APPENDIX G: SPECIALIST TERRESTRIAL ECOLOGICAL IMPACT ASSESSMENT

RHINO OIL & GAS EXPLORATION DRILLING IN ER318, FREE STATE PROVINCE, SOUTH AFRICA

Terrestrial Biodiversity Impact Assessment Report

Version 1.0

Revision 0

Date: 12 April 2023

Eco-Pulse Environmental Consulting Services

Report No: EP622-02

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).
- Procedures to be followed for the assessment and minimum criteria for reporting of identified environmental themes in terms of Section 24(5)(a) and (h) of the NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998, when applying for Environmental Authorisation, as per Government Notice No. 648 in Government Gazette No. 42451 (10 May 2019).

Document Title:	Terrestrial Biodiversity Impact Assessment Report
Project:	Rhino Oil & Gas Exploration Drilling in ER318
Location:	Free State Province, South Africa
Report No.	622-02
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Date:	12 April 2023
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Field of Expertise:	Terrestrial Ecology
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Client:	SLR Consulting (South Africa) (Pty) Ltd

I, **Ryan Kok** (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: 12 April 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
Robyn Phillips Scientist Cossypha Ecological *Pr.Sci.Nat*	Reviewer	Robyn is a Professional Natural Scientist (Pr. Sci. Nat.) registered with the South African Council for Natural Scientific Professions (SACNASP) in the Zoological and Ecological fields of practice. Robyn holds an MSc degree in Zoology from the University of Natal, Pietermaritzburg and has 21 years of experience in the ecological and environmental field. Robyn has worked in all nine provinces of South Africa on many different types of projects requiring biodiversity surveys and ecological assessments as part of the legislated requirements for the Environmental Impact Assessment (EIA) process. She has also been involved in several larger scale strategic projects that require theoretical input from a biodiversity perspective, and also has experience in managing teams of specialists and technical peer review.
Ryan Kok Scientist Eco-Pulse *Pr.Sci.Nat*	Project Manager Field Work Co-author & sign-off	Ryan is a Scientist and Wetland / Aquatic & Terrestrial 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 & terrestrial habitats in KZN, the Free State, Gauteng, Eastern Cape, and Mpumalanga.
Angelique Lazarus Scientist Eco-Pulse	Field Work Author	Angelique holds a BSc degree in Environmental Science, an Honours degree in Biological Sciences and a MSc degree in Ecological Sciences. Her Master's research focused on quantifying the success of a landmark restoration project in eThekwini Municipality by utilizing a multifactor approach to analyse key ecosystem attributes. Angelique has an abundance of terrestrial specific expertise, gained working across a suite of novel projects, particularly with mammals. She is now developing her skill set while acquiring important practical knowledge in specialist studies working with Eco-Pulse.

EXECUTIVE SUMMARY

Rhino Oil and Gas Exploration South Africa (Pty) Ltd (Rhino Oil and Gas) intends to start drilling a limited number of exploration wells within ER318 in the northern Free State in 2023. At this stage of the project Eco-Pule were asked to assess a total of 15 well locations within ER318. This includes 12 sites within ER318-01, 2 sites within ER318-02 and 1 site within ER318-03. An assessment of the terrestrial vegetation communities, habitats, ecosystems, and associated biodiversity was undertaken by Eco-Pulse Environmental Consulting Services in November/December 2022.

The main findings of the report have been summarised below.

Summary of Baseline Terrestrial Biodiversity Assessment:

Three (3) terrestrial vegetation communities were observed within the proposed project development area, namely Western Free State Clay Grassland, Secondary Grassland, and Dense Invasive Plants (see summary Table A).

Table A: Summary of vegetation communities with ecological condition and EIS ratings.

Vegetation Community Type	Threat Status[1]	Condition	Ecological Importance / Sensitivity	Protected Plants Present?
Western Free State Clay Grassland	LC	Poor	Low	No
Secondary Open Grassland	N/A	Poor	Low	No
Dense Invasive Alien Plants	N/A	Lost	Very Low	No

No plant species of conservation importance were recorded within the site areas that were assessed. Fauna of conservation concern were not observed during the site visit, however based on habitat requirements and ranges of species, several might potentially utilise the grasslands habitats in the study area for refuge, feeding/foraging, nesting, and breeding purposes.

Terrestrial Biodiversity Impacts and Impact Management/Mitigation:

Construction phase impacts (cumulative) associated with this project were predicted as being 'insignificant' under a 'poor/standard' mitigation scenario and a 'good' or 'best-practical' mitigation scenario.

Most operational phase impacts (cumulative) will be linked to site disturbance that could open up key natural areas to further impact by Invasive Alien Plants (IAPs) and weeds, leading to further loss of

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

biodiversity and leading to reduced ecosystem condition and functioning. Under a 'poor' mitigation scenario (no follow-up clearing of IAPs post-construction), impacts are generally expected to be of 'insignificant' where poorly mitigated/managed. Overall, operational impacts under 'good' mitigation scenario are also considered to be 'insignificant'.

Key mitigation recommendations include:

- Limit the extent of the drill site camps. Site camps should not extend beyond the proposed 1 ha sites surrounding each proposed well location.
- The boundary of the drill sites must be clearly demarcated.
- Avoid impacts to good condition grassland areas outside the drill site footprint, which are to be 'no-go' areas for construction crews. The location of these 'no-go' areas should be made clear to all staff.
- No temporary construction site amps, vehicle parking or equipment storage to be located outside previously specified areas.
- Rehabilitate any intact grassland that may be accidentally impacted.

Under a best practical mitigation scenario, the project is considered to be environmentally acceptable from a terrestrial biodiversity perspective, provided that the mitigation and management recommendations in Chapter 6 of this report are strictly adhered to. Biodiversity offsets are not considered relevant to this project.

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1. INTRODUCTION

1.1 Project Locality

Exploration Right (ER) area 318 consists of three blocks labelled ER318-01, ER318-02 and ER318-03 (**Figure 1**). These blocks cover a combined area of approximately 230 000 ha in the northern Free State. The town of Wesselsbron is located within ER318-01 with Allanridge being roughly central to the study area. Welkom and Kroonstad are located south and east of the study area, respectively.

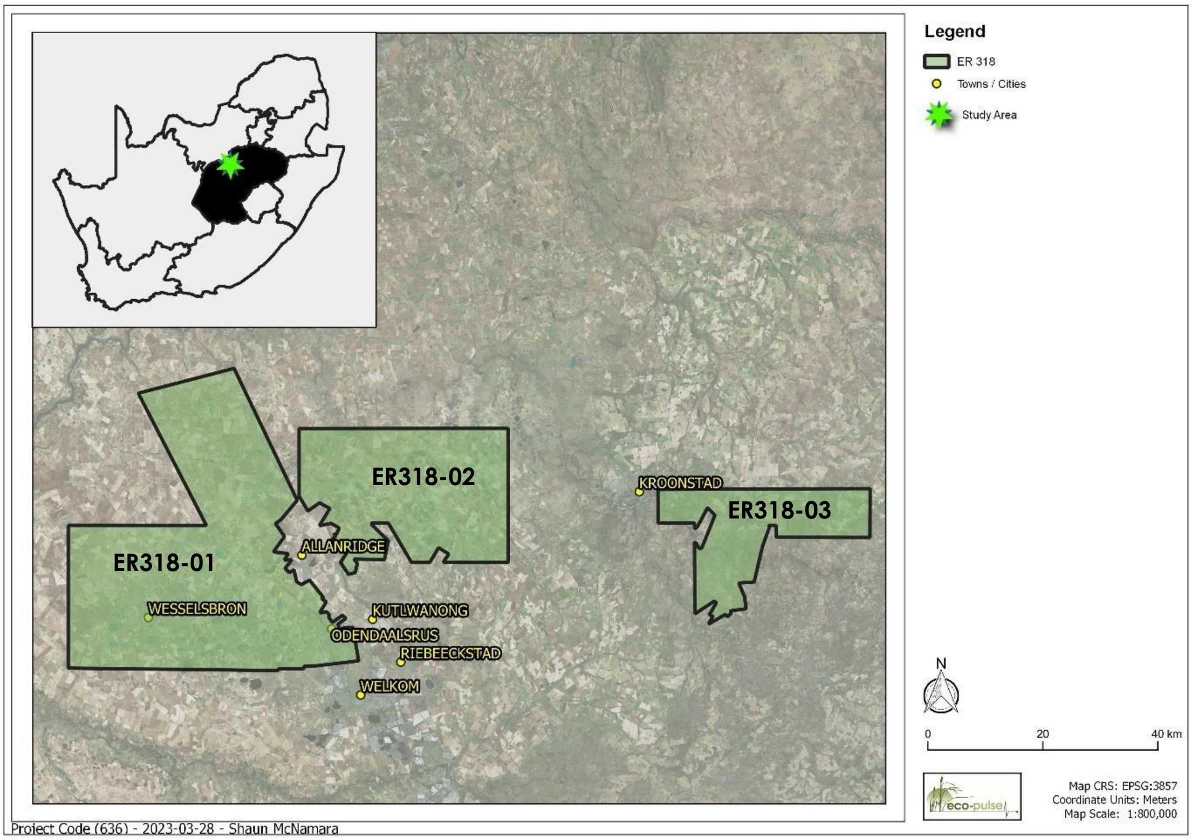

Figure 1: Location of ER318 in relation to nearby towns and cities.

1.2 Project Description

1.2.1 Overview

The Drilling Programme 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 ER318 in 2023. At this stage of the project Eco-Pule were asked to assess a total of 15 well locations with ER318 (**Figure 2**). This includes 12 sites within ER318-01, 2 sites within ER318-02 and 1 site within ER318-03. These sites formed the focal study area for this Terrestrial Biodiversity Assessment. Finer scale maps of each exploration well site can be seen in Figures 20 - 34.

The siting of the 15 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 combined desktop terrestrial and freshwater ecological sensitivity map used for well site selection is shown in **Annexure A.**

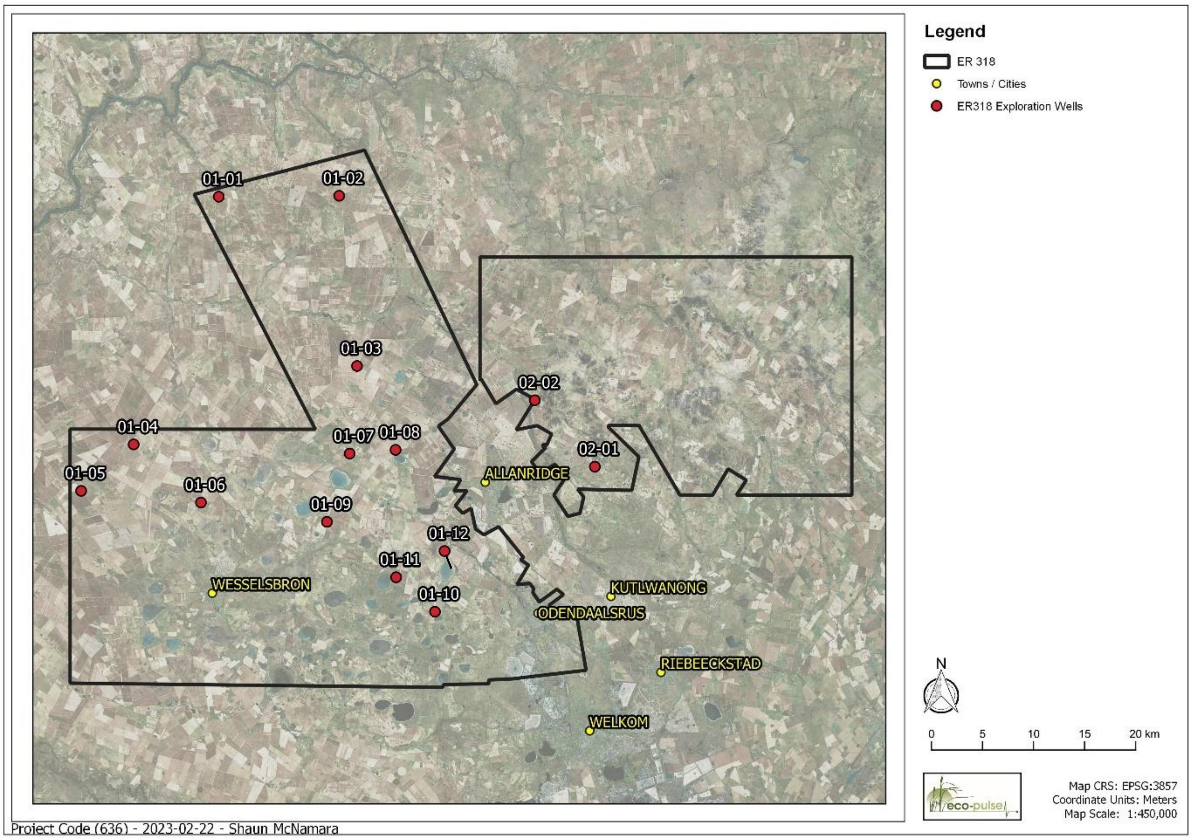

Figure 2: Exploration well sites within ER318 that form the focus of this assessment.

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, Oil and Gas's Drilling Programme 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 15 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)).

1.2.2 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 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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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.

<u>Mobilisation Phase</u>

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 100m x 100m (10 000m^2 / 1ha).

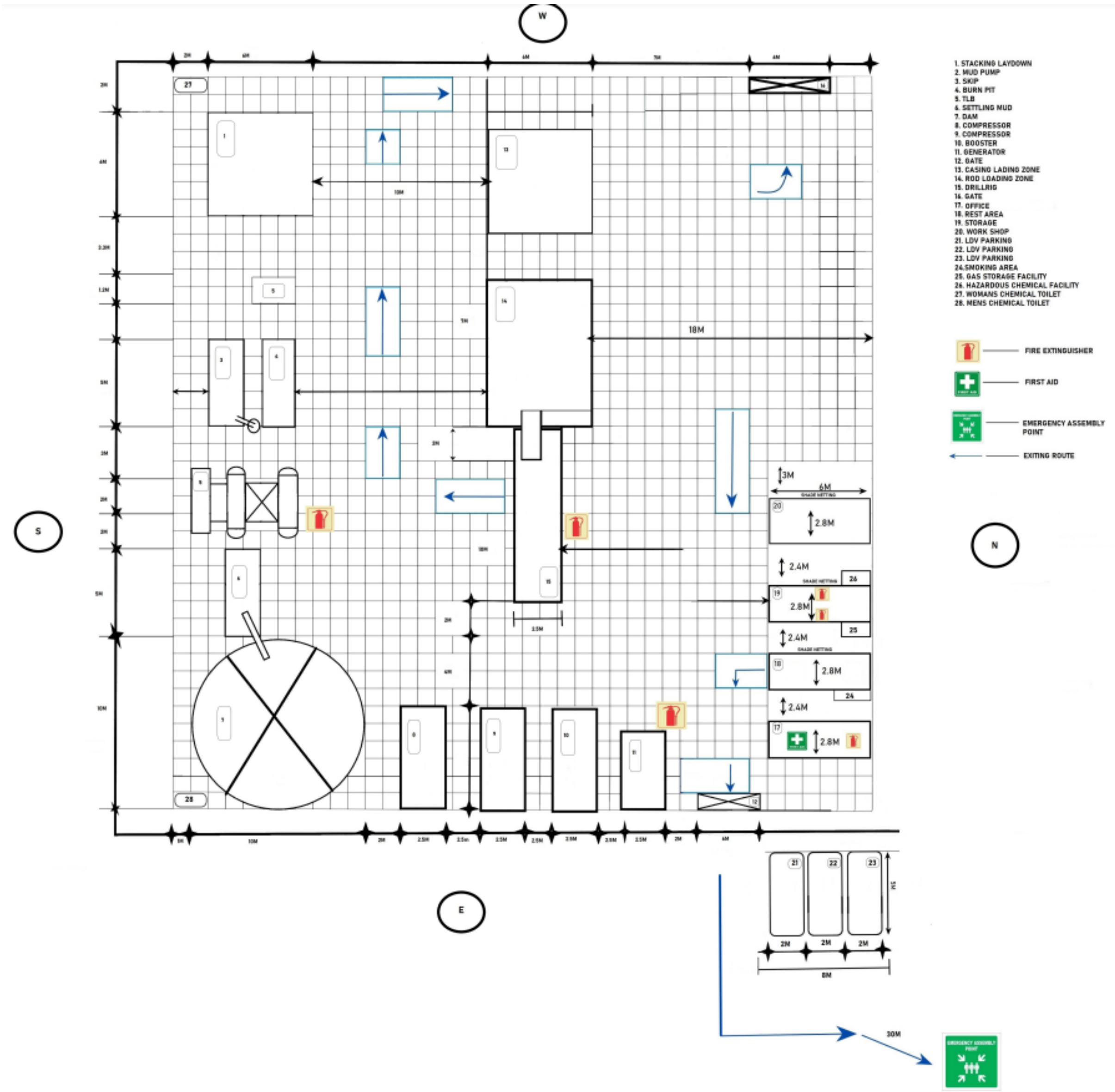

Figure 3: Schematic drill site layout (source: Torque Africa).

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 1000 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.

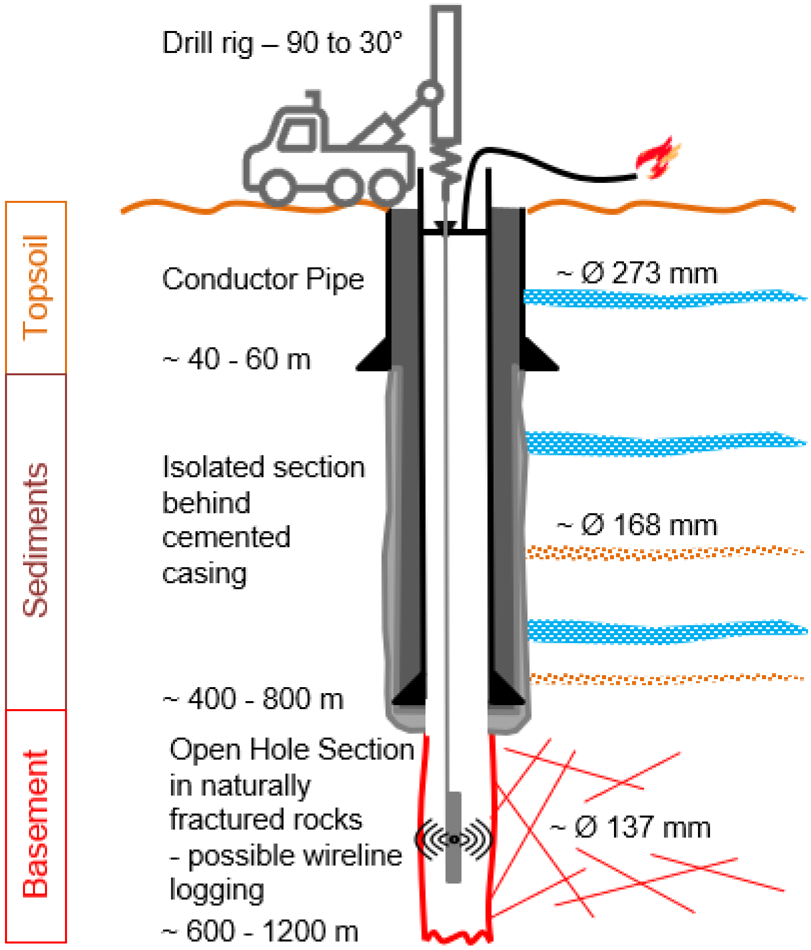

Figure 4: Drilling phase schematic drawing.

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 programme 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.

1.3 Purpose of Assessment

This prospecting project stands to impact (both directly and indirectly) on terrestrial ecosystems. A Terrestrial Ecosystems Impact Assessment that addresses the Terrestrial Biodiversity Theme, the Plant Species Theme and the Animal Species Theme is therefore required to inform the MRA and Environmental Impact Assessment (EIA) requirements for the project in terms of the latest National Environmental Management Act (NEMA): EIA Regulations (2020). This assessment aims to address the Terrestrial Biodiversity and Plant Species Themes; however, it does not address the Animal Species Theme under the new gazetted requirements, and a separate assessment/s will need to be conducted by suitably qualified faunal taxon specialists to address this Theme. This report does however include a desktop faunal Potential Occurrence (POC) assessment and a rapid site verification based on SCC, which flags faunal species that potentially occur within the study area.

1.4 Scope of Work

The following scope of work was undertaken:

- Review of any documented and available studies/information for the site and surrounding areas.
- Desktop level mapping of remaining untransformed terrestrial habitat and vegetation within the development footprint and immediate adjacent areas.
- Contextualisation of the study area in terms of important biophysical characteristics and conservation planning using available spatial datasets and conservation plans including:
    - National Vegetation Types (Mucina & Rutherford, 2006; 2018);
    - Available faunal species records/atlases for the study area;

    - Plants of Southern Africa (POSA) database records for the study area (SANBI);
    - Free State Biodiversity Plan (FSBP; Collins, 2019) – with a focus on identifying Critical Biodiversity Areas (CBAs); and
    - Local level conservation planning assessments and tools.
- Desktop POC assessment of the floral and faunal SCC (SCC) that may occur within the broader study area based on available species records for the region (e.g., POSA database, SABAP2, faunal Red Data Lists, etc.) and which takes into account habitat condition, habitat suitability based on species requirements, species ranges and threat status.
- Undertaking a site walkover and field survey of the key/priority untransformed vegetation and habitat to record necessary information required to assess vegetation condition and the Ecological Importance and Sensitivity (EIS) of mapped communities as well as habitat suitability for key species. This entailed the following:
    - Field surveys of vegetation[2] and habitat along transects across terrestrial habitat types identified including identification of pioneer and alien plant species and description of habitat and vegetation type, and ecological condition rating.
    - Identification and mapping of the geographic location of any terrestrial plant SCC (rare/protected plants and trees) noted during the site assessment.
    - Basic survey (limited to day-time survey) to validate the desktop POC of fauna of conservation concern potentially occurring in the area (where possible) using visual observations of species as well as evidence of their occurrence on the site (e.g., burrows, nests, excavations, animal tracks, etc.)[3],
- Compile plant species lists for the delineated vegetation communities based on available desktop information and site visits with a key focus on noting any species of conservation significance.
- Description of any significant landscape features (including rare or important floral associations).
- A description of the terrestrial biodiversity and ecosystems, including:
    - Main vegetation types[4]
    - Threatened ecosystems, including Listed Ecosystems and locally important habitat types identified;

[2] **Note:** The scope of work excludes any detailed site-based assessments to verify the occurrence of any cryptic species that may occur on the site. If these are flagged as having a high likelihood of occurring on the site, a separate quotation will be provided to undertake further specialist work.
[3] **Note**: The scope of work excludes any detailed fauna trapping. If the potential cryptic faunal species is flagged as having a high likelihood of occurring on the site, this can be addressed by a suitable qualified faunal taxon specialist.
[4] Descriptions of the main vegetation communities will be provided, with an emphasis on reporting on dominant species and species of conservation significance (e.g., rare, protected, red-data listed flora).

  - Ecological connectivity, habitat fragmentation, ecological processes and fine scale habitats;
  - Species, distribution of important habitats and movement patterns identified.
  - Identification of ecological corridors that the development could impede, including migration and movement of flora and fauna.
- Identify the location of all floral SCC recorded during site visits on the property using a hand-held GPS.
- Record general information on fauna (direct sightings or tracks/signs of faunal activity) where possible in order to refine the desktop POC assessments.
- Allocation of condition classes to mapped vegetation communities based largely on a review of aerial photography and supplemented with field data including species composition, vegetation structure and the presence of ruderal, pioneer and invasive alien species.
- Extrapolation of data through ground-truthing (i.e., data from field investigations will be extrapolated where possible to cover areas not investigated in the field and where access was a particular challenge, in order to reduce information gaps). This will be done for similar ecosystem/habitat types identified at a desktop level.
- Assessment of the ecological importance/sensitivity of terrestrial habitat based on key criteria such as threat status, presence of red data species or suitability to support key species of conservation significance, habitat condition, etc.
- Provision of an ecological sensitivity map for the site, including the location of sensitive habitat/vegetation types, protected plants and any recommended terrestrial biodiversity buffer zones (development set-backs) with motivation provided together with preliminary planning and design mitigation / recommendations to avoid and minimise direct and indirect terrestrial ecological impacts (including potential biodiversity buffer zones according to best practice guidelines) for consideration by the client/applicant (i.e. Draft Baseline Report) which will then be discussed prior to the assessment of impacts and report finalisation (designs/layout plans will typically be reviewed and updated as necessary at this stage).
- 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 (e.g., focal faunal species assessments). This would include recommendations for additional seasonal surveys if necessary.
- Identification and description of the various direct and indirect terrestrial ecological impacts for the various phases of the development project (includes construction and operation phases), including:
  - Impact on vegetation species composition and structure
  - Impact on ecosystem threat status
  - Impact on explicit subtypes in the vegetation
  - Impact on overall species and ecosystem diversity

- Impact on populations of species of special concern
- Impact on ecological processes and functionality
- Impact on ecological connectivity

- Provision of impact mitigation measures / recommendations to avoid and minimise direct and indirect impacts, including alternatives in terms of location and design of the development.
- Identification of key impacts that should be monitored as part of on-going management of the site, and recommendation of simple guidelines/methods for ecological monitoring.
- Identification and reporting on any other permit/licensing requirements that may be relevant to the site (for example protected plant/tree permits/license requirements).
- 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 (e.g., focal faunal species assessments).
- Reporting: Compilation of a single Specialist Terrestrial Biodiversity Impact Assessment Report including all relevant maps and supporting information. *Reports will comply with the relevant requirements of the Procedures for the Assessment and Minimum Criteria for Reporting on Identified Environmental Themes when Applying for EA (GN R320 of 2020). The assessment will be conducted in accordance with the minimum requirements of the protocols prescribed for the themes of Terrestrial Biodiversity as specified in the DFFE National Web-based Environmental Screening Tool Report. These protocols replace the requirements of Appendix 6 of the EIA Regulations GN R982, 2014 (as amended) in terms of NEMA.*

1.5 Overview of Relevant Environmental Legislation

Terrestrial ecosystems, their relevant species, vegetation, habitats and biodiversity in general are governed in South Africa by the following legislation:

- National Environmental Management Act (NEMA) No. 107 of 1998 inclusive of all amendments;
- National Environmental Management: Biodiversity Act (NEMBA) No. 10 of 2004;
- The National Environmental Management: Protected Areas Act No. 57 of 2003;
- Conservation of Agricultural Resources Act No. 43 of 1983; and
- National Forests Act No. 84 of 1998.
- At a Provincial level, flora and fauna (plants and animals) of conservation significance are protected by the Free State Nature Conservation Ordinance 8 of 1969.
  - Free State Nature Conservation Ordinance, 1969 (No. 8 of 1969)

2. APPROACH AND METHODS

2.1 Desktop Assessment

2.1.1 Confirmation of Terrestrial Ecosystem Context

The data sources and GIS spatial information listed in Table 1 was consulted to inform the biophysical and conservation context of the biodiversity onsite. The data type, relevance to the project and source of the information has been provided.

Table 2: Data sources and GIS information consulted to inform the Terrestrial Habitat Impact Assessment.

DATA/COVERAGE TYPE	RELEVANCE	SOURCE
Colour aerial photography	Desktop mapping of vegetation communities	Bing / Google Earth™ Imagery
Latest Google Earth ™ imagery	To supplement available aerial photography in mapping vegetation communities	Google Earth™ On-line
5m Elevation Contours (GIS Coverage)	Desktop mapping of vegetation communities	Surveyor General
Geomorphological Provinces of South Africa	Assessment of underlying geology controlling soil formation and consequently vegetation types	Partridge *et al.*, (2010)
South African Vegetation Map (GIS Coverage)	Classification of vegetation types and determination of reference primary vegetation	SANBI (2018)
National Biodiversity Assessment – Threatened Ecosystems Remaining Extent 2020 (GIS Coverage)	Identification of conservation important ecosystems	SANBI (2020)
National Biodiversity Assessment – Threatened Ecosystems (GIS Coverage)	Identification of conservation important ecosystems	SANBI (2018)
Free State Province Biodiversity Plan (GIS Coverage)	Identification of biodiversity areas of conservation importance	Collins (2019)
SANBI On-line threatened species database	Assessment of threatened plant species potentially occurring on site	SANBI on-line database
SANBI's PRECIS (National Herbarium Pretoria Computerized Information System) (electronic database)	Determination of conservation important plant species	http://posa.sanbi.org
Red Data Books (Data Lists of Plants, Mammals, Reptiles and Amphibians)	Determination of conservation important plants, mammals, reptiles and amphibians	Various sources
Second Southern African Bird Atlas Project (SABAP2) (electronic database)	Determination of conservation important birds	SABAP2 (2023
South African National Land-Cover (SANLC) 2020 (GIS Coverage)	Desktop mapping of vegetation communities and documenting current land-use impacts	DFFE (2020)

2.1.2 Species of Conservation Concern Potential Occurrence (POC) Assessment

The purpose of undertaking the potential occurrence assessment was to flag the possible occurrence of Species of Conservation Concern (SCC) in order to highlight floral and faunal species to look out for and/or inform the need for additional focussed floral or faunal surveys. SCC are species that have a high conservation importance in terms of preserving South Africa's high biological diversity. South African conservation agencies use the internationally endorsed IUCN Red List Categories and Criteria to determine the conservation status of biota, which are published in various Red Lists for specific orders of animals and plants. However, the IUCN Red List is considered a global assessment, therefore, South Africa uses a revised system of the IUCN criteria which has been developed to serve as a regional assessment for the country. The regional assessment only accounts for the distribution or range of a species falling within the borders of South Africa, this means that any species not endemic to South Africa will be assessed based on their distribution and numbers within the country and populations and distributions that extend beyond our borders have not been considered as part of the regional assessment.

Consequently, a species' status on the national Red List may differ from its global status on the IUCN Red List. In addition, to including species that are assessed according to the IUCN Red List Criteria as Critically Endangered (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), or Data Deficient (DD); at the regional scale, South Africa has further revised the list of SCC in the country to include: range-restricted species which are not declining and are Nationally Listed as Rare or Extremely Rare [also referred to in some Red Lists as Critically Rare]. The National Web-based EIA Screening Tool has also included endemic or range-restricted species, and some provincially protected species as part of its modelling efforts. Refer to Figure 5 for an overview of the relevant categories of SCC.

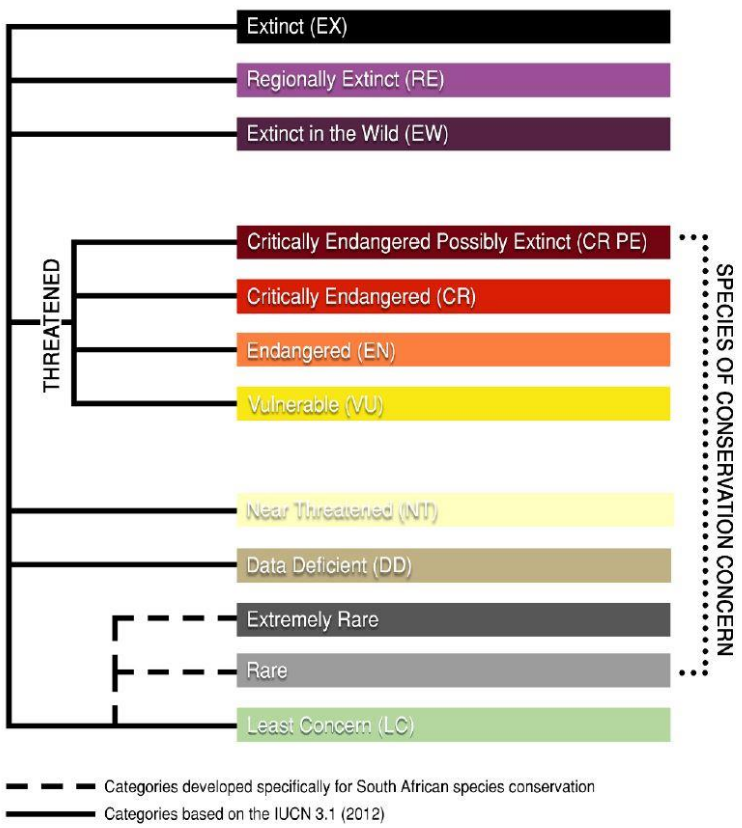

Figure 5: The different categories of SCC modified from the IUCN's extinction risk categories (reproduced in part from IUCN, 2012) - extracted directly from SANBI (2020).

A description of the different South African Plant Red List categories as well as all species that form part of the larger complement considered as SCC is provided in Table 3 (Categories marked with N are non-IUCN national Red List categories for species not in danger of extinction but considered of conservation concern; the IUCN equivalent of these categories is Least Concern (LC).

Table 3: Description of South African Plant Red List Categories (Source: SANBI on-line at http://redlist.sanbi.org/eiaguidelines.php)

Status		Category	Description
SPECIES OF CONSERVATION CONCERN	EXTINCT/APPROACH-ING EXTINCTION	**Extinct (EX)**	A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
		Regionally Extinct (RE)	A species is Regionally Extinct when it is extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
		Extinct in the Wild (EW)	A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside the past range.
	THREATENED SPECIES	**Critically Endangered, Possibly Extinct (CR PE)**	Possibly Extinct is a special tag associated with the category Critically Endangered, indicating species that are highly likely to be extinct, but the exhaustive surveys required for classifying the species as Extinct has not yet been completed. A small chance remains that such species may still be rediscovered
		Critically Endangered (CR)	A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
		Endangered (EN)	A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.
		Vulnerable (VU)	A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.
	OTHER SPECIES OF CONSERVATION CONCERN	**Near Threatened (NT)**	A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is therefore likely to become at risk of extinction in the near future.
		Critically Rare[N]	A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
		Rare[N]	A species is Rare when it meets at least one of four South African criteria for rarity but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria.
		Declining	A species is Declining when it does not meet or nearly meet any of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.
		Data Deficient - Insufficient Information (DDD)	A species is DDD when there is inadequate information to make an assessment of its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that a threatened classification is appropriate.

Status	Category	Description
OTHER CATEGORIES	**Data Deficient - Taxonomically Problematic (DDT)**	A species is DDT when taxonomic problems hinder the distribution range and habitat from being well defined, so that an assessment of risk of extinction is not possible.
	Least Concern (LC)	A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
	Not Evaluated (NE)	A species is Not Evaluated when it has not been evaluated against the criteria. The national Red List of South African plants is a comprehensive assessment of all South African indigenous plants, and therefore all species are assessed and given a national Red List status. However, some species included in Plants of southern Africa: an online checklist are species that do not qualify for national listing because they are naturalized exotics, hybrids (natural or cultivated), or synonyms. These species are given the status Not Evaluated and the reasons why they have not been assessed are included in the assessment justification.

Flora and fauna of conservation significance (including threatened, protected and rare species) likely to occur in the various habitats of the study area were assessed at a desktop level using information obtained from the following documents, on-line services and GIS information:

- List of SCC obtained from the EIA screening tool[5]
- SANBI's Plants of South Africa website (POSA) that allows the interrogation of the Botanical Database of Southern Africa (BODATSA) (http://posa.sanbi.org);
- Outputs of the Free State Terrestrial Biodiversity Plan (Collins, 2019);
- Outputs of the South African Bird Atlas Project (SABAP) (http://sabap2.adu.org.za/);
- Outputs of the South African Frog Atlas Project (SAFAP) (http://safap2.adu.org.za/);
- Atlas of African Orchids (http://vmus.adu.org.za/);
- iNaturalist (https://www.inaturalist.org);
- Geographical distribution data in Biodiversity Management Plans;
- Data from the Animal Demography unit (ADU, 2021);
- Various resources and references for Red Data listed species in South Africa (such as the Red Data Lists of Plants, Mammals, Reptiles and Amphibians).

The habitat requirements/preferences for each plant/animal SCC were reviewed (based on available literature) and then compared with the habitat occurring on the site in order to estimate the likelihood of these species occurring on the target property (as per the assessment matrix in Table 4).

[5] **Note**: In the event that a SCC is either not listed in the Screening Tool Report or it erroneously lists a SCC as highly unlikely to occur within the proposed development footprint, this will be indicated and an explanation/motivation for exclusion or inclusion of the relevant SCC will be provided. Moreover, in the event that the inclusion or exclusion of an SCC affects the outcome of the impact significance assessment, this will also be stipulated as part of the reporting process.

Table 4: Generic matrix used for the estimation and rating of flora/fauna species potential occurrence based on known habitat requirements/preferences and ranges.

<table>
<tr><td colspan="2" rowspan="3"></td><td colspan="4">SPECIES HABITAT REQUIREMENTS/PREFERENCES</td></tr>
<tr><td>Fully met</td><td>Largely met</td><td>Partially met</td><td>Not met</td></tr>
<tr><td>Natural condition</td><td>Fair condition</td><td>Poor-Fair condition</td><td>Poor condition/ Transformed</td></tr>
<tr><td rowspan="3">SPECIES DISTRIBUTION/ RANGE</td><td>Habitat occurs within known species geographic/altitudinal range</td><td>Highly Probable</td><td>Possible</td><td>Unlikely</td><td>Highly unlikely or Improbable</td></tr>
<tr><td>Habitat occurs on the edge of known species geographic/altitudinal range</td><td>Possible</td><td>Possible</td><td>Unlikely</td><td>Highly unlikely or Improbable</td></tr>
<tr><td>Habitat occurs outside of known species geographic/altitudinal range</td><td>Unlikely</td><td>Unlikely</td><td>Highly unlikely or Improbable</td><td>Highly unlikely or Improbable</td></tr>
</table>

The presence/absence of plant species only was then verified during field surveys. While general field observations for fauna were made, no taxon specific faunal sampling was undertaken (such verification would need to be undertaken by a qualified zoologist and taxon specialist who would conduct a faunal survey for the relevant taxa flagged for the site). Faunal features like dens, spoor[6] and skat[7] were recorded where possible but were not sought out. Table 4 below was then used to rate the likelihood of occurrence as either being "Low", "Medium" or "High" or "Confirmed[8]" (if species were observed during fieldwork on site within the development footprint, they were categorised as confirmed).

Table 5. Likelihood of occurrence rating derived from rationale base on distribution and habitat preferences of species at a desktop level, and field-based observations at a site level.

Likelihood of Occurrence Rating	Rationale
Confirmed	Species was observed on-site
High: probable	Highly Probable
Medium: possible	Possible
Medium: unlikely	Unlikely
Low	Highly unlikely or Improbable

[6] Spoor refers to a track of an animal e.g., print made by hooves.
[7] Skat refers to animal droppings.
[8] Definitive answers regarding the presence or absence of a particular SCC are not always possible. In such situations, the precautionary principle is applied so that preventative action is taken in the face of uncertainty. For species that are difficult to detect, it is not always possible to provide compelling evidence that a species does not occur. Therefore, if the habitat conditions appear suitable and there is data to suggest that the species did or could occur (e.g., confirmed records on adjacent properties), then the precautionary approach is to assume that the species does indeed occur there, and mitigation and management decisions need to be made accordingly.

2.2 Baseline Assessment

2.2.1 Vegetation Survey

A field survey was undertaken from the **29th of November to 3rd of December (early-summer)** to collect baseline data and to inform the impact assessment. The site visit and field survey entailed undertaking a site walkover within the study areas, with the following data collected in the field at points rated as high or moderate priority during the desktop prioritisation process:

- **Broad vegetation and structural type** – The vegetation communities encountered were classified into broad vegetation structural types e.g., grassland, bushland, scrubland etc. where applicable. Overall morphology and architecture of the plant community were also recorded where applicable.
- **Quantitative plant species composition** – Species composition refers to the relative proportions (%) of various plant species cover in relation to the total vegetation cover of a given area. The relative abundance of each species encountered was rated qualitatively on a 3-point scale of low, moderate and high based on visual observations.
- **Species of conservation concern (SCC)** – SCC are species that have a high conservation importance in terms of preserving South Africa's biodiversity and include rare and threatened species. This category also includes those classified in the categories Extinct in the Wild (EW), Regionally Extinct (RE), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient - Insufficient Information (DDD).
- **Observable existing onsite impacts** – Evidence of the physical disturbance to vegetation and soils and indirect impacts like erosion, sedimentation, contamination etc. were recorded.
- **Distinct vegetation boundaries** – Clear boundaries between distinct vegetation communities were recorded onsite. Between sampling points boundaries were extrapolated using the latest colour aerial photography for the area.

The location of protected plant species was recorded using a handheld GPS device. Where species could not be identified in the field, samples and photographs were taken to confirm at a later stage using available literature.

Note that no formal vegetation plots were undertaken, and no formal faunal sampling or searches were undertaken. Faunal features such as dens, spoor and skat were recorded where possible, including other visible evidence confirming highly probable evidence of presence.

2.2.2 Vegetation Mapping & Classification

Distinct vegetation communities were broadly mapped based on a combination of observed changes in species composition that were recorded with GPS points during the field visit and a review of available google earth imagery and the latest South African National Land Cover GIS layer (available from DFFE (2020) online at https://egis.environment.gov.za/).

The National Land Cover data in particular was used as a starting point to map secondary and transformed areas.

2.2.3 Ecological Condition Assessment

Vegetation communities / habitat units defined for the study area were assessed qualitatively in terms of their ecological condition. Ecological condition refers to the extent to which the composition, structure and function of an area or biodiversity feature has been modified from a natural reference condition. Table 6 below was used for providing a description and indicators of each ecological condition class. The descriptions provided are based on the Lexicon of Biodiversity Planning in South Africa (SANBI, 2016).

Table 6. Description and indicators of Ecological Condition Classes.

High-level classes	Description	Detailed classes	Description	Indicators
Good	Composition, structure and function are still intact or largely intact.	Natural	Unmodified. No significant changes in composition, structure or function have taken place.	• Characterised by native flora typical of reference sites. • Structural characteristics resemble that of reference plant communities. • Low to no disturbances evident.
		Near-natural	Small changes in composition and structure may have taken place, but ecosystem functions are essentially unchanged.	• A very minor change to vegetation composition is evident at the site. • Abundance of ruderal/pioneer species is slightly higher than natural. • Limited disturbances evident.
Fair	Ecological function is maintained even though composition and structure have been compromised.	Moderately Modified/semi-natural	Ecological function is predominantly unchanged even though composition and structure have been compromised.	• Natural vegetation composition has been moderately altered. • Introduced alien and/or increased ruderal/pioneer species are still clearly less abundant than native species characteristic of the natural species composition. • Moderate change in structural characteristics (e.g., moderate increase / decrease in woody plants). • Moderate disturbances evident

High-level classes	Description	Detailed classes	Description	Indicators
Poor	Ecological function has been severely compromised or lost in addition to structure and composition.	**Severely Modified**	Loss of composition, structure and ecological function is extensive.	• Natural vegetation composition has been largely altered. • Introduced alien and/or increased ruderal/pioneer species occur in approximately equal abundance to the characteristic indigenous species. • High change in structural characteristics relative to reference plant communities. • High levels of grazing / disturbance evident.
		Irreversibly Modified	The ecosystem has been modified completely, with an almost complete loss of composition and structure. All or most ecosystem function has been destroyed and the changes are irreversible.	• Natural vegetation composition has been substantially altered but some characteristic species remain. • Vegetation consists mainly of introduced, alien and/or ruderal/pioneer species. • Evidence of erosion or compaction based on or reflecting high levels of disturbance. • Evidence of recent transformation (e.g. agriculture).
Lost	Composition, structure and function destroyed.	**Outright Loss**	(The result of a hard surface e.g., concrete, as opposed to "irreversibly modified" which may be a soft surface such as irrigated cropland.)	• Present cultivated lands (crops, forestry, etc.). • Developed land (Houses, Roads, etc.)

2.2.4 Site Ecological Importance

Site Ecological Importance (SEI) was assessed based on the approach outlined in the "Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols" compiled by SANBI (2020) according to recommended best-practice for environmental impact assessments in South Africa. The approach detailed below is largely reproduced verbatim with minor adjustments from the document referenced above.

All the vegetation communities that have been mapped as well as any rare or threatened flora recorded occurring on-site were considered 'receptors of impacts' within this terrestrial assessment report. Each receptor (e.g., a threatened floral species or a mapped vegetation community) was taken into consideration to determine the Floral SEI associated with the development project. The process of assessing SEI is described in more detail below (SANBI, 2020).

SEI is considered to be a function of the Biodiversity Importance (BI) of the receptor (e.g., species of conservations concern, the vegetation /community or habitat type present on the site) and its resilience to impacts – Receptor Resilience (RR) as follows:

SEI = BI + RR

BI in turn is a function of Conservation Importance (CI) and the Functional Integrity (FI) of the receptor as follows:

BI = CI + FI

CI is defined here as: "*The importance of a site for supporting biodiversity features of conservation concern present e.g., populations of IUCN Threatened and Near-Threatened species (CR, EN, VU & NT), Rare, range-restricted species, globally significant populations of congregatory species, and areas of threatened ecosystem types, through predominantly natural processes.*"

Key criteria used to inform the CI at a site include the following (SANBI, 2020):

- IUCN Threatened and Near-Threatened Species (CR, EN, VU & NT) - either the global or national assessments, where the global and national assessments differ for the same taxon, the most recent evaluation of status was used in calculating SEI.
- Rare species i.e. those included on South Africa's National Red List as Rare or Critically Rare or Extremely Rare. These are highly restricted species that are currently not declining. However, should any development impact on a population of these species they will immediately qualify under one of the IUCN categories of threat.
- Range-restricted species – the presence of terrestrial flora with a global population extent of occurrence (EOO) of 10 000 km^2 or less.
- Significant areas of threatened vegetation types – this is a function of both the area (size) being considered in relation to the total extent of that vegetation type (i.e. proportion) and how threatened (CR, EN, VU) the vegetation types are; and
- Natural processes – natural unmanaged areas with low levels of ecological disturbance have largely intact natural processes such as pollination, seed dispersal and migration, and thus have greater intrinsic conservation importance than those that are modified through ecological disturbance.

Please note that no faunal species have been assessed as receptors within this report as this should be done by the relevant faunal taxon specialist and is beyond the scope of this vegetation assessment.

Moreover, the SEI has only been assessed for vegetation communities that fall within the project footprint and does not extend to the entire Project Area of Influence which falls beyond the project footprint. Assessment of Conservation Importance will include an assessment of the suitability/potential of the vegetation communities to support floral populations which fall under one of the criteria included for threatened and rare species.

Table 7. Conservation Importance Criteria (SANBI, 2020)

Conservation Importance	Fulfilling Criteria
Very High	• Confirmed or highly likely occurrence of CR, EN, VU or Critically Rare species that have a global EOO of < 10 km^2 • Any area of natural habitat[9] of a CR ecosystem type or large area (> 0.1 % of the total ecosystem type extent[10]) of natural habitat of EN ecosystem type • Globally significant populations of congregatory species (>10% of global population)
High	• Confirmed or highly likely occurrence of CR, EN, VU species that have a global EOO > 10 km2. IUCN threatened species (CR, EN, VU) must be listed under any criterion other than A. If listed as threatened only under Criterion A, include if there are less than 10 locations or < 10 000 mature individuals remaining. • Small area (>0.01% but < 0.1 % of the total ecosystem type extent) of natural habitat of EN ecosystem type or large area (> 0.1 %) of natural habitat of VU ecosystem type. • Presence of Rare species. • Globally significant populations of congregatory species (>1% but <10% of global population).
Medium	• Confirmed or highly likely occurrence of populations of NT species, threatened species (CR, EN, VU) listed under A criterion only and which have more than 10 locations or more than 10 000 mature individuals. • Any area of natural habitat of threatened ecosystem type with status of VU Presence of range-restricted species • > 50 % of receptor contains natural habitat with potential to support SCC
Low	• No confirmed or highly likely populations of SCC • No confirmed or highly likely populations of range-restricted species • < 50 % of receptor contains natural habitat with limited potential to support SCC
Very Low	• No confirmed and highly unlikely populations of SCC • No confirmed and highly unlikely populations of range-restricted species • No natural habitat remaining

FI of the receptor (e.g., the vegetation/fauna community or habitat type) is defined here as the receptors' current ability to maintain the structure and functions that define it, compared to its known or predicted state under ideal conditions.

[9] This excludes areas of transformed habitat within a defined ecosystem even if these are partially restored, e.g. Highveld grasslands that have been converted to maize fields and then abandoned so that some form of functional grassland is restored; this is not natural habitat as it does not and will not in the future have species composition representative of the original natural habitat.
[10] Calculated from the threatened ecosystem of South Africa shapefile available from the SANBI (current available version 2011: http://bgis.sanbi.org/Projects/Detail/49)

Simply stated, FI is: "*A measure of the ecological condition of the impact receptor as determined by its remaining intact and functional area, its connectivity to other natural areas and the degree of current persistent ecological impacts.*" (SANBI, 2020)

These criteria can be defined as (SANBI, 2020):

- **Connectivity to other natural areas** - connectivity, which can also be measured conversely as the degree of habitat fragmentation, refers to how connected habitat patches are to each other, which has a significant influence on numerous ecological processes, such as migration and dispersal opportunities of biota and therefore genetic exchange between populations. Connectivity to other similar habitats becomes more important as the remaining intact and functional area of a habitat decreases, mainly because population sizes decrease and are therefore at greater risk from ecological perturbations and inbreeding effects. The degree of connectivity between habitat patches varies greatly with the dispersal ability of the taxon or taxon group (e.g., fossorial reptiles) in question;
- **Degree of current persistent negative ecological impacts** - persistent negative impacts such as uncontrolled spread of alien and invasive flora effectively decreases both the remaining intact area and ecosystem functioning of a particular habitat; and
- **Remaining intact and functional area** – the proportion of the receptor that supports natural habitat with intact ecological processes - small areas are less likely to withstand ecological degradation compared to large areas and are therefore better able to maintain structure and function allowing for intact ecological processes.

Ecological processes can be considered to be mostly intact and functional if the receptor area has low levels of current ecological disruptors, has good connectivity to other areas and is a relatively large area.

Table 8. Functional Integrity Criteria (SANBI, 2020).

Functional Integrity	Fulfilling Criteria
Very High	• Very large (>100 ha) intact area for any conservation status of ecosystem type or >5 ha for CR ecosystem types • High habitat connectivity serving as functional ecological corridors, limited road network between intact habitat patches • No or minimal current negative ecological impacts with no signs of major past disturbance (e.g. ploughing)
High	• Large (>20 ha but <100 ha) intact area for any conservation status of ecosystem type or >10 ha for EN ecosystem types • Good habitat connectivity with potentially functional ecological corridors and a regularly used road network between intact habitat patches • Only minor current negative ecological impacts (e.g. few livestock utilising area) with no signs of major past disturbance (e.g. ploughing) and good rehabilitation potential
Medium	• Medium (>5 ha but <20 ha) semi-intact area for any conservation status of ecosystem type or > 20 ha for VU ecosystem types • Only narrow corridors of good habitat connectivity or larger areas of poor habitat connectivity and a busy used road network between intact habitat patches

Functional Integrity	Fulfilling Criteria
	• Mostly minor current negative ecological impacts with some major impacts (e.g. established population of alien and invasive flora) and a few signs of minor past disturbance; moderate rehabilitation potential
Low	• Small (>1 ha but <5 ha) area • Almost no habitat connectivity but migrations still possible across some transformed or degraded natural habitat and a very busy used road network surrounds the area. Low rehabilitation potential • Several minor and major current negative ecological impacts
Very Low	• Very small (<1 ha) area • No habitat connectivity except for flying species or flora with wind-dispersed seeds. • Several major current negative ecological impacts

Recalling that BI is a function of CI and the FI of a receptor, BI was thereafter derived from a simple matrix of CI and FI as follows:

Table 9. Biodiversity Importance Matrix (SANBI, 2020).

Biodiversity Importance		Conservation Importance				
		Very High	High	Medium	Low	Very Low
Functional Integrity	Very High	Very High	Very High	High	Medium	Low
	High	Very High	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very Low
	Low	Medium	Medium	Low	Low	Very Low
	Very Low	Medium	Low	Very Low	Very Low	Very Low

RR is defined here as: "*The intrinsic capacity of the receptor to resist major damage from disturbance and /or to recover to its original state with limited or no human intervention.*" (SANBI, 2020)

The fulfilling criteria to evaluate RR is based on the estimated recovery time required to restore an appreciable portion of functionality to the receptor (Table 10). Each rare and threatened species and mapped vegetation community will be assigned a RR Rating ranging from Very High Resilience to Very Low Resilience with a short rational provided for each rating. Receptor resilience is dependent on the nature of the disturbance or impact and therefore needs to be assessed in relation to these factors in the accompanying rationale for each rating assigned. Thus, a receptor is likely to have multiple ratings associated with a suite of anticipated impacts linked to the proposed development. However, only the lowest receptor resilience rating assigned to each receptor will be reported on to highlight the most notable vulnerability associated with a receptor and the relevant anticipated impact that represents the greatest threat.

Table 10. Receptor Resilience Criteria (SANBI, 2020).

Resilience	Fulfilling Criteria
Very High	Habitat that can recover rapidly (~ less than 5 years) to restore > 70 % of the original species composition and functionality of the receptor functionality, or species that have a very high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a very high likelihood of returning to a site once the disturbance or impact has been removed
High	Habitat that can recover relatively quickly (~ 5-10 years) to restore > 70 % of the original species composition and functionality of the receptor functionality, or species that have a high likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a high likelihood of returning to a site once the disturbance or impact has been removed
Medium	Will recover slowly (~more than 10 years) to restore > 70 % of the original species composition and functionality of the receptor functionality, or species that have a moderate likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a moderate likelihood of returning to a site once the disturbance or impact has been removed
Low	Habitat that is unlikely to be able to recover fully after a relatively long period: > 15 years required to restore ~less than 50 % of the original species composition and functionality of the receptor functionality, or species that have a low likelihood of remaining at a site even when a disturbance or impact is occurring, or species that have a low likelihood of returning to a site once the disturbance or impact has been removed
Very Low	Habitat that is unable to recover from major impacts, or species that are unlikely to remain at a site even when a disturbance or impact is occurring, or species that are unlikely to return to a site once the disturbance or impact has been removed

Finally, once both BI and RR were assessed SEI was determined from the final matrix as follows:

Table 11. SEI Matrix (SANBI, 2020).

Site Ecological Importance		Biodiversity Importance				
		Very High	High	Medium	Low	Very Low
Receptor Resilience	Very Low	Very High	Very High	High	Medium	Low
	Low	Very High	High	Medium	Medium	Low
	Medium	High	Medium	Medium	Low	Very Low
	High	Medium	Medium	Low	Low	Very Low
	Very High	Medium	Low	Very Low	Very Low	Very Low

SEI was then clearly mapped for each vegetation community in relation to the proposed development activities and infrastructure. Interpretation of SEI in the context of the proposed development activities was then provided according to Table 12 below.

Table 12. Interpretation of SEI in relation to proposed development activities (SANBI, 2020).

Site Ecological Importance	Interpretation in relation to proposed development activities
Very High	Avoidance mitigation - No destructive development activities should be considered. Offset mitigation not acceptable/not possible (i.e., last remaining populations of species, last remaining good condition patches of ecosystems/unique species assemblages. Destructive impacts for species/ecosystems where persistence target remains.

Site Ecological Importance	Interpretation in relation to proposed development activities
High	Avoidance mitigation wherever possible. Minimization mitigation – Changes to project infrastructure design to limit the amount of habitat impacted; limited development activities of low impact acceptable. Offset mitigation may be required for high impact activities.
Medium	Minimization & restoration mitigation - Development activities of medium impact acceptable followed by appropriate restoration activities.
Low	Minimization & restoration mitigation - Development activities of medium to high impact acceptable followed by appropriate restoration activities.
Very Low	Minimization mitigation - Development activities of medium to high impact acceptable and restoration activities may not be required.

2.3 Biodiversity Impact Assessment Framework

The Biodiversity Impact Assessment has been aligned closely with the minimum criteria and requirements for Terrestrial Biodiversity Impact Assessments 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. 648 (10 May 2019).

For the purposes of this assessment, the assessment of potential impacts was undertaken using an "*Impact Assessment Methodology for EIAs*" adopted by SLR provided to Eco-Pulse on the 16th of January 2023. This assessment was informed by baseline terrestrial biodiversity information contained in this report relating to the importance and sensitivity of terrestrial habitats and potential occurrence of protected species as well as available information on the proposed development provided by the client and experience in similar projects in South Africa and the Free State. Queries regarding the assessment method criteria and the formulas used to generate ratings should be directed towards SLR. Detail of the assessment methodology and impact rating system is provided in **Annexure F.**

The process begins with a description of the proposed prospecting and associated activities (for the various phases, including construction and operation); with the various environmental stressors and direct/indirect risks associated with prospecting activities then defined. Based on the stressors and anticipated risks, impacts are then described under six (6) distinct categories with impact significance assessed for each impact category based on a range of assessment criteria. The general framework for the biodiversity impact assessment is shown below in Table 13.

Table 13. Terrestrial Biodiversity Impact Assessment Framework for the development project.

TERRESTRIAL BIODIVERSITY IMPACT ASSESSMENT FRAMEWORK	
DEVELOPMENT TYPE & ACTIVITIES	
Construction Phase Activities: *To be described and defined*	Operational Phase Activities: *To be described and defined*

ENVIRONMENTAL STRESSORS & RISKS		
Construction Phase Stressors & Risks: *To be identified and described*		Operational Phase Stressors & Risks: *To be identified and described*
TERRESTRIAL BIODIVERSITY IMPACTS		
1	Impact on vegetation structure and plant species composition	
2	Impact on populations of species of special concern	
3	Impact on targets for threatened ecosystems	
4	Impact on ecological processes and functionality of ecosystems	
5	Impact on overall species and ecosystem diversity	
6	Impact on ecological connectivity	

The significance of the potential impacts of the proposed development on terrestrial biodiversity and 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" scenario** – this is a realistic best-case scenario involving the effective implementation of construction mitigation, incorporation of the majority of design mitigation, good operational maintenance and successful rehabilitation. Please note that this realistic scenario does not assume that unrealistic mitigation measures will be implemented and/or measures known to have poor implementation success (>90% of the time) will be effectively implemented.

Impact significance rating classes as presented in the methodology provided to Eco-Pulse by SLR for use in this assessment are outlined in Table 14, below.

Table 14: 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.

2.4 Assumptions and Limitations

The following limitations and assumptions apply to this assessment:

2.4.1 Sampling limitations and assumptions

- The study focused on 'terrestrial' or 'dryland' vegetation occurring within the study area. Wetland/aquatic vegetation and habitats were not included as these were dealt with separately in the Specialist Wetland Assessment Report compiled by Eco-Pulse (Report No. EP622-01).
- The field assessment was undertaken in early-summer (November/December 2022) within the recommended sampling season as prescribed in the "Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Flora and Terrestrial Fauna Species Protocols" compiled by SANBI (2020).
- With ecology being dynamic and complex, there is the likelihood that some aspects (some of which may be important) may have been overlooked.
- Rapid sampling and rapid habitat assessment tools were used due to time and budget constraints and the inherent low sensitivity of the majority of the receiving terrestrial environments at the site. Thus, formal vegetation plots and detailed habitat sampling and analyses were not undertaken, limiting the resolution of the information captured and produced in this study.
- The location of plant species of conservation concern was recorded using a Garmin Montana™ Global Positioning System (GPS) and captured on a map of the area using a Geographical Information System (GIS). GPS accuracy was limited to 3-5m.
- While an assessment of the potential occurrence of floral species of conservation concern has been undertaken, and is informed by readily available information, this provides only a surrogate indicator of the likelihood of such species occurring. This is however regarded as appropriate given the level of habitat degradation/transformation across much of the project area.
- The accuracy of desktop species information is limited to historic data and available databases for the area apply. Note that data and information obtained from published articles, reference books, field guides, official databases or any other official published or electronic sources are assumed to be correct, and no review of such data was undertaken by Eco-Pulse.
- Information on the threat status of plants species was informed by the SANBI Threatened Species Online database, which was assumed to be up to date and accurate at the time of compiling this report. Any changes made after the compilation of the report are therefore not covered.
- The assessment of the potential occurrence of fauna was informed by the presence and condition of ideal habitat for each faunal species. The habitat condition / integrity was used as a surrogate indicator of the likelihood of a particular species being present.
- No formal faunal sampling or surveys were undertaken and this report does not serve as a substitute for detailed and taxon-specific specialist reports required for faunal species flagged as being of very high – medium sensitivity, and where habitat requirements are largely met or evidence of occurrence is found.

- Due to the complexities of ecological systems and the sensitive dependence on initial conditions, any predictions of the effects of perturbation are made with very low confidence.
- Additional information used to inform the assessment was limited to data and GIS coverage's available for the province and district municipality at the time of the assessment.

2.4.2 Vegetation community mapping limitations and assumptions

- Limited GPS data and the SANLC 2020 layer were used to inform the mapping of vegetation communities and assign their condition classes. Therefore, it should be noted that a high degree of uncertainty is associated with this coarse-scale mapping, with the high likelihood that these may be revised following further sampling.

2.4.3 Potential Occurrence Assessment

- Information on the threat status of plants species was informed largely by the SANBI Threatened Species Online database, which was assumed to be up to date and accurate at the time of compiling this report. Any changes made after the compilation of the report are therefore not covered.
- The assessment of the POC of fauna was informed by the presence and condition of ideal habitat for each faunal species. The habitat condition / integrity was used as a surrogate indicator of the likelihood of a particular species being present.
- Additional information used to inform the assessment was limited to data and GIS coverage's available for the province and district municipality at the time of the assessment.
- In terms of faunal surveys and assessments, no formal faunal sampling or surveys were undertaken, and this report does not serve as a substitute for detailed and taxon-specific specialist reports required for faunal species flagged as being of very high – medium sensitivity and where these are likely to occur at the site.

2.4.4 General assumptions and limitations

- This report deals exclusively with a defined area and the extent and the nature of terrestrial habitat and ecosystems in that area.
- Additional information used to inform the assessment was limited to desktop data and GIS coverage's available for the province at the time of the assessment.
- It is assumed that all limitations will be clearly communicated by the EAP to the Commenting and Competent Authorities responsible for reviewing the EIA.

- It is assumed that all relevant Commenting Authorities will be consulted as part of the Application for EA process to establish their requirements for the site and that they will be provided the opportunity to make an input into the formal EIA process required prior to the development of the site.

2.4.5 Impact Assessment

- At the time of this impact significance assessment finalised site plans were available. However, this impact assessment should be regarded as preliminary and subject to more detailed impact evaluations for specific activities if site plan changes are made.
- Ancillary infrastructure such as new roads, powerlines, or pipelines do not form part of this assessment. The omission of these items is not an oversight.
- The impact assessment was only undertaken for a single development scenario (cumulative impacts) under two mitigation scenarios referred to as the ‘realistic poor mitigation’ and ‘realistic good mitigation’ scenarios.
- The assessment of impacts and recommendation of mitigation measures was informed by the site-specific ecological concerns arising from the field survey and based on the assessor’s working knowledge and experience with similar development projects.
- The impact descriptions and assessment are based on the author’s understanding of the proposed development based on information provided.
- Evaluation of the significance of impacts with mitigation considers mitigation measures provided in this report as well as standard mitigation measures.

3. ECOSYSTEM CONTEXT

Understanding the biophysical and conservation context of the study area and surrounding landscape is important as it informs decision making regarding the significance of the area to be affected. In this regard, national, provincial, and regional biophysical and conservation datasets were screened, the results of which are presented in the sections that follow.

3.1 Biophysical Setting & Context

A summary of key biophysical setting details for the study area is presented in Table 15 below.

Table 15. Key biophysical setting details of the study area.

Biophysical Aspects	Desktop Biophysical Details	Source
Elevation	1274 – 1480m a.m.s.l. (above mean sea level)	Google Earth™
Mean annual precipitation (MAP)	500 - 700mm	DWA, 2005
Rainfall seasonality	Early – late summer	DWA, 2005
Geology	Aeolian and colluvial sand overlaying sandstone, mudstone and shale of the Karoo Supergroup (Vaal-Vet Sandy Grassland);	Mucina & Rutherford, 2006

Biophysical Aspects	Desktop Biophysical Details	Source
	deposits of sandstone, mudstone and shale interrupted by dolerite sills (Western Free State Clay Grassland); and andesitic lavas of the Allanridge formation and sediments of the Karoo Supergroup (Kimberley Thornveld).	
Quaternary catchment	C25B, C25C, C25F	DWS
Main collecting river(s) in the catchment	C25B – Sandspruit C25C - Vaal C25F – Vaal	NFEPA Rivers (NBA, 2018)
Ecoregion	Highveld	DWAF, 2007

3.2 Ecological and Conservation Context

To inform the appraisal of current existing disturbances and impacts, as well as the assessment of direct, indirect, and residual impacts associated with the proposed prospecting activities under a post-mitigation scenario, the reference vegetation types and additional spatial conservation data sets ranging from species-specific to landscape scale were interrogated and are summarised below.

3.2.1 Regional Vegetation Types

The national vegetation classification indicates that the reference terrestrial vegetation for the study area comprises **Vaal-Vet Sandy Grassland**, **Kimberley Thornveld** and **Western Free State Clay Grassland** (SANBI, 2018). According to the National Environmental Management: Biodiversity Act or NEMBA: revised national list of threatened terrestrial ecosystems (18 November 2022) **Vaal-Vet Sandy Grassland** is listed as 'Endangered', while **Kimberley Thornveld** and **Western Free State Clay Grassland** are listed as 'Least Concern'. Furthermore, according to the FSBP (Collins, 2019), **Vaal-Vet Sandy Grassland** is considered CR at a provincial level (Table 16). In addition, the red list of threatened ecosystems classification – original extent and remnants – was consolidated. **Vaal-Vet Sandy Grassland, Kimberley Thornveld** and **Western Free State Clay Grassland** are considered endemic to the Free State.

Table 16. National and provincial vegetation classification and threat status (SANBI, 2018; Collins, 2019)

Vegetation Types	National Threat Status	Provincial Threat Status
Vaal-Vet Sandy Grassland	Endangered (EN)	Critically Endangered (CR)
Kimberley Thornveld	LC	LC
Western Free State Clay Grassland	LC	LC

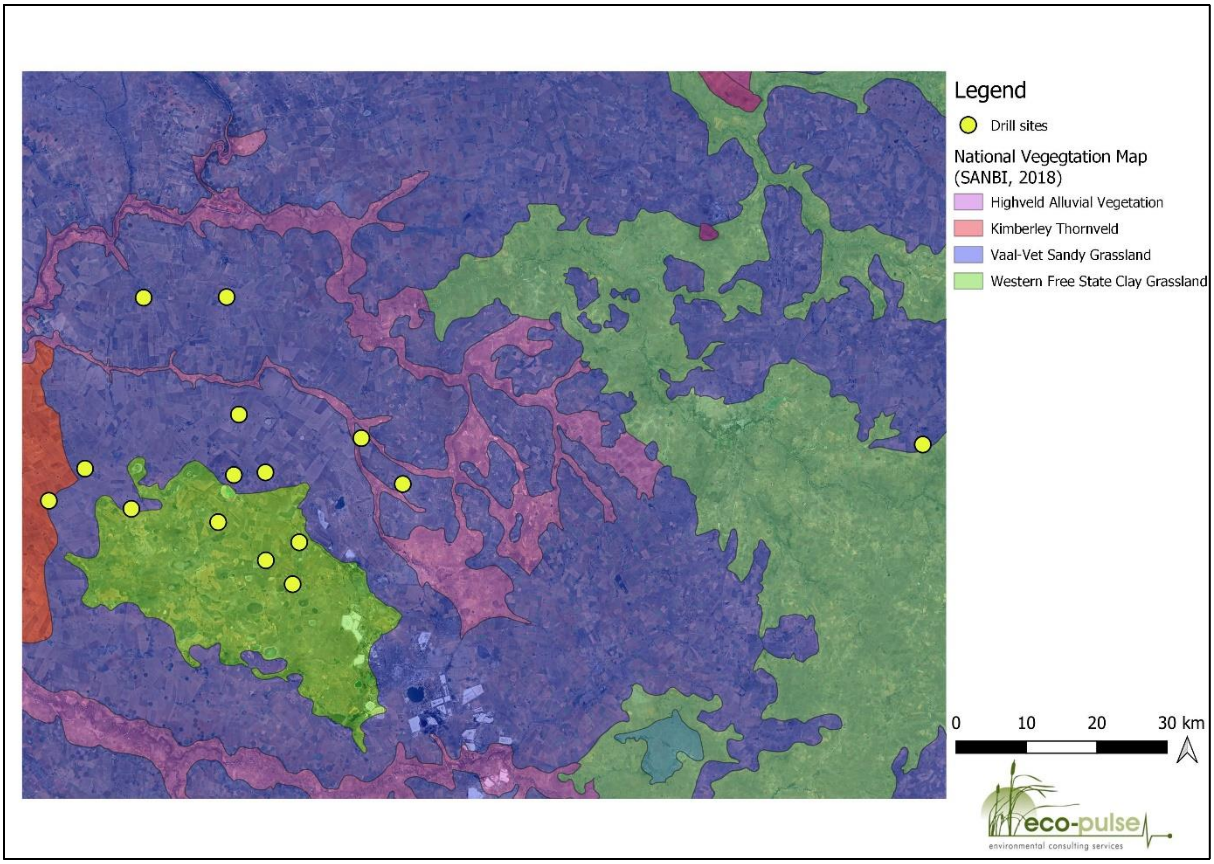

Figure 6. National Vegetation Map (SANBI, 2018).

The reference vegetation types assigned above are characterised by the following important/diagnostic, biogeographically significant and endemic taxa:

Vaal-Vet Sandy Grassland (Mucina & Rutherford, 2011):

Important taxa

Graminoids: *Anthephora pubescens, Aristida congesta, Chloris virgata, Cymbopogon caesius, Cynodon dactylon, Digitaria argyrograpta, Elionurus muticus, Eragrostis chloromelas, E. lehmanniana, E. plana, E. trichophora, Heteropogon contortus, Panicum gilvum, Setaria sphacelate, Themeda triandra, Tragus berteronianus, Brachiaria serrata, Cymbopogon pospischilii, Digitaria eriantha, Eragrostis curvula, E. obtuse, E. superba, Panicum coloratum, pogonarthria squarrosa, Trichoneura grandiglumis, Triraphis andropogonoides.* Herbs: *Stachys spathulate, Barleria macrostegia, Berkheya onopordifolia var. onopordifolia, Chamaesyce inaequilatera, Geigeria aspera var. aspera, Helichrysum caespititium, Hermannia depressa, Hibiscus pusillus, Monsonia burkeana, Rhynchosia adenodes, Selago densiflora, Vernonia oligocephala.* Geophytic Herbs; *Bulbine narcissifolia, Ledebouria marginata.* Succulent Herbs: *Tripteris aghillana var. integrifolia.* Low Shrubs: *Felicia muricata, Pentzia globose, Anthospermum rigidum subsp. Pumilum, Helichrysum gregeanum, H. Paronychiodes, Ziziphus zeyheriana.*

Kimberley Thornveld (Mucina & Rutherford, 2011):

Important taxa

Tall Tree: *Acacia erioloba.* Small Trees: *Acacia karroo, A. mellifera subsp. Detinens, A. tortilis subsp. Heteracantha, Rhus lancea.* Tall Shrubs: *Tarchonanthus camphoratus, Diospyros pallens, Ehretia rigida subsp. Rigida, Euclea crispa subsp. Ovata, Grewia flava, Lycium Arenicola, L. hirsutum, Rhus tridactyla.* Low Shrubs: *Acacia hebeclada subsp. Hebeclada, Anthospermum rigidum subsp. Pumilum, Helichrysum zeyheri, Hermannia comosa, Lycium pilifolium, Melolobium microphyllum, Pavonia burchellii, Peliostomum leucorrhizum, Plinthus sericeus, Wahlenbergia nodosa.* Succulent

Shrubs: *Aloe hereroensis var. hereroensis, Lycium cinereum.* Graminoids: *Eragrostis lehmanniana, Aristida canescense, A. congesta, A. mollissima subsp. Argentea, Cymbopogon pospischilli, Digitaria argyrograpta, D. eriantha subsp. Eriantha, Enneapogon cenchroides, E. scoparius, Eragrostis rigidior, Heteropogon contortus, Themeda triandra.* Herbs: *Barleria macrostegia, Dicoma schinzii, harpagophytum procumbens subsp. Procumbens, Helichrysum cerastioides, Hermbstaedtia odorata, Hibscus marlothianus, Jamesbrittenia aurantiaca, Lippia scaberrima, Osteospermum muricatum, Vahlia capensis subsp. vulgaris.* Succulent Herbs: *Aloe grandidentata, Piaranthus decipiens.*

Western Free State Clay Grassland (Mucina & Rutherford, 2011):

Important taxa

Graminoids: *Aristida adscensionis, A. bipartita, Cynodon dactylon, Eragrostis chloromelas, E. lehmanniana, Panicum coloratum, Themeda triandra, Aristida congesta, Cymbopogon pospischilli, Digitaria eriantha, Eragrostis bicolor, E. curvula, E. micrantha, E. obtuse, E. plana, E. superba, E. thrichophora, Heteropogon contortus, Setaria nigrirostris, Tragus berteronianus, T. koeleriodes, T. racemosus.* Herbs: *Berkheya onopordifolia var onopodifolia, Chamaesyce inaequilatera, Gnaphalium declinatum, Indigofera alternans, Kohautia cynanchica, Nidorella microcephala, Platycarpha parvifolia, Salvia stenophylla, Selago paniculate, Stachys spathulata.* Geophytic Herbs: *Bulbine narcissifolia, Oxalis depressa.* Succulent Herbs: *Tripteris aghillana var. integrifolia.* Low Shrubs: *Lycium cinereum, Pentzia globose, Amphiglossa trifloral, Aptosimum elongatum, Berkheya annectens, Felicia filifolia subsp. Filifolia, F. muricata, Gnida polycephala, Helichrysum dregeanum, Melolobium candicans, Nenax microphylla, Rosenia humilis, Selago saxatilis.* Succulent Shrub: *Hertia pallens.*

Table 17 below indicates the extent of provincial vegetation types within the study area as contained in the FSBP (Collins, 2019). Vaal-Vet Sandy Grassland, Kimberley Thornveld and Western Free State Clay Grassland cover 10.2, 0.5 and 4 hectares of the study area respectively.

Table 17. Conservation targets, ecosystem status and level of protection based on 2019 accumulated transformation statistics of the Free State vegetation types that occur on-site (extracted from Collins, 2019), and the extent in hectares of the vegetation types that occur within the three properties.

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

3.2.2 Regional Conservation Planning

The FSBP is a strategic conservation plan developed in 2019 by the Provincial Authority, Department of Economic, Small Business Development, Tourism and Environmental Affairs (DESTEA) to ensure that representative samples of biodiversity are conserved. It is used as a land use decision support tool in the Free State. In terms of terrestrial conservation, seven conservation categories were developed including (i) Protected. (ii) CBA: Irreplaceable (CBA1), (iii) CBA: Optimal (CBA2), (iv) Ecological Support Area 1 (ESA

1), (v) Ecological Support Area 2 (ESA 2), (vi) Other Natural Areas, and (vii) Degraded. These conservation categories are described in Table 18 below.

Table 18. Description of conservation categories.

Conservation Category	Description
Protected	An area located within a protected area.
Critical Biodiversity Area: Irreplaceable	A site that is irreplaceable or near-irreplaceable for meeting biodiversity targets. There are no or very few other options for meeting biodiversity targets for the features associated with the site. Such sites are therefore critical and they need to be maintained to ensure that features targets are achieved and that such features persist.
Critical Biodiversity Area: Optimal	A site that has been selected based on its complementarity for meeting biodiversity targets. CBA Optimal sites are therefore important but their maintenance is not critical to ensure that features targets are achieved and that such features persist.
Ecological Support Area 1	An area that plays an important role in supporting the ecological functioning of a protected area or Critical Biodiversity Area, or in delivering ecosystem services with minimal degradation.
Ecological Support Area 2	An area that plays an important role in supporting the ecological functioning of a protected area or Critical Biodiversity Area, or in delivering ecosystem services, with degradation, i.e. they can be totally degraded, but not totally transformed.
Other Natural Areas	An area of natural habitat not required to meet biodiversity targets for ecosystem types, species or ecological processes.
Degraded	An area of degraded or transformed habitat that has not been selected as an ESA.

According to the FSBP (Collins, 2019) some of the target areas for the drill sites fall within areas classified as **ESA 2** (see Figures 7 – 12). It is evident from the spatial coverage that the 'ESA 2' status assigned to these areas is vegetation driven due to the current and potential presence of degraded but natural vegetation. However, ESA 2 areas have a marginal presence within site areas, in some cases areas are fully transformed, as shown in Figure 7 - 12. The inclusion of ESA 2 areas within the project area is not considered as a definitive concern.

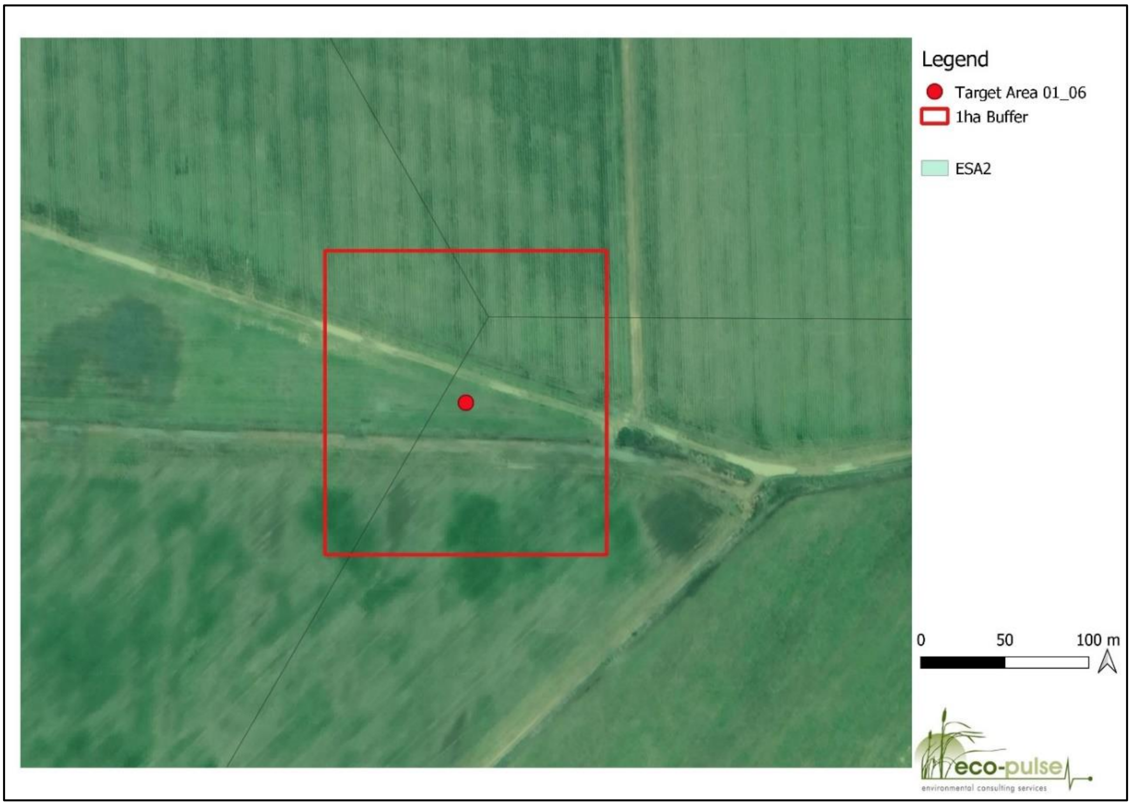

Figure 7 Map showing the extent of 'ESA2 2' according to the Free State Province Biodiversity Plan (Collins, 2019), for Target Area 01_06.

Figure 8 Map showing the extent of 'ESA2 2' according to the Free State Province Biodiversity Plan (Collins, 2019), for Target Area 01_07.

Figure 9 Map showing the extent of 'ESA2 2' according to the Free State Province Biodiversity Plan (Collins, 2019), for Target Area 01_10.

Figure 10 Map showing the extent of 'ESA2 2' according to the Free State Province Biodiversity Plan (Collins, 2019), for Target Area 01_11.

Figure 11 Map showing the extent of 'ESA2 2' according to the Free State Province Biodiversity Plan (Collins, 2019), for Target Area 01_12.

Figure 12 Map showing the extent of 'ESA2 2' according to the Free State Province Biodiversity Plan (Collins, 2019), for Target Area 02_01.

3.2.3 Protected Areas

According to the South African Protected Areas Database (SAPAD) (DFFE, 2023), there are no national protected areas found within the project area. Additionally, the study area has not been flagged for future formal protection according to the spatial outputs of the National Protected Area Expansion Strategy (NPAES) (DFFE, 2018).

3.3 Historic Land Use & Disturbance Regime

An understanding of historic land use and disturbance at the site was gained by reviewing historical imagery and orthophotos. It appears that most of the study area has been impacted by clearing of vegetation for agriculture and the development of roads since 1950. Historic imagery from 1950 – 1961 was reviewed for focal sites, indicating the landscape was likely transformed for agricultural purposes prior to 1950 (Figure 13 – 19). It is clear from the historical images that the landscape has remained fairly consistent – the dominant land use type has remained for agricultural purposes.

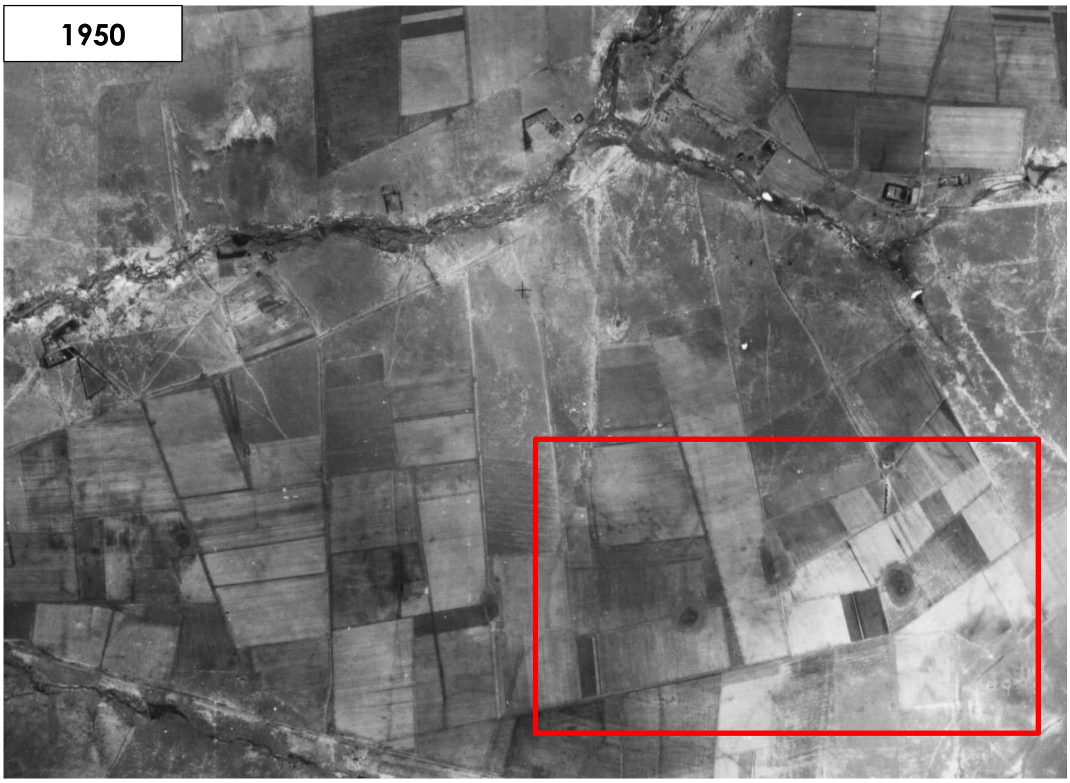

Figure 13 Historical image (aerial photograph) dating back to 1950, the focus area is estimated shown outlined in "red".

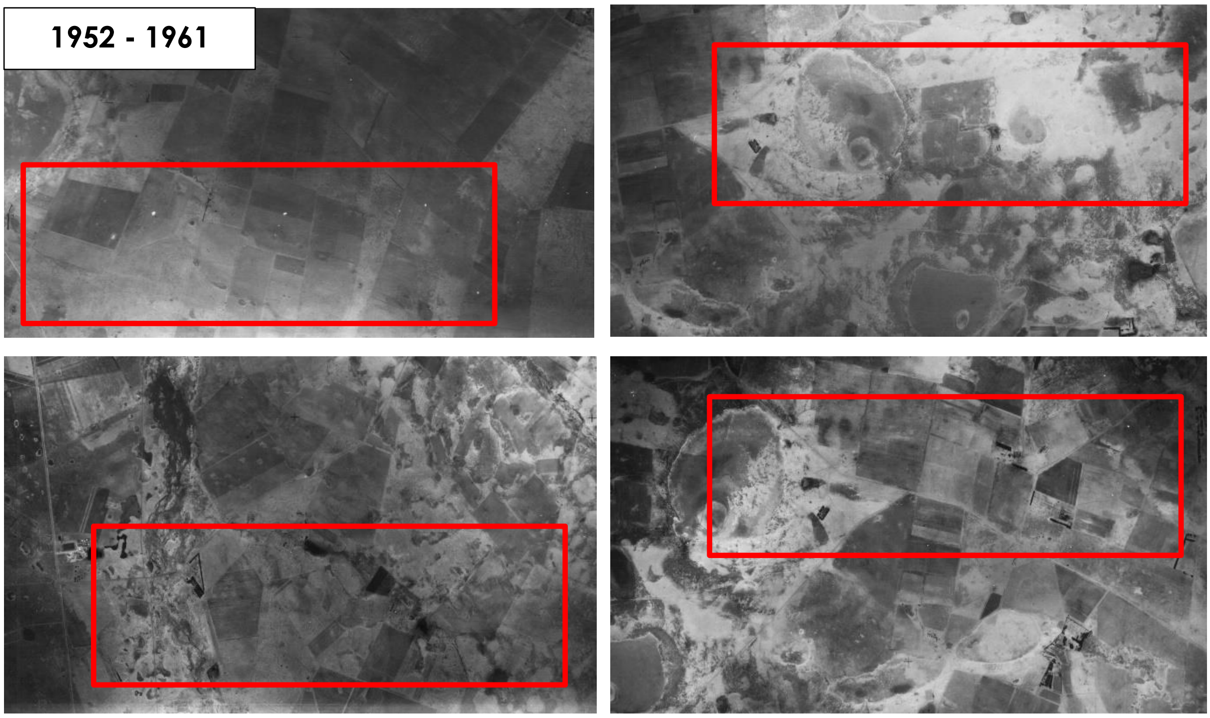

Figure 14 Historical images (aerial photograph) dating back to 1952 – 1960, the focus area is estimated shown outlined in "red".

Figure 15 Google Earth™ satellite imagery of the target areas in 1984, shown in 'yellow'.

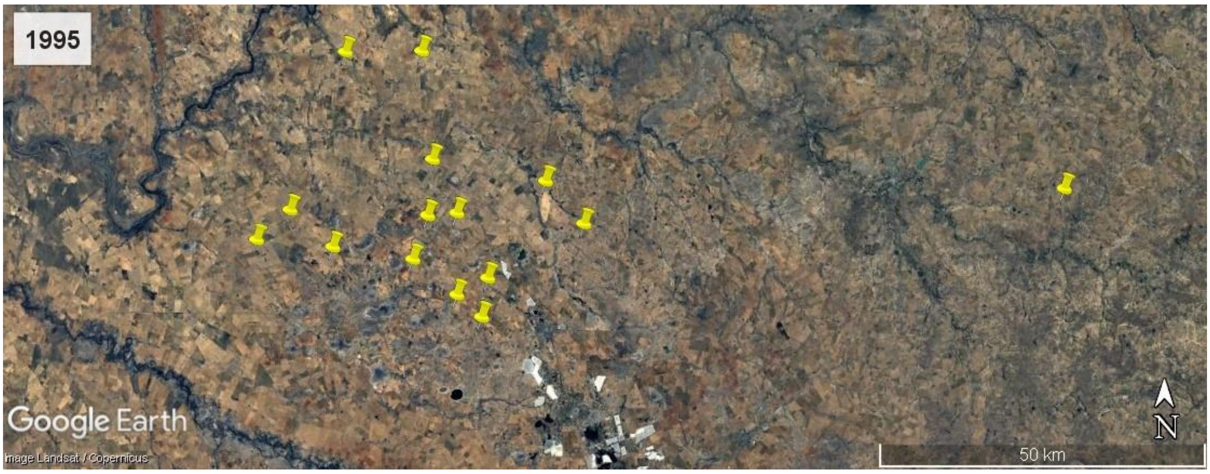

Figure 16 Google Earth™ satellite imagery of the target areas in 1995, shown in 'yellow'.

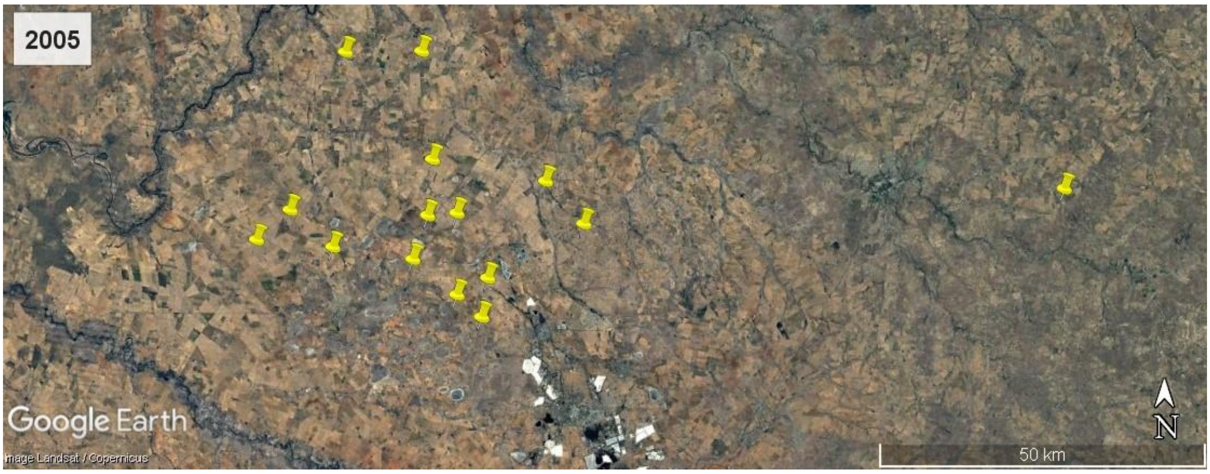

Figure 17 Google Earth™ satellite imagery of the target areas in 2005, shown in 'yellow'.

Figure 18 Google Earth™ satellite imagery of the target areas in 2015, shown in 'yellow'.

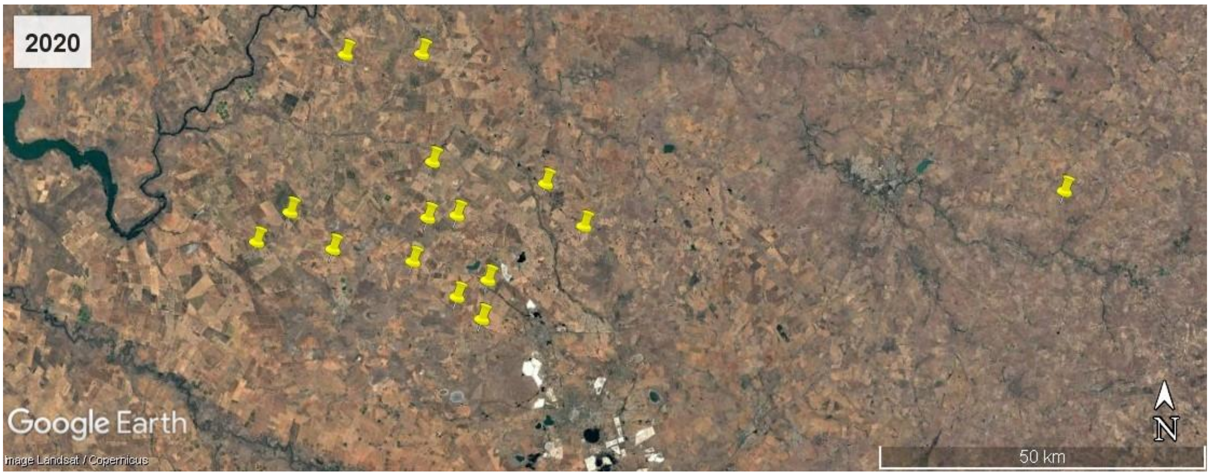

Figure 19 Google Earth™ satellite imagery of the target areas in 2020, shown in 'yellow'.

4. BASELINE VEGETATION & HABITAT ASSESSMENT

4.1 Description of the Vegetation Community

Vegetation and habitat were surveyed on the 15 proposed drilling sites and within a 100m buffer. The various terrestrial vegetation communities discussed in this report were identified and classified according to topographic location, plant species composition, vegetation structure and level of degradation. These vegetation communities are described in detail below. *A full list of the individual plant species identified within the study area as part of the terrestrial vegetation survey is provided in* ***Annexure B****.*

Table 19. Summary of the terrestrial vegetation communities and land use types identified and classified for the sites in November/ December 2022.

Vegetation Community Type	Threat Status[11]	Condition	Protected Plants Present?
Western Free State Clay Grassland	LC	Poor: moderately modified to degraded	No
Secondary Open Grassland	N/A	Poor: moderately modified to degraded	No
Dense Invasive Alien Plants	N/A	Lost: irreversibly modified	No
Cultivated land*	N/A	Lost: irreversibly modified	No
Transformed*	N/A	Lost: irreversibly modified	No

**Note that 'Transformed areas' (i.e., existing developments, roads and infrastructure, bare ground were excluded from the vegetation assessment but are shown mapped in Figure 20 - 34 as 'transformed'.*

Detailed descriptions of each vegetation community are presented below. Note that alien/exotic plant species are shown in "**red**" text in the vegetation descriptions presented.

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

4.1.1 Western Free State Clay Grassland

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

4.1.2 Secondary Open Grassland

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

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

4.1.3 Dense Invasive Alien Plants

This alien/exotic plant dominated community was found to comprise the smallest portion of the non-transformed area within the study area and has essentially been artificially created as a result of anthropogenic disturbance including plantations and removal of indigenous plants. As the name suggests, this community was found to be dominated with Invasive Alien Vegetation: *Pinus sp* and *Eucalyptus sp*.

Although indigenous vegetation was present, it constituted a small minority of the vegetation type, with mainly tolerant and locally common species (remnants of the former grassland communities that would have been present historically), including mainly of indigenous species of least concern, and mainly disturbance-tolerant and pioneer/increaser grasses such as *Panicum maximum* and *Cynodon dactylon*.

Figure 20 Mapped vegetation communities and habitat types identified and described for Target Area 01–01.

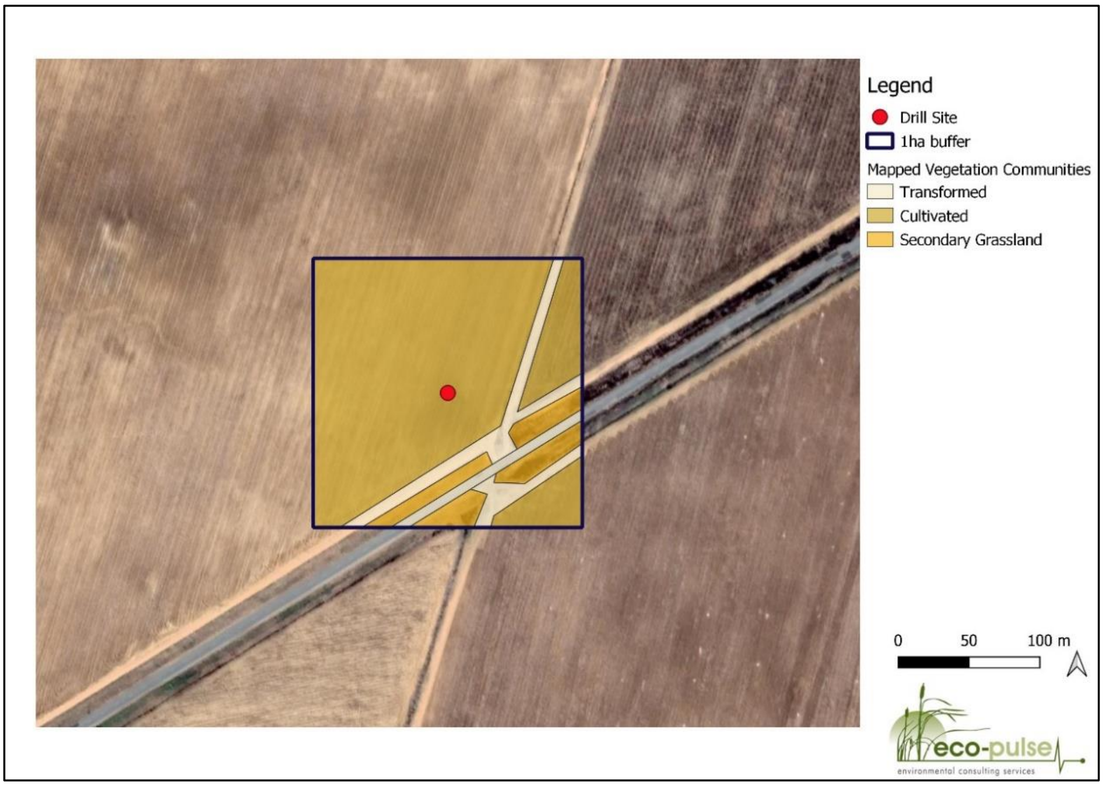

Figure 21 Mapped vegetation communities and habitat types identified and described for Target Area 01–02.

Figure 22 Mapped vegetation communities and habitat types identified and described for Target Area 01–03.

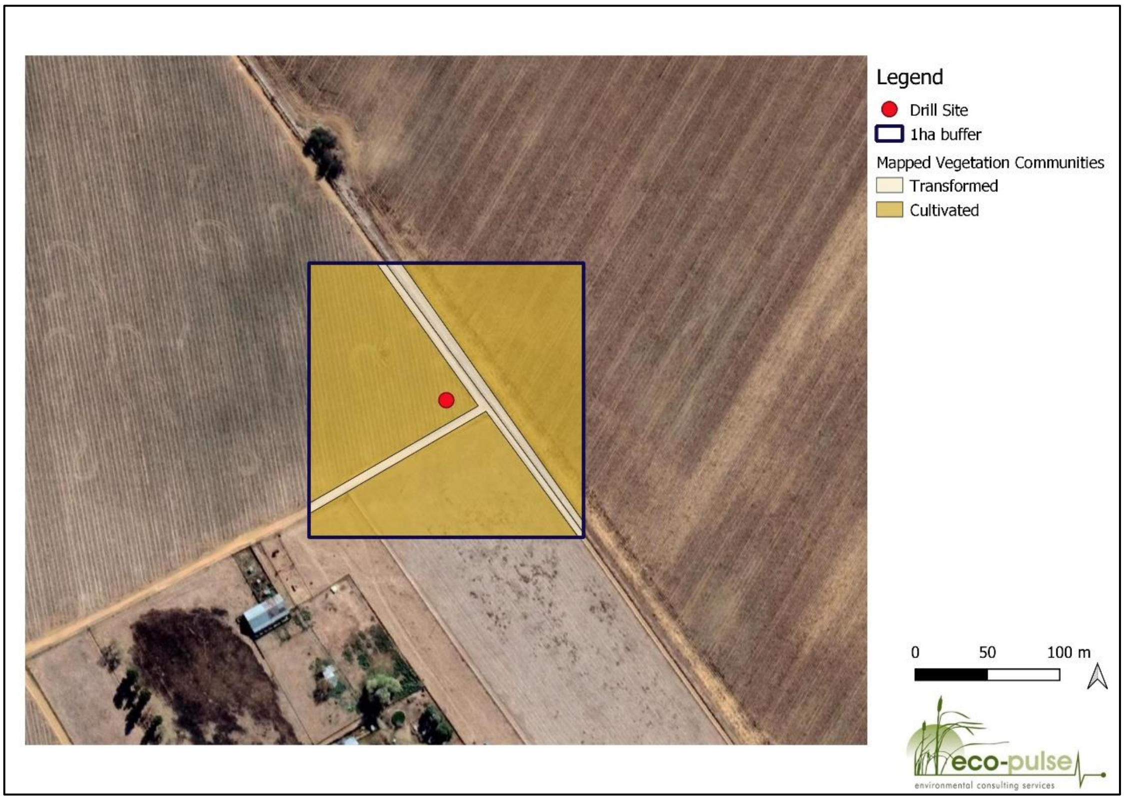

Figure 23 Mapped vegetation communities and habitat types identified and described for Target Area 01–04.

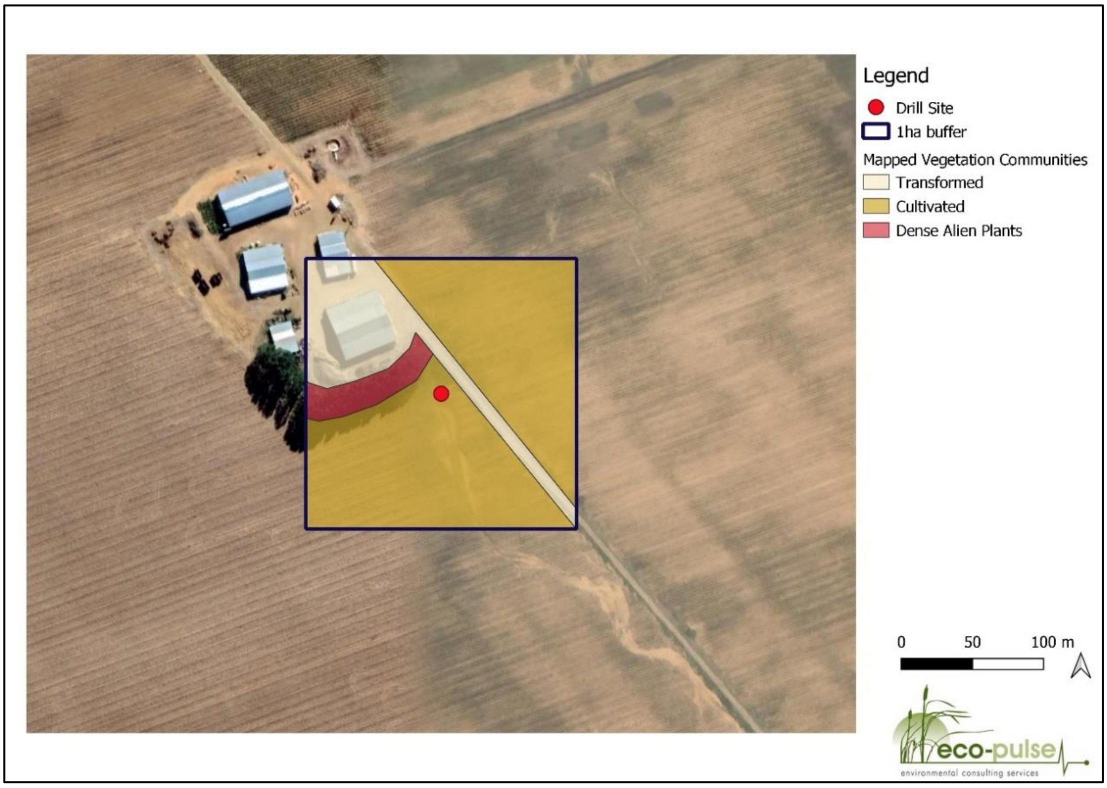

Figure 24 Mapped vegetation communities and habitat types identified and described for Target Area 01–05.

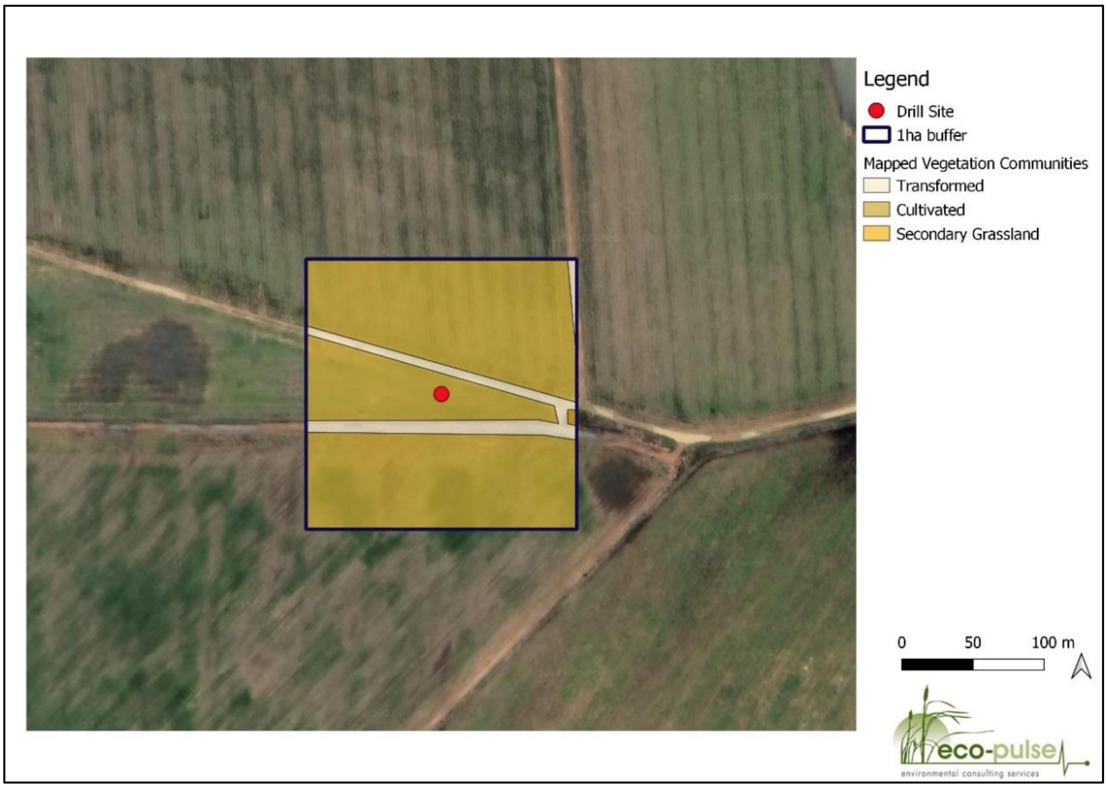

Figure 25 Mapped vegetation communities and habitat types identified and described for Target Area 01–06.

Figure 26 Mapped vegetation communities and habitat types identified and described for Target Area 01–07.

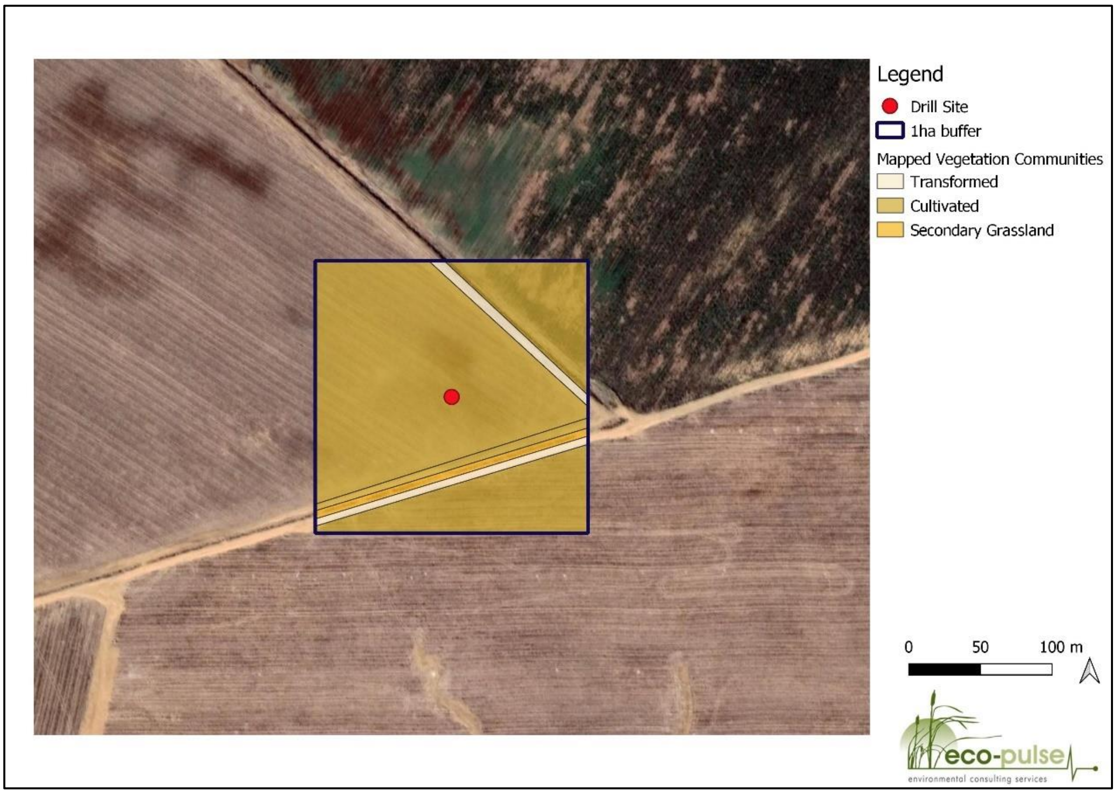

Figure 27 Mapped vegetation communities and habitat types identified and described for Target Area 01–08.

Figure 28 Mapped vegetation communities and habitat types identified and described for Target Area 01–09.

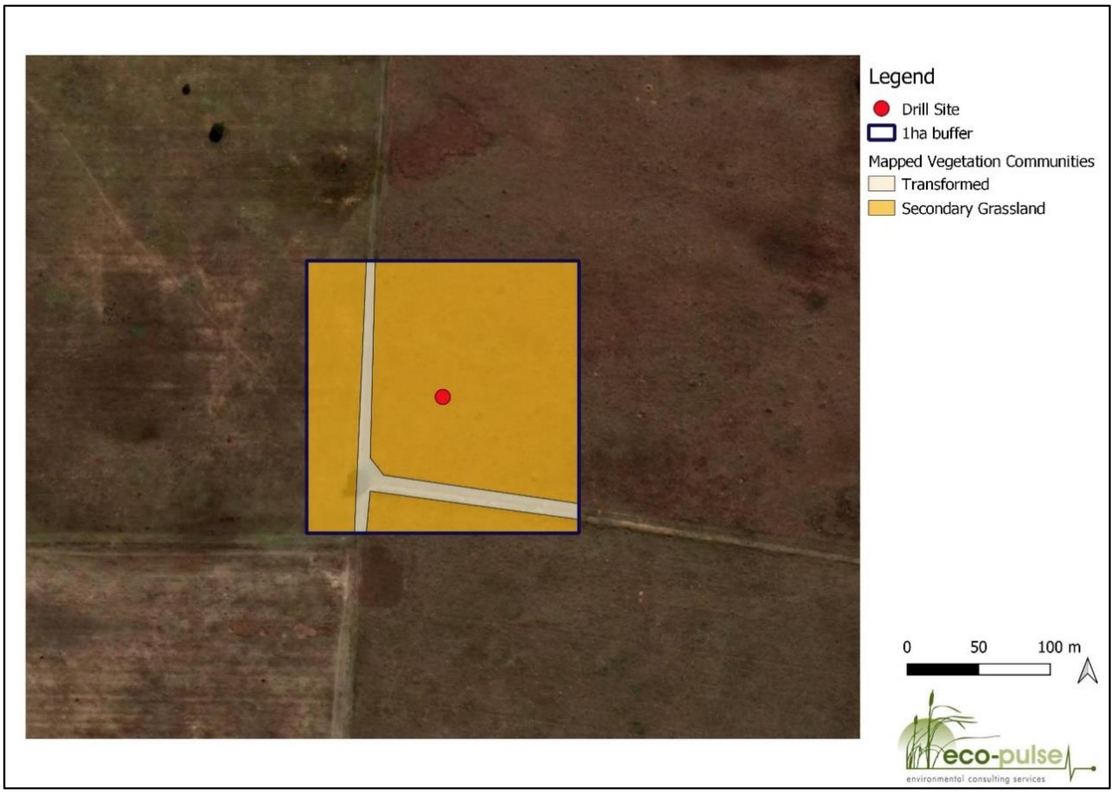

Figure 29 Mapped vegetation communities and habitat types identified and described for Target Area 01–10.

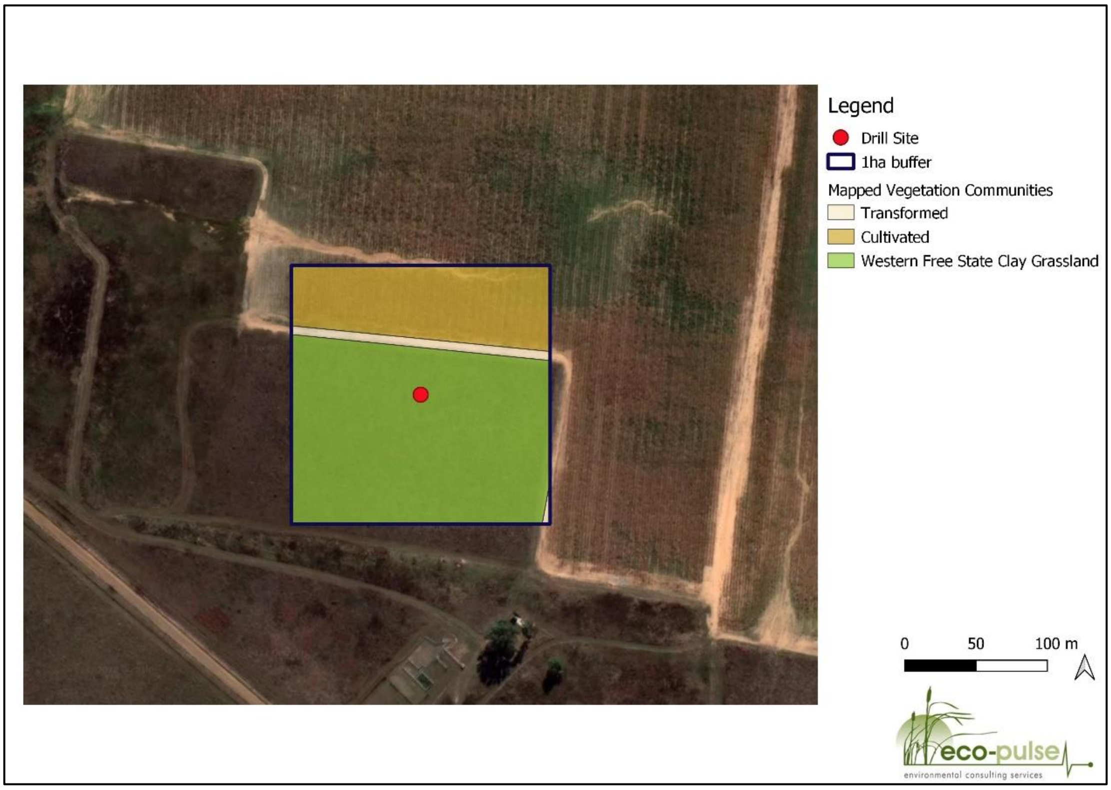

Figure 30 Mapped vegetation communities and habitat types identified and described for Target Area 01–11.

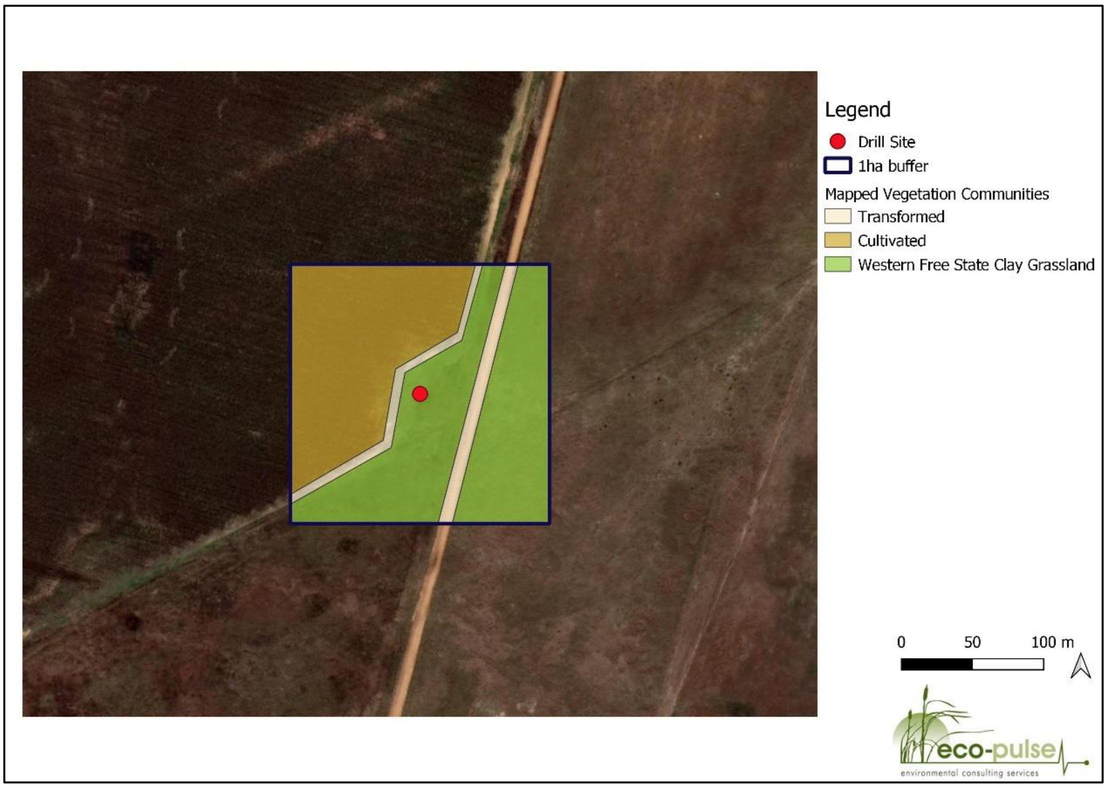

Figure 31 Mapped vegetation communities and habitat types identified and described for Target Area 01–12.

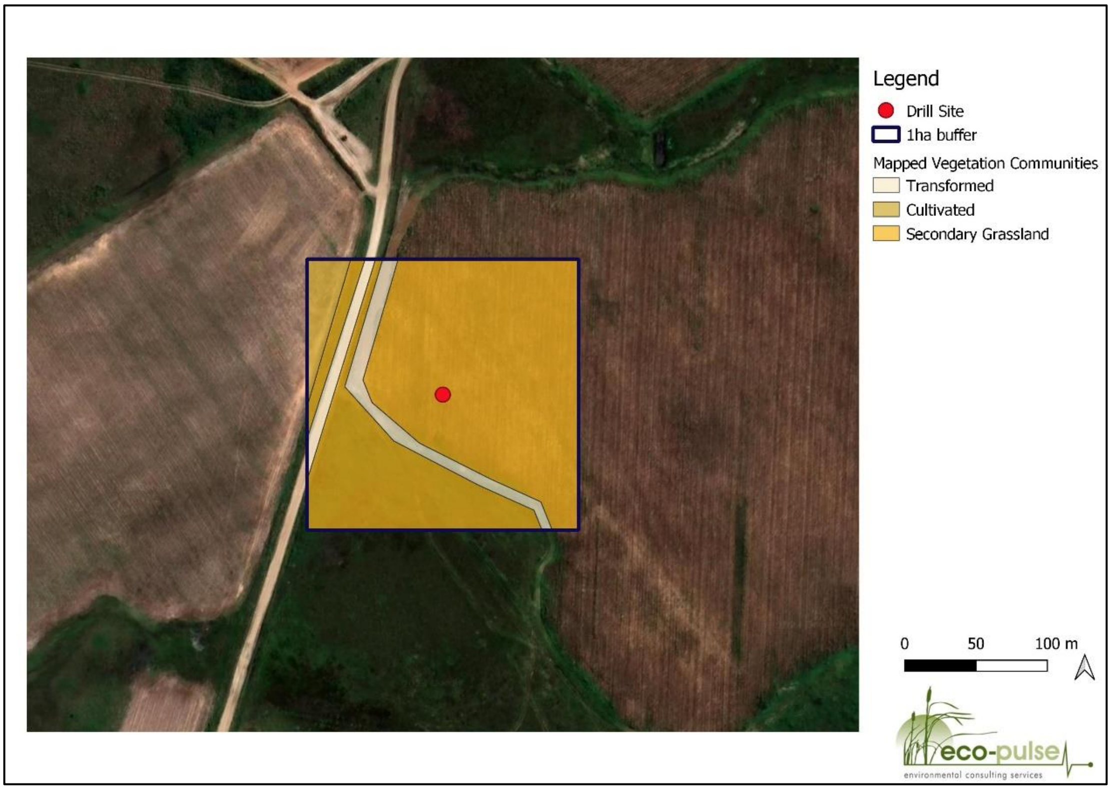

Figure 32 Mapped vegetation communities and habitat types identified and described for Target Area 02–01.

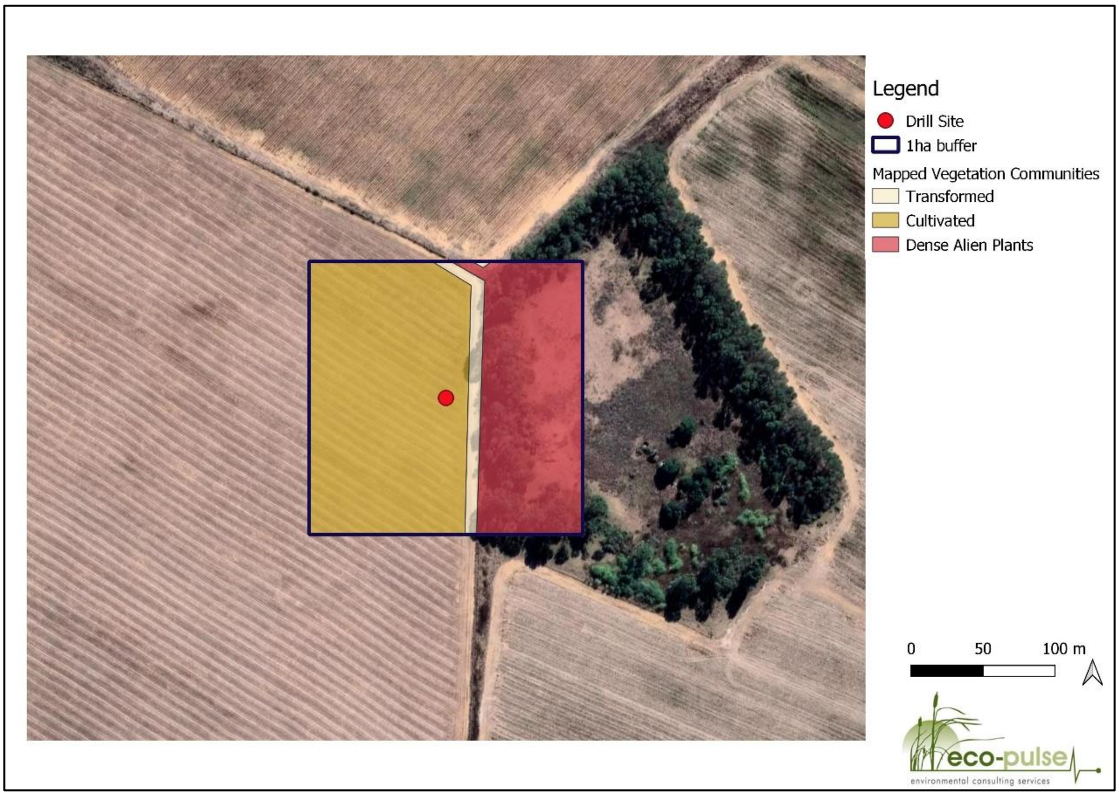

Figure 33 Mapped vegetation communities and habitat types identified and described for Target Area 02–02.

Figure 34 Mapped vegetation communities and habitat types identified and described for Target Area 03–01.

4.2 Protected Plant Species

No protected plants were recorded.

4.3 Faunal Species

No faunal species of conservation importance were observed/ recorded.

4.4 Site Ecological Importance

The results of the site ecological importance assessment are shown in Table 20 and shown graphically on the maps in Figure 35 – 49. The ecological importance and sensitivity (EIS) of the various vegetation communities and habitat types assessed relates to the ability of the ecosystem to meet conservation targets and maintain important biodiversity features, as well as the ecosystem's sensitivity/resilience to ecological change and how significant such change would be.

Table 20. Summary of terrestrial habitat ecological importance ratings.

	1. Degraded Western Free State Clay Grassland	2. Secondary Grassland	4. Dense Invasive Alien Plants
CONSERVATION IMPORTANCE	Low	Low	Very Low
FUNCTIONAL INTEGRITY	Low	Low	Low
BIODIVERSITY IMPORTANCE	Low	Low	Very Low
RECEPTOR RESILIENCE	High	High	Very High
SITE ECOLOGICAL IMPORTANCE RATING	**Low**	**Low**	**Very Low**

Figure 35 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 01-01.

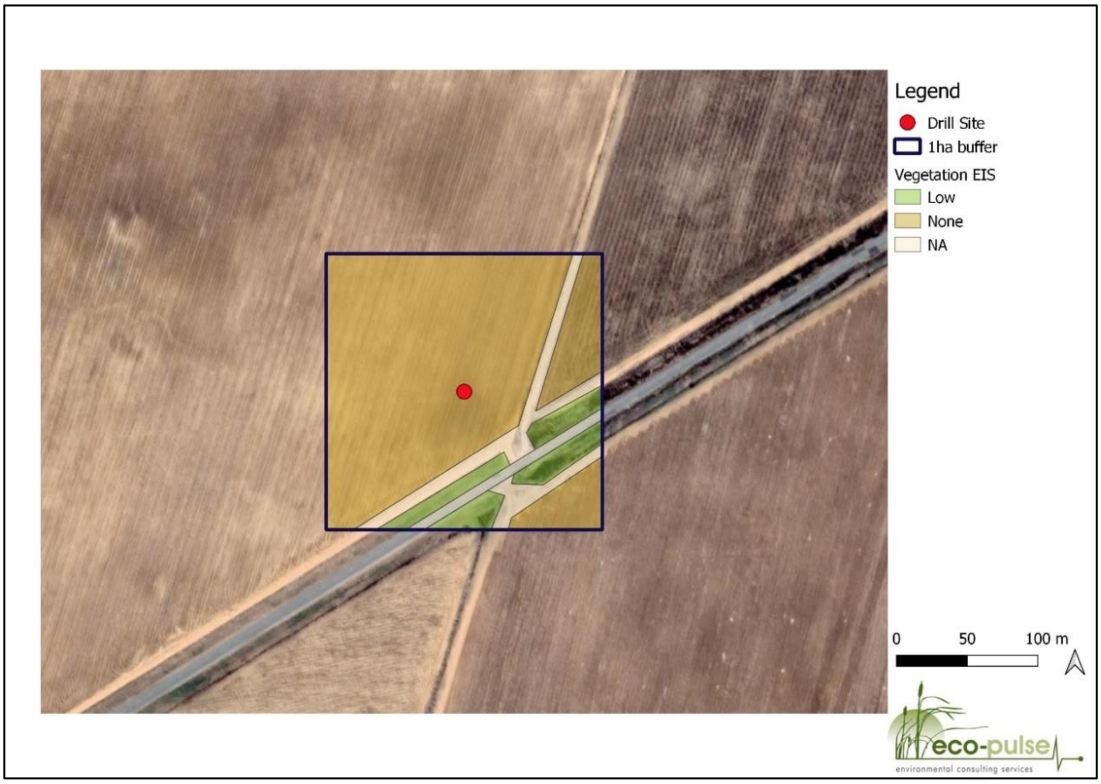

Figure 36 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 01-02.

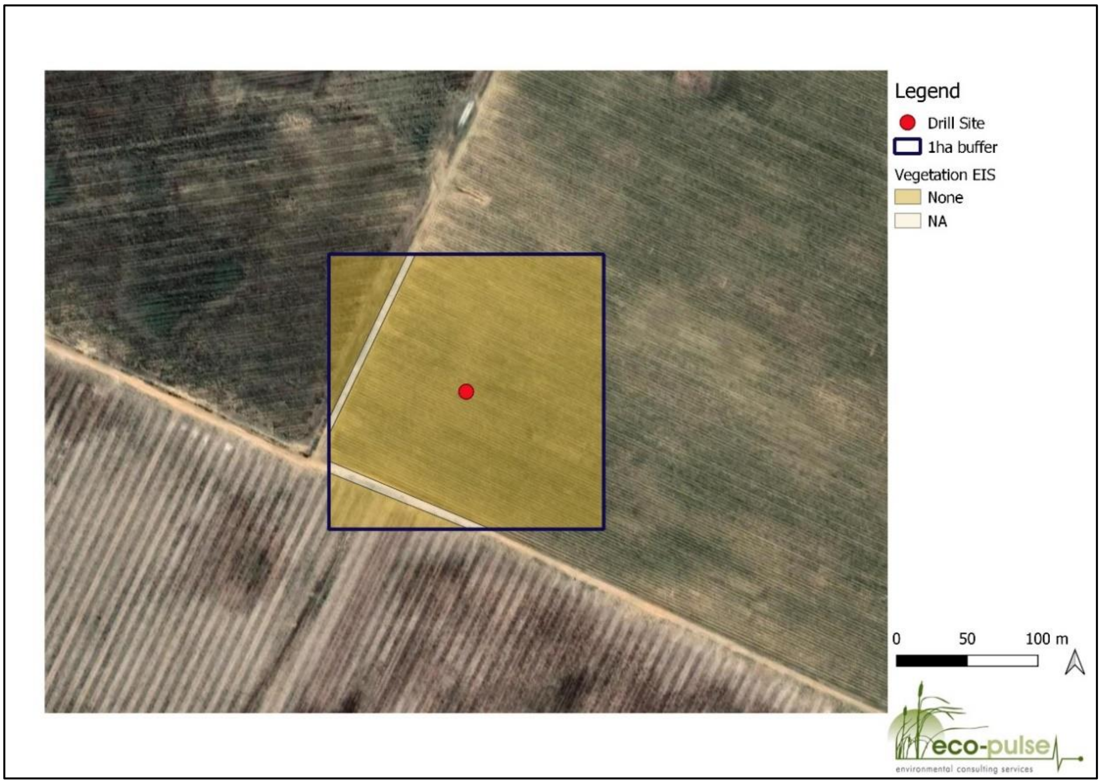

Figure 37 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 01_03.

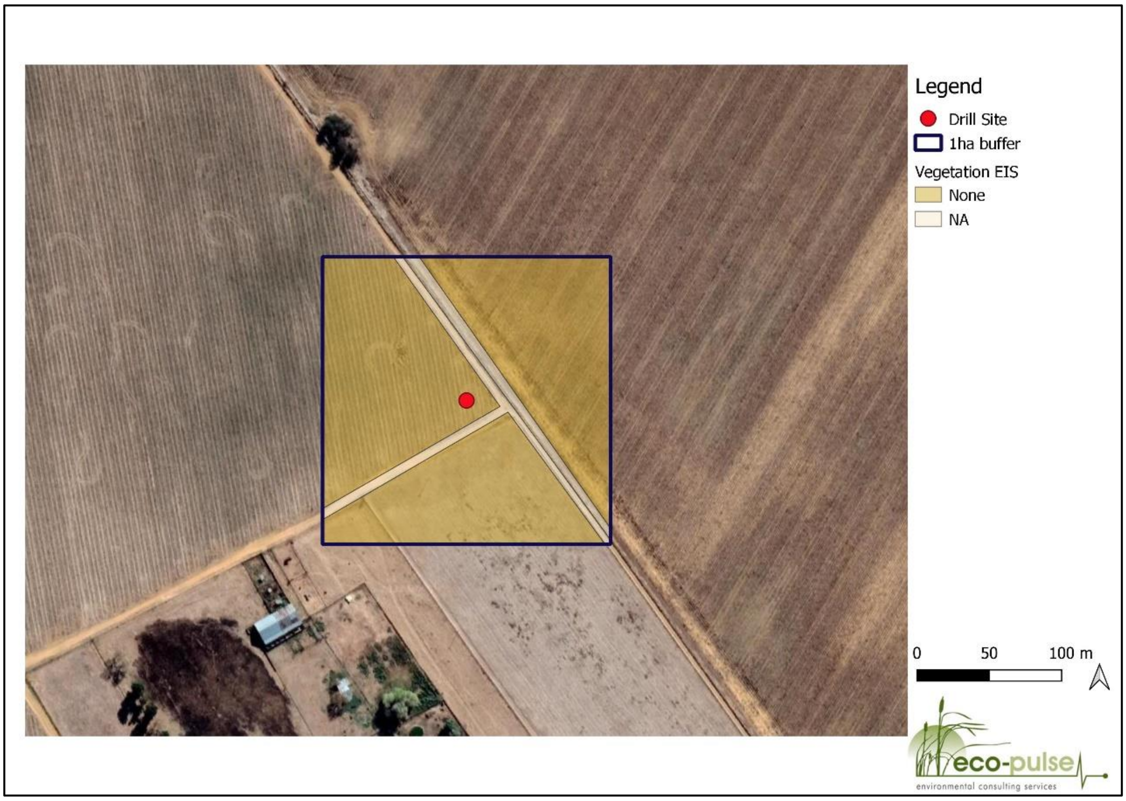

Figure 38 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 01_04.

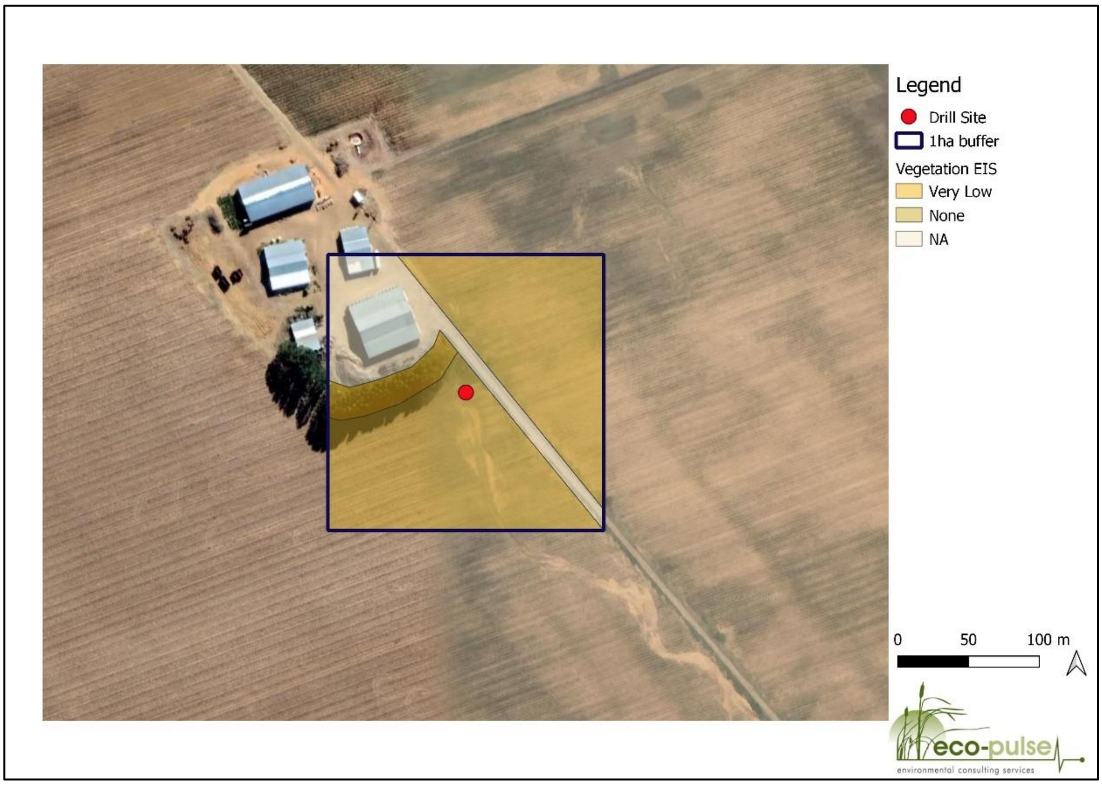

Figure 39 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 01_05.

Figure 40 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 01_06.

Figure 41 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 01_07.

Figure 42 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 01_08.

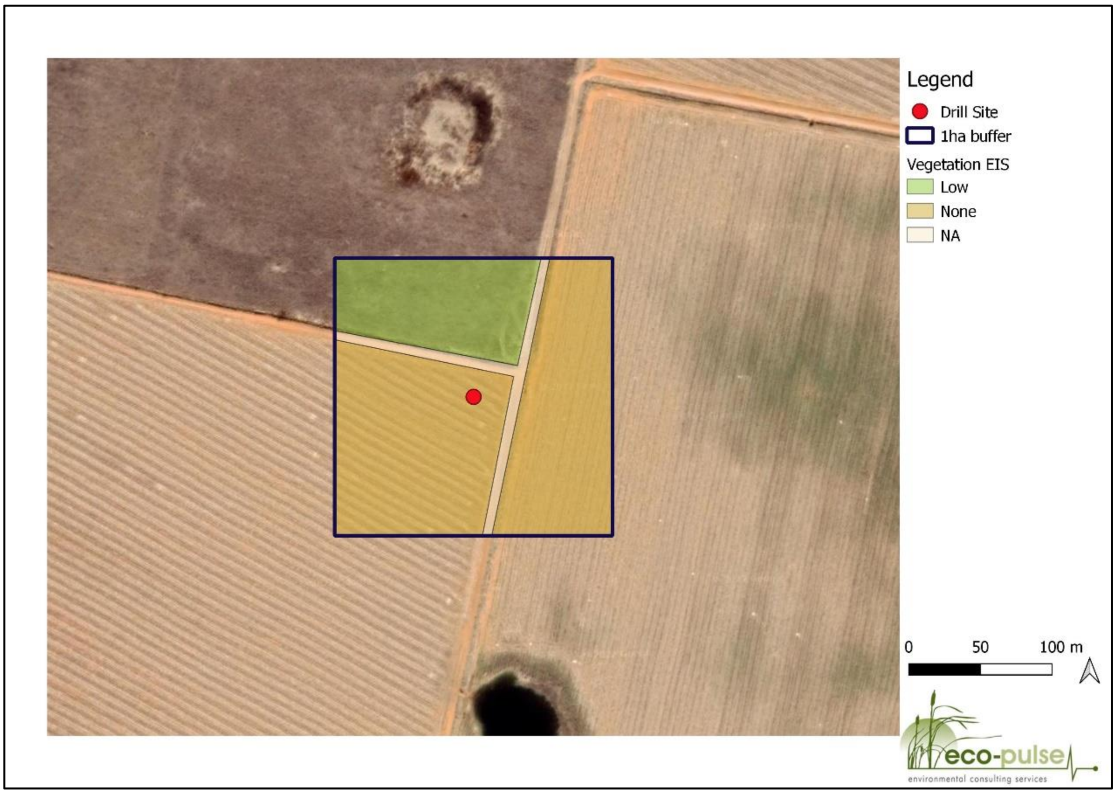

Figure 43 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 01_09.

Figure 44 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 01_10.

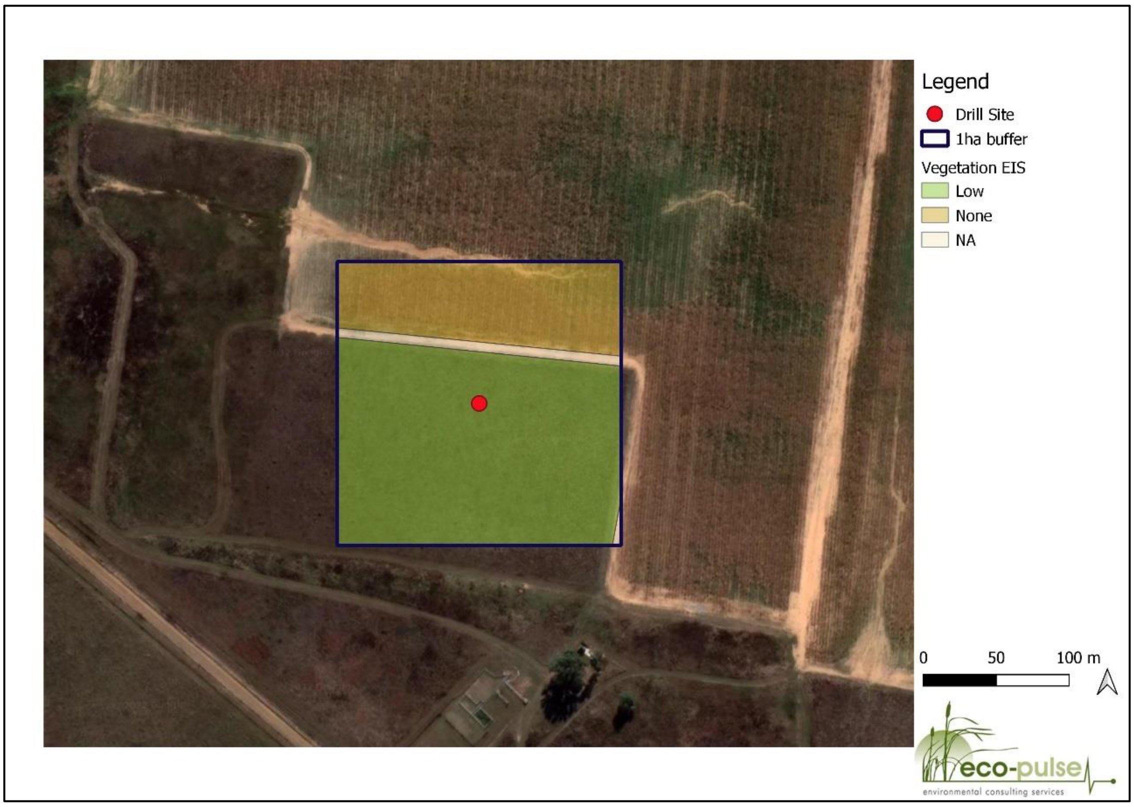

Figure 45 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 01_11.

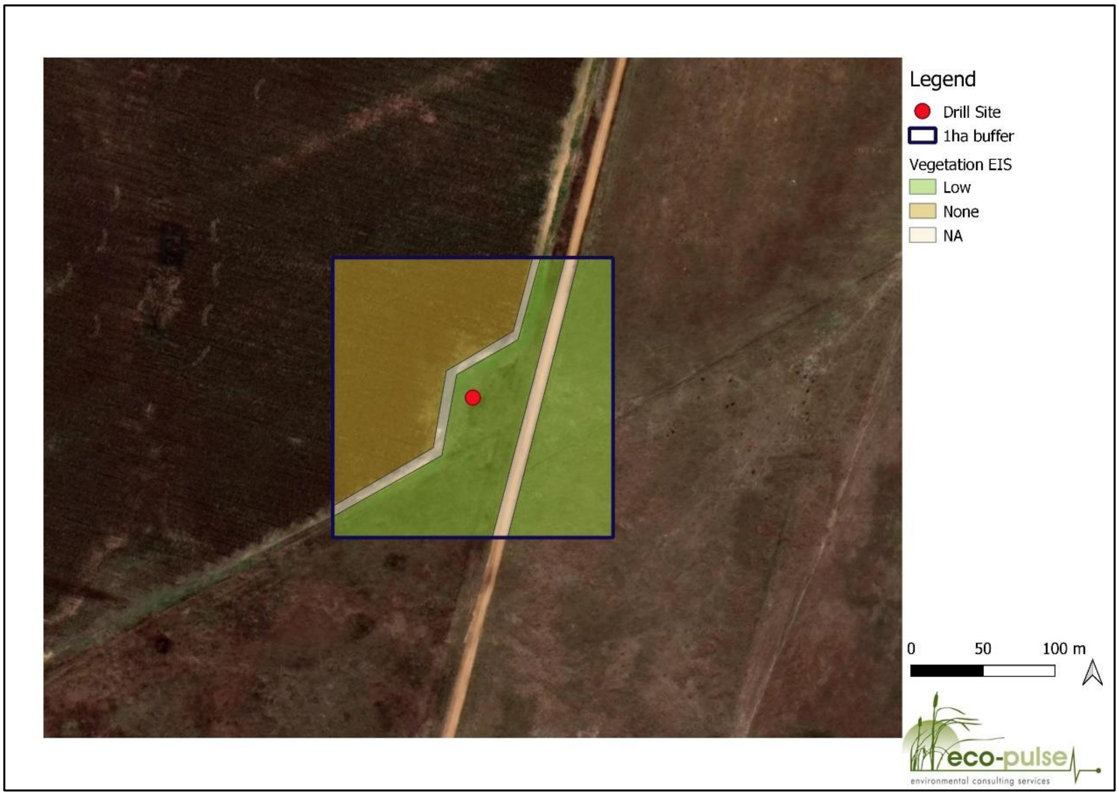

Figure 46 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 01_12.

Figure 47 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 02-01.

Figure 48 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 02-02.

Figure 49 Map showing site ecological importance ratings for terrestrial vegetation communities and habitats, Target Area 03-01.

5. ECOLOGICAL IMPACT ASSESSMENT

Natural ecosystems are inherently vulnerable to human activities and these activities can often lead to irreversible damage or longer term, gradual/cumulative changes to ecosystems. This chapter deals with the identification, description, prediction and significance assessment of the potential construction and operational impacts and risks posed to terrestrial ecosystems, vegetation, habitat and species associated with the proposed gas exploration well drilling. Potential impact consequences are discussed and assessed separately for the establishment 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).The general framework for the risk and impact assessment is shown in Table 21, which presents the expected risks, stressors and impacts for the construction and operational phase of the project.

Table 21. Terrestrial biodiversity impact assessment framework.

<table>
<tr><th colspan="2">TERRESTRIAL BIODIVERSITY IMPACT ASSESSMENT FRAMEWORK</th></tr>
<tr><td colspan="2">DEVELOPMENT TYPE & ACTIVITIES</td></tr>
<tr><td><u>Construction Phase Activities</u>:

Establishment of the exploration well drilling area and associated infrastructure (temporary). Including the following:
• Compressors
• Generators
• Drill rig
• Workshop (temporary)
• Storage areas (temporary)
• Office (temporary)</td><td><u>Operational Phase Activities</u>:

Operation of the exploration well drilling will involve:
• Utilization of the site by staff
• Operation of the drill rig
• Testing of successful exploration wells</td></tr>
<tr><td colspan="2">ENVIRONMENTAL STRESSORS/RISKS</td></tr>
<tr><td colspan="2">• Direct loss or modification of vegetation & terrestrial habitat.
• Soil erosion & resultant sedimentation.
• Impacts to ecological connectivity.
• Ecological disturbance</td></tr>
<tr><td colspan="2">TERRESTRIAL BIODIVERSITY IMPACTS</td></tr>
<tr><td>1</td><td>Impact on vegetation structure and plant species composition</td></tr>
<tr><td>2</td><td>Impact on potential populations of species of special concern</td></tr>
<tr><td>3</td><td>Impact on targets for threatened ecosystems or vegetation types</td></tr>
<tr><td>4</td><td>Impact on ecological processes and functionality of ecosystems</td></tr>
<tr><td>5</td><td>Impact on overall species and ecosystem diversity</td></tr>
<tr><td>6</td><td>Impact on ecological connectivity</td></tr>
</table>

A summary of the terrestrial ecological impact significance assessment for the construction and operational phases of the exploration well drilling project is contained in Table 2 – Table 13, respectively.

Key Assumptions:

- Vehicle access to the drill sites will be via existing roads.
- Construction activities will be confined to the drill site only.

Note that while an attempt has been made to separate impacts into categories, there is inevitably some degree of overlap due to the inherent interrelatedness of many ecological impacts.

5.1 Impact on vegetation structure and plant species composition

This impact refers to the direct physical destruction and/or modification of terrestrial habitat and includes habitat loss impacts, habitat and vegetation degradation impacts (e.g., species composition and abundances changes), and invasive alien plant invasion.

5.1.1 Construction Phase

The establishment of drill sites, including construction of temporary infrastructure will occur in transformed habitats (agricultural fields), and fragments of secondary degraded grasslands and poor condition disturbed grasslands. Therefore, any loss of habitat that might occur within the footprint of each drill site is considered 'insignificant' under a good and poor mitigation scenario. However, modification of habitat through anticipated edge effects in areas adjacent to the proposed drill sites should be avoided.

Table 22. Summary results of the cumulative terrestrial ecological impact significance assessment for construction phase impacts on vegetation structure and plant species composition.

Issue: Vegetation structure and plant species composition		
Phase: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Very Short-term (< 1 year)	Very Short-term (< 1 year)
Extent	Whole site and nearby surroundings	Part of site/property
Consequence	Very low	Very low
Probability	Conceivable (Low)	Unlikely / improbable (Very low)
Significance	Insignificant	Insignificant
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible: The likelihood of loss of plant species composition and vegetation structure is unlikely. However, given the extent and intensity of the impact associated with site establishment, any loss would be inconsequential.	

Degree to which impact may cause irreplaceable loss of resources	None: Impacts will not cause irreplaceable loss.	
Degree to which impact can be avoided	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Degree to which impact can be mitigated	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Cumulative Impact		
Nature of cumulative impacts	Direct cumulative impacts on vegetation structure and plant species composition are not expected.	
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Insignificant	Insignificant

Key mitigation recommendations:

- Limit the extent of the drill site camps. Site camps should not extend beyond the proposed 1 ha sites surrounding each proposed well location.
- The boundary of the drill sites must be clearly demarcated.
- Avoid impacts to good condition grassland areas outside the drill site footprint, which are to be 'no-go' areas for construction crews. The location of these 'no-go' areas should be made clear to all staff.
- No temporary construction site camps, vehicle parking or equipment storage to be located outside previously specified areas.

5.1.2 Operation Phase

During the operation phase terrestrial habitat could also be impacted by workers and machinery during repair and maintenance of onsite infrastructure, and through the potential injudicious movement of vehicles and people across the site that may cause unnecessary habitat disturbance. Surrounding natural habitat must therefore be appropriately safeguarded as 'no-go' areas. Overall impact significance can be regarded as 'insignificant'.

Table 23. Summary results of the <u>cumulative</u> terrestrial ecological impact significance assessment for operation phase impacts on vegetation structure and plant species composition.

Issue: Vegetation structure and plant species composition		
Phase: Operation		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Very Short-term (< 1 year)	Very Short-term (< 1 year)
Extent	Part of site/property	Part of site/property
Consequence	Very low	Very low
Probability	Unlikely / improbable (Very low)	Unlikely / improbable (Very low)
Significance	Insignificant	Insignificant

Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible: The likelihood of loss of plant species is unlikely. However, given the extent and intensity of the drilling, any loss to vegetation structure and plant species composition should be minimal.	
Degree to which impact may cause irreplaceable loss of resources	None: Impacts will not cause irreplaceable loss.	
Degree to which impact can be avoided	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Degree to which impact can be mitigated	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Cumulative Impact		
Nature of cumulative impacts	Direct cumulative impacts are on vegetation structure and plant species composition are not expected.	
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Insignificant	Insignificant

Key mitigation recommendations:

- Limit the extent of the drill site camps. Site camps should not extend beyond the proposed 1 ha sites surrounding each proposed well location.
- The boundary of the drill sites must be clearly demarcated.
- Avoid impacts to good condition grassland areas outside the drill site footprint, which are to be 'no-go' areas for construction crews. The location of these 'no-go' areas should be made clear to all staff.
- No temporary construction site amps, vehicle parking or equipment storage to be located outside previously specified areas.
- On-site IAP control.

5.2 Impact on populations of species of special concern (i.e., protected species)

This impact relates to the potential alteration of habitat that supports threatened plant and animal species, including alteration to the ambient environment by nuisance factors such as noise, vibrations, light pollution, etc. produced by people, machinery and vehicles. It also refers to the loss of important habitat that represent sources of food, shelter, etc. for faunal species of conservation concern.

5.2.1 Construction Phase

Impacts to populations of protected plant species are unlikely since precautionary measures were applied and all sites with protected and threatened species were avoided. Large portions of the study area have already been transformed or degraded, therefore any fauna persisting in the area are likely habituated to the existing disturbance regime (subsistence cultivation, livestock grazing, domestic animals and working dirt roads). Fauna in areas with degraded or disturbed habitat should be flushed-out to adjacent areas during construction, with the arrival of noisy construction machinery and staff. Therefore, any impacts on populations of species of special concern is considered 'insignificant'.

Table 24. Summary results of the cumulative terrestrial ecological impact significance assessment for construction phase impacts on populations of species of special concern.

Issue: Populations of species of special concern		
Phase: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Very Short-term (< 1 year)	Very Short-term (< 1 year)
Extent	Whole site and nearby surroundings	Part of site/property
Consequence	Very low	Very low
Probability	Conceivable (Low)	Unlikely / improbable (Very low)
Significance	Insignificant	Insignificant
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible: The likelihood of loss of species of special concern is unlikely since none were recorded across the study sites. However, given the extent and intensity of the impact associated with site establishment, impact of populations of species of special concern will be inconsequential.	
Degree to which impact may cause irreplaceable loss of resources	None: Impacts will not cause irreplaceable loss.	
Degree to which impact can be avoided	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Degree to which impact can be mitigated	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Cumulative Impact		
Nature of cumulative impacts	Direct cumulative impacts on species of special concern are not expected.	
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Insignificant	Insignificant

Key mitigation recommendations:

- Limit the extent of the drill site camps. Site camps should not extend beyond the proposed 1 ha sites surrounding each proposed well location.
- The boundary of the drill sites must be clearly demarcated.
- Avoid impacts to good condition grassland areas outside the drill site footprint, which are to be 'no-go' areas for construction crews. The location of these 'no-go' areas should be made clear to all staff.
- No temporary construction site amps, vehicle parking or equipment storage to be located outside previously specified areas.

5.2.2 Operation Phase

During the operation, at the local scale the potential loss of important ecological corridors for faunal species movement as well as the loss of seed sources for certain plant species is an inconsequential impact. It will be important to consider the maintenance of existing ecological corridors as far as possible for faunal species and to ensure the exchange of genetic material between threatened plant populations is not compromised in 'no-go' areas. During the operational phase, impacts to remaining intact vegetation outside of the project footprint may also occur as a result of increased human activity and disturbance. Potential impacts include increased levels of alien plant infestations, edge effects, leading to further habitat degradation and biodiversity loss. In addition, noise disturbance during the operational phase may be a temporary nuisance factor for faunal species. Overall impact significance can be regarded as 'insignificant'.

Table 25. Summary results of the <u>cumulative</u> terrestrial ecological impact significance assessment for operation phase impacts on populations of species of special concern.

Issue: Species of special concern		
Phase: Operation		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Very Short-term (< 1 year)	Very Short-term (< 1 year)
Extent	Part of site/property	Part of site/property
Consequence	Very low	Very low
Probability	Unlikely / improbable (Very low)	Unlikely / improbable (Very low)
Significance	Insignificant	Insignificant
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible: The likelihood of loss of species of special concern is unlikely. However, given the extent and intensity of the drilling, impacts on populations of species of special concern are not expected.	
Degree to which impact may cause irreplaceable loss of resources	None: Impacts will not cause irreplaceable loss.	
Degree to which impact can be avoided	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Degree to which impact can be mitigated	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Cumulative Impact		
Nature of cumulative impacts	Direct cumulative impacts on species of special concern are not expected.	
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Insignificant	Insignificant

Key mitigation recommendations:

- Limit the extent of the drill site camps. Site camps should not extend beyond the proposed 1 ha sites surrounding each proposed well location.

- The boundary of the drill sites must be clearly demarcated.
- Avoid impacts to good condition grassland areas outside the drill site footprint, which are to be 'no-go' areas for construction crews. The location of these 'no-go' areas should be made clear to all staff.
- No temporary construction site amps, vehicle parking or equipment storage to be located outside previously specified areas.
- On-site IAP control.

5.3 Impact on targets for threatened ecosystems

This impact refers to the loss of a vegetation unit representative of a rare and/or threatened ecosystem, habitat or vegetation community or a vegetation unit that could be reinstated to such an example with good management and/or rehabilitation.

5.3.1 Construction Phase

Site establishment activities are unlikely to have any impact on the capacity to meet provincial and national conservation targets. Proposed drill sites traverse degraded and transformed habitats. Overall impact significance can be regarded as 'insignificant'.

Table 26. Summary results of the cumulative terrestrial ecological impact significance assessment for construction phase impacts on targets for threatened ecosystems.

Issue: Targets for threatened ecosystems		
Phase: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Negligible change (Very low)	Negligible change (Very low)
Duration	Very Short-term (< 1 year)	Very Short-term (< 1 year)
Extent	Whole site and nearby surroundings	Part of site/property
Consequence	Very low	Very low
Probability	Unlikely / improbable (Very low)	Unlikely / improbable (Very low)
Significance	Insignificant	Insignificant
Additional Assessment Criteria		
Degree to which impact can be reversed	All sites exclude threatened ecosystems, therefore conservation targets will not be impacted.	
Degree to which impact may cause irreplaceable loss of resources	None: Impacts will not cause irreplaceable loss.	
Degree to which impact can be avoided	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Degree to which impact can be mitigated	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Cumulative Impact		

Nature of cumulative impacts	Direct cumulative impacts on targets for threatened ecosystems are not expected.	
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Insignificant	Insignificant

Key mitigation recommendations:

- Limit the extent of the drill site camps. Site camps should not extend beyond the proposed 1 ha sites surrounding each proposed well location.
- The boundary of the drill sites must be clearly demarcated.
- Avoid impacts to good condition grassland areas outside the drill site footprint, which are to be 'no-go' areas for construction crews. The location of these 'no-go' areas should be made clear to all staff.
- No temporary construction site amps, vehicle parking or equipment storage to be located outside previously specified areas.

5.3.2 Operation Phase

It will be important to combat alien plant invasions associated with the edge effects created by drill site activities through the implementation of a comprehensive alien plant control programme. A sustainable grassland management programme would also be useful in ensuring surrounding remaining intact habitat outside the project footprint is not further degraded through increased anthropogenic pressures. Overall impact significance can be regarded as 'insignificant'.

Table 27. Summary results of the <u>cumulative</u> terrestrial ecological impact significance assessment for operation phase impacts on targets of threatened ecosystems.

Issue: Targets for threatened ecosystems		
Phase: Operation		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Negligible change (Very low)	Negligible change (Very low)
Duration	Very Short-term (< 1 year)	Very Short-term (< 1 year)
Extent	Part of site/property	Part of site/property
Consequence	Very low	Very low
Probability	Unlikely / improbable (Very low)	Unlikely / improbable (Very low)
Significance	Insignificant	Insignificant
Additional Assessment Criteria		
Degree to which impact can be reversed	All sites exclude threatened ecosystems, therefore conservation targets will not be impacted.	
Degree to which impact may cause irreplaceable loss of resources	None: Impacts will not cause irreplaceable loss.	

Degree to which impact can be avoided	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Degree to which impact can be mitigated	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Cumulative Impact		
Nature of cumulative impacts	Direct cumulative impacts on targets for threatened ecosystems are not expected.	
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Insignificant	Insignificant

Key mitigation recommendations:

- Limit the extent of the drill site camps. Site camps should not extend beyond the proposed 1 ha sites surrounding each proposed well location.
- The boundary of the drill sites must be clearly demarcated.
- Avoid impacts to good condition grassland areas outside the drill site footprint, which are to be 'no-go' areas for construction crews. The location of these 'no-go' areas should be made clear to all staff.
- No temporary construction site amps, vehicle parking or equipment storage to be located outside previously specified areas.
- On-site IAP control.

5.4 Impact on ecological processes and functionality of ecosystems

This impact refers to the indirect impacts of adjacent land cover modification and transformation on surface runoff, soil moisture and rates of erosion and sedimentation, and associated ecological impacts like invasion by invasive alien plants and habitat degradation. This impact also includes the alteration or deterioration in the chemical and biological characteristics of soil and water, which inevitably impacts negatively on flora and fauna.

5.4.1 Construction Phase

Impacts to the structure and condition of vegetation will likely affect ecological processes and the functioning of surrounding intact ecosystems which are known to provide a variety of valuable ecosystem goods and services. Impacts to transformed and degraded vegetation will be less significant. Overall impact significance can be regarded as 'insignificant'.

Table 28. Summary results of the cumulative terrestrial ecological impact significance assessment for construction phase impacts on ecological processes and functionality of ecosystems.

Issue: Ecological processes and ecosystem functionality		
Phase: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Very Short-term (< 1 year)	Very Short-term (< 1 year)
Extent	Whole site and nearby surroundings	Part of site/property
Consequence	Very low	Very low
Probability	Conceivable (Low)	Unlikely / improbable (Very low)
Significance	Insignificant	Insignificant
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible: The likelihood that ecological processes and functionality of ecosystems will be impacted is unlikely. However, given the extent and intensity of the impact any loss would be insubstantial.	
Degree to which impact may cause irreplaceable loss of resources	None: Impacts will not cause irreplaceable loss.	
Degree to which impact can be avoided	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Degree to which impact can be mitigated	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Cumulative Impact		
Nature of cumulative impacts	Direct cumulative impacts on ecological processes and functionality of ecosystems are not expected.	
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Insignificant	Insignificant

Key mitigation recommendations:

- Limit the extent of the drill site camps. Site camps should not extend beyond the proposed 1 ha sites surrounding each proposed well location.
- The boundary of the drill sites must be clearly demarcated.
- Avoid impacts to good condition grassland areas outside the drill site footprint, which are to be 'no-go' areas for construction crews. The location of these 'no-go' areas should be made clear to all staff.
- No temporary construction site amps, vehicle parking or equipment storage to be located outside previously specified areas.
- Rehabilitate any intact grassland that may be accidentally impacted.

5.4.2 Operation Phase

Impacts to vegetation of outside of the project footprint during the operational phase may occur as a result of increased human activity and associated disturbance (e.g., increased alien plant invasion, as well as light and noise pollution – with respect to faunal species). This is likely to continue to impact on terrestrial ecosystem processes and functioning, reducing overall biodiversity and ecosystem functional services/values. Overall impact significance can be regarded as 'insignificant'.

Table 29. Summary results of the cumulative terrestrial ecological impact significance assessment for operation phase impacts on ecological processes and ecosystem functioning.

Issue: Ecological process and ecosystem functioning		
Phase: Operation		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Very Short-term (< 1 year)	Very Short-term (< 1 year)
Extent	Part of site/property	Part of site/property
Consequence	Very low	Very low
Probability	Unlikely / improbable (Very low)	Unlikely / improbable (Very low)
Significance	Insignificant	Insignificant
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible: The likelihood that ecological processes and functionality of ecosystems will be impacted by drilling is unlikely. Any loss or impact would be minimal and temporary.	
Degree to which impact may cause irreplaceable loss of resources	None: Impacts will not cause irreplaceable loss.	
Degree to which impact can be avoided	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Degree to which impact can be mitigated	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Cumulative Impact		
Nature of cumulative impacts	Direct cumulative impacts on ecological processes and functionality of ecosystems are not expected.	
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Insignificant	Insignificant

Key mitigation recommendations:

- Limit the extent of the drill site camps. Site camps should not extend beyond the proposed 1 ha sites surrounding each proposed well location.
- The boundary of the drill sites must be clearly demarcated.
- Avoid impacts to good condition grassland areas outside the drill site footprint, which are to be 'no-go' areas for construction crews. The location of these 'no-go' areas should be made clear to all staff.

- No temporary construction site amps, vehicle parking or equipment storage to be located outside previously specified areas.
- Rehabilitate any intact grassland that may be accidentally impacted.
- On-site IAP control.

5.5 Impact on overall species and ecosystem diversity

This impact refers to the loss of genetic, species, habitat/ecosystem and/or functional diversity.

5.5.1 Construction Phase

Overall species and ecosystem diversity at the site can be considered moderately low to low, with fragments of degraded and disturbed habitat hosting a low diversity of plant species. Overall impact significance can be considered 'insignificant'.

Table 30. Summary results of the cumulative terrestrial ecological impact significance assessment for construction phase impacts on overall species and ecosystem diversity.

Issue: Overall species and ecosystem diversity		
Phase: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Very Short-term (< 1 year)	Very Short-term (< 1 year)
Extent	Whole site and nearby surroundings	Part of site/property
Consequence	Very low	Very low
Probability	Conceivable (Low)	Unlikely / improbable (Very low)
Significance	Insignificant	Insignificant
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible: The likelihood that overall species and ecosystem diversity will be impacted is unlikely. However, given the extent and intensity of the impact any loss would be insubstantial.	
Degree to which impact may cause irreplaceable loss of resources	None: Impacts will not cause irreplaceable loss.	
Degree to which impact can be avoided	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Degree to which impact can be mitigated	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Cumulative Impact		
Nature of cumulative impacts	Direct cumulative impacts on overall species and ecosystem diversity are not expected.	
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**

	Insignificant	Insignificant

Key mitigation recommendations:

- Limit the extent of the drill site camps. Site camps should not extend beyond the proposed 1 ha sites surrounding each proposed well location.
- The boundary of the drill sites must be clearly demarcated.
- Avoid impacts to good condition grassland areas outside the drill site footprint, which are to be 'no-go' areas for construction crews. The location of these 'no-go' areas should be made clear to all staff.
- No temporary construction site amps, vehicle parking or equipment storage to be located outside previously specified areas.

5.5.2 Operation Phase

Impacts to remaining vegetation outside of the project footprint during the operational phase may occur as a result of increased human activity and associated disturbance, as well as indirect impacts to ecosystems. This is likely to continue to impact on ecosystem processes and functioning, reducing overall biodiversity should the remaining intact vegetation communities continue to be mismanaged. Therefore, an invasive alien plant control programme for the site would be important mitigation measure. Overall impact significance can be regarded as 'insignificant'.

Table 31. Summary results of the cumulative terrestrial ecological impact significance assessment for operation phase impacts on overall species and ecosystem diversity.

Issue: Overall species and ecosystem diversity		
Phase: Operation		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Very Short-term (< 1 year)	Very Short-term (< 1 year)
Extent	Part of site/property	Part of site/property
Consequence	Very low	Very low
Probability	Unlikely / improbable (Very low)	Unlikely / improbable (Very low)
Significance	Insignificant	Insignificant
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible: The likelihood that overall species and ecosystem diversity will be impacted by drilling is unlikely. Any loss or impact would be minimal and temporary.	
Degree to which impact may cause irreplaceable loss of resources	None: Impacts will not cause irreplaceable loss.	
Degree to which impact can be avoided	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Degree to which impact can be mitigated	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Cumulative Impact		

Nature of cumulative impacts	Direct cumulative impacts on overall species and ecosystem diversity are not expected.	
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Insignificant	Insignificant

Key mitigation recommendations:

- Limit the extent of the drill site camps. Site camps should not extend beyond the proposed 1 ha sites surrounding each proposed well location.
- The boundary of the drill sites must be clearly demarcated.
- Avoid impacts to good condition grassland areas outside the drill site footprint, which are to be 'no-go' areas for construction crews. The location of these 'no-go' areas should be made clear to all staff.
- No temporary construction site amps, vehicle parking or equipment storage to be located outside previously specified areas.
- On-site IAP control.

5.6 Impact on ecological connectivity

This impact refers to the potential reduction in ecological connectivity between the study area being assessed and adjacent habitats/ecosystems and the effects this may have on the movement of faunal species. Impacts on habitat connectivity will likely be a temporary impact following construction and since no key wildlife corridors will be severed, the significance of the impact is likely to be 'insignificant'.

5.6.1 Construction Phase

There might be some habitat connectivity surrounding the drill site area at select sites, albeit reduced. Avoiding habitat outside of the project area will assist with maintaining local level connectivity and attaining impact significance to an overall 'insignificant' level.

Table 32. Summary results of the <u>cumulative</u> terrestrial ecological impact significance assessment for construction phase impacts on ecological connectivity.

Issue: Ecological connectivity		
Phase: Construction		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Very Short-term (< 1 year)	Very Short-term (< 1 year)
Extent	Part of site/property	Part of site/property
Consequence	Very low	Very low
Probability	Unlikely / improbable (Very low)	Unlikely / improbable (Very low)

Significance	Insignificant	Insignificant
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible: Given the expected duration and extent of site establishment any impacts on ecological connectivity will be short-term and ecological process should revert to pre-disturbance standards.	
Degree to which impact may cause irreplaceable loss of resources	None: Impacts will not cause irreplaceable loss.	
Degree to which impact can be avoided	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Degree to which impact can be mitigated	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Cumulative Impact		
Nature of cumulative impacts	Direct cumulative impacts on ecological connectivity are not expected.	
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Insignificant	Insignificant

Key mitigation recommendations:

- Limit the extent of the drill site camps. Site camps should not extend beyond the proposed 1 ha sites surrounding each proposed well location.
- The boundary of the drill sites must be clearly demarcated.
- Avoid impacts to good condition grassland areas outside the drill site footprint, which are to be 'no-go' areas for construction crews. The location of these 'no-go' areas should be made clear to all staff.
- No temporary construction site amps, vehicle parking or equipment storage to be located outside previously specified areas.

5.6.2 Operation Phase

Vegetation on site still is largely degraded and in poor condition. Overall impact significance can be regarded as 'insignificant'.

Table 33. Summary results of the cumulative terrestrial ecological impact significance assessment for operation phase impacts on ecological connectivity.

Issue: Ecological connectivity		
Phase: Operation		
Criteria	**Without Mitigation**	**With Mitigation**
Intensity	Minor change (Low)	Negligible change (Very low)
Duration	Very Short-term (< 1 year)	Very Short-term (< 1 year)
Extent	Part of site/property	Part of site/property
Consequence	Very low	Very low

Probability	Unlikely / improbable (Very low)	Unlikely / improbable (Very low)
Significance	Insignificant	Insignificant
Additional Assessment Criteria		
Degree to which impact can be reversed	Fully reversible: Given the expected duration and extent of on-site drilling any impacts on ecological connectivity will be short-term and ecological processes should revert to pre-disturbance standards.	
Degree to which impact may cause irreplaceable loss of resources	None: Impacts will not cause irreplaceable loss.	
Degree to which impact can be avoided	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Degree to which impact can be mitigated	High: Impacts can be avoided through the implementation of mitigation measures as outlined below.	
Cumulative Impact		
Nature of cumulative impacts	Direct cumulative impacts on ecological connectivity are not expected.	
Extent to which a cumulative impact may arise	Unlikely	
Rating of cumulative impacts	**Without Mitigation**	**With Mitigation**
	Insignificant	Insignificant

Key mitigation recommendations:

- Limit the extent of the drill site camps. Site camps should not extend beyond the proposed 1 ha sites surrounding each proposed well location.
- The boundary of the drill sites must be clearly demarcated.
- Avoid impacts to good condition grassland areas outside the drill site footprint, which are to be 'no-go' areas for construction crews. The location of these 'no-go' areas should be made clear to all staff.
- No temporary construction site amps, vehicle parking or equipment storage to be located outside previously specified areas.
- On-site IAP control.

6. IMPACT MITIGATION AND MANAGEMENT

A strong legislative framework which backs up South Africa's obligations to numerous international conservation agreements creates the necessary enabling legal framework for the protection and management of terrestrial ecosystems and biodiversity in the country. According to the National Environmental Management Act No. 107 of 1998 (NEMA): sensitive, vulnerable, highly dynamic or stressed ecosystems (such as terrestrial forests and grasslands) require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure. NEMA also requires "*a risk-averse and cautious approach which takes into account the limits of current knowledge about the consequences of decisions and actions*". The 'precautionary principle' therefore applies, and cost-effective measures must be implemented to pro-actively prevent degradation of the region's natural resources, biodiversity and the social systems that depend on terrestrial ecosystems and habitats. ***Ultimately, the risk of ecological degradation and biodiversity reduction/loss must drive sustainability in development design.***

Of particular 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.*"

6.1 Mitigation Hierarchy

The protection of terrestrial ecosystems (grasslands in this instance) and associated biodiversity typically begins with the mitigation of risks and avoidance of adverse impacts and where such avoidance is not feasible; to apply appropriate mitigation in the form of reactive practical actions that minimises or reduces impacts. The management of ecosystems should aim to prevent the occurrence of large-scale damaging events as well as repeated, chronic, persistent, subtle events which can in the long-term be far more damaging (e.g., as a result of sedimentation and pollution).

'Impact Mitigation' is a broad term that covers all components involved in selecting and implementing measures to conserve biodiversity and prevent significant adverse impacts as a result of potentially harmful activities to natural ecosystems. The mitigation of negative impacts on terrestrial vegetation, habitat and associated biodiversity is a legal requirement for authorisation purposes and must take on different forms depending on the significance of impacts and the particulars of the target area being affected. This generally follows some form of 'mitigation hierarchy' (see Figure 15) 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.

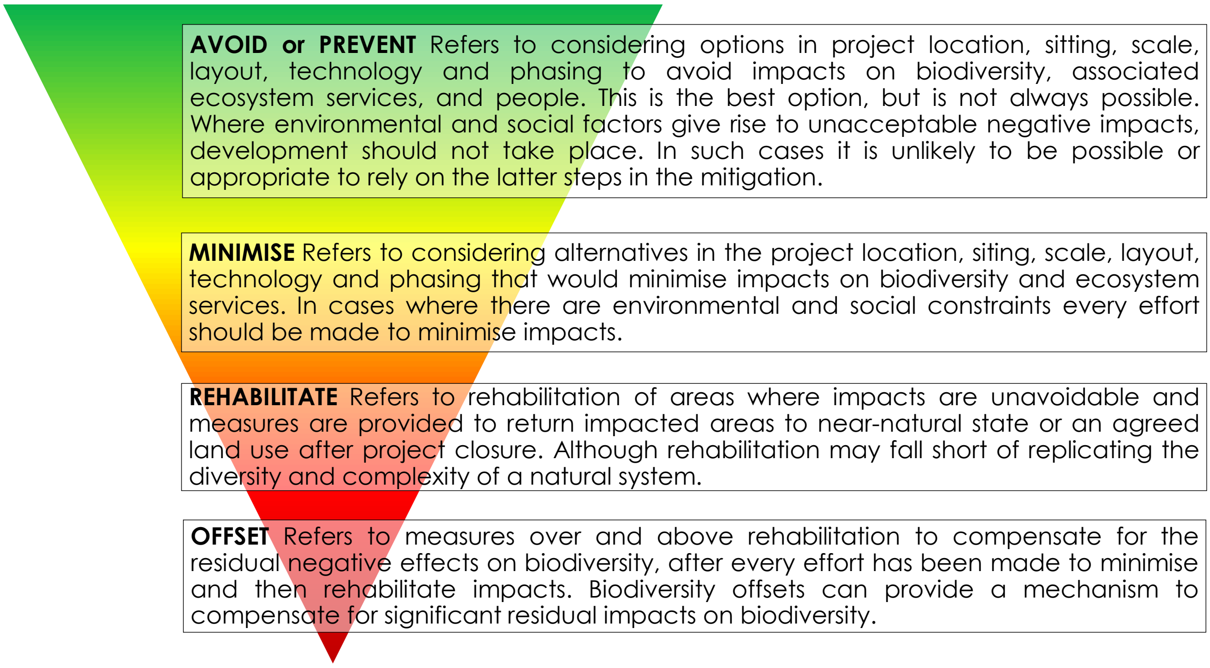

Figure 50 Diagram illustrating the 'mitigation hierarchy' (after DEA *et al*., 2013).

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 best be accommodated without incurring significant negative impacts to the receiving environment. In cases where the receiving environment cannot support the development or where the project will destroy the natural resources on which local communities are wholly dependent for their livelihoods or eradicate unique biodiversity; the development may not be feasible and the developer knows of these risks, and can plan to avoid them, the better. In the case of particularly sensitive or threatened/endangered ecosystems, where ecological impacts can be severe, the guiding principle should generally be "*anticipate and prevent*" rather than "*assess and repair*".

Examples of mitigation can include changes to the scale, design, location, siting, process, sequencing, phasing, and management and/or monitoring of the proposed development activities, as well as the restoration or rehabilitation of habitats and vegetation disturbed during construction. Where environmental impacts can be severe, the guiding principle should be "anticipate and prevent" rather than "assess and repair". In dealing with potential development risks and impacts to terrestrial ecosystems and biodiversity, during both the construction and operation phases of the development project, mitigation would be best achieved through phases or stepped approach to the project which should be implemented as follows:

1. **Avoiding 'direct impacts'** to important and / or intact terrestrial ecosystems wherever possible through appropriate and informed development planning;

2. Secondly, **attempting to reduce the risk of incurring significant 'indirect impacts'** through the integration of appropriate management of storm water, erosion control and pollution control into the development design and through relevant onsite control measures (where relevant);
3. Thirdly**, addressing residual impacts to areas** through onsite post-construction phase **rehabilitation and re-vegetation**; and
4. Lastly, applying relevant **biodiversity offsets** as a means of compensating for residual impacts associated with the loss of primary vegetation/habitat and/or conservation important species of flora/fauna (*not applicable to this project*).

Note that storm water management recommendations and sediment control mitigation measures are outlined in the Wetland and Aquatic Assessment report (Eco-Pulse Report No. 622-01, 2023). These have not been reiterated in this report as erosion and sediment related impacts to both freshwater and terrestrial environments are not considered significant for the proposed exploration well drilling project.

6.2 Implementation of Mitigation Measures

In terms of Section 2 and Section 28 of NEMA (National Environmental Management Act, 1998), the landowner/developer is responsible for any environmental damage, pollution or ecological degradation caused by their activities "inside and outside the boundaries of the area to which such right to, permission relates". In dealing with the range of potential ecological impacts to natural ecosystems and biodiversity highlighted in this report, this would be best achieved through the incorporation of the management & mitigation measures (recommended in this report) into the Construction Environmental Management Programme (EMPr) for the development project.

The EMPr should define the responsibilities, budgets and necessary training required for implementing the recommendations made in this report. This will need to include appropriate monitoring as well as impact management and the provision for regular auditing to verify environmental compliance. The EMPr should be enforced and monitored for compliance by a suitably qualified/trained ECO (Environmental Control Officer) with any additional supporting EOs (Environmental Officers) having the required competency skills and experience to ensure that environmental mitigation measures are being implemented and appropriate action is taken where potentially adverse environmental impacts are highlighted through monitoring and surveillance. The ECO will need to be responsible for conducting regular site-inspections of the construction process and activities and reporting back to the relevant environmental authorities with findings of these investigations. The ECO will also need to be responsible for preparing a monitoring programme to evaluate construction compliance with the conditions of the EMPr and RoD/EA, once issued.

6.3 Development Planning: *Environmental Guidelines and Principles*

At the forefront of mitigating impacts to terrestrial vegetation, habitat and biodiversity should be the incorporation of ecological and environmental sustainability concepts into the design of the development project, with a central focus on the following:

1. Ensuring that direct impacts to sensitive vegetation and habitat are avoided wherever possible through ecologically sound and sustainable development layout planning that takes into account the location and sensitivity of the remaining ecological infrastructure at the site;
2. Employing creative design principles and ecologically sensitive methods in infrastructure design and layouts to minimise the risk of indirect impacts;
3. Ensuring that storm water management design and implementation takes into account the requirements of the environment; and
4. Taking necessary efforts aimed at minimising/reducing potential waste streams.

6.4 Construction Phase Impact Mitigation Measures

The following project-specific mitigation measures are recommended during the construction phase of the project. The following mitigation measures must be implemented in conjunction with any generic measures provided in the Environmental Management Programme (EMPr).

6.4.1 'No-go' areas and working area demarcations

- 'No-Go' areas to be shown on a site layout map and demarcated on the ground. 'No-Go' areas should include intact grassland areas in the vicinity of the proposed drill sites. ('No-Go' areas have been avoided by application on the 'precautionary approach', therefore adherence to limiting site activities to the 1ha will suffice this recommendation).
- The extent of the proposed 1 ha site camp areas should be clearly demarcated. The movement of workers and equipment should be contained within the site camp area as far as practically possible.
- Demarcation work must be signed off by the Environmental Control Officer (ECO) before any work commences.
- Demarcations are to remain until construction and rehabilitation is complete.
- No equipment laydown or storage areas must be located outside of the site camp footprints.
- Access to and from the development area should be either via existing roads or within site camp footprints.

- Any contractors found working inside the 'no-go' areas (areas outside the construction/ working footprint) should be fined as per a fining schedule/system setup for the project.

6.4.2 Vegetation management

- 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.

6.4.3 Invasive alien plant control

- All alien invasive vegetation that colonises the construction site must be removed, preferably by uprooting. The contractor should consult the ECO regarding the method of removal.

6.4.4 Management of wildlife

- Education of workers/employees onsite focused on avoiding unnecessary harm to wildlife will assist in mitigating this impact. Contractor induction and staff/labour environmental awareness training needs are to be identified and implemented through staff/contractor environmental induction training. This should include basic environmental training based on the requirements of the EMPr, including training on avoiding and conserving local wildlife.
- 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 (such as snakes, rats, mice, etc.).
- Any fauna that are found within the construction zone must be moved to the closest point of natural or semi-natural habitat outside the construction area.
- The handling and relocation of any animal perceived to be dangerous/venomous must be undertaken by a suitably trained individual.
- All vehicles accessing the site should adhere to a low-speed limit (30km/h is recommended) to avoid collisions with susceptible species such as reptiles (snakes and tortoises).
- No litter, food or other foreign material should be disposed of on the ground or left around the site or within adjacent natural areas and should be placed in demarcated and fenced rubbish and litter areas that are animal proof.
- Ensure that workers accessing the site conduct themselves in an acceptable manner while on site, both during work hours and after hours.

6.4.5 Fire management

- No open fires to be permitted on construction sites. Fires may only be made within the construction camp and only in areas and for purposes approved by the ECO.
- Fire prevention facilities must be present at all hazardous storage facilities.
- Ensure adequate fire-fighting equipment is available and train workers on how to use it.
- Ensure that all workers on site know the proper procedure in case of a fire occurring on site.
- Smoking must not be permitted in areas considered to be a fire hazard.

6.4.6 Nuisance management

- Noise and vibrations should be minimized where possible.
- No activities should be permitted at the site after dark (between sunset and sunrise), except for security personnel guarding the development site.

6.4.7 Rehabilitation of accidental/ unintended physical disturbance

Activities in 'no-go' areas are strictly prohibited. Any damage to 'no-go' areas that takes place during the construction phase must be rehabilitated immediately. A site-specific rehabilitation plan would need to be developed in this instance and a terrestrial ecologist consulted in this regard should such disturbance occur.

6.4.8 Construction phase monitoring

- Compliance monitoring will be the responsibility of a suitably qualified/trained ECO (Environmental Control Officer).
- A photographic record of the state of the terrestrial ecosystems prior to the commencement of site establishment must be kept for reference and rehabilitation monitoring purposes.
- The ECO must undertake weekly compliance monitoring audits. Terrestrial ecosystem aspects that must be monitored related to monitoring freshwater ecosystem impacts include:
    - The condition of the demarcation fence/barrier.
    - Evidence of any 'no-go' area incursions.
    - The condition of the temporary runoff, erosion and sediment control measures and evidence of any failures or sediment deposits within watercourses.
    - Evidence of erosion.
    - 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 methods and success.
- Once the construction and rehabilitation has been completed, the ECO should conduct a close-out site audit within a month of completion of rehabilitation.

6.5 Operational Phase Impact Mitigation Measures

The following mitigation measures are recommended to address the operational impacts.

6.5.1 Invasive alien plant control

Regular alien plant control within the project footprint and associated access roads is necessary to ensure that revegetated and disturbed areas affected during the construction phase are not colonised by invasive alien plants during the operational phase of this project. Any clearing that takes place during the construction phase should be supplemented by periodic follow-up IAP clearing phases every 3 months up to one year, depending on IAP infestation levels observed on-site which should be determined by the relevant appointed ECO for the project. Recommendations regarding IAP clearing outlined in the construction phase mitigation measures should likewise be adhered to and are applicable also to the operational phase.

6.5.2 Ecosystem rehabilitation and management

The following are general land preparation requirements for all areas requiring rehabilitation (prior to any re-vegetation occurring):

- All rubble, litter, foreign materials and waste products need to be removed from the construction area and disposed of at licensed local waste disposal/landfill facilities. Minimise additional disturbance by limiting the use of heavy vehicles and personnel during clean-up operations.
- Any soil stockpiles/spoil material must spread evenly on the ground to match the natural slope.
- All Invasive Alien Plants (IAPs) and weeds must be removed from target sites, preferably by uprooting.
- Any erosion features within the construction site must be stabilised. Compacted soil infill, rock plugs, gabions, excavation and reshaping or any other suitable measures can be used for this purpose.
- Where significant soil compaction has occurred, the soil may need to be ripped in order to reduce its bulk density thus improving the chances that vegetation can become established at the site. Rip and / or scarify all disturbed and compacted areas of the construction site. The ECO,

with the assistance of the engineer, will specify whether ripping and / or scarifying is necessary, based on the site conditions.

- Immediately after ripping and scarifying disturbed areas, about 300mm of topsoil must be applied. The thickness of the topsoil may be reduced at the instruction of the engineer.
- The topsoil must be compacted to similar compaction levels as natural soils in the area. The engineer will provide detailed advice on this.
- For seeding, the soil needs to be prepared to optimise germination. This is typically undertaken by hand hoeing to loosen the soil in the seedbed but should be firm enough to facilitate good contact between the seeds and the soil.

Revegetation of disturbed terrestrial areas

Immediately after preparing the soil, re-vegetation must commence in order to help bind the soil and prevent soil erosion and to inhibit IAP/weed establishment which will compete with the natural vegetation for space, light, nutrients and water. In this regard, the following mitigation measures is to be implemented for disturbed terrestrial habitats/vegetation:

Re-vegetation Method 1: Planting of plugs / sprigs (for disturbed grassland areas)

The following recommendations apply to re-vegetation of areas disturbed during construction:

- The timing of planting is best done shortly before or at the beginning of the growing season (i.e. spring, or at the onset/early summer).
- Once the soil surface is prepared and stabilised, plugs are to be established at moderate densities in alternating rows / patches with areas to be planted. The pattern of planting is to be determined as part of the detailed plan for implementation.
- When using vegetation plugs, the spacing of plugs should not be too wide and planting should be done in patches rather than wider spacing.
- If the soil into which the plugs are to be planted is dry, it will be necessary to add a suitable hydroscopic gel to the receiving cavity at the time the plug is planted (Granger, 2014).
- It is essential that when a plug is planted that the receiving cavity is slightly deeper than the length of the root ball so that when the cavity is pinched closed a slight depression remains around the base of the leaves. This is especially important if the plugs are small and planted into dry soil even though hydroscopic gel has been added to the cavity.
- Live plugs of suitable indigenous grasses such as *Aristida junciformis, Digitaria eriantha, Cynodon dactylon* and *Eragrostis curvula* can be obtained from a commercial source.
- Note that any harvesting from donor grassland areas must be undertaken with caution so as not to unduly disturb the donor site. For whole/growing plants, ensure that plants are dug up with as much of their roots intact and such that the soil around the roots is not disturbed (i.e. intact root ball). Care also needs to be taken that weeds/alien plants are not transplanted with the donor plants.

- Collected plants should be replanted as quickly as possible following removal (i.e., within hours of harvesting).
- Large clumps of plants can be carefully separated into smaller clumps or into several individual stems with attached roots, known as slips.
- The plants should be planted with their roots in as much of the original soil medium as possible from which they were removed.
- When planting the material, dig a hole deep enough to ensure that the roots do not bend upwards.
- The soil around the plant should be firmly compacted.
- Temporary erosion protection measures must only be removed once good vegetation cover has established.
- It is essential that survival of all plants be monitored closely for at least the first eight weeks from the day following their planting and any dead plants be replaced as soon as possible.
- No exotic/alien plants are to be used in re-vegetation.

Re-vegetation Method 2: Seeding by broadcasting or hydroseeding (for areas with bare soils/completely cleared of vegetation)

- Hydroseeding or manual broadcasting of seed is the second preferred option to re-vegetating slopes and areas with bare soils completely void of vegetation. The advantages of hydroseeding include faster germination, increased plant survival, and the ability to cover large, often inaccessible areas rapidly.
- The slurry (basic materials) for hydroseeding must consist of water, seed, fertiliser, anti-erosion compounds (soil binders) and organic supplements to enhance grass growth.
- Prior to seeding, water must be sprayed over the target area to provide added moisture.
- The target groundcover of re-vegetated areas shall be no less than 80% of specified vegetation and there must be no bare patches of more than 500 x 500 mm in maximum dimension.
- Ideal species for seeding are mat forming or tufted pioneer grasses that can become quickly established at the site to provide immediate cover in order to stabilise soils and reduce erosion risk. Recommended pioneer grasses for attaining an initial cover at disturbed sites (based on the climate and soil occurring at the site) may include a number of fast-growing and mat-forming (stoloniferous or rhizomatous) runner grasses such as *Cynodon dactylon*[12] (Couch grass), *Chloris gayana* (Rhodes grass) and/or *Eragrostis tef*.
- No exotic/alien plants are to be used in re-vegetation.

[12] Note that *Cynodon dactylon* has recently been listed as an "invasive" species in terms of NEMBA and requires a plant permit to be obtained for the use this species in planting projects. A sterile (non-invasive) cultivar should be sourced if this species is to be used and the relevant permit obtained.

6.6 Biodiversity Offsets

Biodiversity offsets are typically required in certain situations to compensate for residual impacts to ecosystems and biodiversity once all other forms of mitigation have been considered. Should it be possible to avoid protected plants, direct impacts of 'High' significance will be avoided, such that the only impacts will be incurred by degraded grassland which is 'vulnerable'. Given that impacts to grassland is unlikely to negate meeting conservation targets set for this type at this stage, **biodiversity offsets are not considered relevant to this project.**

7. CONCLUSION

The Specialist **Terrestrial Biodiversity Impact Assessment** contained in this report was undertaken by Eco-Pulse Consulting in November/December 2022. This report outlines the conservation context assessments for the study area and contains the baseline terrestrial ecosystem assessment findings. Based on the findings of this assessment, three broad vegetation communities (Degraded Western Free State Clay Grassland, Secondary Grassland and Dense Invasive Alien Plants) were described on-site, considered to be of poor condition with a 'Low' to 'Very Low' SEI rating. In addition, the vegetation community, Western Free State Clay Grassland, is endemic to the Free State and listed nationally as a 'least concern' ecosystem. The vegetation communities found within the sites are no longer representative of good condition Western Free State Clay Grassland, Vaal-Vet Sandy Grassland and Kimberley Thornveld, and are highly degraded due to disturbance (grazing) and transformation for agricultural utilisation. There is no evidence supporting concern for probable occurrence of SCC at any of the sites surveyed.

Recommendations have been provided to try and avoid and minimise potential impacts in accordance with the first two steps of the mitigation hierarchy. Under a best practical mitigation scenario, the project is considered to be environmentally acceptable from a terrestrial biodiversity perspective, provided that the mitigation and management recommendations in Chapters 6 and 7 of this report are strictly adhered to. Biodiversity offsets are not considered relevant to this project.

8. REFERENCES

Collins, N.B., 2019 Free State Province Biodiversity Plan: CBA map. Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs. Internal Report.

Collins, N.B., 2019. Free State Province Biodiversity Plan: Technical Report v1.0. Free State Department of Economic, Small Business Development, Tourism and Environmental Affairs. Internal Report.

Avian Demographic Unit. 2017. Online database.

Bates, M.F., Branch, W.R., Bauer, A.M., Burger, M., Marais, J., Alexander, G.J., De Villiers, M.S., (eds). 2014. Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland. Suricata 1. South African National Biodiversity Institute (SANBI), Pretoria.

Bengtsson, J., Bullock, J.M., Egoh, B., Everson, C., Everson, T., O'Connor, T., O'Farrell, P.J., Smith, H.G. and Lindborg, R., 2019. Grasslands—more important for ecosystem services than you might think. Ecosphere, 10(2), p.e02582.

Bromilow, C. (2012). Problem Plants and Alien Weeds of South Africa, Third Edition. Pretoria: Briza Publishers.

Chittenden, H., 2009. Robert's Bird Guide: A comprehensive field guide to over 950 bird species in southern Africa.

Department of Environmental Affairs (DEA), 2017. Policy on Biodiversity Offsetting in South Africa (Draft). Version 2 (Revision 1), Friday, 22 September 2017.

Department of Environmental Affairs, Department of Mineral Resources, Chamber of Mines, South African Mining and Biodiversity Forum and South African Biodiversity Institute. 2013. Mining and Biodiversity Guideline: Mainstreaming biodiversity into the mining sector. Pretoria.

DWAF (2007) A Level II River Ecoregion classification System for South Africa, Lesotho and Swaziland. Resource Quality Services, Department of Water Affairs and Forestry, Pretoria, South Africa.

Lawrence, D. (2007). Impact Significance Determination - Design Approach. In Environmental Impact Assessment Review 27 (pp. 730 - 754).

Mucina, L. & Rutherford, M.C. (eds) Reprint 2011. The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria. ISBN: 978-1919976-21-1

Newman K (2002) Newman's birds of southern Africa, Struik, Cape Town

SANBI, S. A. (2010). Threatened Species: A guide to Red Lists and their use in conservation. Pretoria.

SANBI. 2013. Grasslands Ecosystem Guidelines: landscape interpretation for planners and managers. Compiled by Cadman, M., de Villiers, C., Lechmere-Oertel, R. and D. McCulloch. South African National Biodiversity Institute, Pretoria.

Skowno, A.L., Raimondo, D.C., Poole, C.J., Fizzotti, B. & Slingsby, J.A. (eds.). 2019. South African National Biodiversity Assessment 2018 Technical Report Volume 1: Terrestrial Realm. South African National Biodiversity Institute, Pretoria

South African National Biodiversity Institute (SANBI). 2020. Species Environmental Assessment Guideline. Guidelines for the implementation of the Terrestrial Fauna and Terrestrial Flora Species Protocols for environmental impact assessments in South Africa. South African National Biodiversity Institute, Pretoria.

Version 3.1 2022.

South African National Biodiversity Institute. 2018 Final Vegetation Map of South Africa, Lesotho and Swaziland [Vector] 2018. Available from the Biodiversity GIS website, downloaded on 22 September 2020.

9. ANNEXURES

Annexure A: Combined Desktop Freshwater & Terrestrial Ecological Sensitivity Map for ER318

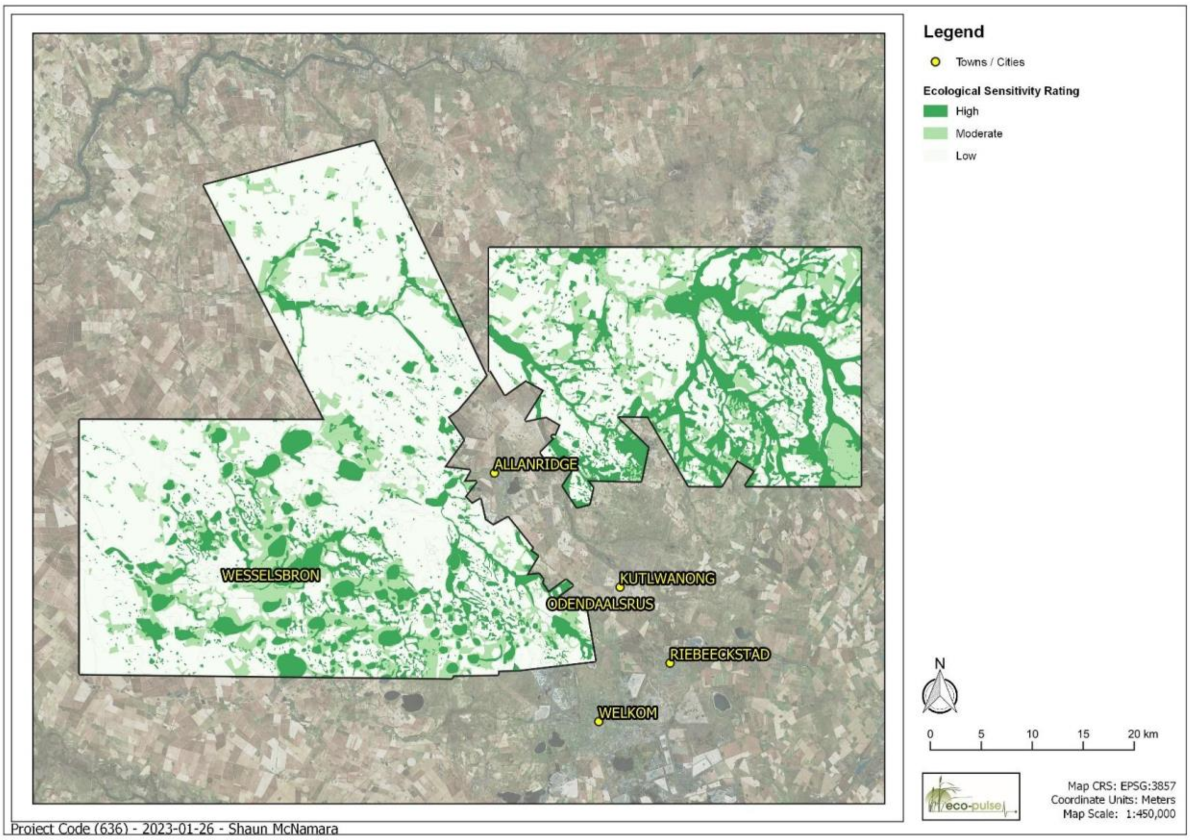

Figure 51 Eco-Pulse desktop ecological sensitivity map.

Annexure B: List of Plant Species encountered during rapid site walkover

- *Acrotome hispida*
- *Andropogon appendiculatus*
- *Andropogon schirensis*
- Argemone ochroleuca
- *Aristida congesta*
- Aristida junciformis
- *Berkheya seminivea*
- *Bidens Pilosa*
- Cirsium vulgare
- Conyza bonariensis
- *Cosmos bipinnatus*
- *Cucumus zeyheri*
- *Cymbopogon caesius*
- Cynodon dactylon
- *Cyperus congestus*
- *Digitaria eriantha*
- *Diheteropogon amplectens*
- *Eragrostis capensis*
- *Eragrostis curvula*
- Eucalyptus sp.
- *Felicia mossamedensis*
- *Geigeria burkei*
- *Haplocarpa lyrate*
- *Helichrysum dregeanum*
- Helichrysum epapposum
- *Heteropogon contortus*
- *Hibiscus microcarpus*
- Hilliardiella oligocephala
- *Hyparrhenia hirta*
- *Oxalis corniculate*
- Panicum maximum
- Pinus sp.
- *Polygala hottentotta*
- *Scabiosa columbaria*
- *Senecio inornatus*
- *Setaria sphacelate*
- Sonchus oleraceus
- Tagetes minuta
- Themeda triandra

- *Vachellia karroo*
- Verbena bonariensis
- *Ziziphus zeyheri*

Annexure C: List of Mammal Species encountered or expected to occur on site during rapid site walkover

- Aardvark (*Orycteropus afer)*
- Black-backed Jackal (*Canis mesomelas)*
- Cape Porcupine (*Hystrix africaeaustralis)*
- Common Duiker (*Sylvicapra grimmia)*
- Ground squirrel (*Xerus inauris)*
- Meerkat (Suricata suricatta)
- Slender Mongoose (*Galerella sanguinea)*
- Steenbok (*Raphicerus campestris)*
- Warthog (*Phacochoerus africanus)*

Annexure D: List of Bird Species encountered or expected to occur on site during rapid site walkover

- African Pipit (*Anthus cinnamomeus)*
- Ant-eating Chat (*Myrmecocichla formicivore)*
- Black-shouldered Kite (*Elanus axillaris)*
- Cape Sparrow (*Passer melanurus)*
- Cape Turtle Dove *(Cape Turtle Dove)*
- Common Fiscal *(Lanius collaris)*
- Crowned Lapwing (*Vanellus coronatus)*
- Diederik Cuckoo (*Chrysococcyx caprius)*
- Egyptian goose (*Alopochen aegyptiaca)*
- Grey Heron (*Ardea cinerea)*
- Hadeda Ibis (*Bostrychia hagedash)*
- Helmeted Guineafowl (*Numida meleagris)*
- House Sparrow (*Passer domesticus)*
- Jackal Buzzard (*Buteo rufofuscus)*
- Natal Spurfowl (*Pternistis natalensis)*
- Southern Red Bishop (*Euoplectes orix)*
- Spur-winged Goose (*Plectropterus gambensis)*
- Tawny-flanked Prinia (*Prinia subflava)*

Annexure E: Desktop SCC Likelihood of Potential Occurrence Assessment

The determination of ecological importance requires the consideration of whether the vegetation community described and classified in this assessment provide habitat for rare or threatened flora and fauna. In order to inform the EIS assessment and flag the need for additional floral or faunal surveys, a desktop likelihood of occurrence assessment of threatened flora and fauna was undertaken based on available data on species records and distributions, habitat preference and the recorded vegetation condition that acted as proxy for habitat condition and suitability.

Flora Likelihood of Occurrence

Interrogation of SANBI's online New POSA species database and the EIA online screening tool highlighted the potential occurrence of numerous protected, endemic and threatened species within the study area. Review of the habitat preference of threatened species against vegetation communities recorded within the study area highlighted the potential presence of 5 species which are considered Endangered, Vulnerable, Near Threatened, Data Deficient, Rare and/or Endemic. No species were flagged by POSA. Details of the assessment results are provided in Table 34.

Table 34. Flora of conservation significance: POC assessment

Scientific Name	Threat Status	Habitat Preferences	Rationale	POC	Source
Sesbania notialis	LC (En)	Free State, Northern Cape and North West. This taxon was not selected in any one of four screening processes for highlighting potential taxa of conservation concern for detailed assessment and was hence given an automated status of Least Concern.	Outside of distribution range.	Low	POSA
Eragrostis pseudobtusa	NE (En)	Unknown (not assessed).	NA	Unknown	POSA
Rushcia ruralis	LC (En)	Eastern Cape, Free State, Limpopo, Mpumalanga, Northern Cape, North West, and Western Cape. This taxon was not selected in any one of four screening processes for highlighting potential taxa of conservation concern for detailed assessment and was hence given an automated status of Least Concern.	Outside of distribution range.	Low	POSA

Ceropegia differens	LC (En)	Free State, Northern Cape, Eastern Cape and Western Cape. Tuberous geophyte growing in primarily the desert and dry shrubland biomes.	Within distribution range.	Probable	POSA
Sporobolus oxyphyllus	LC (En)	Eastern Cape, Free State, Northern Cape and North West. Grassland and Nama Karoo growing in areas with 'sodic' soil at the edges of salt pans and on saline vleis.	Within distribution range and habitat requirements met.	Probable	POSA

Fauna Likelihood of Occurrence

The findings of the desktop faunal likelihood of occurrence (LOC) assessment have been summarised in this section of the report. Potential amphibians, avifauna (birds), mammals, reptiles and invertebrates of conservation concern (i.e. Red-Dated Listed Species: CR: Critically Endangered, EN: Endangered, VU: Vulnerable, NT: Near Threatened) are documented below. *Note that species of Least Concern (LC), endemic species and species with restricted ranges have been excluded from the assessment, with the focus being on Red-Data species.*

A. Mammals

Review of the available Red List databases highlighted 18 mammal species of conservation concern modelled to occur within and around the study area. Conservation important small mammal species are unlikely to occur within transformed habitats in the study area, although some species may potentially utilise the more intact remnant primary grassland patches (see Table 35 below for details). Larger mammal species have either been eradicated or have moved away from the area due to the presence of human activity and disturbance associated with human occupation in the area.

Table 35. Potential occurrence of mammal species within the study area.

Species Name	Threat Status	Habitat Requirements/ Preferences	Rationale	POC	Source
Southern African Hedgehog *(Atelerix frontalis)*	NT	The distribution mainly falls within savannah and grassland vegetation types, within which it is found in a wide variety of semi-arid and sub-temperate habitats, including scrub brush, western Karoo, grassland and suburban gardens (Skinner & Chimimba 2005). They require ample ground cover, for cover, nesting and insect food sources (Skinner & Chimimba 2005). Key grassland vegetation types include the Soweto Highveld, Eastern Highveld, Rand Highveld, Carletonville Dolomite, Vaal-Vet Sandy and Frankfort Highveld Grasslands. The main savannah vegetation types include Polokwane Plateau Bushveld, Central Sandy Bushveld, Kimberley Thornveld, Moot Plains Bushveld, and Queenstown Thornveld (Mucina & Rutherford 2006). Northern Upper Karoo vegetation is also one of the important vegetation types for the species.	Within distribution range and habitat requirements largely met.	Possible	EWT Red List
Temminck's Ground Pangolin *(Smutsia temminckii)*	VU	It is a predominantly solitary, terrestrial species that is present in various woodland and savannah habitats, preferring arid and mesic savannah and semi-arid environments at lower altitudes, often with thick undergrowth, where average annual rainfall ranges between 250 and 1,400 mm (Skinner & Chimimba 2005). They also occur in floodplain grassland, rocky slopes and sandveld up to 1,700 m (Coulson 1989; Pietersen 2013), but are absent from Karroid regions, tropical and coastal forests, Highveld grassland and coastal regions. The range is believed to largely be determined by the presence and abundance of ant and termite prey species and the availability of dens or above-ground debris in which to shelter.	Within distribution range but habitat requirements not met.	Low	EWT Red List & Mammal Map
White-tailed Rat *(Mystromys albicaudatus)*	VU	Very little is known about this rare species in the wild. It is terrestrial and nocturnal and has several unusual physiological features: Their stomachs are adapted, via a complex microfauna and ruminant-like digestive system, to digest a wide range of plant foods that contain chemical defences and are thus not eaten by other species (Perrin & Maddock 1983; Downs & Perrin 1995), but there are no available data on preferred plant species from wild populations. It has a high metabolic rate well adapted to the Highveld winter (Monadjem et al. 2015), during which it reduces its activity and foraging times. However, there is no evidence suggesting that White-tailed Rats enter torpor (Perrin 2013).	Within distribution range and habitat requirements largely met.	Possible	EWT Red List & Mammal Map

Cape Clawless Otter *(Aonyx capensis)*	NT	Cape Clawless Otters are predominantly aquatic and seldom found far from permanent water. Fresh water is an essential habitat requirement, not only for drinking but also for rinsing their fur. As otters do not have a subcutaneous layer of fat like most other aquatic mammals, they rely on their dense fur for thermoregulation. Thus, rinsing their fur in freshwater followed by rolling in sand, grass or reeds helps them cleanse their fur and restore the thermoregulatory properties. Generally, they will only occur in marine habitats provided there is access to fresh water (coastal rivers or estuaries) and rocky shores are preferred for foraging (van Niekerk et al. 1998), and otter activity is often found near thick vegetation, abundant food supply and fresh water (van der Zee 1982; Arden-Clarke 1986; van Niekerk et al. 1998).	Within distribution range and habitat requirements largely met by rivers within study area.	Possible	EWT Red List & Mammal Map
Spotted-Necked Otter (Hydrictis maculicollis)	VU	Spotted-necked Otters are thought to inhabit freshwater habitats where water is not silt-laden, and is unpolluted, and rich in small fishes (Perrin & Carugati 2000a; d'Inzillo Carranza & Rowe-Rowe 2013). However, anecdotal observations suggest they can occur, and can be common, in relatively polluted rivers, such as the Braamfonteinspruit, Jukskei River and Blesbokspruit, Gauteng Province (Ponsonby, thesis, in prep.), and the Vaal River (Power 2014). More surveys are needed to determine at what threshold of water quality otter densities decline. The home range of these otters has been estimated at 5.9–27.4 km2 and the mean length of river within home ranges was 14.8 km (Perrin et al. 2000).	Within distribution range and habitat requirements largely met by rivers within study area.	Possible	EWT Red List & EIA Screening Tool
African Striped Weasel *(Poecilogale albinucha)*	NT	This species is mainly found in savannah and grassland habitats, although it probably has a wide habitat tolerance and has been recorded from lowland rainforest, semidesert grassland, fynbos (with dense grass) and pine plantations (Larivière & Jennings 2009; Stuart & Stuart 2013). Preferred habitats are grassy; for example, the few records from arid southwestern Africa are associated with semi-desert grassland (Stuart & Stuart 2013). African Striped Weasels may reach their highest densities in moist grasslands (Rowe-Rowe 1992) and are also found in montane grassland (Medland & Dudley 1995). Road kills have been collected from areas of pastures and cultivated fields (Monadjem 1998; Stuart et al. 2015). They are predominantly nocturnal but are occasionally seen during the day. They may make use of existing rodent burrows but are also good burrowers themselves.	Within distribution range and habitat requirements largely met.	Possible	EWT Red List

Black-footed Cat (*Felis nigripes*)	VU	The Black-footed Cat is one of the world's smallest cats, with females weighing an average of 1.3 kg and males larger at 1.93 kg (Sliwa 2013). The conspecific and more common African Wildcat (Felis silvestris) is considerably larger (females 3.9 kg; males 5.1 kg) (Sliwa et al. 2010). Unlike most cat species, these cats are predominantly ground dwellers and will not readily take to trees. They lead a solitary existence except when with kittens or during brief mating periods. Black-footed Cats are extremely secretive in nature. They are strictly crepuscular and nocturnal and are active throughout the night, even hunting at temperatures of –8˚C (Olbricht & Sliwa 1997). During the day, the cats make use of dens. The species prefers hollowed out abandoned termite mounds when available (especially for the kittens, Figure 3), but will use dens dug by other animals such as Springhares, Cape Ground Squirrels (Xerus inauris) and Aardvark (Orycteropus afer). It is a specialist of open, short grass areas with an abundance of small rodents and ground roosting birds.	Within distribution range and habitat requirements largely met.	Possible	EWT Red List
Southern Mountain Reedbuck (*Redunca fulvorufula fulvorufula*)	EN	Mountain Reedbuck live on grass-covered ridges and hillsides in broken rocky country and high-altitude grasslands often with some tree or bush cover (Avenant 2013). This distinguishes their habitat use from the more lowland grassland species, the Southern Reedbuck (R. arundinum) (Skinner & Chimimba 2005). They also occur in drier hilly areas (such as the Nama Karoo), utilising steep slopes and the bases of hills for grazing. They are predominantly grazers and eat the greenest, softest parts of grasses such as Red Grass (Themeda triandra) and Thatch Grass (Hyparrhenia spp.) (Irby 1977). They tend to avoid very open areas with no cover. The availability of drinking water is crucial.	Mostly within game reserves or game farms. Habitat requirements not met otherwise.	Low	EWT Red List
Grey Rhebok (*Pelea capreolus*)	NT	Grey Rhebok are associated with rocky hills, grassy mountain slopes, and plateau grasslands in the eastern extent of their distribution. In the south and southwest, their distribution is associated with the rocky hills of mountain fynbos and the little Karoo. They are predominantly browsers, often feeding on groundhugging forbs, and largely water independent, obtaining most of their water requirements from their food (Avenant 2013). Forbs constitute the majority of their diet, especially the flowers and leaves of the plants (Esser 1973; RoweRowe 1983a; Beukes 1988). They require good grass cover within their home ranges for shelter and to hide from predators, but often use steep open areas with little cover when feeding.	Within distribution range and habitat requirements largely met.	Possible	EWT Red List
Vlei Rat (*Otomys auratus*)	NT	This species is associated with mesic grasslands and wetlands within alpine, montane and sub-montane regions (Monadjem et al. 2015), typically occurring in dense vegetation in close proximity to water (for example, Wandrag et al. 2002; Watson 2006). In the Drakensberg range, O. angoniensis occurs on the lower slopes in savannah habitats, O. auratus and O. laminatus occur at mid-elevation in grasslands and O. sloggetti at the highest elevations in alpine heath habitats (Monadjem et al. 2015). Where O. auratus and O. angoniensis co-occur at the same site, the former is associated with sedges and grasses adapted to densely vegetated wetlands with wet soils, while the latter is associated with plant species that typically grow in the drier margins of wetlands (Davis 1973).	Within distribution range and habitat requirements largely met.	Possible	EWT Red List & Mammal Map

Leopard (*Panthera pardus)*	VU	The Leopard has a wide habitat tolerance, including woodland, grassland savannah and mountain habitats but also occur widely in coastal scrub, shrubland and semidesert (Hunter et al. 2013; Stein et al. 2016). Densely wooded and rocky areas are preferred as choice habitat types.	Mostly within game reserves or game farms. Habitat requirements not met otherwise.	Low	Mammal Map
(Southern African) Tsessebe (*Damaliscus lunatus lunatus)*	VU	Generally, an inhabitant of floodplains and other grasslands in sub-Saharan Africa (IUCN SSC Antelope Specialist Group 2008). In South Africa, the Tsessebe formerly occurred in the bushveld and lowveld, often at the ecotone between grassland and woodland. Their preferred habitats are Kimberley Thornveld and Mopane Bushveld. They do not occur in forests, arid or montane habitats (above 1,500 m) (Duncan 2013).	Mostly within game reserves or game farms. Habitat requirements not met otherwise.	Low	Mammal Map
Serval (*Leptailurus serval)*	NT	In sub-Saharan Africa, Servals are mostly found in and around marshland, well-watered savannah and long-grass environments, and are particularly associated with reedbeds and other riparian vegetation types (Thiel 2015). Servals can penetrate dense forest along waterways and through grassy patches and are able to tolerate agricultural areas to some extent provided cover is available (Hunter & Bowland 2013; Ramesh & Downs 2013). However, they have quite specific habitat requirements, so may be locally restricted to smaller areas within their broad distribution range (Sunquist & Sunquist 2002).	Habitat requirements largely met by areas of intact grassland with wetland areas.	Possible	Mammal Map
Brown Hyena (*Hyaena brunnea)*	NT	The Brown Hyaena is widespread across southern Africa and is found in the following habitat types: desert areas with annual rainfall less than 100 mm (particularly along the Skeleton Coast in Namibia), semi-desert, open scrub and open woodland savannah with a maximum rainfall up to about 700 mm. It shows an ability to survive close to urban areas (Kuhn 2014). It requires some type of cover in which to lie up during the day. For this it favours rocky, mountainous areas with bush cover in the bushveld areas of South Africa (Skinner 1976).	Mostly within game reserves or game farms. Habitat requirements not met otherwise.	Low	Mammal Map QDGS 2727DA, 2727DC
Bontebok (*Damaliscus pygargus pygargus)*	VU	The historical distribution range of Bontebok is very closely associated with the East Coast Renosterveld bioregion, which comprises four different vegetation types: Western Rûens Shale Renosterveld (14% remaining), Central Rûens Shale Renosterveld (13% remaining), Eastern Rûens Shale Renosterveld (19% remaining) and Mossel Bay Shale Renosterveld (Mucina & Rutherford 2006). Bontebok are almost exclusively grazers (Beukes 1984), with a preference for short grass and recently burnt veld (Beukes 1987; Novellie 1987; Kraaij & Novellie 2010).	Mostly within game farms. Outside of natural distribution range Habitat requirements not met otherwise.	Low	Mammal Map
Roan Antelope (*Hippotragus equinus)*	EN	Roan Antelope inhabit savannah woodlands and grasslands within the bushveld and Lowveld of southern Africa and prefer habitats with a cover of high grasses and woody plants (Dorgeloh 1998; Knoop & Owen-Smith 2006), which play an important role for both grazing and calving (Chardonnet & Crosmary 2013). As such, they may be especially sensitive to changes in grass height and composition, as Roan Antelope rely on grass to camouflage their young and for foraging (Havemann et al. 2016). Roan Antelope are most abundant in moist or dystrophic savannas and sandveld woodlands where soils are predominantly infertile.	Mostly within game farms. Outside of natural distribution range Habitat requirements not met otherwise.	Low	Mammal Map

Oribi (*Ourebia ourebia)*	EN	Oribi inhabit savannah woodlands, floodplains and other open grasslands, from around sea level to about 2,200 m sl (Mpumalanga Province). They reach their highest density on floodplains and moist tropical grasslands, especially in association with large grazers. They prefer open grassland in good condition containing a mosaic of both short grass for feeding and long grass for feeding and shelter (Rowe-Rowe 1994; Perrin & Everett 1999, Stears 2015).	Mostly within game reserves or game farms. Habitat requirements not met otherwise.	Low	EIA Screening Tool

B. Avifauna (birds)

Birds of conservation concern were identified through use of the South African Bird Atlas Project (SABAP) database (available online at http://sabap2.adu.org.za/). Whilst the majority of species recorded by the SABAP2 are considered locally common birds, there are 28 bird species that are considered to be of conservation concern based on their threat status (Table 36, below).

Table 36. Summary of the potential occurrence of bird species within the study area.

Species Name	Threat Status	Habitat Requirements/ Preferences	Rationale	POC	Source
Maccoa Duck *(Oxyura maccoa)*	NT	Within the region, the species occurs in large numbers (391-700 individuals) at sites in Mpumalanga, Free State and Western Cape provinces with smaller numbers being recorded in KwaZulu-Natal, Gauteng, Limpopo, North West, Northern Cape and Eastern Cape provinces. The species is largely sedentary, making short post-breeding dispersals, presumably in response to changing environmental conditions (Clark 1964, Kear 2005) although these movements are not well understood (Abebe et al. 2007). During the breeding season, the Maccoa Duck prefers small, shallow and nutrient-rich inland freshwater lakes (Johnsgard and Carbonell 1996), although it also takes advantage of man-made infrastructure such as farm dams and sewage farms (Johnsgard and Carbonell 1996). Outside of the breeding season, the species will make use of larger sites with deeper water (Berruti et al. 2005). Breeding takes place from July through to April, with a peak in September to November (Johnsgard 1978). The timing of breeding is thought to be related to rainfall (Abebe et al. 2007). Nests are in emergent vegetation over deep water and, being attached to vegetation, are prone to flooding when water levels rise (Abebe et al. 2007).	Within distribution range and habitat requirements met by farm dams and wetlands within the larger study area.	Possible	SABAP2
Ground Woodpecker *(Geocolaptes olivaceus)*	LC	It occurs on rocky slopes, mostly in areas dominated by grass and shrubs; including road cuttings or derelict buildings (Hockey et al. 2005). It is mainly sedentary but there is some suggestion that it could be an altitudinal migrant, and individuals may wander away from mountainous areas in the non-breeding season (Hockey et al. 2005).	Within distribution range and habitat requirements met.	Possible	SABAP2

European Roller *(Coracias garrulus)*	NT	Birds arrive in the austral spring between October/November and depart again in March/April (Kovács et al. 2008). Within the region, the species is concentrated in the upper-middle Limpopo River drainage, the Lowveld region of Mpumalanga and Limpopo, and coastal KwaZulu-Natal (Herremans 1997). It is an irregular visitor to Eastern Cape and Western Cape provinces (Rowan 1983). European Rollers are hole-nesters, making use of natural cavities or abandoned excavated burrows of other species (e.g., Green Woodpecker Picus viridis). Pairs are monogamous, maintaining territory and nest site fidelity for up to three years (Dementiev et al. 1951).	Within distribution range and habitat requirements largely met by larger patches of remaining indigenous vegetation of the following vegetation types within the study area.	Possible	SABAP2
African Grass-Owl *(Tyto capensis)*	VU	While historically more widespread in Free State, North West and Limpopo, the species is now known from only a few widely scattered localities in these provinces (Mendelsohn 1997). African Grass Owls appear most concentrated in areas with rainfall of 700-800 mm per year (Tarboton and Erasmus 1998) and have been recorded at altitudes from sea-level to 1 900 masl. As its name implies, the species typically roosts and breeds in tall, rank grass or sedges associated with damp substrates such as permanent and non-perennial wetlands and streams (Tarboton et al. 1987, Kemp 2005), although it will breed in any area of long grass and is not exclusively associated with wetlands. It constructs a series of tunnels, caves and landing platforms around the nest and roost, and therefore requires tall grass that offers concealment from above, and has relatively rigid but pliable blades, such as the grass species Imperata cylindrica.	Within distribution range and habitat requirements largely met by larger patches of remaining indigenous vegetation of the following vegetation types within the study area.	Possible	SABAP2
Ludwig's Bustard *(Neotis ludwigii)*	EN	Within the region, it occurs predominantly in the dry Karoo region of western South Africa (Herholdt 1988), extending eastwards into Free State, southwards into Eastern Cape and Western Cape provinces and northwards into Northern Cape. Ludwig's Bustard occurs in the flat, open, semi-arid shrublands of the Succulent Karoo, Nama Karoo and Namib (Allan 1994). It is tolerant of a variety of habitats and, depending on rainfall, may be found in the western grasslands of Free State and Eastern Cape, the southern Kalahari and cultivated fields and pastures (Allan 1994).	Within distribution range and habitat requirements fully met.	Probable	SABAP2
Blue Korhaan *(Eupodotis caerulescens)*	LC	It is found on high grassveld, usually above 1,500 m (del Hoyo et al. 1996), where it inhabits open, fairly short grassland and a mixture of grassland and karoo dwarf-shrubland within 1km of water, with termite mounds and few or no trees (del Hoyo et al. 1996, Taylor et al. 2015). It also inhabits old and fallow cropland, pastures and winter cultivation (del Hoyo et al. 1996). It feeds on insects, scorpions, small lizards and vegetable matter. It apparently benefits from small-scale agriculture, as it regularly forages in crop fields and planted pastures. Breeding occurs from August to April, mainly in October and November (del Hoyo et al. 1996). The nest is situated on bare open ground, often in short, thick grass or cropland (del Hoyo et al. 1996).	Within distribution range and habitat requirements largely met.	Possible	SABAP2

Grey Crowned Crane *(Balearica regulorum)*	EN	Within the region, the range of the species is divided between three core areas: the Eastern Cape and Transkei area; KwaZulu-Natal; and eastern Free State (van Niekerk 2011). Atlas records do not indicate occurrence in Lesotho with birds recorded there being considered non-breeding vagrants (Osborne and Tigar 1990.Grey Crowned Cranes require mixed wetland-grassland habitats (Filmer and Holtshausen 1992). They typically nest within or on the edges of wetlands, while foraging in wetlands, nearby grasslands, and croplands (Morrison and Bothma 1998). Non-breeders roost communally at night in trees or on overhead utility structures while breeding pairs roost on the ground, in wetlands at the nest (Morrison and Bothma 1998). Foraging takes place in short to medium height open grassland, lightly wooded savannah and agricultural fields (Pomeroy 1980). Cultivated lands play an important role with 56% of records of Grey Crowned Cranes in cultivated lands, 7% of which were maize fields (van Niekerk 2011),	Within distribution range and habitat requirements fully met.	Probable	SABAP2
Blue Crane *(Grus paradisea)*	NT	In South Africa, Blue Cranes occur in three core areas: 1) the eastern grasslands, centred in KwaZulu-Natal, Mpumalanga and north-eastern Free State provinces; 2) the central Karoo in the Northern Cape, southern Free State and Eastern Cape provinces; and 3) the Overberg and Swartland regions of Western Cape Province (McCann et al. 2007).Blue Cranes are dry-grassland birds, found in open grassland habitats and ecotones between the Grassland and Nama Karoo biomes (Allan 2005). They are also commonly found in agricultural landscapes, especially in Western Cape Province. Here they use a matrix of pastures and cereal croplands, moving seasonally between these habitats as food availability and visibility changes throughout the year (Allan 1995). Blue Cranes normally roost in wetlands or dams (Young et al. 2003)	Within distribution range and habitat requirements fully met.	Probable	SABAP2
Black-tailed Godwit *(Limosa limosa)*	NA	Black-tailed godwits are much more likely to be found on inland wetlands than the more coastal bar-tailed godwit. They migrate in flocks to western Europe, Africa, south Asia and Australia.	Within distribution range and habitat requirements largely met by wetlands.	Possible	SABAP2
Curlew Sandpiper *(Calidris ferruginea)*	LC	The species breeds across Arctic Siberia from the Chosa Bay to Kolyuchinskaya Gulf (north Chukotskiy Peninsula) (Russia) (Lappo et al. 2012), and winters from sub-Saharan Africa through the Middle East and south and south-east Asia to Australasia (van Gils and Wiersma 1996). In the winter its diet consists of polychaete worms, molluscs, crustaceans (such as amphipods, brine shrimps and copepods), and occasionally insects and seeds (del Hoyo et al.1996). It is a full migrant, moving long distances by well-travelled routes (del Hoyo et al. 1996, Snow and Perrins 1998).	Possibly migrant.	Possible	SABAP2

Greater Painted-snipe *(Rostratula benghalensis)*	NT	In the region, the species is spatially and temporally erratic in occurrence, with its presence and abundance largely determined by rainfall. Its movements are poorly understood and apparently complex and unpredictable. Furthermore, even in areas where it is reasonably numerous (such as northern Kruger National Park and the Limpopo Valley), it is easily overlooked. It occurs at scattered wetland localities aGreater Painted-snipe are limited to freshwater wetlands, where they prefer secluded muddy areas adjacent to concealing vegetation (Urban et al. 1986). The species occurs sparsely along the shorelines of dams, lakes and pans, on the banks of slow-flowing rivers, on marshy floodplains, in temporarily flooded grassland, at rainwater pools on clay soils with plentiful adjacent cover, and in other similar locations. Birds often congregate where the water is receding but vacate such habitats when the water level falls beyond the fringes of vegetation (Hockey and Tree 2005). Reported occurrence in savannah and other terrestrial vegetation types is conditional on the presence of suitable, usually ephemeral, wetlands (Navarro 1997). Due to its nomadic and partly migratory lifestyle, wanderers are occasionally encountered at small, isolated waterbodies in arid regions.cross much of the north-eastern half of the country, as well as sparsely in coastal areas in Eastern Cape, mainly in summer.	Within distribution range and habitat requirements fully met.	Probable	SABAP2
Chestnut-banded Plover *(Charadrius pallidus)*	NT	Within the region, the Chestnut-banded Plover occurs sparsely along the Northern, Western and Eastern Cape coastlines, and at scattered locations at inland waterbodies, mostly in Northern Cape, western Free State and North West provinces but occasionally elsewhere (for a summary of recent inland records see Peacock et al. 2014). The Chestnut-banded Plover is strongly associated with hyper-saline or hyper-alkaline wetlands, including natural and man-made salt pans and commercial saltworks (Turpie 2005), often in hyper-arid regions where rainfall can be as little as 20 mm per year. It occurs less frequently around lagoons, shallow-water bays, estuaries and estuarine salt marshes in coastal areas, and rarely in freshwater habitats (Urban et al. 1986) or temporary beach lagoons created at extreme spring tides (Hockey and Douie 1995). It is usually found in areas devoid of vegetation, and only rarely ventures greater than 50 m from the water's edge. Nests are placed on pebbly substrata or on dry mud (Tarboton 2011).	Within distribution range and habitat requirements partially to largely met.	Possible	SABAP2
Burchell's Courser *(Cursorius rufus)*	VU	SABAP2 records show that it still persists in scattered locations in the dry interior, with concentrations of records in south-western Free State, Northern Cape and North West.Burchell's Courser shows a preference for open, desert and semi-desert habitats, often occurring in the most sparsely vegetated areas available (Cohen and Spottiswoode 2000). Typical habitats include heavily grazed or burnt grassland, stony or gravelly plains, stubbly sandveld, dry riverbeds and edges of saline pans (Hockey and Douie 1995, Maclean and Herremans 1997). Historically it may have been associated with large ungulate herds, and it is still regularly seen in the vicinity of wild ungulate herds and to some extent, domestic grazers, for example, around stock watering points. It occasionally makes use of ploughed fields or cereal croplands with small emerging seedlings (Lloyd 2005).	Within distribution range and habitat requirements partially to largely met.	Possible	SABAP2

Black-winged Pratincole *(Glareola nordmanni)*	NT	Always gregarious, the Black-winged Pratincole occurs in small groups or large flocks of hundreds or even many thousands of birds (Maclean and Herremans 1997). It feeds mainly during the early morning and evening, hawking insects in flight (Tree 2005). Within the region, it prefers open grassland, edges of pans and cultivated fields (Barnes 2000), responding quickly to insect outbreaks occurring after storms. It is also attracted to agricultural activities that disturb insects. Resting birds often loaf along shallow, sparsely vegetated shorelines of dams and lakes.	Within distribution range and habitat requirements largely met.	Possible	SABAP2
Caspian Tern *(Hydropogne caspia)*	VU	The species breeds colonially, with the season varying between localities (Crawford 1997). The number of colonies used for breeding and the numbers of birds present at each varies widely between years (Crawford 1997). Breeding habitat used along the coast is largely offshore islands with an increasing use of sandy beaches and islands at salt works, where protection is offered (du Toit et al. 2003). Breeding at inland sites takes place on small, low islets in pans and dams. Caspian Terns are intolerant of any form of disturbance while breeding. A generation length of 12.2 years is provided by BirdLife International (2014). Hunting is carried out 3-20 m above the water, parallel to, and within 100 m of the shoreline. Birds dive head first into water when catching prey (Cyrus and McLean 1994) and feed throughout the day with most activity during the morning. Their diet consists almost entirely of fish of 5-20 cm in length and weighing 10-20 g.	Habitat requirements not met.	Low	SABAP2
Greater Flamingo *(Phoenicopterus roseus)*	NT	The Greater Flamingo occurs in large flocks of up to tens of thousands, often with Lesser Flamingos Phoeniconaias minor. Movements take place mostly at night, and in response to inundation of ephemeral pans (Simmons 2005). Little is known regarding regional movements, but apparent large influxes from East Africa occur during the breeding season, particularly to Sua Pan, Botswana (McCulloch and Borello 1998). Feeds on brine shrimps, brine flies, molluscs and diatoms by wading in water, bill upside down, filtering food from mud (Simmons 2005). Main breeding sites in southern Africa are Etosha Pan and Sua Pan, but occasionally breeds at a number of smaller wetlands in South Africa (Anderson 2000a, 2000b), although these breeding attempts are often unsuccessful (Simmons 2005). Most of the recruitment to the South African population originates from Sua Pan. Breeding has been successful in South Africa at Lake St Lucia (Porter and Forrest 1974), De Hoop Vlei, Bredasdorp (Uys et al. 1961, 1963) and several wetlands in the Northern Cape (Boshoff 1979, Anderson 2000a).	Habitat requirements partially met by pans.	Unlikely	SABAP2
Lesser Flamingo *(Phoeniconaias minor)*	NT	The Lesser Flamingo's non-breeding distribution in South Africa is centred on the central Highveld, but it also occurs along the West and South coasts (Borello et al. 1998). Large numbers have been recorded at Lake St Lucia, KwaZulu-Natal (IBA SA058), Berg River (IBA SA104), Wadrif Saltpan and Langebaan Lagoon (IBA SA105) in Western Cape, and Kamfers Dam, Northern Cape (IBA SA032) (Taylor 1999). It is a vagrant to Swaziland (Parker 1994) and a potential vagrant to Lesotho (Osborne and Tigar 1990). The Lesser Flamingo occurs on open, eutrophic, shallow saline and alkaline wetlands, such as salt pans and coastal lagoons and estuaries (Brown et al. 1982, Williams and Velásquez 1997). Lesser Flamingos are colonial nesters, with colonies numbering tens of thousands (Simmons 2005). Nest turrets of varying height are constructed on flooded pans (Berry 1972). Breeding takes place usually during the summer months after pans are inundated but may extend into winter (Simmons 1996).	Habitat requirements largely met by pans.	Possible	SABAP2

Southern Bald Ibis *(Geronticus calvus)*	VU	The Southern Bald Ibis is endemic to the region, occurring in north-eastern Free State, Mpumalanga, Limpopo, inland areas of KwaZulu-Natal, most of Lesotho and western Swaziland; the species is naturally re-establishing in Eastern Cape, just south of the Lesotho border (Pocock and Uys 1967, Cooper and Edwards 1969, Bonde 1993, Allan 1997, Barnes 2005). Southern Bald Ibis are found mostly in high-altitude grasslands, although they are known to use grasslands right down to the coast, including artificial grassland such as sports fields, golf courses and irrigated meadows (Manry 1985a,b). For breeding, the species requires cliffs with suitable ledges, generally above water. Apart from the modified grasslands mentioned above, the species also uses old maize fields, croplands, firebreaks and open spaces in towns when foraging.	Within distribution range and habitat requirements largely met.	Possible	SABAP2 & EIA Screening Tool
Great White Pelican *(Pelecanus onocrotalus)*	VU	Great White Pelicans inhabit estuaries, lagoons, coastal bays, shallow lakes, floodplain pans and dams where they feed on fish and, at times, other seabirds (Kemper et al. 2007). Dry-land roosts in open areas are needed. These are typically islands, wide shorelines or peninsulas associated with the waterbodies where the birds feed (Crawford 2005).	Dams and pans within study area may provide suitable habitat.	Possible	SABAP2
Yellow-billed Stork *(Mycteria ibis)*	EN	The Yellow-billed Stork occurs throughout sub-Saharan Africa and western Madagascar (del Hoyo et al. 1992). It is widespread within the region, but avoids arid western areas and has been described as a facultatively nomadic species (del Hoyo et al. 1992).Yellow-billed Storks forage in a diversity of permanent and seasonal wetland habitats, with open shallow water that is generally free of vegetation (del Hoyo et al. 1992, Hancock et al. 2010). Food includes frogs, small fish and other small aquatic prey (del Hoyo et al. 1992). The species is usually gregarious, and is often found with other waterbirds (Anderson 1997).	Within distribution range and habitat requirements largely met.	Possible	SABAP2
Black Stork *(Ciconia nigra)*	VU	Within the region, it occurs predominantly in the southern and eastern provinces, avoiding the drier interior and west (Siegfried 1967). The species is suspected to undergo complex seasonal movements (Tarboton et al. 1987). The Black Stork is mainly piscivorous with fish constituting 91% of the diet (Chevallier et al. 2008). The species is absent from seasonal pans lacking fish (Allan 1997) but is readily found at dams, shallow pans and floodplains. The diet of nestlings differs to that of adults, and is predominantly made up of amphibians and insects (Hampl et al. 2005).	Within distribution range and habitat requirements partially met by dams and larger pans.	Possible	SABAP2
Abdim's Stork *(Ciconia abdimii)*	NT	Within the region the Abdim's Stork has been described as locally common to abundant in North West, Limpopo, Free State and Mpumalanga provinces (Anderson 1997), with localised movements in response to environmental cues such as food availability (Anderson 1997).Abdim's Stork is normally found in grasslands, sparsely wooded savannah, near pans and in cultivated fields, in groups of up to 100 birds (Anderson 2005).	Within distribution range and habitat requirements largely met.	Possible	SABAP2
Marabou Stork *(Leptoptilos crumenifer)*	NT	The Marabou Stork occurs throughout sub-Saharan Africa. Within the region, it is primarily a non-breeding visitor from farther north in Africa, with only scattered and sporadic breeding records known from the Kruger National Park (Whyte et al. 1993, Anderson 2005) and one established breeding site in Hlane Royal National Park in eastern Swaziland (Reilly and Wasdell 1965, Monadjem et al. 2012). Birds have also recently started breeding at Pongolo Game Reserve (northern KwaZulu-Natal), with at least some of these breeding birds having fledged from the Swazi population (A Monadjem unpubl. data). In contrast to the rest of Africa, Marabou Storks are largely confined to large conservation areas within the region (Anderson and Herremans 1997).	Within distribution range and habitat requirements only met if larger conservation area forms part of the study area (which is unlikely) therefore going with not met for now.	Low	SABAP2

Sentinel Rock-Thrush *(Monticola explorator)*	LC	This species occurs in high altitude grassland and heathland associated with stones, including rocky areas and felled areas containing exposed rocks (see Hockey et al. 2005). It is resident in some areas (such as Lesotho and in the Drakensbergs), in others it may make some seasonal, altitudinal movements (Hockey et al. 2005), being only a winter visitor to grasslands in Gauteng (Taylor et al. 2015). The species is not found in the Lesotho lowlands (<1,800 m), but can be found sympatrically with M. rupestris at a ratio of 1:5 in the foothills (up to 2,200 m). In the highlands, the ratio of M. explorator is much higher, while in the Alpine zone (>2,500 m) it comprises more than 90% of all Monticola breeding pairs, and is a dominant species in the avian assemblage (Kopij 2010, 2014, 2015a, b).	Within distribution range, habitat requirements largely met.	Possible	SABAP2
Melodious Lark *(Mirafra cheniana)*	LC; En	The species inhabits grassland slopes, preferring open areas with open spaces between tussocks, typically where grass is shorter than 50 cm, but avoids wetter lowlands (del Hoyo et al. 2004). It forages on the ground, feeding on seeds, mostly of grasses, but also taking some insects. Breeding in South Africa takes place in September-March, mostly in November-January, and in January-March in Zimbabwe. It is probably monogamous and territorial. The nest is a domed structure with a side entrance, constructed with coarse grasses and lined with finer grass leaves. Its clutch-size is 2-4 eggs. It is generally resident, although there are seasonal fluctuations and local movements in response to dry-season fires (del Hoyo et al. 2004).	Within distribution range but habitat requirements only partially met.	Unlikely	SABAP2
Botha's Lark *(Spizocorys fringillaris)*	EN	Botha's Lark is endemic to eastern South Africa's upland grasslands, with a restricted distribution centred on south-eastern Mpumalanga (Amersfoort, Bethal, Hendrina, Ermelo, Wakkerstroom, Volksrust and Standerton districts) and the adjacent eastern Free State (west of Wesselbron, Heilbron, Warden, Verkykerskop and Harrismith districts) (Barnes 2000). The bulk of its population occurs in the Vaal River catchmentBotha's Lark is confined to short upland grassland at altitudes of 1 500-1 900 masl in eastern South Africa. Within this restricted geographical area, it is further confined to flat or gently sloping grassland with short, dense, heavily grazed natural grass on plateaus and upper hill slopes. It is mostly found on shallow turf soils (Tarboton et al. 1987), and particularly black clay soils in the Moist Clay Highveld Grassland vegetation type (Barnes 2000). Despite a widespread search in its stronghold in south-eastern Mpumalanga, Maphisa et al. (2009) recorded it in very few localities, indicating that the species is far more habitat-specific, within its Area of Occupancy, than originally thought. Botha's Lark is mostly restricted to fairly short grass (4-6 cm), either recently burned or unburned, but heavily grazed (Maphisa 2004). Likewise, Barnes (2000) reported its preference for severely grazed and bare trampled patches, and the species often breeds in recently burnt grassland (Maphisa et al. 2009). Suitably cropped or recently burnt grassland habitat is often present in the vicinity of kraals and old lands, and where stock is concentrated; the species is frequently found in such locations, especially outside the breeding season (Earlé and Grobler 1987, Tarboton et al. 1987). It is also recorded from moist, open Themeda triandra grassland (Hall and Moreau 1970). It avoids rocky areas, taller grass in bottomlands and valleys, vleis, croplands and planted pastures (Allan et al. 1983, Dean and Allan 1997). It is usually found singly, in pairs on in small groups of 3-6, but occasionally in larger groups of up to 10 birds (Herholdt and Grobler 1987).	Within distribution range and habitat requirements largely met.	Possible	SABAP2

African Rock Pipit *(Anthus crenatus)*	NT	The African Rock Pipit is endemic to South Africa and Lesotho, and possibly western Swaziland. It is considered to be mostly resident and sedentary throughout its range (Clancey 1997). Except for isolated populations in Northern Cape Province, its range is virtually continuous and no subspecies are differentiated. Its distribution lies mainly south-east of a line connecting Cape Town in Western Cape Province and Barberton in Mpumalanga Province. Centres of abundance lie in south-western Free State, along the mountainous border of Northern Cape, Western Cape and Eastern Cape provinces, and in the interior highlands of Lesotho (Peacock 2006). As its name implies, the African Rock Pipit is closely associated with rocky or boulder-strewn slopes and rocky scree. It occurs in a wide altitudinal band of up to 3 000 m in Lesotho (Clancey 1997), and in a range of climatic conditions: western birds occur in semi-arid karroid vegetation while eastern birds occur in mesic, high-rainfall, temperate alpine grasslands. Throughout its range, it is limited to steep, rocky slopes of mountains, koppies, valleys, gorges and rock outcrops. It requires some grassy cover as well as scattered shrubs or small trees, which, together with prominent boulders, are used as song-posts.	Within distribution range and habitat requirements largely met.	Possible	SABAP2
Secretary Bird *(Sagittarius serpentarius)*	VU	The species prefers open grassland and scrub, with the ground cover shorter than 50 cm and with sufficient scattered trees as roost/nest sites. It extends into savannah where sufficiently open areas exist (Boshoff and Allan 1997, Dean and Simmons 2005). It is absent from Mountain Fynbos, forest, dense woodland and very rocky, hilly or mountainous woodland (Boshoff and Allan 1997). It occurs from sea-level to montane grasslands over 2000 m. Nests are large, stick platforms usually built on top of isolated flat-crowned trees, and particularly vachellias (acacias); where indigenous thorny trees are not available, alien pines or wattles may also be used (Tarboton 2011).	Within distribution range and habitat requirements largely met.	Possible	EIA Screening Tool

C. Reptiles

All reptile species are sensitive to major habitat alteration and fragmentation. As a result of human presence in the area coupled with disturbance, alterations to the original reptilian fauna are expected to have already occurred and reptiles of conservation concern are therefore less likely to be present within the degraded secondary habitat on site. However, there is a possibility that some reptile species may occur within the more intact habitat on site where anthropogenic impacts are limited.

Table 37.Potential occurrence of reptile species within the study area.

Species Name	Threat Status	Habitat Requirements/ Preferences	Rationale	POC	Source
Giant girdled lizard *(Smaug giganteus)*	VU	This species is found in Highveld grassland. It is unique among the cordylids as it an obligate burrower living in self-excavated burrows (Branch 1998, Parusnath et al. 2017). It can be considered a habitat specialist, that is highly philopatric for burrowing sites. Although it is a large lizard, it will not easily disperse across the landscape to make new burrows should its habitat be destroyed. It is diurnal and insectivorous, although plant material may also be consumed (Jacobsen 1989). Females reproduce only every second year (Van Wyk 1991), and the generation length has been estimated at 15 years (Parusnath et al. 2017).	Within distribution range, habitat requirements partially to largely met.	Possible	SANBI Threatened Species Database and EIA Screening Tool

D. Amphibians

No frog SCC are expected to occur within site areas.

E. Invertebrates

Very few formal surveys of invertebrates have been carried out in the study area. A review of the EIA Screening Tool Report for the site, LepiMap, SpiderMap, ScorpionMap, OdonataMap accessed from http://vmus.adu.org.za/; highlighted one (1) species that could potentially occur on site.

Table 38. Summary of noteworthy invertebrates that could occur within the study area

Species Name	Threat Status	Habitat Requirements/ Preferences	Rationale	POC	Source	Species Name
Heilbron cupid *(Orachrysops mijburghi)*	*Butterfly*	EN	Endemic to the Free State and Gauteng provinces in South Africa, from Heilbron in the south to Doornkuil and in the vicinity of Suikerbosrand Nature Reserve near Heidelberg in the north.Moist habitats fringing ephemeral streams in undulating lowlands (Suikerbosrand and Heilbron); valleys within a south-facing hillside (Greylingstad).	Within distribution range, habitat requirements largely met.	Possible	LepiMap & EIA Screening Tool

Annexure F: 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.