APPENDIX F: AQUATIC ECOLOGICAL IMPACT ASSESSMENT

RHINO OIL & GAS EXPLORATION DRILLING IN ER294, FREE STATE PROVINCE, SOUTH AFRICA

Wetland & Aquatic Assessment Report

Version 1.0

Revision 0

Date: 30 March 2023

Eco-Pulse Environmental Consulting Services

Report No: EP623-01

Prepared for: **SLR Consulting (South Africa) (Pty) Ltd**

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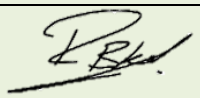
SPECIALIST ASSESSMENT REPORT DETAILS AND DECLARATION OF INDEPENDENCE

This is to certify that the following report has been prepared as per the requirements of:

- Section 32 (3) of the NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (Act No. 107 OF 1998) ENVIRONMENTAL IMPACT ASSESSMENT REGULATIONS 2014 as per Government Notice No. 38282 GOVERNMENT GAZETTE, 4 DECEMBER 2014 (as amended in 2017).
- The Department of Human Settlements, Water & Sanitation for Water Use Licensing and aquatic assessment as outlined in the '*Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals*' contained in the Government Gazette No. 40713 of 24 March 2017.

Assessment Type:	Wetland & Aquatic Assessment
Project:	Rhino Oil & Gas Exploration Drilling in ER294
Location:	Free State Province, South Africa
Report No.	623-01
Version No.	1.0
Revision:	Rev 0
Date:	30 March 2023
Author:	Shaun McNamara (*MSc.)*
Field of Expertise:	Wetland & Aquatic Ecology
Internal Reviewer:	 Ryan Kok (Pr.Sci.Nat.)
Client:	SLR Consulting (South Africa) (Pty) Ltd

I, **Shaun McNamara** (report author), hereby declare that this report has been prepared independently of any influence or prejudice as may be specified by the relevant environmental authorities.

Signed:  Date: 30 March 2023

Details of Specialist Team

The relevant experience of specialist team members involved in the compilation of this report are briefly summarized below. *Curriculum Vitae's* of the specialist team are available on request.

Specialist	Role	Details
Ryan Kok Scientist Eco-Pulse *Pr.Sci.Nat.*	Project Manager Field work and Sign-off	Ryan is a Scientist and Wetland / Aquatic Ecologist at Eco-Pulse with a BSc degree in Environmental Science; BSc Honours and MSc degree in Biological & Ecological Sciences. He is a registered Professional Natural Scientist (*Pr. Sci. Nat.*) with >5 years' experience, having worked extensively on numerous specialist ecological assessment projects, for wetland/aquatic habitats in KZN, the Free State, Gauteng, Eastern Cape, and Mpumalanga.
Shaun McNamara Scientist Eco-Pulse	Fieldwork and author	Shaun is a Scientist at Eco-Pulse with an Honours degree in Environmental Water Management, with a strong focus on integrated catchment management and wetland ecology. He also holds an MSc in Geography with his dissertation focusing on fluvial geomorphology and processes of wetland formation and evolution. Shaun has experience in the collection and analysis of data relating to wetland and aquatic assessments.

1. EXECUTIVE SUMMARY

This report sets out the findings of the **Wetland & Aquatic Impact Assessment** to inform the application for 1) environmental approval in terms of the NEMA: EIA Regulations (2014, *as amended in 2017*) and 2) a water use license application (WULA) in terms of the National Water Act, for the proposed exploration drilling of 5 well in ER294 in the Free State Province. The main findings of the assessment have been summarized below.

Project Locality & Overview:

Exploration Right (ER) area 294 consists of two blocks labelled ER294-04and ER294-05 (**Figure 1**). These blocks cover a combined area of approximately 200,000 ha in the northern Free State. ER294-04 covers an area between Kroonstad and Steynrus. Petrus Steyn is roughly central to ER294-05.

The Drilling Program and Time Schedule proposed by Rhino Oil and Gas Exploration South Africa (Pty) Ltd (Rhino Oil and Gas) is to start drilling a limited number of exploration wells within ER294 in 2023. At this stage of the project Eco-Pule were asked to assess a total of 5 well locations with ER294 (**Figure 2**). This includes 3 sites within ER294-04 and 2 sites within ER294-05. These sites formed the focal study area for this Wetland and Aquatic Assessment. Finer scale maps of each exploration well site can be seen in **Figure 7** to **Figure 10**.

The siting of the 5 exploration wells was informed by a desktop freshwater and terrestrial ecological sensitivity assessment which was completed by Eco-Pulse in March 2022. The purpose of this assessment was to ensure that the well siting process attempted to avoid ecologically sensitivity habitat from the early planning phase of the proposed project. The desktop mapped watercourses compiled as part of this initial sensitivity assessment were successfully used for well siting as no wells or site camps have been placed within watercourses, or within 20m of a watercourse, with most wells being located >100 m from the nearest watercourse. The combined desktop terrestrial and freshwater ecological sensitivity map used for well site selection is shown in **Figure 12** (**Annexure A).**

Catchment Context:

Exploration Well 04-02 falls within DWS quaternary catchment C60F. C60F is drained by the Blomspruit River (**Figure 6**). Well sites 04-04 and 04-03 are in catchment C60C. The main river draining this catchment is the Vals system. Well sites 05-01 and 05-02 are located within C70D, drained by the Doringspruit River system.

Baseline River PES & EIS:

Watercourses occurring within a 500 m radius of the proposed 1 ha well sites were mapped at a desktop level and classified in terms of their Hydrogeomorphic (HGM) type in accordance with the national wetland/river classification defined by Ollis *et al.* (2013). This was done using a GIS software through analysis of available aerial images, elevation contours, and existing wetland and river coverages for the

region. An initial desktop screening of 'impact potential' for identified watercourse units within a 500 m radius of the well sites was then undertaken at a desktop level with the results being verified in the field. This process revealed that one wetland unit were rated as having the potential to be impacted by the establishment of the well sites. The assessed wetland was a seep unit. This unit was assessed as being in a B PES category and considered to be of high EIS due to the wetland being a largely intact examples of a critically endangered wetland type. This wetland is therefore important for achieving national ecosystem conservation targets.

Impact Significance Assessment:

All construction / site establishment phase impacts associated with project are insignificant. This is due to site establishment activities being minimally invasive (no earthworks or clearing) and because all watercourses are located more than 100 m from any site. Operation phase impacts to hydrological and geomorphological processes are of very low significance. 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. Operation phase ecological disturbance impacts are of very low significance. This is because the 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.

Impact Type	Impact Significance Rating	
	'poor' mitigation scenario	'good' mitigation scenario
CONSTRUCTION / ESTABLISHMENT PHASE		
Direct physical loss or modification of freshwater habitat	**Insignificant**	**Insignificant**
Alteration of hydrological and geomorphological processes	**Insignificant**	**Insignificant**
Impacts to water quality	**Insignificant**	**Insignificant**
Impacts to ecological connectivity and/or ecological disturbance impacts	**Insignificant**	**Insignificant**
Impact Type	**Impact Significance Rating**	
	'poor' mitigation scenario	**'good' mitigation scenario**
OPERATION PHASE		
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**
Impacts to ecological connectivity and/or ecological disturbance impacts	**Very Low**	**Ver Low**

Risk Assessment to inform S21 (c) & (i) Water Use Licensing:

Possible activities, aspects (or stressors) and potential ecological risks associated with the planned project that could potentially manifest into impacts to watercourse condition / functioning have been identified in this report. A summary of the potential risk and impacts ratings for the proposed development activities is provided in **Table 28**. It is important to also note that the Risk Assessment in this section overlaps strongly with the impact significance assessment findings which is to be expected since the risk ratings should in essence align to a large degree with the impact ratings.

General Notice (GN) 509, published in Government Gazette (GG) no. 40229 under Section 39 of the National Water Act (No. 36 of 1998) in August 2016, allows for Section 21 (c) and (i) water uses to be generally authorised if risks and be reduced to acceptable level. In this case risks can be managed to acceptable levels suggesting that the project can be authorised under a GA. Note that this is provided that only Section 21 (c) and (i) water uses apply to the project as there is no GA notice for the remaining water uses. The water use licencing requirements will need to be confirmed with the DWS.

Activity	Aspects	Impact	Risk Rating
CONSTRUCTION PHASE	Potential accidental direct physical modification to freshwater habitat during construction	Direct physical loss or modification of freshwater habitat	Low
	Altered surface water runoff patterns and volumes and altered sediment supply regimes	Alteration of hydrological and geomorphological processes	Low
	Accidental leakages and spillages of hazardous substances reaching watercourses as runoff during rainfall events.	Impacts to water quality	Low
	Noise, vibrations, and dust which have the potential to temporarily disturb and displace fauna that make use of watercourses for refuge.	Impacts to ecological connectivity and/or ecological disturbance impacts	Low
OPERATIONAL PHASE	Potential accidental direct physical modification to freshwater habitat by staff, vehicles, and machinery during the drilling phase of the project.	Direct physical loss or modification of freshwater habitat	Low
	Disruption of groundwater and surface water interactions	Alteration of hydrological and geomorphological processes	Low
	Expelled mud. accidental leakages, and spillages of hazardous substances reaching watercourses as runoff during rainfall events.	Impacts to water quality	Low
	Operation of the drill rig	Impacts to ecological connectivity and/or ecological disturbance impacts	Low

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2. INTRODUCTION

2.1 Project Locality

Exploration Right (ER) area 294 consists of two blocks labelled ER294-04 and ER294-05 (**Figure 1**). These blocks cover a combined area of approximately 200 000 ha in the northern Free State. ER294-04 covers an area between Kroonstad and Steynrus. Petrus Steyn is roughly central to ER294-05.

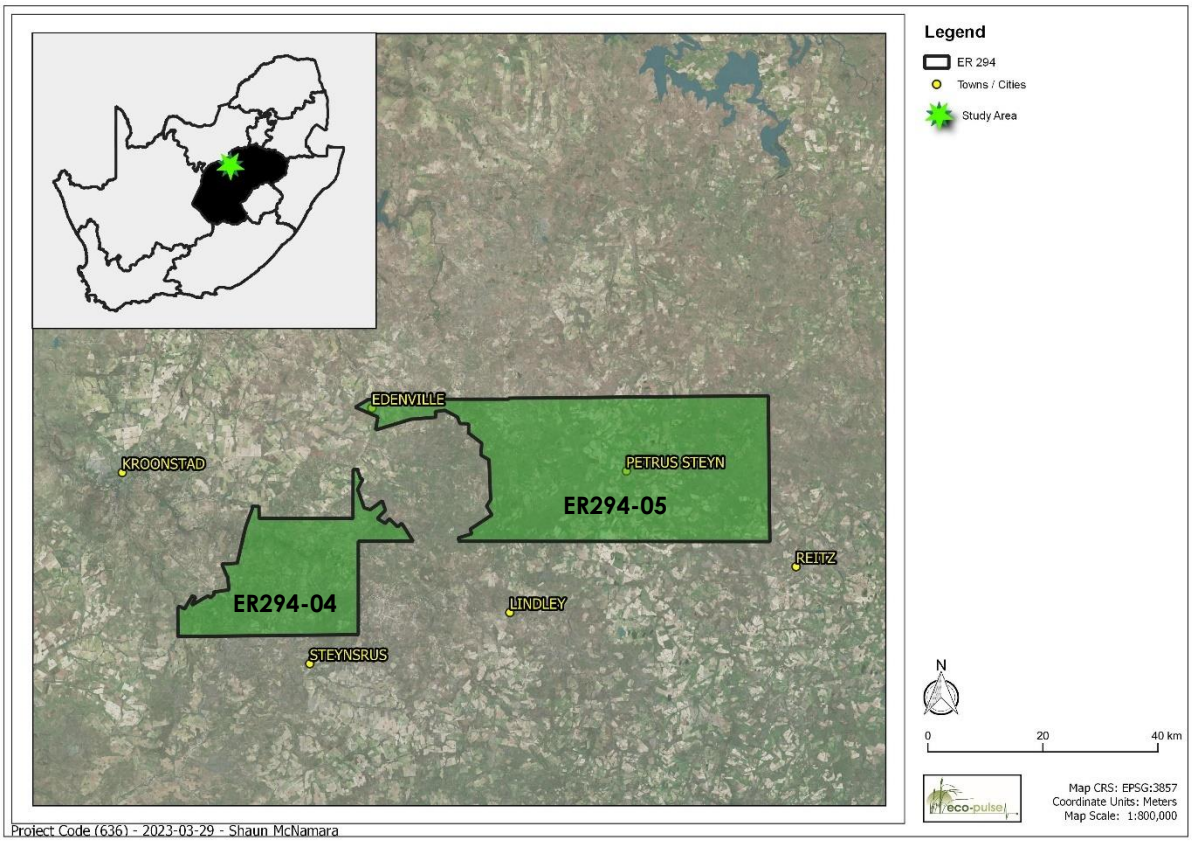

Figure 1: Location of ER294 in relation to nearby towns and cities.

2.2 Project Description

2.2.1 Overview

The Drilling Program and Time Schedule proposed by Rhino Oil and Gas Exploration South Africa (Pty) Ltd (Rhino Oil and Gas) is to start drilling a limited number of exploration wells within ER294 in 2023. At this stage of the project Eco-Pule were asked to assess a total of 5 well locations with ER294 (**Figure 2**). This includes 3 sites within ER294-04 and 2 sites within ER294-05. These sites formed the focal study area for this Wetland and Aquatic Assessment. Finer scale maps of each exploration well site can be seen in **Figure 7** to **Figure 10**.

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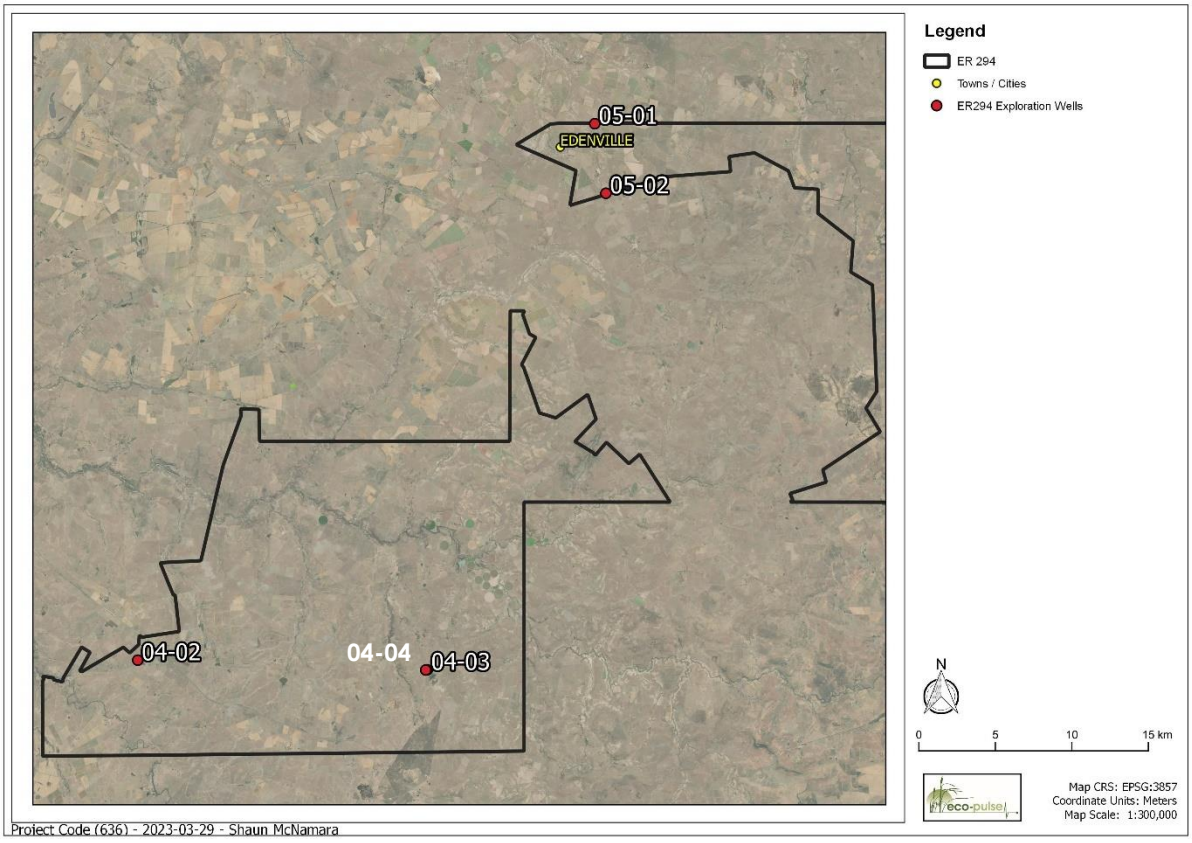

Figure 2: Exploration well sites within ER294 that form the focus of this assessment.

The drilling time to complete one exploration well is estimated to take approximately 3 to 4 weeks. If any of the first exploration wells result in the identification of commercially viable commodities (hydrocarbons, helium, or hydrogen), Rhino Oil and Gas's Drilling Program and Project Schedule would be updated to include the drilling of additional exploration wells at different locations within the Exploration Area. The results of the first few wells drilled within the Exploration Areas will influence the positioning and pace of the rest of the drilling campaign based on the interpretation of the geological, geophysical, fluid sampling data. The sequencing of the drilling campaign will be dynamic and influenced by the learnings of each new well. The location of additional exploration wells to the 5 that form the focus of this study have therefore not yet been determined and have not been addressed in this present study.

Completed exploration wells will be tested to evaluate their commerciality. At the end of operations, unsuccessful / non-viable wells will be plugged and abandoned ("decommissioned"). 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 Environmental Impact Assessment (EIA) process for Production Rights (PR)).

2.2.2 Exploration Well Drilling Method

Based on the overall subsurface rock in each area of interest, it is anticipated that exploratory drilling will be conducted using a truck mounted drilling rig with air and mud drilling capabilities. The specifications for a truck mounted drilling rig similar to that likely to be used for this project are presented in **Table 1**. Based on regional experience, Rhino Oil and Gas's drilling contractor anticipates that the drilling will be done by air drilling, thus not requiring a mud plant. However, for safe operations and well control backup options, a small temporary mud plant will be available at each well site.

Table 1: Example of onshore drill rig specifications parameters (source: www.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

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

A local logistics base will be in close vicinity to the Exploration Area. It will likely be shared with other ongoing drilling activities undertaken by the drilling contractor for other mining exploration operations in the area who are developing and producing the 'Virginia' field in the Free State. The 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 regarding the location of this base site will be undertaken after a logistic survey. Activities associated with the establishment and operation of the local logistics base have not been assessed as part of this present study.

For the duration of the drilling operation, the drill site will be supported by supply trucks. These trucks will supply the drill site from the local logistics base two to four times a week with cement, mud, and equipment such as casing, drill pipe and tubing. They will also remove waste. Supply trucks will utilise existing regional, local, and farm road networks to access each well site.

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 Oil and Gas's drilling contractor from authorized sources. There will be no water abstraction from local watercourses for operational use. The drinking (potable) water for the personnel on the drill site will be bottled water.

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

- Mobilisation of the truck mounted rig and supply trucks to the Rhino Oil and Gas Target Area;
- 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.

Mobilisation Phase

During mobilisation, the drill rig and supporting equipment will arrive and once on location, the well site will be prepared by the drilling contractor. Infrastructure and equipment associated with the drill sites are all non-fixed and will be removed once drilling at the site ceases. A typical drill site schematic is provided in **Figure 3**. Whilst the exact layout of each drill site will vary based on site specific restrictions and characteristics, each drill site will have a maximum total footprint of approximately 100 m x 100 m (10, 000 m^2 / 1 ha).

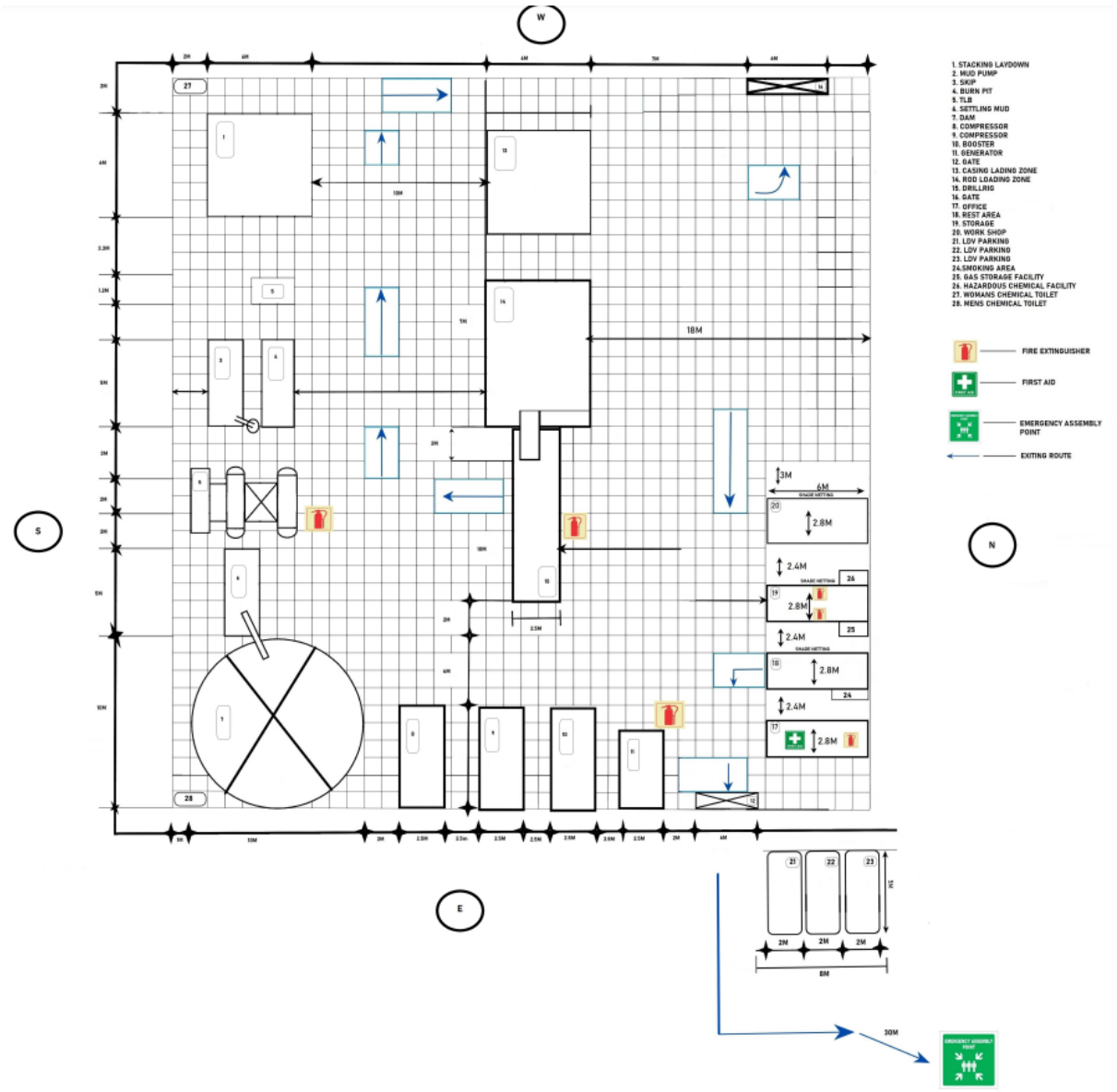

Figure 3: Schematic drill site layout (source: Torque Africa).

Drilling & Well Testing Phase

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. A standard well design and programme for onshore wells is described below (Section 1.3). The final well path will be defined according to the reservoir target and final location of the wellhead at surface.

During the drilling phase, different drilling bit sizes will be used to drill a series of telescoping holes, from the surface to the total depth of the planned well. The first hole, the outer diameter, is the biggest and 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 4**.

During the drilling process, drilling fluids such as compressed air (or muds) is 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 m to isolate from any ground water. In the bottom sections of the well, air drilling will be mainly carried out. The water-based mud programme will only be deployed if high rock formation pressure is encountered.

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. Once each hole section has been drilled, casing (steel tubulars) is run into the well and cemented in place to secure/seal the hole interval just drilled and to allow for the drilling of the next (smaller) hole section. The cement operation consists 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 directly on the surface in immediate proximity of the well after going through a cyclone separator. The physical and chemical properties of the drilling fluid are constantly monitored and adjusted to suit varying down-hole conditions. These conditions are, in part, due to the variation in formation pressure within the well bore at different depths.

In 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) Rhino Oil and Gas will redrill the well in a nearby location. The initial open hole will be cemented up and abandoned. No redrill sites have been assessed as part of this study. It is, however, anticipated that the redrill sites will be located suitably close the assessed exploration well sites to not warrant additional detailed assessment.

Once drilled, successful wells will be capped with well head valve connected to metering equipment with a flare stack at the end of it. 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. While testing, hydrocarbons are sent to a flare boom with a burner to ensure as complete combustion of fluids (including hydrocarbons) as possible. It is anticipated that a maximum well test time for this project will be approximately 30 days.

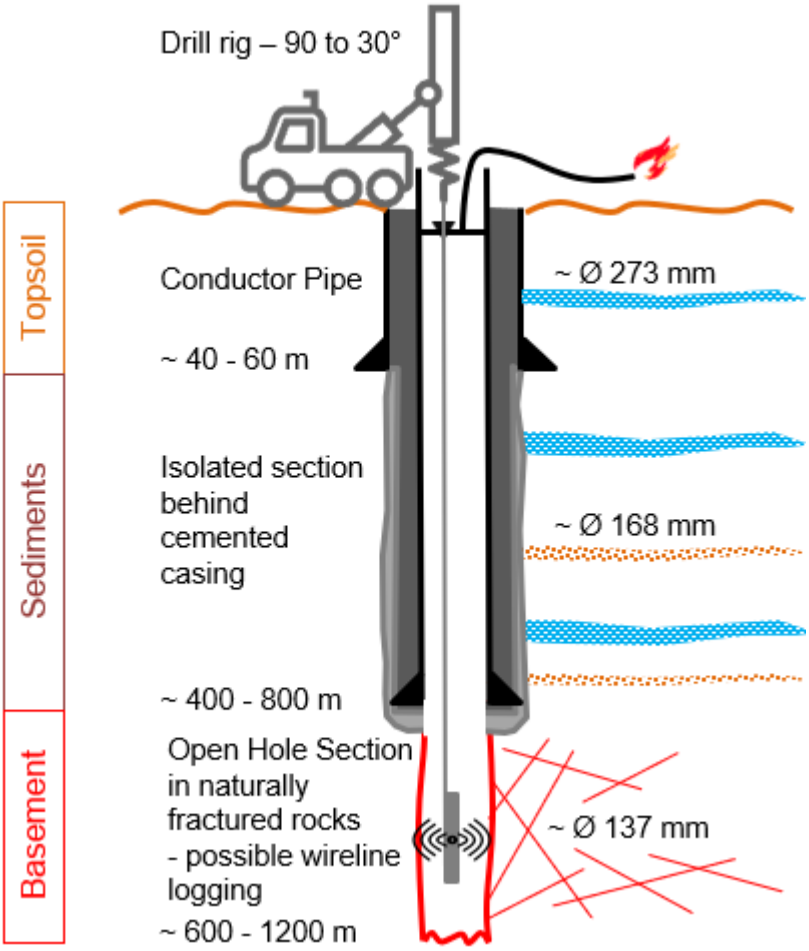

Figure 4: Drilling phase schematic drawing.

Well Abandonment / Decommissioning Phase

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. The plugging and abandonment job will be final, in that no re-entry of the well will take place. 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.

Demobilisation Phase

On completion of drilling, the drill rig and support trucks will leave the wellsite location. A final well site verification survey will be performed to check the condition of the wellsite.

2.3 Purpose of Assessment

A Wetland and Aquatic Impact Assessment Report is required to inform the project Environmental Authorisation (EA) process according to the latest NEMA: EIA Regulations, and the Water Use License Application (WULA) process in terms of the National Water Act.

2.4 Scope of Work

Phase 1 – Desktop Watercourse Delineation & Sensitivity Assessment

- Undertake a desktop assessment mapping of all watercourses (wetlands and rivers) within the three targeted blocks using available wetland mapping datasets (NWM 5, NFEPA wetland and river coverage, Free State Biodiversity Plan, etc.) as well as available digital imagery and elevation contour data in GIS.
- Classification of wetlands and channeled watercourses (rivers/streams) at a desktop level using the National Wetland Classification Guidelines (Ollis *et al.*, 2013).
- Review of Freshwater Ecosystem Context as well as the Ecological and Conservation Setting in the exploration right (ER) areas, based on available literature, existing databases (e.g., SANBI, NFEPA and other provincial databases).
- Determine high sensitivity / no-go areas based on the available desktop information.
- Provision of a Desktop Ecological Sensitivity Assessment Methodology Report accompanied by a delineation and sensitivity map for the project to guide drilling sites for prospect planning.

The scope of work for Phase 1 of the assessment was completed in March 2022. The desktop ecological

mapping and sensitivity assessment information was then used by SLR and Rhino Oil and Gas to refine the location of the proposed initial exploration well sites. The proposed well locations to form the focus of Phase 2 of this assessment were provided to Eco-Pulse in November 2022.

Phase 2 – Wetland and Aquatic Assessment

- Identification of all watercourses within 500m of the proposed exploration well sites that could be measurably negatively affected by the project (this constituted the study area).
- Contextualization of the study area in terms of important biophysical characteristics and freshwater conservation planning through a review of available spatial datasets and relevant conservation plans.
- Site visit to delineate watercourses within the study area using the methods outlined in the guideline document 'A practical procedure for the identification and delineation of wetland and riparian areas' (DWAF, 2005).
- Refinement of desktop wetland and riparian boundaries in the study area by extrapolating field sampling data across the project area.
- Assessment of wetland PES and EIS for potentially impacted watercourses using the following methods:
    - Assessment of the Present Ecological State (PES) of wetland units using published assessment tools, namely the Level 1B WET-HealthV2 tool (Macfarlane *et al*., 2020).
    - Rapid assessment of the Importance and Sensitivity of the delineated wetland units based on professional opinion with substantiation from onsite observations of the study area only.
- Identification, description, and significance rating of the various direct and indirect wetland and aquatic ecological impacts for the various phases of the proposed well drilling, including a broad comment / statement on the cumulative wetland and aquatic ecological impacts likely to arise from the project on the broader region (where applicable).
- Application of the "DWS Risk Assessment Matrix" at a project level, as detailed in the General Authorization in terms of Section 39 of the National Water Act No. 36 of 1998 for Water Uses as defined in Section 21 (c) or Section 21 (i), as contained in Government Gazette No. 40229, 26August 2016 and contained within the DWS document titled 'Section 21(c) and (i) Risk-based assessment and authorization, October 2014, Edition 2' to inform water licensing requirements for the project (i.e. full WULA vs GA).
- Provision of construction and operational impact mitigation / recommendations to avoid and minimize direct and indirect impacts, including buffer zones.
- Describe any assumptions made and any uncertainties or gaps in knowledge, as well as identifying the need for any future specialist inputs should these be deemed relevant to the project.
- Reporting: Compilation of a single specialist Wetland and Aquatic Assessment Report including all relevant maps and supporting information.

2.5 Overview of Relevant Environmental Legislation

The link between ecological integrity of freshwater resources and their continued provision of valuable ecosystem goods and services to burgeoning populations is well-recognised, both globally and nationally (Rivers-Moore *et al.,* 2007, Vörösmarty *et al*., 2010). In response to the importance of freshwater wetland and aquatic resources, protection has been campaigned at national and international levels. Relevant environmental legislation pertaining to the protection and use of wetland and aquatic ecosystems in South Africa has been included in **Table 2**, below.

Table 2: Description of relevant environmental legislation pertaining to rivers and wetlands in South Africa.

South African Constitution 108 of 1996	This includes the right to have the environment protected through legislative or other means.
National Environmental Management Act 107 of 1998	This is a fundamentally important piece of legislation and effectively promotes sustainable development and entrenches principles such as the 'precautionary approach', 'polluter pays', and requires responsibility for impacts to be taken throughout the life cycle of a project.
Environmental Impact Assessment (EIA) Regulations	New regulations have been promulgated in terms of Chapter 5 of NEMA and were published on 4 December 2014 in Government Notice No. R. 32828. In addition, listing notices (GN 983-985) lists activities which are subject to an environmental assessment.
The National Water Act 36 of 1998	Chapter 4 of the National Water Act is of relevance to wetlands and addresses the use of water and stipulates the various types of Licenced and un-licenced entitlements to the use water. Water use is defined very broadly in the Act and effectively requires that any activities with a potential impact on wetlands (within 500m upstream or downstream of a wetland) be authorized.
General Authorisations (GAs)	These have been promulgated under the National Water Act and were published under GNR 398 of 26 March 2004. Any uses of water which do not meet the requirements of Schedule 1 or the GAs, require a Licence which should be obtained from the Department of Water and Sanitation (DWS).
National Environmental Management: Biodiversity Act No. 10 of 2004	The intention of this Act is to protect species and ecosystems and promote the sustainable use of indigenous biological resources. It addresses aspects such as protection of threatened ecosystems and imposes a duty of care relating to listed invasive alien plants.
Conservation of Agricultural Resources Act 43 of 1967	The intention of this Act is to control the over-utilization of South Africa's natural agricultural resources, and to promote the conservation of soil and water resources and natural vegetation. This includes wetland systems and requires authorizations to be obtained for a range of impacts associated with cultivation of wetland areas.

Other pieces of legislation that may also be of some relevance to wetlands/rivers include:

- The National Forests Act No. 84 of 1998; and
- Nature and Environmental Conservation Ordinance No. 19 of 1974.

3. BASELINE ASSESSMENT APPROACH AND METHODS

3.1 General Approach

The general approach to the wetland and aquatic ecosystem baseline assessment was based on the proposed framework for freshwater ecosystems assessment proposed in the Water Research Commission's (WRC) report titled: 'Development of a decision-support framework for wetland assessment in South Africa and a Decision-Support Protocol for the rapid assessment of wetland ecological condition' (Ollis *et al*., 2014). This is shown in **Figure 5**.

Note that the wetland and aquatic ecosystem impact assessment report will be developed in line with the requirements of the Department of Water & Sanitation (DWS) for Water Use Licensing, as outlined in the 'Regulations Regarding the Procedural Requirements for Water Use License Applications and Appeals' contained in the Government Gazette No. 40713 of 24 March 2017 and in accordance with the requirements in the latest NEMA Minimum Requirements and Protocol for Specialist Aquatic Biodiversity Impact Assessment as contained in the "*Procedures to be followed for the assessment and minimum criteria for reporting of identified environmental themes of Section 45 (a) and (h) of the National Environmental Management Act, 1998, when applying for Environmental Authorization*", contained in Government Gazette No. 320 (20 March 2020).

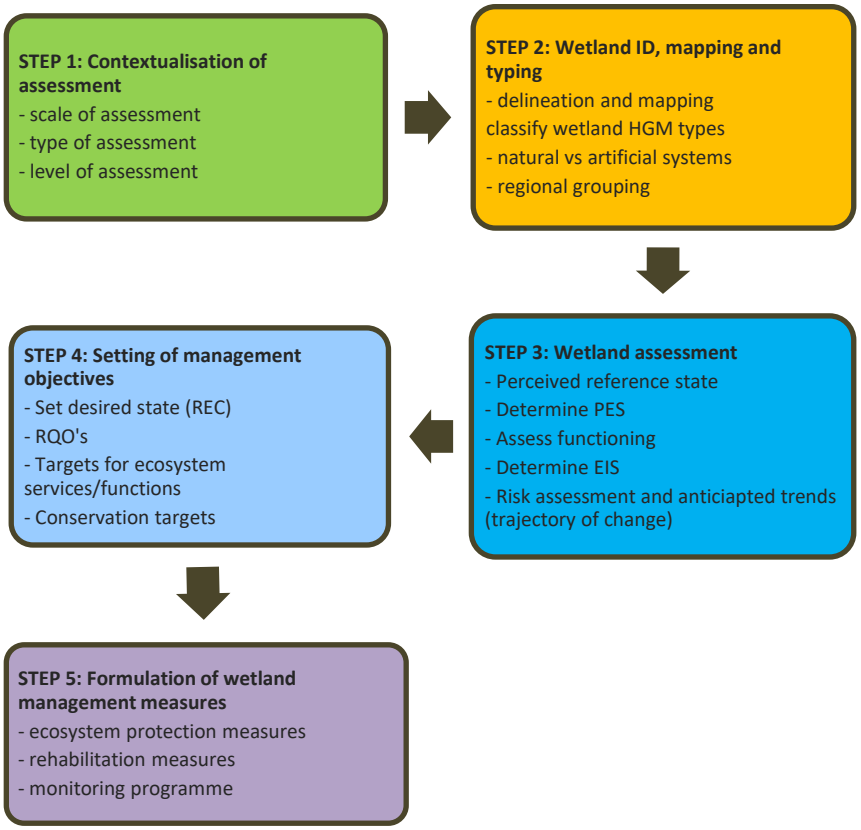

Figure 5: Proposed decision-support framework for wetland/aquatic assessment in SA (after Ollis et al., 2014).

3.2 Desktop & Baseline Assessment Methods

3.2.1 Data Sources Consulted

The data sources and GIS spatial information listed in **Table 3** were consulted to inform the specialist assessment. The data type, relevance to the project and source of the information has been provided.

Table 3: Data sources and GIS information consulted to inform the assessment.

DATA/COVERAGE TYPE	RELEVANCE	SOURCE
Biophysical Context		
Colour aerial photography	*Desktop mapping of drainage network, wetlands, etc.*	NGI (online)
Latest Google Earth ™ imagery	*To supplement available aerial photography where needed*	Google Earth™ Online
DWA Eco-regions (GIS Coverage)	*Classification of local Ecoregions*	DWA (2005)
Geomorphological Provinces of South Africa	*Understand regional geomorphology controlling the physical environment*	Partridge *et al.* (2010)
South African Vegetation Map (GIS Coverage)	*Classify vegetation types and determination of reference primary vegetation*	Mucina & Rutherford (2012)
NFEPA: river and wetland inventories (GIS Coverage)	*Highlight potential onsite and local rivers and wetlands*	WRC (2011)
Conservation Context		
Inland Aquatic (Freshwater) Realm of the 2018 SANBI National Biodiversity Assessment (GIS Coverage)	*Provides insight into the national conservation planning status of watercourses in the study area*	Van Deventer et al. (2019)
NFEPA: River, wetland, and estuarine FEPAs (GIS Coverage)	*Shows location of national aquatic ecosystems conservation priorities*	WRC (2011)
Strategic Water Source Areas (GIS Coverage)	*Location and extent of strategic water source areas*	Le Maitre et al. (2018)
Free State Province Biodiversity Plan – (GIS Coverage)	*Provincial conservation planning importance.*	Collins (2019)

3.2.2 'Impact Potential' Screening Assessment

Desktop mapped watercourses with a 500m radius (DWS regulated area for water use licencing) of the proposed explorations wells were assigned preliminary 'likelihood of impact' ratings based on the likelihood that activities associated with exploration drilling could result in measurable direct or indirect changes to the mapped watercourse units. 'Likelihood of impact' ratings were refined following the completion of field work. Each watercourse unit was ascribed a qualitative 'impact potential' rating according to the ratings and descriptions provided in **Table 4**, below.

Table 4: Qualitative 'likelihood of impact' ratings and descriptions.

Likelihood of Impact Rating	Description of Rating Guidelines
Likely	These resources are likely to require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located **within the footprint** of the proposed development activity and will definitely be impacted by the project; and/or ➢ resources located **within 15m upstream and/or upslope** of the proposed development activity and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ resources located **within 15m or downslope** of the development and trigger requirements for Environmental Authorisation according to the NEMA: EIA regulations; and/or ➢ resources located downstream within the following parameters: o **within 15m downstream** of a low risk development; o **within 50m downstream** of a moderate risk development; and/or o **within 100m downstream** of a high-risk development e.g. mining or large industrial land uses.
Possible	These resources may require impact assessment and a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located **within 32m but greater than 15m upstream, upslope or downslope** of the proposed development; and/or ➢ resources located within a range at which they are likely to incur indirect impacts associated with the development (such as water pollution, sedimentation, and erosion) based on development land use intensity and development area. This is generally resources located downstream within the following parameters: o **within 32m downstream** of a low risk development; o **within 100m downstream** of a moderate risk development; and/or o **within 500m downstream** of a high-risk development (note that the extent of the affected area downstream could be greater than 500m for high risk developments or developments that have extensive water quality and flow impacts e.g. dams / abstraction and treatment plants);
Unlikely	These resources are unlikely to require impact assessment or Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located a distance upstream, upslope or downslope (>32m) of the proposed development and which are unlikely to be impacted by the development project; and/or ➢ resources located downstream but well beyond the range at which they are likely to incur impacts associated with the development (such as water pollution, sedimentation and erosion). This is generally resources located downstream within the following parameters: o **greater than 32m downstream** of a low risk development; o **greater than 100m downstream** of a moderate risk development; and/or o **greater than 500m downstream** of a high-risk development (note that the extent of the affected area downstream could be greater than 500m for high risk developments or developments that have extensive water quality and flow impacts e.g. dams / abstraction and treatment plants);
None	These resources will not require impact assessment or a Water Use License in terms of Section 21 (c) & (i) of the National Water Act for the following reasons: ➢ resources located within another adjacent sub-catchment and which will not be impacted by the development in any way, shape or form.

3.2.3 Baseline Watercourse Assessment

The methods of data collection, analysis and assessment employed as part of the baseline assessment are briefly discussed in this section. The assessments undertaken as part of this study are listed in **Table 5**, along with the relevant published guidelines and assessment tools / methods / protocols utilised.

Table 5: Summary of methods used in the baseline assessment.

Method/Technique		Reference for Methods/Tools Used
Riparian and wetland areas delineation		A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005)
Classification of riparian and wetland units		National Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis et al., 2013)
Wetlands	**Present Ecological State (PES)**	Level 1b WET-Health assessment (Macfarlane *et al*., 2020).
	Wetland Ecological Importance & Sensitivity (EIS)	EIS assessment tool developed by Eco-Pulse based on guidance in the WET-Ecoservices manual (Kotze, et al., 2021).

3.3 Impact Assessment Framework & Methodology

The impact assessment process began with a general description of the proposed activity (construction / establishment and operation phases), with the various environmental stressors and risks associated with these activities then being defined. Impacts were then described under four (4) distinct 'groups' with impact significance assessed for each group based on a range of assessment criteria. The assessment criteria were provided to Eco-Pulse by SLR on the 16th of January 2023. Detail of the assessment methodology and impact rating system is provided in **Annexure B**. Queries regarding the assessment method criteria and the formulas used to generate ratings should be directed towards SLR.

The impact assessment was informed by baseline information contained in this report relating to the sensitivity of freshwater habitats and potential occurrence of protected species, as well as on information relating to the proposed exploration drilling activities. The general framework for the wetland and aquatic impact assessment is shown in **Table 6**.

Table 6: Wetland and aquatic ecosystem impact assessment framework for development projects.

AQUATIC ECOSYSTEM IMPACT ASSESSMENT FRAMEWORK	
DEVELOPMENT ACTIVITIES	
Construction Phase Description:	**Operation Phase Description:**
Establishment of the drill site by the contractor. This will entail the arrival and / or delivery and placement of moveable (non-fixed) drill site infrastructure and equipment including the following: • Compressors • Generators • Drill rig • Temporary workshop • Temporary storage areas • Temporary offices • Hazardous substance storage zones • Chemical toilets	Utilization of the established drill site by staff for the purpose of operating the drill rig and for the testing of successful exploration wells.
FRESHWATER ECOSYSTEM IMPACT & RISK ASSESSMENT GROUPS	
1 Direct physical loss or modification of freshwater habitat.	

2	Alteration of hydrological and geomorphological processes (*flow, erosion & sediment regime changes*).
3	Impacts to water quality.
4	Impacts to ecological connectivity and / or ecological disturbance impacts.

The significance of potential impacts associated with the proposed development on freshwater ecosystems was assessed for the following scenarios:

- **Realistic "poor mitigation" scenario** – this is a realistic worst-case scenario involving the poor implementation of construction mitigation, bare minimum incorporation of recommended design mitigation, poor operational maintenance, and poor onsite rehabilitation.
- **Realistic "good mitigation" scenario** – this is a realistic best-case scenario involving the effective implementation of construction mitigation, incorporation of most of the design mitigation, good operational maintenance, and successful rehabilitation.

Impact significance rating classes as presented in the methodology provided to Eco-Pulse by SLR for use in this assessment are outlined in **Table 7**, below.

Table 7: Impact significance categories and definitions.

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.

3.4 Risk Assessment Method

Government Notice 509 of 2016 published in terms of Section 39 of the NWA sets out the terms and conditions for the General Authorization of Section 21(c[1]) and 21(i[2]) water uses, key among which is that only developments posing a 'Low Risk' to watercourses can apply for a GA. Note that the GA does not apply to the following activities:

- Water use for the rehabilitation of a wetland as contemplated in GA 1198 contained in GG 32805

[1] 21(c): Impeding or diverting the flow of water in a watercourse
[2] 21(i): Altering the bed, banks, course, or characteristics of a watercourse

(18 December 2009).

- Use of water within the 'regulated area'[3] of a watercourse where the Risk Class is **Medium or High.**
- Where any other water uses as defined in Section 21 of the NWA must be applied for.
- Where storage of water results from Section 21 (c) and/or (i) water use.
- Any water use associated with the construction, installation or maintenance of any sewerage pipeline, pipelines carrying hazardous materials and to raw water and wastewater treatment works.

To this end, the DWS have developed a Risk Assessment Matrix/Tool to assess water risks associated with development activities. The DWS Risk Matrix/Assessment Tool (based on the DWS 2015 publication: 'Section 21 (c) and (i) water use Risk Assessment Protocol') was applied to the proposed project. The tool uses the following approach to calculating risk:

RISK = CONSEQUENCE X LIKELIHOOD

whereby:

CONSEQUENCE = SEVERITY + SPATIAL SCALE + DURATION

and

LIKELIHOOD = FREQUENCY OF ACTIVITY + FREQUENCY OF IMPACT + LEGAL ISSUES + DETECTION

The key risks associated with the proposed development project are presented in **Table 6**. For each of the stressors, risk was assessed qualitatively using the DWS risk matrix tool.

It is important to note that the risk matrix/assessment tool also makes provision for the downgrading of risk to low in borderline moderate/low cases subject to independent specialist motivation granted that (i) the initial risk score is within twenty-five (25) risk points of the 'Low' class and that mitigation measures are provided to support the reduction of risk. The tool was applied to the project for the highest risk activities and watercourses and was used to inform WUL requirements for the proposed development.

3.5 Key Documents Consulted

- SLR. 2023. Rhino Oil and Gas - Project Description. Draft Document authored by Mathew Hemming in January 2023.

3.6 Assumptions, Limitations & Information Gaps

The following limitations and assumptions apply to this wetland and aquatic assessment:

[3] The 'regulated area' of a watercourse; for Section 21 (c) or (i) of the Act refers to:

i. The outer edge of the 1:100 yr flood line and/or delineated riparian habitat, whichever is greatest, as measured from the centre of the watercourse of a river, spring, natural channel, lake or dam.
ii. In the absence of a determined 1:100 yr flood line or riparian area, refers to the area within 100m from the edge of a watercourse (where the edge is the first identifiable annual bank fill flood bench).
iii. A 500m radius from the delineated boundary of any wetland or pan.

3.6.1 General assumptions & limitations

- This report deals exclusively with a defined area and the extent and nature of wetland and aquatic ecosystems in that area.
- Additional information used to inform the assessment was limited to data and GIS coverages available for the province at the time of the assessment.
- All field assessments were limited to day-time assessments.

3.6.2 Sampling limitations & assumptions

- Although all watercourses occurring within 500m of the proposed activities were mapped at a desktop level, field investigations were limited to only those areas that stand to be measurably negatively affected (these areas constituted the study area of assessment).
- The watercourses making up the study area were determined using Eco-Pulse's qualitative 'likelihood of impact' rating system presented in **Table 4**, above.
- The mapping and classification of the watercourse units outside of the study area but occurring within a 500 m radius of activities should be considered preliminary and coarse in resolution. In most instances these units were not verified in the field.
- Sampling by its nature means that not all parts of the study area were visited. The assessment findings are thus only applicable to those areas sampled, which were extrapolated to the rest of the study area.
- The outer boundary of the watercourses identified can be considered definitive only in the vicinity of field sampling locations. Beyond such location the outer boundary was extrapolated using aerial photography and 5 m contours.
- The accuracy of the delineations is based solely on the recording of wetland and aquatic indicators using a GPS. GPS accuracy will therefore influence the accuracy of the mapped sampling points. All soil/vegetation/terrain sampling points were recorded using a Garmin Montana™ Global Positioning System (GPS) and captured using Geographical Information Systems (GIS) for further processing.
- All vegetation information recorded was based on the onsite visual observations of the author and no formal vegetation sampling was undertaken. Thus, the vegetation information provided has limitations for true botanical applications.
- With ecology being dynamic and complex, there is the likelihood that some aspects (some of which may be important) may have been overlooked.
- While disturbance and transformation of habitats can lead to shifts in the type and extent of freshwater ecosystems, it is important to note that the current extent and classification is reported on here.

3.6.3 'Seasonality' of the Assessment

- Eco-Pulse undertook the field visit in December 2022 (summer). One infield visit does not fully cover the seasonal variation in conditions at the site.

3.6.4 Baseline Ecological Assessment

- The PES and EIS assessments make use of qualitative assessment tools and thus the results are open to professional opinion and interpretation. We have tried to substantiate all claims where applicable and necessary.
- The EIS assessment did not specifically address in detail all the finer-scale ecological aspects of the water resources such as a list of aquatic fauna likely to occur (i.e., amphibians) within the onsite watercourses.

3.6.5 Impact Assessment

- The impact assessment was undertaken considering two mitigation scenarios referred to as the 'realistic poor mitigation' and 'realistic good mitigation' scenarios.
- The evaluation of impact significance under the 'realistic good mitigation' scenario assumes all project design and impact mitigation measures presented in Chapter 7 will be implemented during planning, construction, and operation of the drill sites.
- The impact descriptions and assessment are based on the author's understanding of the proposed development founded on the information provided by the client.

3.6.6 Risk Assessment

- All risk ratings generated by the DWS risk matrix are conditional on the effective implementation of the mitigation measures provided in the specialist wetland and aquatic habitat assessment report for the project.
- For the purposes of this study, the term 'stressor[4]' was favoured instead of the term 'aspect' referred to in the DWS risk matrix.
- For the purposes of this study, the criterion 'frequency of stressor occurrence' was favoured instead of the criterion 'frequency of activity' referred to in the DWS risk matrix.
- For the severity ratings, impacts were assessed on their merits rather than automatically scoring impacts as 'disastrous' as guided in the DWS risk matrix.
- The severity assessment for changes in flow regime and physico-chemical impacts were interpreted in terms of the changes to the local freshwater ecosystem represented by the potentially affected reaches.

[4] Any physical, chemical, or biological entity that can induce an adverse response to the structure and function of an ecosystem (Reference: USEPA (1998). Guidelines for Ecological Risk Assessment; Notice Fed. Reg. 6326846-26924. Environmental Monitoring Systems Laboratory, Office of Research and Development, US Environmental Protection Agency, Cincinnati, Ohio.

4. DESKTOP ASSESSMENT

4.1 Biophysical & Conservation Context

4.1.1 Biophysical Context

A summary of key biophysical details for study area and catchment area is presented in **Table 8**, below.

Table 8: Key details of the study area.

Freshwater Ecosystem Assessment Summary	
Location	Fezile Dabi District Municipality – Free State Province
Ecoregion (DWAF, 2007)	Highveld
National Water Act Water Management Area (WMA)	Vaal
Quaternary Catchment	C60C, C60F, C70D
Main Collecting River in the Catchment	C60C - Vals C60F – Blomspruit C70D – Doringspruit
Dominant Study Area Watercourse Types	Wetlands

4.1.2 Drainage Setting & Catchment Context

Exploration Well 04-02 falls within DWS quaternary catchment C60F. C60F is drained by the Blomspruit River (**Figure 6**). Well sites 04-04 and 04-03 are in catchment C60C. The main river draining this catchment is the Vals system. Well sites 05-01 and 05-02 are located within C70D, drained by the Doringspruit River system.

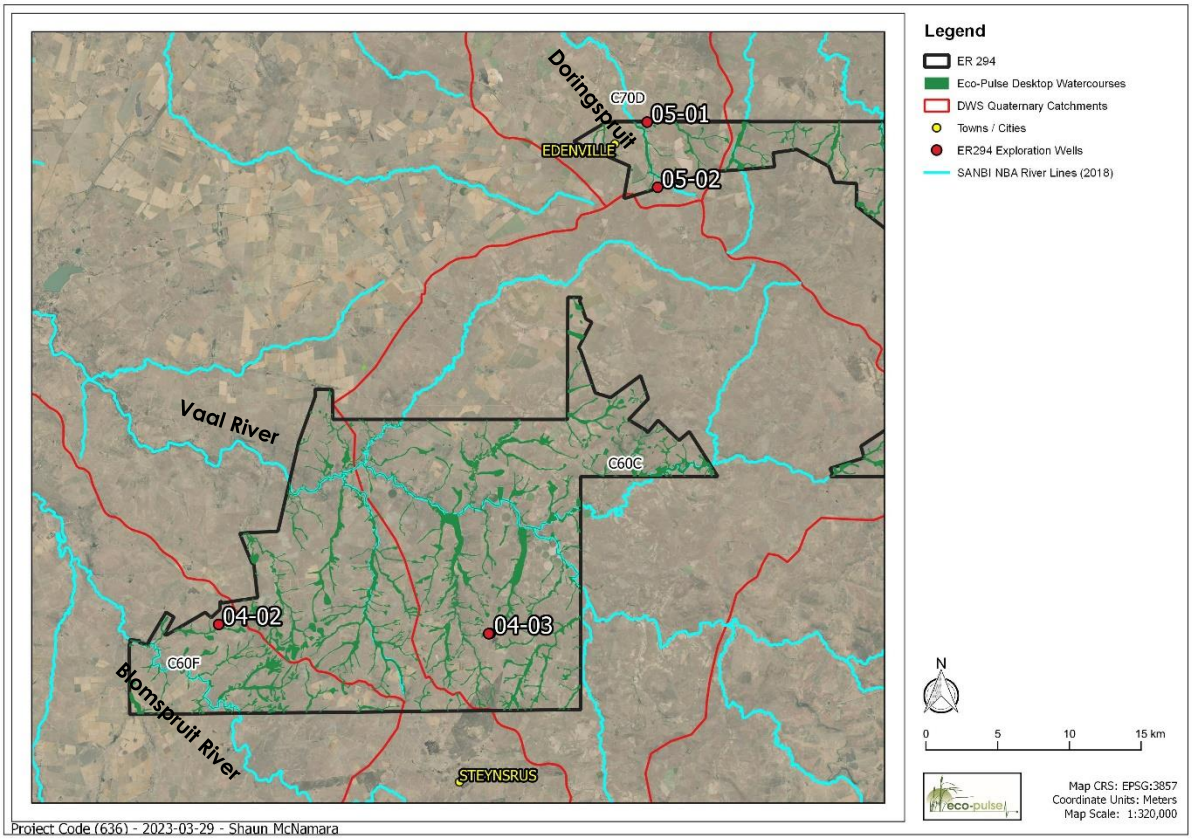

Figure 6: Quaternary catchments and local drainage network that characterises the project study area.

4.1.3 Freshwater Conservation Context

National and provincial conservation datasets were screened for the study area, the results of which are presented in **Table 9**.

Table 9: Key freshwater conservation context details for the study area.

NATIONAL LEVEL CONSERVATION PLANNING CONTEXT		
Conservation Planning Dataset	**Feature**	**Conservation Planning Status**
National Freshwater Ecosystem Priority Areas (NFEPA) (WRC, 2011)	Catchment Planning Units: 2215, 2468, 2537	No assigned FEPA Status
2018 National Biodiversity Assessment – Inland Aquatic / Freshwater Realm (GIS Coverage)	Vals Blomspruit Doringspruit	Critically Endangered
	Study Area Wetlands (Dry Highveld Grassland Bioregion)	• Unchanneled Valley Wetland – Critically Endangered • Seep – Critically Endangered • Depression – Least Threatened
PROVINCIAL AND REGIONAL LEVEL CONSERVATION PLANNING CONTEXT		
Conservation Planning Dataset	**Relevant Conservation Feature**	**Conservation Planning Status**

NATIONAL LEVEL CONSERVATION PLANNING CONTEXT		
Conservation Planning Dataset	**Feature**	**Conservation Planning Status**
Free State Province Biodiversity Plan (Collins, 2019)	Watercourses	Critical Biodiversity Area (Irreplaceable) or Ecological Support Area.

5. WATERCOURSE LIKLIHOOD OF IMPACT SCREENING

Watercourses occurring within a 500 m radius of the proposed 1 ha well sites were mapped at a desktop level and classified in terms of their Hydrogeomorphic (HGM) type in accordance with the national wetland/river classification defined by Ollis *et al.* (2013). This was done using a GIS software through analysis of available aerial images, elevation contours, and existing wetland and river coverages for the region. An initial desktop screening of 'impact potential' for identified watercourse units within a 500 m radius of the well sites was then undertaken at a desktop level with the results being verified in the field.

This process revealed that a single watercourse unit has the potential to be impacted by the establishment of the well sites. This was based on the proximity of the drill site to the wetland, such that indirect impacts could potentially occur. These watercourses are summarised in **Table 10**, below This watercourse units therefore required further assessment to inform the water use licence application (WULA) in terms of the requirements of Chapter 4 and Section 21 (c) and (i) water uses in terms of the National Water Act No. 36 of 1998, and the environmental authorisation in terms of National Environmental Management Act No. 107 of 1998.

All other watercourse units identified within a 500 m radius of the proposed well sites were either located in a different sub-catchment to the proposed well sites, or were located sufficiently far from the proposed activities, such that direct or indirect impacts are unlikely. These watercourses were not included in the formal assessment to follow.

The outcomes of the watercourse impact likelihood screening assessment are displayed in **Figure 7** to **Figure 10**, below.

Table 10: Wetland units that have the potential to be impacted by the proposed exploration well drilling project.

Watercourse Label	HGM Type	Well Site
SEEP-01 (Figure 8)	Seep Wetland	ER294-04-04

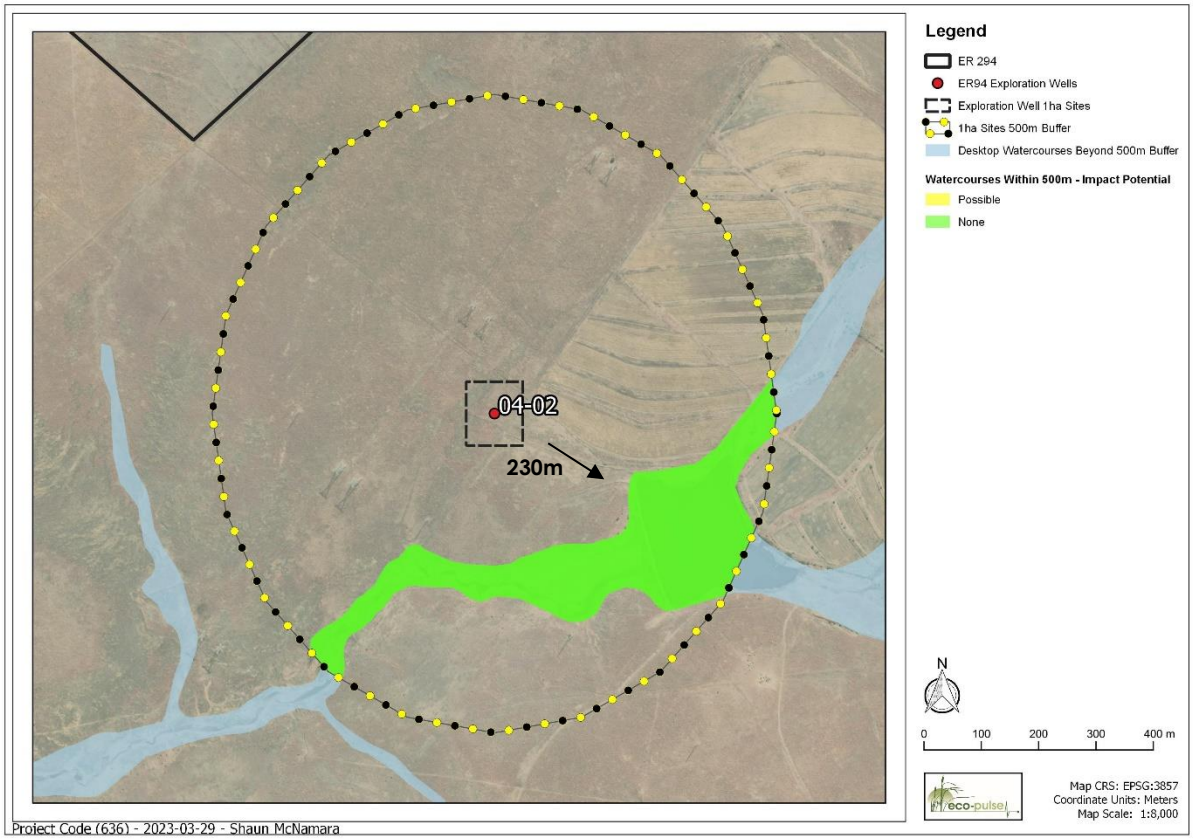

Figure 7: Outcomes of the watercourse impact likelihood assessment for site ER294-04-02.

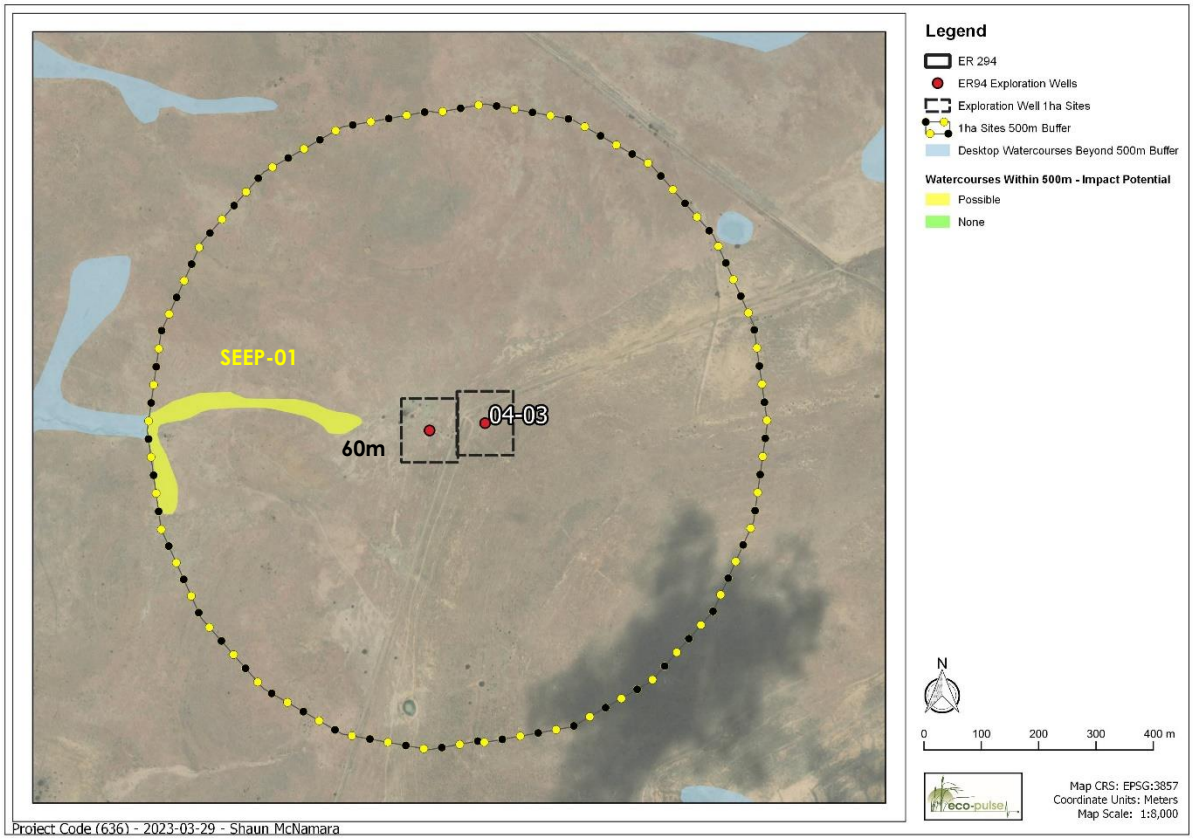

Figure 8: Outcomes of the watercourse impact likelihood assessment for sites ER294-04-03 and 04-04.

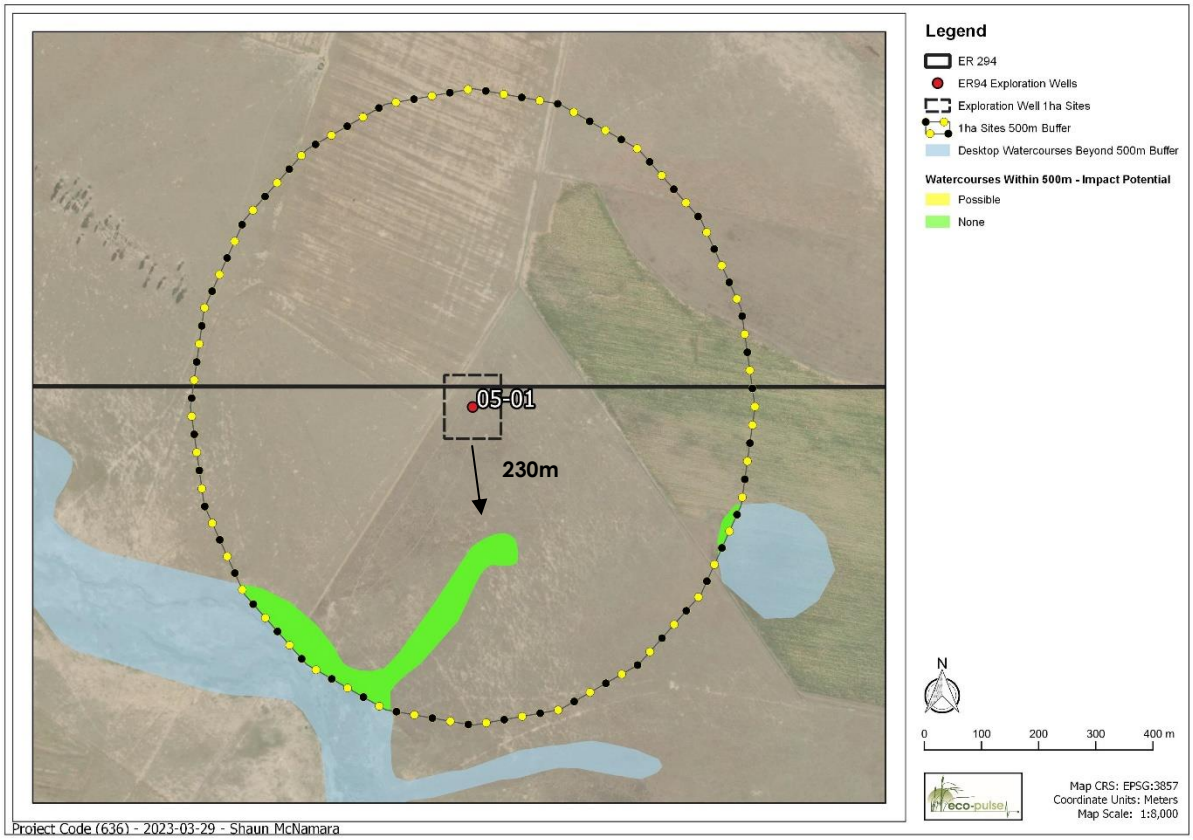

Figure 9: Outcomes of the watercourse impact likelihood assessment for site ER294-05-01.

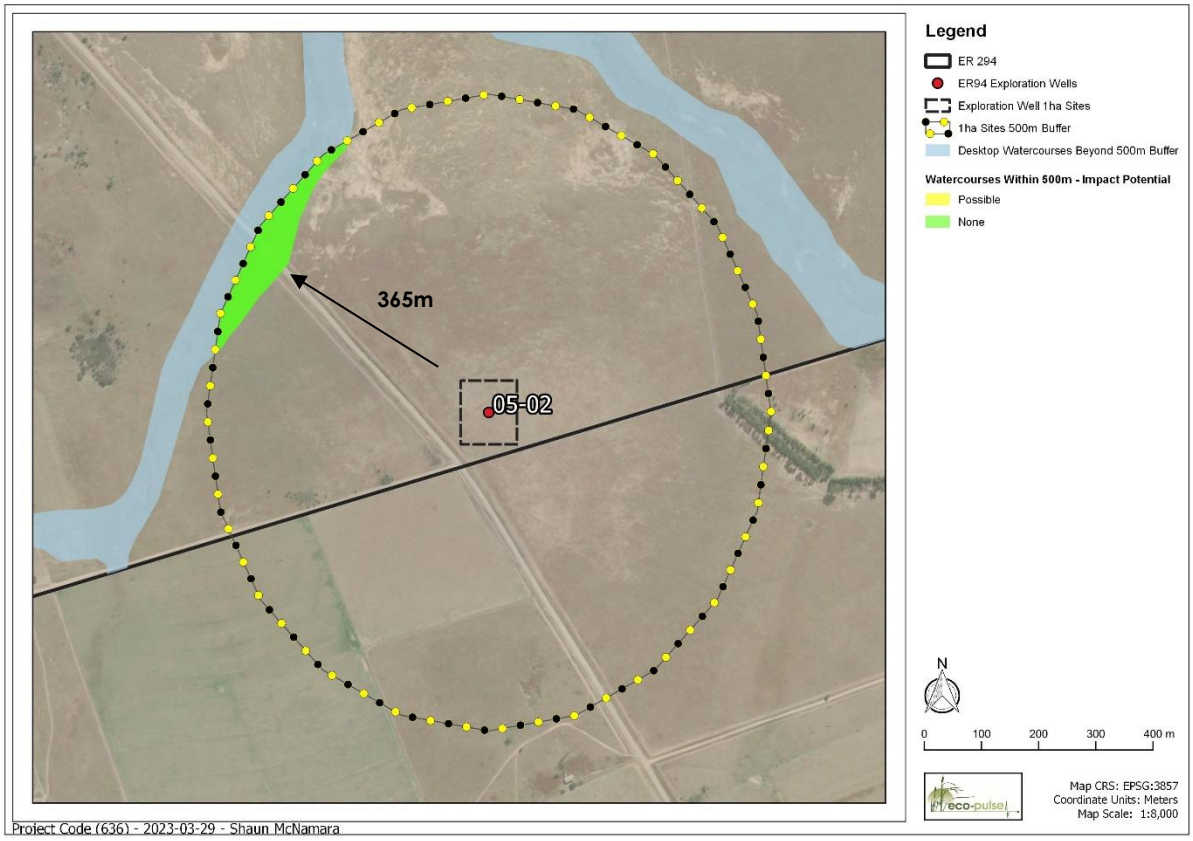

Figure 10: Outcomes of the watercourse impact likelihood assessment for site ER294-05-02.

6. BASELINE HABITAT ASSESSMENT

The baseline habitat assessment focused on the wetland unit rated as having the potential to be impacted by the proposed exploration well drilling project (**Table 10**). The extent (infield delineation), classification, habitat characteristics, present ecological state (PES) and ecological importance and sensitivity (EIS) of this unit is discussed in this section of the report.

6.1 Classification & Habitat Characteristics

The infield sampling of soil and vegetation in conjunction with the recording of diagnostic topographical / terrain indicators and features enabled the delineation of one wetland that could be impacted by this project. A summary of the key biophysical characteristics of each of the delineated watercourse units is provided in **Table 11**.

Table 11: Summary of the key hydro-geomorphic and biophysical characteristics of Wetland 'SEEP 01'

SEEP 01	
Well Site	ER294-04-04
HGM classification	Seep Wetland
Dominant wetness zone	Temporary wetland
Dominant water input	Diffuse lateral subsurface flow
Sampled soil characteristics	**Seasonal soils sampled:** Dark grey sandy loam (7.5YR 2/2), low matrix chromas (1-2), low matrix values (1-2), low abundance of faint orange mottles.
Vegetation characteristics	**Hygrophilous grassland community:** • Dominant and sub-dominant species: *Paspalum urvillei, Setaria sphacelata* • Moderately abundance species: *Sporobolus africanus, Juncus effuses, Kyllinga sp.*
	 **Photo 1:** View across SEEP 01

6.2 Present Ecological State (PES) Assessment

This section of the specialist report documents the findings of the PES assessment and provides descriptions of key impacts and PES scores and ratings for the assessed wetland. This information is contained in **Table 12**. Seep 01 was assessed as being largely natural (B PES Category).

Table 12: PES Summary for the assessed wetland units.

Units	Hydrology	Geomorphology	Vegetation	Water quality	PES Score	PES %	PES Class	Key Impact(s)
SEEP 01	1.3 B	1.3 B	1.8 B	0.6 A	1.2	88%	B Largely Natural	Impacts are limited to a minor change in wetland and catchment grassland cover due to the grazing of cattle. This impact is limited as controlled rotational grazing is utilised by the farm owner. Following periods of intensive grazing the reduced basal cover could be associated with slightly altered water and sediment supply regimes to the seep wetland.

6.3 Ecosystem Services Assessment

An assessment of wetland ecosystem services (i.e., wetland functionality) was conducted using the WET-Ecoservices tool (Kotze *et al*., 2020). The outcomes of the ecosystem services assessment are summarised in **Table 13** and **Table 14.**

6.3.1 Regulating Services

The assessed seep wetland is not considered important for the provision of regulating ecosystem services. This is largely due to its small size, limited catchment area, and the temporarily saturated nature of the system.

Table 13: Summary of regulating services importance scores for the assessed wetland.

Wetland Unit	Regulating Services Scores (0-4)								Importance Rating
	Flood attenuation	Streamflow regulation	Sediment trapping	Erosion control	Phosphate removal	Nitrate removal	Toxicant removal	Carbon storage	
SEEP 01	0.0	0.5	0.6	0.0	0.6	0.3	0.5	0.7	Very Low

6.3.2 Provisioning and Cultural Services

All wetlands in the study area are considered to supply limited provisioning and cultural services. This is due to the lack of demand for these services in the context of the study area setting.

Table 14: Summary of provisioning & cultural services importance scores for the assessed wetland.

Wetland Process Units	Provisioning & Cultural Services Scores (0-4)							Overall Rating
	Water supply	Harvestable natural resources	Food for livestock	Cultivated foods	Tourism and recreation	Education and research	Cultural and spiritual	
SEEP 01	0.0	0.0	0.7	1.3	0.0	0.4	0.0	**Very Low**

6.4 Wetland EIS Assessment

Wetland EIS Assessments were conducted for all wetland process unit groups. The wetland EIS assessment involved rating four (4) major components, namely:

- Ecological Importance in terms of biodiversity maintenance (from ecosystem services assessment)
- Ecological Importance in terms of cultural and provisions functions (from ecosystem services assessment)
- Ecological Importance in terms of regulating functions (from ecosystem services assessment)
- Ecological sensitivity

A summary of the EIS assessment is provided in **Table 15**. The seep wetland was assessed as being of high EIS. This is due to the wetland being a largely intact examples of a critically endangered wetland type. This wetland is therefore important for achieving national ecosystem conservation targets.

Table 15: Summary of EIS scores and EIS rating for the assessed wetlands.

Wetland Process Units	Rating (out of 4)			
	Ecological Importance	Ecological Sensitivity	EIS Score	EIS Rating
SEEP 01	3.2	1.8	3.1	**High**

6.5 Recommended Ecological Category (REC) & Management Objectives (RMOs)

The recommended ecological category (REC) is the target or desired state of resource units that is required to meet water resource management objectives and quality targets. It is determined through the consideration of the PES, EIS, and realistic opportunities to improve the PES, driven by context, and

setting. Within the Ecological Reserve context, Ecological Categories A to D can be recommended as future states depending on the EIS and PES (Kleynhans & Louw, 2007). Ecological Categories E and F PES are regarded as ecologically unacceptable, and remediation is needed if possible (Kleynhans & Louw, 2007). A generic matrix for the determination of RECs and RMOs for water resources is shown in **Table 16**, below.

Table 16: Generic matrix for the determination of REC and RMO for water resources (based on Kleynhans and Louw, 2007).

			EIS			
			Very high	**High**	**Moderate**	**Low**
PES	**A**	**Pristine/Natural**	A Maintain	A Maintain	A Maintain	A Maintain
	B	**Largely Natural**	A Improve	A/B Improve	B Maintain	B Maintain
	C	**Fair**	B Improve	B/C Improve	C Maintain	C Maintain
	D	**Poor**	C Improve	C/D Improve	D Maintain	D Maintain
	E/F	**Very Poor**	D Improve	E/F Improve	E/F Improve	E/F Improve

Based on the matrix in **Table 16**, the minimum recommended management objective (RMO) for the assessed wetland is to improve PES (**Table 17**).

Table 17: REC and RMO for the delineated watercourse units based on their PES and EIS ratings.

Watercourse Units	PES	EIS	REC	RMO
SEEP 01	B: Largely Natural	High	A/B	Improve

7. IMPACT AND RISK ASSESSMENTS

This section deals with the assessment of the potential construction and operation phase risks and impacts associated with the proposed gas exploration well digging. Potential impact consequences are discussed and assessed separately for the construction and operational phases under a 'realistic poor' and 'realistic good' or 'best practice' mitigation scenarios as defined in the 'methods' section of this report (*refer to Section 2.3*).

7.1 Direct Physical Loss or Modification of Freshwater Habitat

Key Assumptions:

- Vehicle access to the drill sites will be via existing roads with there being no planned new watercourse road crossings.

7.1.1 Construction / Establishment Phase

There is no planned infrastructure within 20 m of any watercourses at any of the proposed exploration well sites. There are therefore no planned direct impacts to any freshwater habitat areas during the well site establishment process. There is however the potential for accidental direct physical modification to freshwater habitat during construction. Given the distance of watercourses from the proposed well sites accidental incursions into watercourses are, however, not likely. Overall, construction phase direct impacts to watercourses are considered 'insignificant'. Although such impacts are unlikely under a realistic 'good' scenario. The overall construction phase impact significance of direct physical habitat loss is therefore low.

Table 18. Construction phase direct physical loss or modification of freshwater habitat impact significance rating.

Issue: Direct Physical Loss or Modification of Freshwater Habitat		
Phase: Construction		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate	Moderate
Duration	Very Short-Term	Very Short-Term
Extent	Site	Site
Consequence	Very Low	Very Low
Probability	Conceivable	Unlikely
Significance	**Insignificant**	**Insignificant**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Fully reversable:** Should accidental incursions into onsite wetlands occur this can be quickly and effectively remediated	
Degree to which impact may cause irreplaceable loss of resources	**None**	
Degree to which impact can be avoided	**High:** The great distance between the proposed drill sites and onsite wetlands means that avoiding accidental direct impact to freshwater habitat can be	

Issue: Direct Physical Loss or Modification of Freshwater Habitat		
Phase: Construction		
	easily avoided through staff simply being aware of the locations of wetlands in the general vicinity to ensure workers and machinery do not venture towards those zones.	
Degree to which impact can be mitigated	**High:** The impact can be completely mitigated through the avoidance of wetlands by machinery and staff during the well site establishment period.	
Cumulative Impact		
Nature of cumulative impacts	**No direct impacts** are expected as part of this project. This project is therefore not associated with the cumulative loss or modification of freshwater habitat in the study area.	
Extent to which a cumulative impact may arise	**Unlikely**	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	**Insignificant**

Key Mitigation:

- No areas outside the pre-determined well site footprint may be used for the storage of site infrastructure. To this end the outer edges of the well sites must be clearly demarcated using a high visibility barrier / fencing. The demarcation must be signed off by the project ECO.
- Construction staff should be made aware of the location and extent of all watercourses in the vicinity of the proposed well sites. These should be considered strict no-go zones for the duration of onsite works.
- Drivers and machine operators must take specific care to avoid watercourses when manoeuvring vehicles and heavy equipment.

7.1.2 Operation Phase

There is the potential for accidental direct physical modification to freshwater habitat by staff, vehicles, and machinery during the drilling phase of the project. Given the distance of watercourses from the proposed well sites accidental incursions into watercourses are, however, not likely. Overall, construction phase direct impacts to watercourses are 'insignificant'.

Table 19. Operation phase direct physical loss or modification of freshwater habitat impact significance rating.

Issue: Direct Physical Loss or Modification of Freshwater Habitat		
Phase: Construction		
Criteria	Without Mitigation	With Mitigation
Intensity	Moderate	Moderate
Duration	Very Short-Term	Very Short-Term
Extent	Site	Site
Consequence	Very Low	Very Low
Probability	Unlikely	Unlikely
Significance	**Insignificant**	**Insignificant**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Fully reversable:** Should accidental incursions into onsite wetlands occur this can be quickly and effectively remediated	
Degree to which impact may cause irreplaceable loss of resources	**None**	
Degree to which impact can be avoided	**High:** The great distance between the proposed drill sites and onsite wetlands means that avoiding accidental direct impact to freshwater habitat can be easily avoided through staff simply being aware of the locations of wetlands in the general vicinity to ensure workers and machinery do not venture towards those zones.	
Degree to which impact can be mitigated	**High:** The impact can be completely mitigated through the avoidance of wetlands by machinery and staff during the well site establishment period.	
Cumulative Impact		
Nature of cumulative impacts	**No direct impacts** are expected as part of this project. This project is therefore not associated with the cumulative loss or modification of freshwater habitat in the study area.	
Extent to which a cumulative impact may arise	**Unlikely**	
Rating of cumulative impacts	Without Mitigation	With Mitigation
	Insignificant	**Insignificant**

Key Mitigation:

- No areas outside the pre-determined well site footprint may be used for the storage of site infrastructure. To this end the outer edges of the well sites must be clearly demarcated using a high visibility barrier / fencing. The demarcation must be signed off by the project ECO.

- Staff should be made aware of the location and extent of all watercourses in the vicinity of the proposed well sites. These should be considered strict no-go zones for the duration of onsite works.

7.2 Alteration of Hydrological and Geomorphological Processes

Key Assumptions:

- The establishment of the drilling sites by the contractor will not entail the clearing of vegetation or stripping of soil. All equipment and other mobile infrastructure will rather be placed on the land surface and later removed.

7.2.1 Construction / Establishment Phase

Typical construction phase impacts to watercourse hydrological and geomorphological processes include altered surface water runoff patterns and volumes and altered sediment supply regimes. These impacts arise when construction activities require land clearing and stripping, resulting in an alteration to natural watercourse landcover. The establishment of the drilling sites will not require and stripping and will cause a negligible change in landcover. Additionally, the selected drill sites are generally located more than 100 m away from any watercourse (with none located within 20 m of a watercourse, and generally on very flat terrain. Therefore, there is not expected to be any alteration of watercourse hydrological and geomorphological processes during the construction phase of this project.

Table 20: Construction phase hydrological and geomorphological process impact significance rating.

Issue: Alteration of Hydrological and Geomorphological Processes		
Phase: Construction		
Criteria	Without Mitigation	With Mitigation
Intensity	Negligible	Negligible
Duration	Very Short-Term	Very Short-Term
Extent	Site	Site
Consequence	Very Low	Very Low
Probability	Conceivable	Unlikely
Significance	**Insignificant**	**Insignificant**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Full reversable:** Although the occurrence of erosion or sediment deposition events within wetlands is improbable, should this occur the extent and intensity of the impact is likely to be minimal and completely repairable.	
Degree to which impact may cause irreplaceable loss of resources	**None**	
Degree to which impact can be avoided	**High:** The lack of stripping and earthworks, the great distance between the proposed drill sites and onsite wetlands, and the flat terrain that characterises the study area all mean that the establishment of the drill sites is unlikely to cause any alteration to watercourse hydrological and geomorphological processes.	

Issue: Alteration of Hydrological and Geomorphological Processes		
Phase: Construction		
Degree to which impact can be mitigated	**High:** The lack of stripping and earthworks, the great distance between the proposed drill sites and onsite wetlands, and the flat terrain that characterises the study area all mean that should additional runoff or sediment be generated during the establishment of the sites, this will be easily managed on the site without causing any impacts to the surrounding environment.	
Cumulative Impact		
Nature of cumulative impacts	The establishment of the drill sites is **unlikely** to cause any alteration to watercourse hydrological and geomorphological processes. 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**

Key Mitigation:

- Avoid any vegetation removal or soil stripping during drill site establishment.

7.2.2 Operation Phase

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 discharged on the land surface in 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'.

Table 21: Operation phase hydrological and geomorphological process impact significance rating

Issue: Alteration of Hydrological and Geomorphological Processes		
Phase: Operation		
Criteria	Without Mitigation	With Mitigation
Intensity	Negligible	Negligible
Duration	Permanent	Permanent
Extent	Site	Site
Consequence	Low	Low
Probability	Conceivable	Conceivable

Issue: Alteration of Hydrological and Geomorphological Processes		
Phase: Operation		
Significance	**Very Low**	**Very Low**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Irreversible:** Once the drill hole is in place, this interruption to groundwater resources cannot be removed. The intensity of impacts to surface water resources because of the presence of the sealed and capped well is however expected to be negligible.	
Degree to which impact may cause irreplaceable loss of resources	**None**	
Degree to which impact can be avoided	**None:** The drilling of wells that may intersect groundwater resources is unavoidable as part of this project. The likelihood and intensity of any impacts to surface water resources is however expected to be negligible.	
Degree to which impact can be mitigated	**None:** The drilling of wells that may intersect groundwater resources is unavoidable as part of this project. The likelihood and intensity of any impacts to surface water resources is however expected to be negligible.	
Cumulative Impact		
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**

Key Mitigation:

- The Key impact to watercourse hydrological and geomorphological processes during drilling is the interruption of surface water groundwater interactions. It will not be possible for drilling to avoid intersecting groundwater resources to mitigate any potential impacts of this nature. The likelihood of groundwater interruptions causing a notable impact upon surface water resources is however considered to be very low. Additionally, the intensity of impacts to wetland hydrological regime, should these occur, is expected to be negligible given the localised nature of well site groundwater penetrations.

7.3 Impacts to Water Quality

7.3.1 Construction / Establishment Phase

Construction phase impacts to watercourse surface water quality could occur as a result of contaminants from accidental leakages and spillages of hazardous substances reaching watercourses as runoff during rainfall events. Examples include oil / fuel spills from equipment or vehicles and leakages from the onsite chemical toilets. The distance of the drill sites from any watercourses and the limited topography of the study area means that, even if a spill did occur, the harmful substances are highly unlikely to reach any watercourses. Therefore, there is not expected to be any alteration of watercourse surface water quality during the construction phase of this project. The application of the mitigation measures provided below will limit the likelihood of water quality impacts.

Table 22: Construction phase water quality impact significance rating.

Issue: Impacts to Water Quality		
Phase: Construction		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor	Minor
Duration	Very Short-Term	Very Short-Term
Extent	Site	Site
Consequence	Very Low	Very Low
Probability	Conceivable	Unlikely
Significance	**Insignificant**	**Insignificant**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Full reversable:** Although the occurrence of watercourse contamination is improbable, should this occur the extent and intensity of the impact is likely to be minimal and completely repairable.	
Degree to which impact may cause irreplaceable loss of resources	**None**	
Degree to which impact can be avoided	**High:** Simple measures as outlined below will fully mitigate the risk of construction phase impacts to watercourse surface water quality.	
Degree to which impact can be mitigated	**High:** Simple measures as outlined below will fully mitigate the risk of construction phase impacts to watercourse surface water quality.	
Cumulative Impact		
Nature of cumulative impacts	The establishment of the drill sites is **unlikely** to be associated with water quality issues for study area watercourses. 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**

Key Mitigation:

- The proper storage and handling of hazardous substances (e.g., fuel, oil, cement, etc.) needs to be administered.
- Mixing and / or decanting of all chemicals and hazardous substances must take place on an impermeable surface and must be protected from the ingress and egress of stormwater.
- Drip trays should be utilised at all fuel dispensing areas.
- Spills must be cleaned up immediately and contaminated soil / material disposed of appropriately at a registered site.
- Address potential spill and leakage risks on site through the implementation of Best Management Practices (BMPs) for the control and management of hazardous substances.

7.3.2 Operation Phase

Should water-based mud be used as a drilling fluid, this will be discharged on the land surface in the vicinity of the drill site. The 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 expelled drilling fluid therefore has the potential to impact upon nearby watercourses. However, the distance of each drill site from the study area wetlands means that this is as unlikely occurrence. It is possible that spillages of fuels, lubricants, and other hazardous substances could occur at the drill sites during operation. The flat nature of the sites, and the distance of the sites from watercourses means that such spills will be easy to contain in an isolated area without impacting watercourses.

Table 23: Operation phase water quality impact significance rating.

Issue: Impacts to Water Quality		
Phase: Operation		
Criteria	Without Mitigation	With Mitigation
Intensity	Minor	Minor
Duration	Very Short-Term	Very Short-Term
Extent	Site	Site
Consequence	Very Low	Very Low
Probability	Conceivable	Unlikely
Significance	**Insignificant**	**Insignificant**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Full reversable:** Although the occurrence of watercourse contamination is improbable, should this occur, the extent and intensity of the impact is likely to be minimal and completely repairable.	
Degree to which impact may cause irreplaceable loss of resources	**None**	
Degree to which impact can be avoided	**High:** Simple measures as outlined below will fully mitigate the risk of construction phase impacts to watercourse surface water quality.	
Degree to which impact can be mitigated	**High:** Simple measures as outlined below will fully mitigate the risk of construction phase impacts to watercourse surface water quality.	

Issue: Impacts to Water Quality		
Phase: Operation		
Cumulative Impact		
Nature of cumulative impacts	The operation of the drill sites is unlikely to be associated with water quality issues for study area watercourses. 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**

Key Mitigation:

- The proper storage and handling of hazardous substances (e.g., fuel, oil, cement, etc.) needs to be administered.
- Mixing and / or decanting of all chemicals and hazardous substances must take place on an impermeable surface and must be protected from the ingress and egress of stormwater.
- Drip trays should be utilised at all fuel dispensing areas.
- Spills must be cleaned up immediately and contaminated soil / material disposed of appropriately at a registered site.
- Address potential spill and leakage risks on site through the implementation of Best Management Practices (BMPs) for the control and management of hazardous substances.

7.4 Impacts to Ecological Connectivity and/or Ecological Disturbance Impacts

7.4.1 Construction / Establishment Phase

During drill site establishment 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. Such faunal species are likely to include amphibians, reptiles, birds, and small mammals. This is however unlikely as the drill sites are located a good distance away from watercourses. Additionally, construction phase disturbances will be temporary. The overall construction phase ecological connectivity / disturbance impact significance is therefore insignificant.

Table 24: Construction ecological connectivity and / or ecological disturbances impact significance ratings

Issue: Ecological connectivity and / or ecological disturbances		
Phase: Construction		
Criteria	Without Mitigation	With Mitigation
Intensity	Negligible	Negligible
Duration	Very Short-Term	Very Short-Term

Issue: Ecological connectivity and / or ecological disturbances		
Phase: Construction		
Extent	Site	Site
Consequence	Very Low	Very Low
Probability	Conceivable	Unlikely
Significance	**Insignificant**	**Insignificant**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Full reversable:** the temporary nature of establishment phase disturbances means that affected fauna will soon return to the area.	
Degree to which impact may cause irreplaceable loss of resources	**None**	
Degree to which impact can be avoided	**High:** Simple measures as outlined below will fully mitigate the risk of construction phase ecological disturbances.	
Degree to which impact can be mitigated	**High:** Simple measures as outlined below will fully mitigate the risk of construction phase ecological disturbances.	
Cumulative Impact		
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**

Key Mitigation:

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

7.4.2 Operation Phase

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.

Table 25: Operation phase ecological connectivity and / or ecological disturbances impact significance ratings

Issue: Ecological connectivity and / or ecological disturbances		
Phase: Operation		
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**	**Ver Low**
Additional Assessment Criteria		
Degree to which impact can be reversed	**Full reversable:** the temporary nature of the well drilling means that affected fauna will soon return to the area.	
Degree to which impact may cause irreplaceable loss of resources	**None**	
Degree to which impact can be avoided	**Low:** the drilling process will inevitably create noise and vibrations. The impact is however of low intensity and temporary in nature.	
Degree to which impact can be mitigated	**Low:** the drilling process will inevitably create noise and vibrations. The impact is however of low intensity and temporary in nature.	
Cumulative Impact		
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**

Key Mitigation:

- 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.

7.5 Impact Significance Assessment Summary Table

A summary tables containing the impact significance assessment ratings is presented below (**Table 26** and **Table 27**). Key outcomes of the impact significance assessment are as follows:

- All construction / site establishment phase impacts are insignificant. This is due to site establishment activities being minimally invasive (no earthworks or clearing) and because all watercourses are located more than 100 m from any site.
- Operation phase impacts to hydrological and geomorphological processes are considered to be of very low significance. 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.
- Operation phase ecological disturbance impacts are of very low significance. This is because the 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.
- All other operation phase impacts are insignificant.

Table 26: Construction phase impact significance assessment summary table.

Impact Type	Impact Significance Rating	
	'poor' mitigation scenario	'good' mitigation scenario
CONSTRUCTION / ESTABLISHMENT PHASE		
Direct physical loss or modification of freshwater habitat	**Insignificant**	**Insignificant**
Alteration of hydrological and geomorphological processes	**Insignificant**	**Insignificant**
Impacts to water quality	**Insignificant**	**Insignificant**
Impacts to ecological connectivity and/or ecological disturbance impacts	**Insignificant**	**Insignificant**

Table 27: Operation phase impact significance assessment summary table.

Impact Type	Impact Significance Rating	
	'poor' mitigation scenario	'good' mitigation scenario
OPERATION PHASE		
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**
Impacts to ecological connectivity and/or ecological disturbance impacts	**Very Low**	**Ver Low**

7.6 Risk Assessment to Inform S21 (c) & (i) Water Use Licensing

It is our understanding that the purpose of the risk matrix tool developed by the DWS is to give a preliminary indication of the likely impact / degree of change (consequence) of activities (water uses) on local and regional water resources. For the purposes of this study, the degree of change is reflected in PES change and/or the change in the supply of regulating ecosystem services.

Possible activities, aspects (or stressors) and potential ecological risks associated with the planned project that could potentially manifest into impacts to watercourse condition / functioning have been identified in this report. A summary of the potential risk and impacts ratings for the proposed development activities is provided in **Table 28**. It is important to also note that the Risk Assessment in this section overlaps strongly with the impact significance assessment findings which is to be expected since the risk ratings should in essence align to a large degree with the impact ratings.

General Notice (GN) 509, published in Government Gazette (GG) no. 40229 under Section 39 of the National Water Act (No. 36 of 1998) in August 2016, allows for Section 21 (c) and (i) water uses to be generally authorised if risks and be reduced to acceptable level. In this case risks can be managed to acceptable levels suggesting that the project can be authorised under a GA. Note that this is provided that only Section 21 (c) and (i) water uses apply to the project as there is no GA notice for the remaining water uses. The water use licencing requirements will need to be confirmed with the DWS.

Table 28: Summary of the risk matrix assessment scores and ratings for each activity and risk group.

Activity	Aspects	Impact	Risk Rating
CONSTRUCTION PHASE	Potential accidental direct physical modification to freshwater habitat during construction	Direct physical loss or modification of freshwater habitat	**Low**
	Altered surface water runoff patterns and volumes and altered sediment supply regimes	Alteration of hydrological and geomorphological processes	**Low**

Activity	Aspects	Impact	Risk Rating
	Accidental leakages and spillages of hazardous substances reaching watercourses as runoff during rainfall events.	Impacts to water quality	**Low**
	Noise, vibrations, and dust which have the potential to temporarily disturb and displace fauna that make use of watercourses for refuge.	Impacts to ecological connectivity and/or ecological disturbance impacts	**Low**
OPERATIONAL PHASE	Potential accidental direct physical modification to freshwater habitat by staff, vehicles, and machinery during the drilling phase of the project.	Direct physical loss or modification of freshwater habitat	**Low**
	Disruption of groundwater and surface water interactions	Alteration of hydrological and geomorphological processes	**Low**
	Expelled mud. accidental leakages, and spillages of hazardous substances reaching watercourses as runoff during rainfall events.	Impacts to water quality	**Low**
	Operation of the drill rig	Impacts to ecological connectivity and/or ecological disturbance impacts	**Low**

*For further details on risk assessment scores and ratings refer to **Annexure C** of this report.*

8. IMPACT MITIGATION

A strong legislative framework backs up South Africa's obligations to numerous international conservation agreements and creates the necessary enabling legal framework for the protection and management of freshwater resources in the country. Given the value of these ecosystems, it is against the law to deliberately damage wetlands and rivers. The law therefore places, directly and indirectly, the responsibility on landowners and other responsible parties, to manage and restore wetland and aquatic ecosystems where relevant.

According to the National Environmental Management Act No. 107 of 1998 (NEMA), sensitive, vulnerable, highly dynamic, or stressed ecosystems, such as wetlands or rivers require specific attention in management and planning procedures.

Of importance is the requirement of 'duty of care' with regards to environmental remediation stipulated in Section 28 of NEMA (National Environmental Management Act No.107 of 1998):

Duty of care and remediation of environmental damage: "(1) *Every person who causes has caused or may cause significant pollution or degradation of the environment must take reasonable measures to prevent such pollution or degradation from occurring, continuing, or recurring, or, in so far as such harm to the environment is authorised by law or cannot be reasonably be avoided or stopped, to minimise and rectify such pollution or degradation of the environment.*"

8.1 The 'Mitigation Hierarchy': Best Practice Environmental Planning Framework

'Impact Mitigation' is a broad term that covers all components involved in selecting and implementing measures to conserve biodiversity and prevent significant adverse impacts because of potentially harmful activities. This generally follows some form of 'mitigation hierarchy' (**Figure 11**), which aims firstly at avoiding disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided, to minimise, rehabilitate, and then finally offset any remaining significant residual impacts.

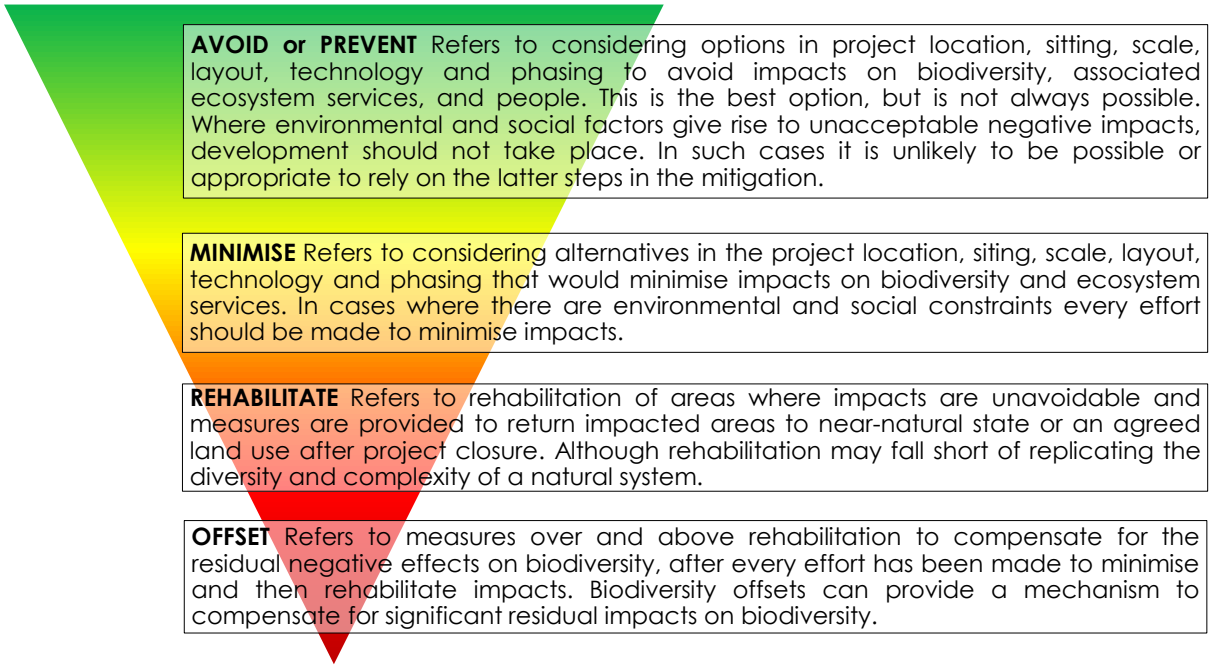

Figure 11: Diagram illustrating the 'mitigation hierarchy' (after DEA et al., 2013).

The mitigation hierarchy is inherently proactive, requiring the on-going and iterative consideration of alternatives in terms of project location, siting, scale, layout, technology, and phasing until the proposed development can be best accommodated without incurring significant negative impacts to the surrounding environment.

A stepped approach has therefore been followed in trying to minimize impacts to freshwater water resources in the area. The steps followed are outlined below:

1	**Firstly, attempting to avoid/prevent impacts through appropriate project design and location**	*Buffer zone recommendations.*
2	**Secondly, employing mitigation measures aimed at minimizing the likelihood and intensity of potential risks/impacts**	*Construction and operation phase mitigation measures*
3	**Thirdly, addressing residual impacts to freshwater habitat:**	*Not applicable to this project*
4	**Lastly, compensating for any remaining/residual impacts associated with permanent habitat transformation:**	*Not applicable to this project*

8.2 Wetland Buffer Zone Recommendations:

'Buffer zones' (also termed "development set-backs") are strips of vegetated undeveloped land intended to act as a protective barrier between human activities and sensitive habitats. Although there are no legislative requirements regarding the establishment of buffers around water resources in the South African legislation, the application of buffers is aligned with the principles of the National Water Act (1998), which is to provide for the sustaining of water quality and preserving natural aquatic habitats and ecosystem functions.

The wetland ecosystem buffer model produced by Macfarlane & Bredin (2016) was applied to watercourses in the vicinity of the proposed exploration well sites. This model produces a recommended buffer output based on potential risks associated with the proposed activity, with the output also taking into consideration the sensitivity of onsite freshwater resources. The 'Exploratory Drilling' activity was used for this buffer assessment. Based on the threats posed by the proposed activity, the buffer model calculated appropriate buffer widths under two scenarios:

1. Without specific Mitigation; and
2. With specific Impact / Risk Mitigation

The buffer model outputs is summarised in **Table 29** below.

Note: under the current well layout scenario no infrastructure or activities are set to occur within the recommended 10 m buffer zone area.

Table 29: Summary of buffer recommendations for the proposed development project as produced by the Macfarlane and Bredin (2016) buffers model.

Project Phase	Recommended Aquatic Buffer Width	
	Without specific mitigation	With specific mitigation
Construction	15 m	10 m
Operation	15 m	10 m
Final Buffer Width	**15 m**	**10 m**

8.3 Site Camp Selection

- Attempts must be made to situate the site camp on flat ground that is at least 10 m away from the edge of the nearest watercourse. A larger buffer zone is however preferable.
- The location of the camp site should be approved by the appointed ECO.

8.4 Mitigation and Management Measures

The following mitigation measures must be implemented in conjunction with any generic measures provided in the Environmental Management Programme (EMPr).

8.4.1 'No-Go' Areas During Establishment & Drilling

- All watercourses must be considered no-go areas for the duration of the site establishment and drilling processes.
- Staff must be informed of the location of all watercourses in the vicinity of the proposed drill sites.
- To outer edges of the drill site must be demarcated using a high visibility barrier / fencing. The demarcation must be signed off by the project ECO.
- No equipment laydown or storage areas must be located within 10 m of any watercourse.
- Access to the drill sites should, as far as practically possible, be via existing roads.
- Should new access roads to any drill sites be required, these must avoid all watercourses. New access routes must be approved by the Environmental Control Officer (ECO), and the outer edge of access routes must be staked out by the contractor using brightly coloured stakes prior to being used by machinery.
- All disturbed areas within and beyond the demarcated drill sites that are intentionally or accidentally disturbed must be rehabilitated to the satisfaction of the ECO prior to the sites being packed up.

8.4.2 Runoff, Erosion, and Sediment Control

- Existing vegetation cover at the drill site should be maintained throughout site establishment and drilling. Equipment and machinery should be placed onto the land surface without clearing or stripping vegetation.
- Should areas be accidentally disturbed all exposed / bare surfaces must be re-vegetated immediately.
- If re-vegetation of exposed surfaces cannot be established immediately temporary erosion and sediment control measures must be installed and maintained until such a time that re-vegetation can commence.

8.4.3 Hazardous Substances / Materials Management

- The proper storage and handling of hazardous substances (e.g., fuel, oil, cement, etc.) needs to be administered.
- Mixing and / or decanting of all chemicals and hazardous substances must take place on an impermeable surface.
- Drip trays should be utilised at all fuel dispensing areas.
- Hazardous storage and refuelling areas must be bunded prior to their use on site during the construction period. Bund walls should be high enough to contain at least 110% of any stored volume.

- An emergency spill response procedure must be formulated for the site, and staff are to be trained in spill response.
- All necessary equipment for dealing with spills of fuels / chemicals must be available at the site.
- Spills must be cleaned up immediately and contaminated soil / material disposed of appropriately at a registered site.
- Contaminated water containing fuel, oil or other hazardous substances must never be released into the environment. It must be disposed of at an appropriate registered site.
- Vehicle maintenance should not take place on site unless a specific bunded area is constructed for such a purpose.

8.4.4 Solid Waste Management

- Litter generated by the staff crew must be collected in rubbish bins and disposed of at registered sites.
- Adequate rubbish bins and waste disposal facilities must be available on site and at the construction camp.
- Regular clearing / maintenance of bins is required.
- The contractor must clear and completely remove all general waste, construction plant, equipment, surplus rock, and other foreign materials from the site.

8.4.5 Water Abstraction and Use

- No water is to be abstracted from any watercourse for use in drilling activities without prior approval by the Department of Water and Sanitation (DWS), subject to acquiring a relevant Water Use License in terms of Section 21 (a) of the National Water Act for taking water from a water resource.

8.4.6 Invasive Alien Plant Control

- All alien invasive vegetation that colonises the site must be regularly cleared. The contactor should consult the ECO regarding the method of removal.

8.4.7 Noise & Dust Pollution Minimisation

- Noise and vibrations should be minimized where possible.

8.4.8 Wildlife Management

Appropriate environmental awareness talks must be given to workers. This must include training on the need to protect wildlife and conserve biodiversity. Key messages should include:

- No firewood or medicinal plants may be harvested from natural areas.
- No wild animal may under any circumstance be hunted, snared, captured, injured, killed, harmed in any way, or removed from the site. This includes animals perceived to be vermin.

- Access to sensitive habitat types (e.g., wetland, riparian, and instream areas) outside of the construction zone should not permitted.
- Any fauna that are found within at site should be moved to the closest point of natural or semi-natural vegetation.

8.4.9 Monitoring Measures

- The ECO must undertake regular compliance monitoring audits. Freshwater ecosystem aspects that must be monitored include:
    - The condition of the temporary runoff, erosion and sediment control measures
    - The condition of waste bins and the presence of litter within the working area.
    - Evidence of solid waste within the no-go areas.
    - Evidence of hazardous materials spills and soil contamination.
    - Presence of alien invasive and weedy vegetation within the working area.
    - Rehabilitation and re-vegetation successes and failures.
- Once the drill has been completed, the ECO should conduct a close out site audit.

9. CONCLUSION

The Drilling Program and Time Schedule proposed by Rhino Oil and Gas Exploration South Africa (Pty) Ltd (Rhino Oil and Gas) is to start drilling a limited number of exploration wells within ER294 in 2023. At this stage of the project Eco-Pule were asked to assess a total of 5 well locations with ER294 (**Figure 2**).

Watercourses occurring within a 500 m radius of the proposed 1 ha well sites were mapped at a desktop level and classified in terms of their Hydrogeomorphic (HGM) type in accordance with the national wetland/river classification defined by Ollis *et al.* (2013). This was done using a GIS software through analysis of available aerial images, elevation contours, and existing wetland and river coverages for the region. An initial desktop screening of 'impact potential' for identified watercourse units within a 500 m radius of the well sites was then undertaken at a desktop level with the results being verified in the field. This process revealed that a single wetland unit has the potential to be impacted by the establishment of the well sites. This was based on the proximity of the drill sites, such that indirect impacts could potentially occur. The assessed seep wetland was assessed as being largely natural (B PES Category). The main impact affecting the assessed unit was limited to a minor change in wetland and catchment grassland cover due to the grazing of cattle. The seep wetland was assessed as being of high EIS.

All construction / site establishment phase impacts associated with project are insignificant. This is due to site establishment activities being minimally invasive (no earthworks or clearing) and because the watercourse is located more than 60 m from the drilling site. Operation phase impacts to hydrological and geomorphological processes are of very low significance. 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. Operation phase ecological disturbance impacts are of very low significance. This is because the 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.

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11. ANNEXURES

Annexure A: Combined Desktop Freshwater & Terrestrial Ecological Sensitivity Map for ER294

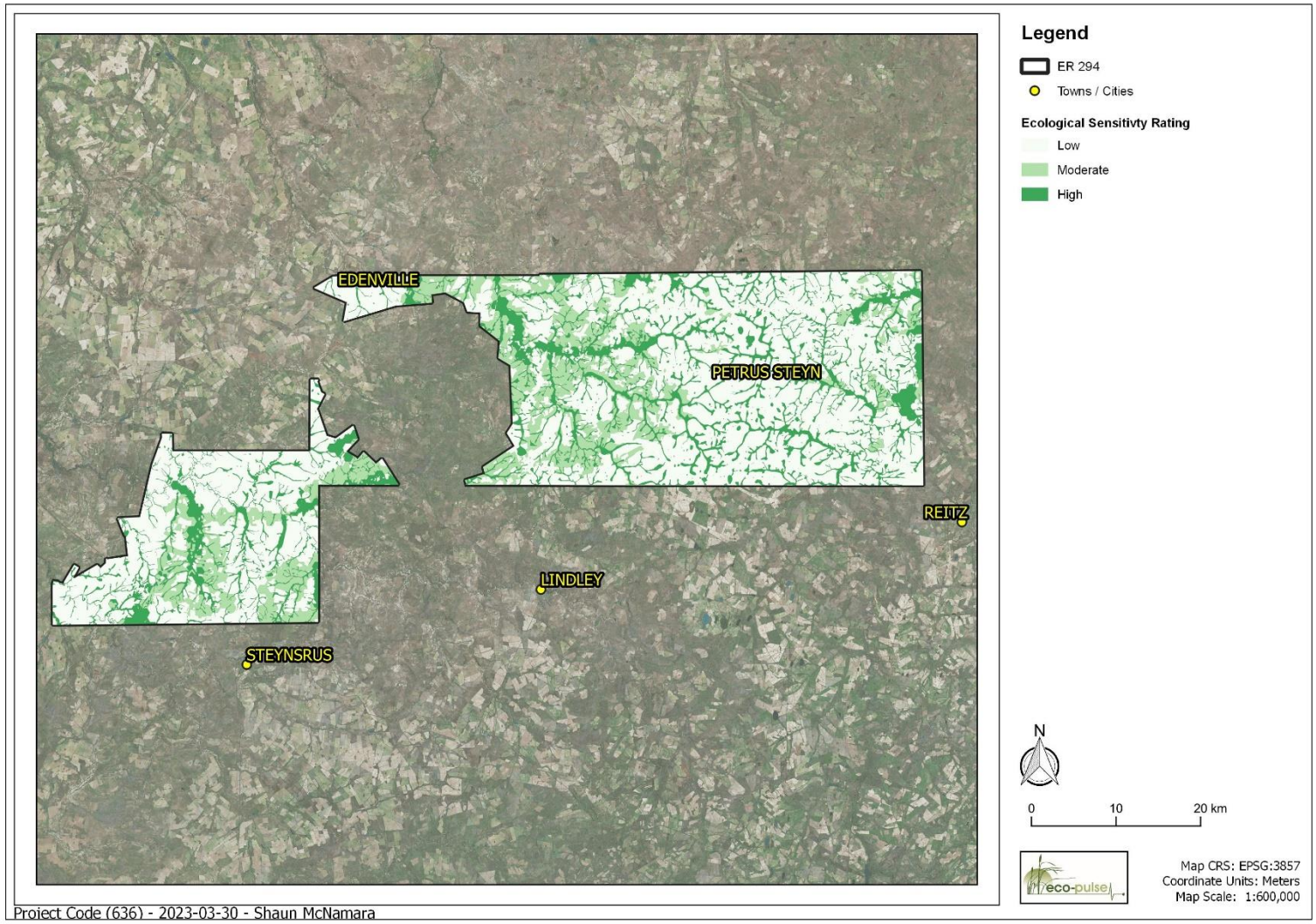

Figure 12: Eco-Pulse desktop ecological sensitivity map.

Annexure B: SLR 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.

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 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.

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.
Criteria for POTENTIAL FOR CUMULATIVE IMPACTS	**UNLIKELY**	Low likelihood of cumulative impacts arising.
	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.

Annexure C: DWS Risk Matrix Assessment Table.

Table 30: DWS risk matrix assessment

Activity	Aspect	Flow Regime	Physico & chemical (water Quality)	Habitat (Geomogh & Vegetation)	Biota	Severity	Spatial Scale	Duration	Consequence	Frequency of Activity	Frequency of Impact	Legal Issues	Detection	Likelihood	Significance	Risk Rating
Construction Phase	Direct physical loss or modification of freshwater habitat	1	1	2	2	**1.5**	1	1	**3.5**	1	1	5	2	**9**	**31.5**	**Low**
	Alteration of hydrological and geomorphological processes	2	2	2	1	**1.75**	1	1	**3.75**	1	1	5	2	**9**	**33.75**	**Low**
	Impacts to water quality	1	2	2	2	**1.75**	1	1	**3.75**	1	1	5	2	**9**	**33.75**	**Low**
	Impacts to ecological connectivity and/or ecological disturbance impacts	1	1	1	2	**1.25**	1	1	**3.25**	1	1	5	2	**9**	**29.25**	**Low**
Operation Phase	Direct physical loss or modification of freshwater habitat	1	1	2	2	**1.5**	1	1	**3.5**	1	1	5		**7**	**24.5**	**Low**
	Alteration of hydrological and geomorphological processes	2	2	2	1	**1.75**	1	1	**3.75**	1	1	5	4	**11**	**41.25**	**Low**
	Impacts to water quality	1	2	2	2	**1.75**	1	1	**3.75**	1	1	5	2	**9**	**33.75**	**Low**
	Impacts to ecological connectivity and/or ecological disturbance impacts	1	1	1	2	**1.25**	1	1	**3.25**	1	1	5	4	**11**	**35.75**	**Low**