meet these obligations, Rhino appointed specialist GCS Water and Environment (Pty) Ltd a final rehabilitation, decommissioning and closure plan. As part of the closure planning GCS calculated a financial which is provided below (Table 8-2 for detailed calculations per GCS, 2023).

Table 8-2: Calculation of the financial provision for closure and rehabilitation

Quantum Calculation for Financial Provision for Rehabilitation and Mine Closure							
Mine: Rhino Oil and Gas (Pty) Ltd				**Location:** Free State Province			
Evaluator: M van Rooyen from GCS (Pty) Ltd				**Date:** 10 April 2023			
No.	**Description**	**Unit**	**A: Quantity**	**B: Master Rate (rands)**	**C: Multiplication factor**	**D: Weighting factor 1 E=AxBxCxD**	**Amount (rands)**
			Step 4.5	**Step 4.3**	**Step 4.3**		
1	Down hole surveys for wells	/well/m	50.00	24 318.96	1.00	1.0	1 215 948.00
2	Un-block collapsed wells	well	5.00	158 641.00	1.00	1.0	793 205.00
3	Sealing of wells, capping and abandonment	No	5.00	120 000.00	1.00	1.0	600 000.00
4	General surface rehabilitation	ha	0.50	176 301.82	1.00	1.0	88 150.91
5	Establishing vegetation	ha	0.50	60 161.84	1.00	1.0	30 080.92
6	Closure phase monitoring	annually	2.00	18 202.00	1.00	1.0	36 404.00
7	Rehabilitation monitoring	annually	2.00	18 202.00	1.00	1.0	36 404.00
8	Rehabilitation care and maintenance	annually	2.00	24 500.00	1.00	1.0	49 000.00
	Subtotal 1						**2 849 192.83**
9	Preliminaries and general	**Ad 12% of Subtotal 1 if subtotal 1 < R 100 000 000.00**					341 903.14
10	Contingencies	**Ad 10% of Subtotal 1**					284 919.28
	Subtotal 2						**3 476 015.25**
11	Post closure monitoring - surface water	annually	2.00	37 202.00	1.00	1.0	74 404.00
12	Annual groundwater quality monitoring (post-closure)	bi-annually	4.00	60 202.00	1.00	1.0	240 808.00
13	Gas leakage monitoring	/5yr	2.00	113 270.32	1.00	1.0	226 540.64
14	Latent and residual risk provision (redrill and plugging of borehole)	sum	1.00	529 767.81	1.00	1.0	529 767.81
Subtotal 3 - Sum of Items 1 to 14							**4 547 535.70**
Multiply sum of 1 to 14 by Weighting Factor 2 (weighting factor 2 = 1.00)							**4 547 535.70**
VAT @15%							682 130.36
Grand Total (Subtotal 3 plus VAT)							**5 229 666.06**

8.3 FINAL PROJECT ALTERNATIVES

The preferred, final project alternative is the drilling and testing of up to 40 exploration wells within the proposed well drilling target areas. The fifteen 'identified wells' would be sited at the locations in the Table below. The balance of 25 'unseen wells' would be subject to compliance with the EMPr which includes, amongst other, adhering to the environmental constraints used to identify the initial 15 'identified well' sites.

Target Area	Site Name	Surveyor General Code
Target Area 1	Drill Site - 01	F00500000000010200000
	Drill Site – 02	F00500000000024100000
	Drill Site – 03	F04100000000025200000
	Drill Site – 04	F04100000000021300000
	Drill Site – 05	F04100000000015600000
	Drill Site – 06	F04100000000032800000
	Drill Site – 07	F04100000000022000000
	Drill Site – 08	F04100000000033300000
	Drill Site – 09	F04100000000008900000
	Drill Site – 10	F02400000000015400000
	Drill Site – 11	F04100000000021000000
	Drill Site – 12	F02400000000011500000
Target Area 2	Drill Site – 01	F02400000000045800000
	Drill Site – 02	F02400000000004600000
Target Area 3	Drill Site – 01	F02000000000074800000

8.4 RECOMMENDATIONS OF THE EAP

The key principles of sustainability, including ecological integrity, economic efficiency, and equity and social justice, are integrated below as part of the supporting rationale for recommending an opinion on whether the proposed project should be approved or not.

Ecological integrity

It is SLR's opinion that the proposed updated EWP which proposes the development and testing of up to 40 exploration wells would have limited (Insignificant to Low) impact on the ecology, biodiversity or conservation status of any habitat or species within the ER application area.

Economic efficiency

It is SLR's opinion that the proposed updated EWP (including the development and testing of up to 40 exploration wells) as proposed would have no direct impact on any aspect of the local economy within the ER application area.

Equity and social justice

It is SLR's opinion that the proposed updated EWP (including the development and testing of up to 40 exploration wells) as proposed would have no direct impact on any social aspect within the ER application area.

It is therefore the opinion of SLR, in terms of the sustainability criteria described above and the nature and extent of the proposed updated EWP, that the generally Low, Very Low and Insignificant assessment of impacts, with the implementation of the proposed mitigation measures, should support a positive decision being made by the Minister of Mineral Resources and Energy (or delegated authority) in this regard. Since the proposed exploration activities are associated with Rhino's updated EWP, the applicant requests that that Environmental Authorisation (should it be granted) be issued and remain valid for a period of 10-years or more which will afford Rhino to undertake the updated EWP during the current ER period as well as any future renewal periods as afforded by MPRDA.

APPENDIX A: EAP UNDERTAKING

APPENDIX B: CURRICULA VITAE (INCLUDING REGISTRATIONS) OF THE PROJECT TEAM

APPENDIX C: PUBLIC PARTICIPATION PROCESS DOCUMENTATION

Comments and Responses Report

APPENDIX D: PETROLEUM EXPLORATION WELL DRILLING APPLICATION AREA

Appendix 4.1:	Regulation 2(2) plan of the Well Drilling ER Application Area
Appendix 4.2:	List of properties within the Target Areas/Areas of Interest
Appendix 4.3:	Corner points of the Target Areas

APPENDIX E: WELL SITE LOCALITY PLAN

APPENDIX F: SPECIALIST AQUATIC ECOLOGICAL IMPACT ASSESSMENT

APPENDIX G: SPECIALIST TERRESTRIAL ECOLOGICAL IMPACT ASSESSMENT

APPENDIX H: SPECIALIST CULTURAL HERITAGE IMPACT ASSESSMENT

APPENDIX I: SPECIALIST PALAEONTOLOGICAL IMPACT ASSESSMENT

APPENDIX J: SPECIALIST GEOHYDROLOGICAL IMPACT ASSESSMENT

APPENDIX K: ENVIRONMENTAL MANAGEMENT PROGRAMME

APPENDIX L: CLOSURE AND REHABILITATION PLAN

RECORD OF REPORT DISTRIBUTION

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