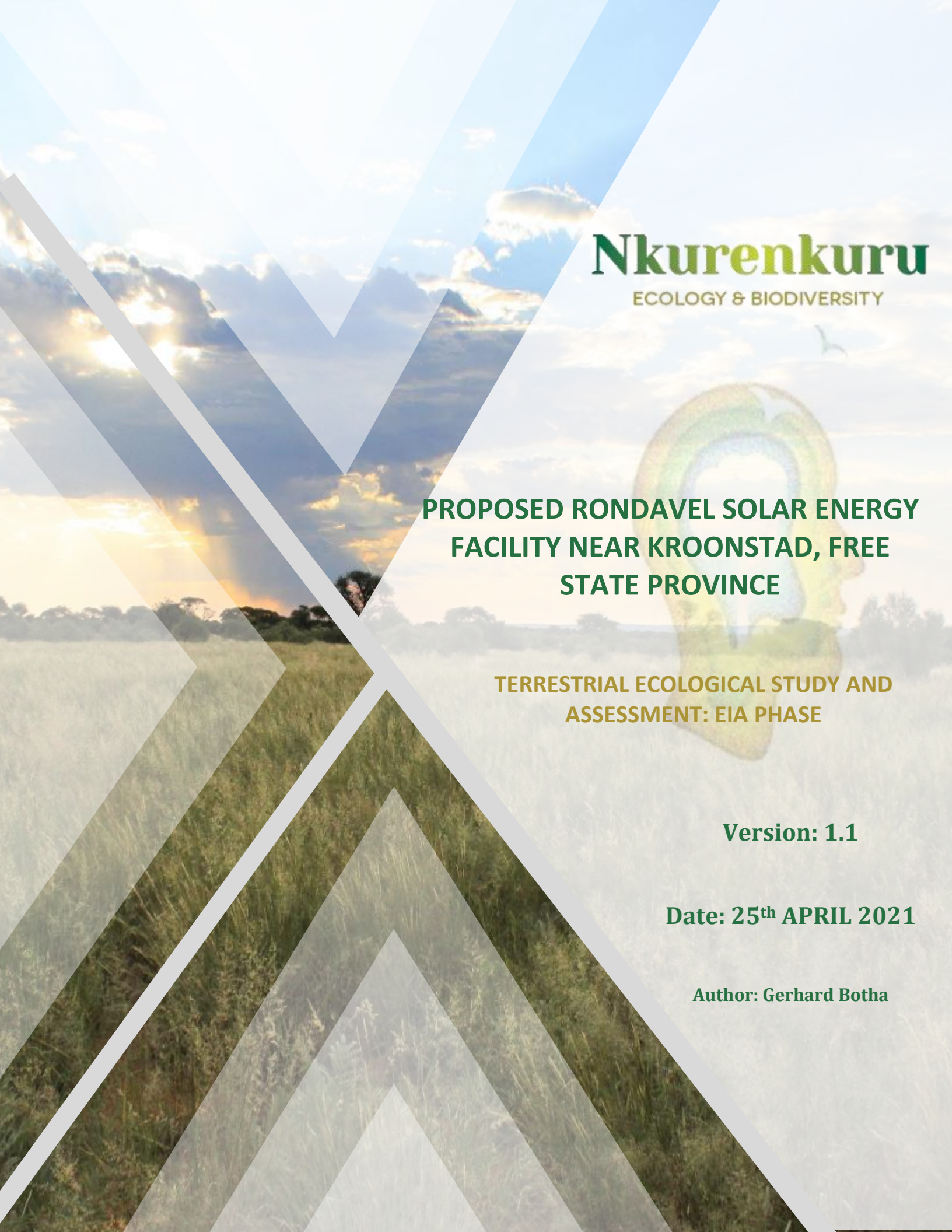

Nkurenkuru
ECOLOGY & BIODIVERSITY

PROPOSED RONDAVEL SOLAR ENERGY FACILITY NEAR KROONSTAD, FREE STATE PROVINCE

TERRESTRIAL ECOLOGICAL STUDY AND ASSESSMENT: EIA PHASE

Version: 1.1

Date: 25th APRIL 2021

Author: Gerhard Botha

PROPOSED RONDAVEL SOLAR ENERGY FACILITY NEAR KROONSTAD, FREE STATE PROVINCE

Report Title: Terrestrial Ecological Study and Assessment: EIA Phase

Authors: Mr. Gerhard Botha

Project Name: Proposed Rondavel Solar Energy Facility near Kroonstad, Free State Province

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I. DECLARATION OF CONSULTANTS INDEPENDENCE

- act/ed as the independent specialist in this application;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- have and will not have any vested interest in the proposed activity proceeding;
- have disclosed, to the applicant, EAP and competent authority, any material information that has or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- am fully aware of and meet the responsibilities in terms of NEMA, the Environmental Impact Assessment Regulations, 2014 (specifically in terms of regulation 13 of GN No. R. 326) and any specific environmental management Act, and that failure to comply with these requirements may constitute and result in disqualification;
- have provided the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- am aware that a false declaration is an offense in terms of regulation 48 of GN No. R. 326.

REPORT AUTHORS

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Field of expertise: Fauna & flora, terrestrial biodiversity, wetland ecology, aquatic and wetland, aquatic biomonitoring, and wetland habitat evaluations. BSc (Hons) Zoology and Botany, MSc Botany (Phytosociology) from 2011 to present.

April 2021

II. STATEMENT OF WORK

» This study has been executed in accordance with and meet the responsibilities in terms of:
  - NEMA, the Environmental Impact Assessment Regulations, 2014 (specifically in terms of regulation 13 of GN No. R. 326);
  - 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:
    - 3(c): Protocol for the assessment and reporting of environmental impacts on terrestrial animal species.
    - 3(d): Protocol for the assessment and reporting of environmental impacts on terrestrial plant species.

REPORT AUTHOR

Gerhard Botha *Pr.Sci.Nat* 400502/14 (Botanical and Ecological Science)

Field of expertise: Fauna & flora, terrestrial biodiversity, wetland ecology, aquatic and wetland, aquatic biomonitoring, and wetland habitat evaluations. BSc (Hons) Zoology and Botany, MSc Botany (Phytosociology) from 2011 to present.

Refer to Appendix 3 for curriculum vitae, Appendix 4 for relevant work experience and Appendix 5 for SACNASP Registration.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

PROPOSED RONDAVEL SOLAR ENERGY FACILITY NEAR KROONSTAD, FREE STATE PROVINCE

TERRESTRIAL ECOLOGICAL ASSESSMENT: EIA PHASE

1. INTRODUCTION

Client

Savannah Environmental (Pty) Ltd. on behalf of South Africa Mainstream Renewable Power Developments (Pty) Ltd.

Project

Proposed 100 MWac Rondavel Photovoltaic (PV) Solar Energy Facility (SEF), Battery Energy Storage System (BESS) and associated infrastructure located near the town of Kroonstad in the Moqhaka Local Municipality (Fezile Dabi District) of the Free State Province of South Africa

Proposed Activity

South Africa Mainstream Renewable Power Developments (Pty) Ltd is proposing the construction and operation of the grid connection infrastructure for the proposed 100 MWac Rondavel Solar Energy Facility, Battery Energy Storage System (BESS) and associated infrastructure located near the town of Kroonstad in the Moqhaka Local Municipality (Fezile Dabi District) of the Free State Province of South Africa (**Error! Reference source not found.**). The total size of the project area is approximately 223ha whilst the development footprint itself will cover 183ha and includes the footprint of the substation which will cover a total area of approximately 3.3ha.

The properties investigated include:
» Remaining Extent of the farm Rondavel No. 627 (main and grid site);
» Remaining Extent of the farm Boschplaat No. 330 (grid site); and
» Remaining Extent of the farm Salie No. 1837 (grid site).

The Rondavel SEF is proposed on the following properties:
»
- Remaining Extent of the farm Rondavel Noord No. 1475; and
- Remaining Extent of the farm Rondavel No. 627.

The grid connection infrastructure is proposed on the following properties:

» Remaining Extent of the farm Boschplaat No. 330 (grid site); and
» Remaining Extent of the farm Salie No. 1837 (grid site).

*** Please take not that even though the proposed grid connection has been mentioned above and the proposed alternatives are illustrated below in Figure 1, the assessment of this infrastructure will be done in a separate Environmental Basic Assessment Report. This Environmental Scoping Report deals exclusively with the SEF and associated components.**

As mentioned, the proposed SEF is envisaged to have a generating capacity of up to 100MW and would include the following infrastructure:

» Solar Arrays:
» Solar Panel Technology - Mono and Bifacial Photovoltaic (PV) Modules;
» Mounting System Technology – single axis tracking, dual axis tracking or fixed axis tracking PV;
» Underground cabling (up to 33kV)
» Centralised inverter stations or string inverters; Power Transformers;
» Building Infrastructure
» Offices;
» Operational control centre;
» Operation and Maintenance Area / Warehouse / workshop;
» Ablution facilities;
» Battery Energy Storage System;
» Substation building.
» Electrical Infrastructure
» 33/132kV Independent Power Producer (IPP) onsite substation including associated equipment and infrastructure
» Underground cabling and overhead power lines (up to 33kV)
» Associated Infrastructure:
» Access roads and Internal gravel roads;
» Fencing and lighting;
» Lightning protection
» Permanente laydown area;
» Temporary construction camp and laydown area;
» Telecommunication infrastructure;
» Concrete batching plant (if required);
» Stormwater channels; and water pipelines.

- Laydown area;
- Telecommunication infrastructure;

Access to the SEF: **R34** – The road links Kroonstad with Welkom and is a two-lane, in both direction, paved road. The road is in a reasonable condition, although it is displaying some degree of rutting. The road falls under the jurisdiction of SANRAL.

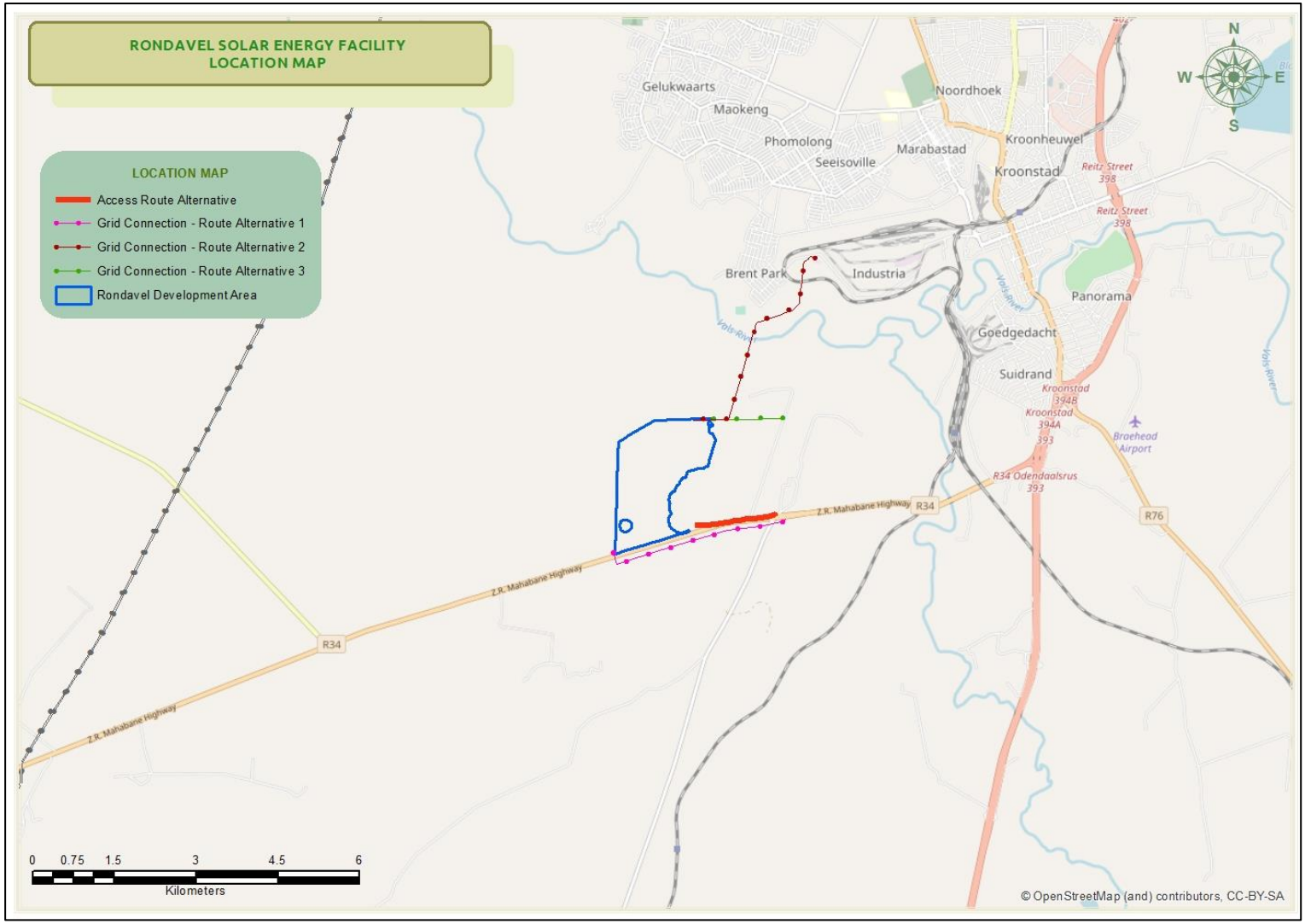

Figure 1: Proposed location of the Rondavel SEF

Terms of reference

To conduct a terrestrial ecological (fauna and flora) study for an environmental impact assessment of the target areas where the establishment of the solar energy facility and associated infrastructure is proposed to be located and provide a professional opinion on terrestrial ecological issues pertaining to the target area to aid in future decisions regarding the proposed project.

Conditions of this report

Findings, recommendations and conclusions provided in this report are based on the authors' best scientific and professional knowledge and information available at the time of compilation. No form of this report may be amended or extended without the prior written consent of the author. Any recommendations, statements or conclusions drawn from or based on this report must clearly cite or make reference to this report. Whenever such recommendations, statements or conclusions form part of a main report relating to the current investigation, this report must be included in its entirety.

Assumptions, Limitations and Gaps in the Information Presented

The following refers to general limitations that affect the applicability of information represented within this report (also refer to Conditions of the Report):

- This report specifically focuses on the identification, delineation, and classification of the various ecological features characterising the study area as well as the species (fauna & flora) associated with such features.
- Accuracy of the maps, routes and desktop assessments is based on the current 1:50 000 topographical map series of South Africa;
- Accuracy of Global Positioning System (GPS) coordinates was limited to 4m accuracy in the field.
- A single survey limited the amount of flora and flora identified at the site. In order to obtain a thorough comprehensive understanding of the dynamics of communities and the status of conservation worthy species[1] in an area, vegetation and faunal assessments should always consider investigations in terms of different time scales (across seasons/years) and through replication. However, due to time constraints, such long-term studies are not feasible and most conclusions will be based on instantaneous sampling bouts.

[1] Conservation worthy species refers to all endemic, rare or threatened species.

» While every care is taken to ensure that the data presented are qualitatively adequate, inevitably conditions are never such that that is possible. The nature of the vegetation, seasonality, human intervention etc. limit the veracity of the material presented.

Relevant legislation

The following legislation was taken into account whilst compiling this report:

Provincial

» The Free State Nature Conservation Bill, 2007

The above-mentioned Nature Conservation Bill accompanied by all amendments is regarded by the Free State Department: Economic, Small Business Development, Tourism and Environmental Affairs (DESTEA) as the legally binding, provincial documents, providing regulations, guidelines and procedures with the aim of protecting game and fish, the conservation of flora and fauna and the destruction of problematic (vermin and invasive) species.

National

» National Environmental Management Act / NEMA (Act No 107 of 1998), and all amendments and supplementary listings and/or regulations;
» Environment Conservation Act (ECA) (No 73 of 1989) and amendments;
» National Environmental Management Act: Biodiversity Act / NEMA:BA (Act No. 10 of 2004) and amendments;
» The National Water Act 36 of 1998
» General Authorisations (GAs): As promulgated under the National Water Act and published under GNR 398 of 26 March 2004.
» National Forest Act 1998 / NFA (No 84 of 1998);
» National Veld and Forest Fire Act (Act No. 101 of 1998); and
» Conservation of Agricultural Resources Act / CARA (Act No. 43 of 1983) and amendments.

International

» Convention on International Trade in Endangered Species of Fauna and Flora (CITES);
» The Convention on Biological Diversity;
» The Convention on the Conservation of Migratory Species of Wild Animals; and
» The RAMSAR Convention.

2. METHODOLOGY

GIS (Mapping/Spatial Analysis)

Data sources from the literature and GIS spatial information have been consulted and used where necessary in the study.

A National Aeronautics and Space Administration (NASA) Shuttle Radar Topography Mission (SRTM) (V3.0, 1 arcsec resolution) Digital Elevation Model (DEM) have been obtained from the United States Geological Survey (USGS) Earth Explorer website. Basic desktop terrain analysis has been performed on this DEM using ArcGis (10.4.1) software that encompassed a slope, landforms and channel network analyses in order to detect potential outcrops, ridges, landscape depressions and drainage networks.

The above-mentioned spatial data along with Google Earth Imagery (Google Earth ©) have been utilized to identify and delineate habitat/ecosystem features/units.

Additional existing data layers that were incorporated into this assessment, in order to determine important (sensitive) terrestrial and freshwater entities are summarised below in Table 1:

Table 1: Data coverages used to inform the ecological and freshwater resource assessment.

	Data/Coverage Type	Relevance	Source
Biophysical Context	**1:50 000 Relief Line** (5m Elevation Contours GIS Coverage)	Desktop mapping of terrain and habitat features as well as drainage network.	National Geo-Spatial Information (NGI)
	1:50 000 River Line (GIS Coverage)	Highlight potential on-site and local rivers and wetlands and map local drainage network.	CSIR (2011)
	Free State Province Land-Cover (from SPOT5 Satellite imagery circa 2009)	Shows the land-use and disturbances/transformations within and around the impacted zone.	DETEA (2009)
	South African Vegetation Map (GIS Coverage)	Classify vegetation types and determination of reference primary vegetation.	Mucina *et al.* (2018)
	NFEPA: river and wetland inventories (GIS Coverage)	Highlight potential on-site and local rivers and wetlands.	CSIR (2011)
	NBA 2018 National Wetland Map 5 (GIS Coverage)	Highlight potential on-site and local wetlands	SANBI (2018)
	NBA 2018 Artificial Wetlands (GIS Coverage)	Highlight potential on-site and local artificial wetlands	SANBI (2018)
Cons ervati	**NFEPA: River, wetland and estuarine FEPAs** (GIS Coverage)	Shows location of national aquatic ecosystems conservation priorities.	CSIR (2011)

	National Biodiversity Assessment – Threatened Ecosystems (GIS Coverage)	Determination of national threat status of local vegetation types.	SANBI (2011)
	Terrestrial Critical Biodiversity Areas of the Fee State (GIS Coverage)	Determination of provincial terrestrial conservation priorities and biodiversity buffers.	DESTEA (2015)
	SAPAD – South Africa Protected Areas Database (GIS Coverage)	Shows the location of protected areas within the region	http://egis.environment.gov.za DEA (2020)
	SACAD – South Africa Conservation Areas Database (GIS Coverage)	Shows the location of conservation areas within the region	http://egis.environment.gov.za DEA (2020)

Habitat and Floristic Analysis

Literature Study

The Botanical Database of Southern Africa (BODATSA) have been consulted in order to obtain a list of species recorded within the area. This species list provided an indication of the potential diversity expected within the area, the potential presence of range restricted species and other Species of Conservation Concern (SCC). The Red List of South African Plants website (SANBI, 2016) was also utilized to provide the most current account of the national status of flora. Based on this analysis of available floristic literature, as well as the identification and delineation of habitat units, a list of SCC likely to occur within the project site was generated.

Additional information regarding ecosystems, vegetation types, and SCC include the following sources:

» The Vegetation of South Africa, Lesotho and Swaziland (Mucina & Rutherford, The Vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19., 2018);
» Grassland Ecosystem Guidelines: landscape interpretation for planners and managers (SANBI, 2013); and
» Red List of South African Plants (Raimondo, et al., 2009; SANBI, 2016).

Botanical Survey Methods (Floristic Analysis and Habitat Delineation)

Prior to the site visit, the vegetation was delineated into homogenous units using satellite imagery, existing land cover maps and a SRTM DEM. Sampling of floristic (Flora SCC) and habitat data was done simultaneously by combining to scientifically recognised methods, namely the plot method and the timed random meanders, wherein a timed meander will be conducted and at a specified time plot sampling (all floristic data including cover-abundance) will be conducted.

The timed random meander method is a highly efficient method for conducting floristic analysis specifically in detecting flora SCC and maximising floristic coverage. In addition, the method is time and cost effective and highly suited for compiling flora species lists and therefore gives a rapid indication of flora diversity. The timed meander search was performed based on, as mentioned a slight adaptation (addition of plots) of the original technique described by Goff et al. (1982). Suitable habitat for SCC were identified according to Raimondo et al. (2009) and targeted as part of the timed meanders.

In terms of plot/releve sampling the guidelines for phytosociological classifications and descriptions of vegetation in southern Africa (Brown et al., 2013) was followed. At several sites (plots) within each homogeneous unit, a survey of total visible floristic composition and the relative cover percentage of each species were recorded, following established vegetation survey techniques (Mueller-Dombois & Ellenberg 1974; Westhoff & Van der Maarel 1978). These vegetation survey methods have been used as the basis of a national vegetation survey of South Africa (Mucina et al. 2000) and are considered an efficient method of describing vegetation and capturing species information. Notes were additionally made of the general habitat and any other features, biotic and abiotic, that might have an influence on the composition of landscape components and functioning of the landscape. All floristic and environmental data was captured using Braun-Blanquet Data Sheets.

Phytosociological analysis was carried out using the standard TurboVeg phytosociological database (Hennekens and Schaminée 2001) and TWINSPAN classification techniques with JUICE (Tichý 2002). The assessment did not cover an extensive area necessary to fully describe plant communities; hence, the vegetation is simply described in terms of 'vegetation units', which may be associations within plant communities. Extrapolation of vegetation units from survey sites to entire sample area was done by traversing the larger area without doing additional surveys as such and mapping this on Google Earth satellite data.

Plant species nomenclature follows Germishuizen and Meyer (2003), Henderson (2001) and Bromilow (2010).

Faunal Analysis

Literature Study

The list of mammal and herpetofaunal species predicted to occur in the region and their respective likelihood of occurrence within the study area was generated based on known distributions and habitat suitability, based on online and literature sources such as MammalMap, ReptileMap, FrogMap and the ReptileAtlas as well as field guides such as, Skinner & Chimimba (2005), Apps (ed. 2012), Stuart & Stuart (1998), Bates *et al* (2014),

Minter *et al*. (2004), Branch (2009) and Du Preez and Carruthers (2009). The literature study focussed on querying the online database to generate species lists for the 2727CA, 2727CC, 2727CB and 2727CD quatre degree squares (QDS).

The predicted list is typically heavily influenced by factors other than just distribution or biome type. Factors such as habitat suitability, current land use, current levels of disturbance and structural integrity of the habitats all influence the potential for predicted species to occur in the vicinity of the study area. There is a high likelihood that not all mammal species known to occur within the region will be located within the study area and surrounding areas. Therefore, a 'Likelihood of Occurrence' (LOO) and a 'Species of Conservation Concern' review will be applied to any potential omissions in the data set. For the LOO analysis, a full summary of Red List faunal species (IUCN, 2017), as well as other SCC will be tabulated, with a LOO applied.

Likelihood of Occurrences will be based upon available spatial imagery and will be based on:

» Habitat suitability;
» Overlap with known distributions;
» Rarity of the species; and
» Current Impacts.

Mammal distribution data were obtained from the following sources:

» The Mammals of the Southern African Subregion (Skinner & Chimimba, 2005);
» The 2016 Red List of Mammals of South Africa, Lesotho and Swaziland (www.ewt.org.za) (EWT, 2016);
» Animal Demography Unit (ADU) - MammalMap Category (MammalMap, 2017) (mammalmap.adu.org.za);
» Stuarts' Field Guide to Mammals of Southern Africa – Including Angola, Zambia & Malawi (Suart & Stuart, 2015)
» A Field Guide to the Tracks and Signs of Southern, Central and East African Wildlife (Stuart & Stuart, 2013).
» Smither's Mammals of Southern Africa (Apps, ed. 2012)

Herpetofauna distribution and species data were obtained from the following sources:

» South African Reptile Conservation Assessment (SARCA) (sarca.adu.org);
» A Guide to the Reptiles of Southern Africa (Alexander & Marais, 2007);
» Field guide to Snakes and other Reptiles of Southern Africa (Branch, 1998);
» Atlas and Red list of Reptiles of South Africa, Lesotho and Swaziland (Bates et al.,
» 2014);
» A Complete Guide to the Frogs of Southern Africa (du Preez & Carruthers, 2009);
» Animal Demography Unit (ADU) - FrogMAP (frogmap.adu.org.za);
» Atlas and Red Data Book of Frogs of South Africa, Lesotho and Swaziland (Mintner et

» al., 2004); and
» Ensuring a future for South Africa's frogs (Measey, 2011).

Faunal Survey Methods

A. Mammal Assessment

Likelihood of Occurrence

There is a high likelihood that not all mammal species known to occur within the study area and surrounding areas will be located during the survey. Therefore, a 'Likelihood of Occurrence' (LOO) and a 'Species of Special Consideration (SCC)' review was applied to any potential omissions in the data set. For the LOO analysis, a full summary of Red List mammals (IUCN, 2017), as well as other SCC was tabulated, with a LOO modifier applied. The relevant species of special consideration were addressed separately based on the data collected during the fieldwork, in context to the development and the effects on the species (both ecologically and spatially).

Likelihood of Occurrences are based upon:
» Habitat suitability;
» Overlap with known distributions;
» Rarity of the species; and
» Current Impacts.

Spoor Tracking

Spoor tracking enabled detailed sampling of mammalian species without the need for trapping or direct observation. All spoor, including footprints, den sites, burrows, hairs, scrapings and diggings were recorded and documented by detailed geo-referenced photography. Spoor tracking took place during general fieldwork, during specific timed spoor tracking drives/transects and at carefully chosen locations such as roads and other areas with highly trackable substrates. In addition, all camera trap sites (see below) were subjected to spoor tracking.

Camera trapping

The use of camera trapping has long been considered as a valuable ecological census tool in the field of African Mammalogy and this method was a primary focus of the field study. Baited cameras were deployed during survey. Bait stations were chosen based on available cover around the area, the presence of any promising signs (e.g. tracks, scats, tree scrapings) and the likelihood of possible habitat for important species. The baits used consisted of a mixture of pilchards and oats that was pureed to a fine pulp. Cameras were

set to record 3 images, with a 40 second delay between events. Four cameras were deployed.

Nocturnal surveys and daytime observations

Nocturnal Surveys: This technique is an essential tool in mammalian sampling, simply because most of the target species are only active after dark. A high-powered spotlight was used from the vehicle to illuminate nocturnal species. Some mammal species were located from vocalisations. A single night drive of 2 hours was carried out during the study.

Direct Observations: All mammals observed during the sampling period, their geographic coordinates and the surrounding habitat were recorded. This data was used to supplement the overall habitat analysis to give context to the area. Animals were encountered through driving, normal routine movement through the study area, active searching of refugia and finally, through spotlighting at night.

Sherman Trapping

Sherman trapping was done for three trap nights. Three trap lines were deployed and traps were placed on the ground and baited with a mixture of peanut butter, olive oil, oats and marmite. Two trap lines comprised of 30 traps each whilst the third trap line comprised of 20 traps. The distance between each trap varied between 15 and 20 meters and was dependent on the transition between habitats. Each trap line traversed as many habitats as possible. Captured animals were moved from the traps into clear plastic bags, identified, photographed and then released unharmed. The specific period of sampling is regarded as the most preferable period for sampling as the rodent population and activity is typically at its highest during autumn.

B. Herpetofauna Assessment

Due to the limited time available for the field survey, no trapping was performed in order to maximise prime active searching time by eliminating the need to install, service and dismantle the traps. Instead, the survey aimed to focus on intensive active searching.

Active Searching

Reptiles were searched for on foot within the study area during the day and night. Specific habitat types were selected, beforehand, where active sampling was focused intently (point samples). The habitat of these point samples was described and photographs were taken. Active searching for reptiles occurred for approximately 1 hour per point sample and involved:

» Photographing active reptiles from a distance with a telephoto lens (300m telephoto lens);

» Lifting up and searching under debris, rocks or logs (rocks and logs were always returned to their original positions);
» Scanning for any signs of reptiles such as shed skins, the positive identification of which was taken as an observation of that species; and
» Catching observed reptiles by hand. All captured reptiles were photographed and released unharmed.

Nocturnal herpetofauna were searched for by driving slowly on the roads during a single night. Amphibians (frogs and toads) are nocturnal and were searched for by torchlight during a single night at the pans, and the watercourse. Each amphibian encountered at a particular site was identified and photographed where possible. Positive identification of acoustic signals (males call to attract females) was also used as a means of identifying amphibians.

Opportunistic sampling

Reptiles, especially snakes, are incredibly elusive and difficult to observe. Consequently, all possible opportunities to observe reptiles were taken in order to augment the standard sampling procedures described above. As a result, the other participating biodiversity specialists assisted through opportunistically taking photographs of reptiles and amphibians within the study area. These images were copied for proper identification and added to the list of random observations unless a specific location of the observation was provided.

Criteria used to Assess the Site Sensitivity

The broad-scale ecological sensitivity map of the site was produced by integrating the available ecological and biodiversity information available in the literature and various spatial databases (e.g. SIBIS, BGIS). The ecological sensitivity of the different units identified during the field work was rated according to the following scale:

Table 2: Explanation of sensitivity rating

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
VERY HIGH	Indigenous natural areas that include any of the following: ▪ Critical habitat for range restricted species of conservation concern that have a distribution range of less than 10 km^2 ▪ Presence of species of conservation concern listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable according to the IUCN Red List 3.1. Categories and Criteria or listed as Nationally Rare	▪ CBA 1 areas ▪ Remaining areas of vegetation type listed in Draft Ecosystem List of NEM:BA as Critically Endangered, Endangered, or Vulnerable. ▪ Protected forest patches. ▪ Confirmed presence of populations of species of conservation concern

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
	▪ Habitats/Vegetation types with high conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk). ▪ Protected habitats (areas protected according to national/provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas, Lake Areas Development Act). These areas/habitats are irreplaceable in terms of species of conservation concern May also be positive for the following: ▪ High intrinsic biodiversity value (high species richness and/or turnover, unique ecosystems) ▪ High value ecological goods and services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value) ▪ Low ability to respond to disturbance (low resilience, dominant species very old).	(Critically Endangered, Endangered, Vulnerable & Rare)
HIGH	Indigenous natural areas that are positive for any of the following: ▪ High intrinsic biodiversity value (moderate/high species richness and/or turnover). ▪ Confirmed habitat highly suitable for species of conservation concern (Those species listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable according to the IUCN Red List 3.1. Categories and Criteria). ▪ Moderate ability to respond to disturbance (moderate resilience, dominant species of intermediate age). ▪ Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk). ▪ Moderate to high value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value). These areas/habitats are unsuitable for development due to a very likely impact on species of conservation concern May also contain the following:	▪ CBA 2 "critical biodiversity areas". ▪ Confirmed habitat where species of conservation concern could potentially occur (habitat is suitable, but no confirmed records). ▪ Habitat containing individuals of extreme age. ▪ Habitat with low ability to recover from disturbance. ▪ Habitat with exceptionally high diversity (richness or turnover). ▪ Habitat with unique species composition and narrow distribution. ▪ Ecosystem providing high value ecosystem goods and services.

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
	▪ Protected habitats (areas protected according to national/provincial legislation, e.g. National Forests Act, Draft Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act)	
Medium	Suspected habitat for species of conservation concern based either on there being records for this species collected I the past prior to 2002 or being a natural area included in a habitat suitability model (Those species listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable according to the IUCN Red List 3.1. Categories and Criteria). Indigenous natural areas that are contain one or two of the following factors, ▪ Moderate intrinsic biodiversity value (moderate species richness and/or turnover). ▪ Moderate to moderate low ability to respond to disturbance (moderate resilience, dominant species of intermediate age). ▪ Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk). ▪ Moderate value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value).	▪ CBA 2 "corridor areas", ESA 1 and ESA2. ▪ Habitat with moderate diversity (richness or turnover). ▪ Suspected habitat for species of conservation concern.
Low	Degraded or disturbed indigenous natural vegetation No Natural habitat remaining	

Assessment of Impacts

The Environmental Impact Assessment methodology assists in the evaluation of the overall effect of a proposed activity on the environment. This includes an assessment of the significant direct, indirect, and cumulative impacts. The significance of environmental impacts is to be assessed by means of the criteria of extent (scale), duration, magnitude (severity), probability (certainty) and direction (negative, neutral or positive).

» The **nature**, which includes a description of what causes the effect, what will be affected and how it will be affected.

» The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development) or regional,

Immediate area	1
Whole site (entire surface right)	2
Neighboring areas	3
Regional	4
Global (Impact beyond provincial boundary and even beyond SA boundary)	5

» The **duration**, wherein it was indicated whether:

Lifetime of the impact will be of a very short duration (0 – 1 year)	1
The lifetime of the impact will be of a short duration (2 – 5 years)	2
Medium-term (5 -15 years)	3
Long term (> 15 years)	4
Permanent	5

» The **magnitude**, quantified on a scale from 0 – 10,

small and will have no effect on the environment	2
minor and will not result in an impact on processes	4
moderate and will result in processes continuing but in a modified way	6
high (processes are altered to the extent that they temporarily cease)	8
very high and results in complete destruction of patterns and permanent cessation of processes	10

» The **probability** of occurrence, which describes the likelihood of the impact actually occurring. Probability was estimated on a scale of 1 -5,

very improbable (probably will not happen)	1
improbable (some possibility, but low likelihood)	2
probable (distinct possibility)	3
highly probable (most likely)	4
definite (impact will occur regardless of any prevention measures)	5

» The **significance**, was determined through a synthesis of the characteristics described above and can be assessed as;

»

- **LOW**,
- **MEDIUM** or
- **HIGH**;

» the **status**, which was described as either positive, negative or neutral.
» the degree of which the impact can be reversed,
» the degree to which the impact may cause irreplaceable loss of resources,
» the degree to which the impact can be mitigated.

The significance was calculated by combining the criteria in the following formula:

S=(E+D+M)P where;

» S = Significance weighting
» E = Extent
» D = Duration
» M = Magnitude
» P = Probability

The significance weightings for each potential impact are as follows;

Table 3: Rating table used to rate level of significance.

RATING	CLASS	MANAGEMENT DESCRIPTION
< 30	**Low (L)**	Where the impact would not have a direct influence on the decision to develop the area.
30 - 60	**Medium (M)**	Where the impact could influence the decision to develop in the area unless it is effectively mitigated.
> High	**High (H)**	Where the impact must have an influence on the decision process to develop in the area.

3. THE IMPORTANCE OF BIODIVERSITY AND CONSERVATION

The term 'Biodiversity' is used to describe the wide variety of plant and animal species occurring in their natural environment or 'habitat'. Biodiversity encompasses not only all living things but also the series of interactions that sustain them, which are termed ecological processes. South Africa's biodiversity provides an important basis for economic growth and development; and keeping our biodiversity intact is vital for ensuring the on-going provision of ecosystem services, such as the production of clean water through good catchment management. The role of biodiversity in combating climate change is also well recognised and further emphasises the key role that biodiversity management plays on a global scale (Driver et al., 2012). Typical pressures that natural ecosystems face from human activities include the loss and degradation of natural habitat, invasive alien species,

pollution, and waste and climate change (Driver et al.,2012). High levels of infrastructural and agricultural development typically restrict the connectivity of natural ecosystems, and maintaining connectivity is considered critical for the long-term persistence of both ecosystems and species, in the face of human development and global climatic change. Loss of biodiversity puts aspects of our economy and quality of life at risk and reduces socioeconomic options for future generations as well. In essence, then, sustainable development is not possible without it.

4. DESKTOP ECOLOGICAL ANALYSIS

Land use and Land Cover

The Free State Province Land-Cover dataset (2009) were queried as part of the desktop study (Figure 2). Land-cover is a critical information component for a wide range of regional and local planning and management activities, especially in terms of resource conservation and environmental monitoring. The Free State Province Land-Cover dataset I provides a digital, seamless, vegetation and land-cover map of the entire Free State Province, suitable for 1:50 000 scale (or coarser) GIS modelling applications. This dataset was developed using 2009 SPOT5 satellite imagery. Furthermore, this vegetation and land-cover dataset is compatible with the latest South African land-cover classification standards. In addition to the land-cover data, a comprehensive set of digital aerial reference photographs, acquired as part of the land-cover map accuracy verification field survey process has been supplied as a geo-referenced GIS database.

According to this dataset almost the entire footprint is undeveloped comprising of various forms of grasslands and wetland features. The most prominent impact within the SEF footprint is transport networks.

Due to the relatively large scale of the map 1:50 000 and the fact that this land cover map was compiled back in 2009, variations in the land-use and vegetation cover may be present or may have changed of a period of time. As such, current (and historical) available areal and satellite imagery was analysed at a much closer elevation, of between 770 and 3.5km.

<u>The results of this spatial analysis were as follows:</u>

Land cover and land-use changes often indicate major impacts on biodiversity, especially if those changes show the loss of natural habitat due to urban sprawl, cultivation, etc.

It was confirmed that the majority of the site comprise of a grassland comprising of a relative high coverage of dwarf and larger shrubs. According to Mucina and Rutherford

(2006), where this type of grassland is characterized by dwarf karoo bushes and Acacia karroo (also known as *Vachellia karroo*) shrubs, it is typically an indication of degraded, overgrazed and trampled low-lying clayey areas. The prominent land use activity within this area is livestock grazing, and the condition described above (overgrazing) is likely applicable to this area. Patches of highly degraded grasslands are most likely associated with watering and feeding points as well as areas located near kraals.

Also prominent within the area are freshwater wetland features such as wetlands and non-perennial watercourses (usually comprising of *Acacia karroo* dominated thicket-type riparian fringes and floodplain wetlands). Such a freshwater resource feature is located along the eastern portion of the SEF footprint and flows in a northern direction towards the Vals River which is the most important and prominent drainage feature within the region. The SEF footprint is located adjacent and north of the R34 route.

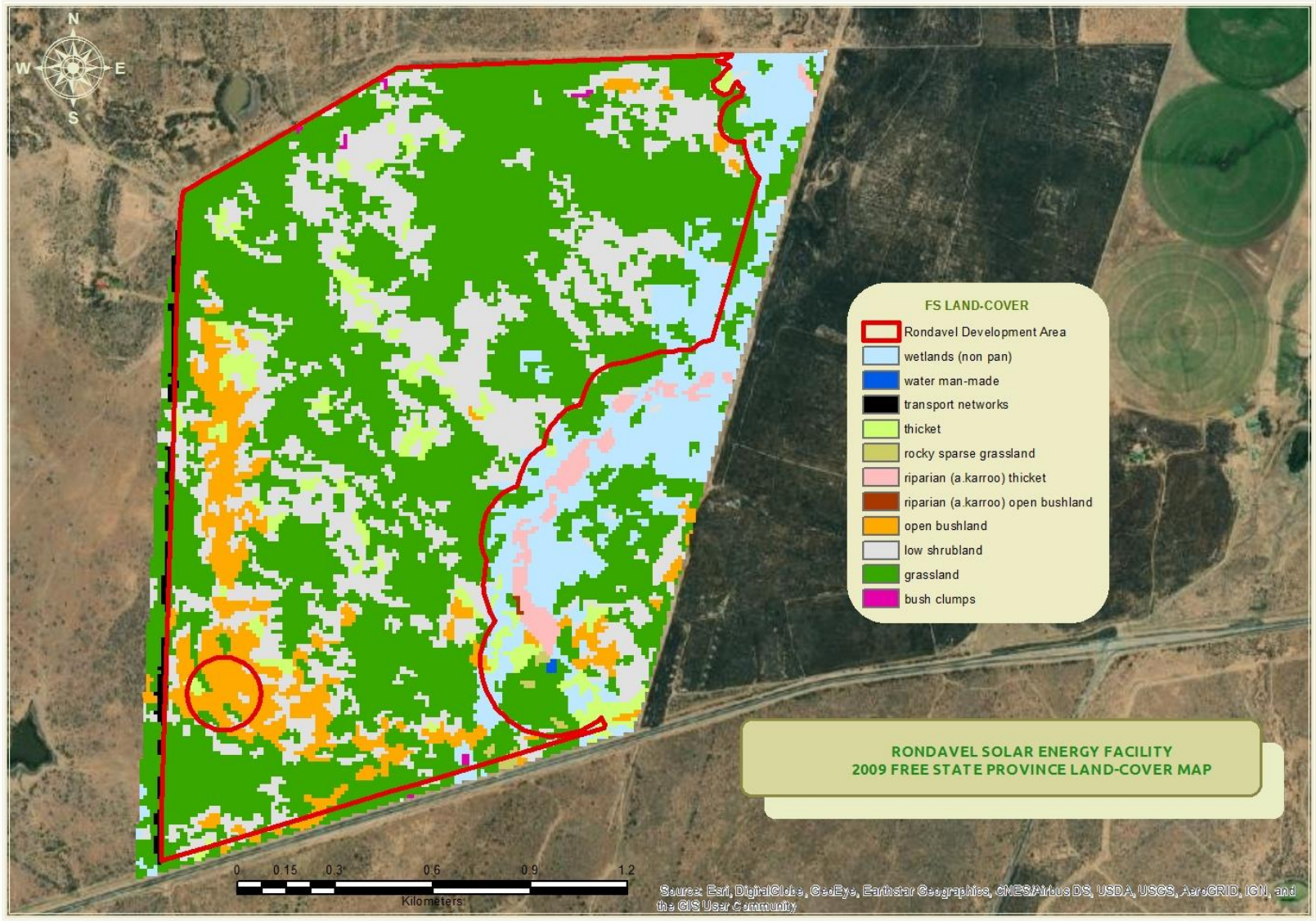

Figure 2: 2009 Free State Province Land-Cover Map

Regional/Local Biophysical Setting

The development footprint is located on the Remaining Extent of the farm Rondavel Noord No. 1475, and the Remaining Extent of the farm Rondavel No. 627., situated approximately 13.3km (south-west) from the town of Kroonstad (central) (Figure 1) within the Moqhaka Local Municipality and the Fezile Dabi District Municipality in the Free State Province. The site is accessible via the R34 route, which links Kroonstad with Welkom.

The Rondavel Solar Energy Facility will have a generating capacity of up to 100MW and will cover an area of approximately 182 ha.

Land use within the project site is mostly for farming. Farming practices consist of livestock farming (cattle) farming with some "free" roaming small game and larger introduced game such as Kudu (*Tragelaphus strepsiceros*), Nyala (*Tragelaphus angasii*), Waterbuck (*Kobus ellipsiprymnus*) and Plains Zebra (*Equus quagga*). Due to the low land capability of the dominant soil forms within the project site, the area has never been cultivated and as such the vegetation within the project area can be regarded as primary. In terms of the surrounding landscape, most farmers also utilize their lands as natural grazing for livestock (primarily cattle). However, the breeding of scarce and large game has become increasingly popular within the area and include game such as African Savanna Buffalo (*Syncerus caffer*), Nyala (*Tragelaphus angasii*), Roan Antelope (*Hippotragus equinus*), Sable Antelope (*Hippotragus niger*), Waterbuck (*Kobus ellipsiprymnus*), Lechwe (*Kobus leche*) and Common Reedbuck (*Redunca arundinum*). Crop production is not a common feature within the area, with old cultivated areas being transformed into pastures. A few pivots are located a few properties to the east where arable land is available.

Prominent anthropogenic features within the region include the R34 route as well as the S172 secondary route to the south east, smaller dirt and twin track routes, cattle and game fences (mostly electrified), homesteads, kraals, cattle feeding and watering points, reservoirs and small farm dams (mostly instream) and power lines. Apart from these anthropogenic features, most of the region is poorly developed and, as mentioned, predominantly used for livestock and game farming.

The site lies in an area considered to be a local steppe climate (BSk according to Köppen-Geiger Climate Classification). The site thus falls within a cold semi-arid region arid area, with a mean annual temperature of 16.6°C and a mean annual precipitation of 545mm (predominantly mid-summer). The driest month is July with 7mm whilst the greatest amount of precipitation occurs in December with an average of 107mm. January is the warmest month of the year with an average temperature of 22.4°C, whilst the coldest month is June with an average temperature of 8.8°C. The first occurrence of frost may be experienced as early as the onset of May and marks the end of the growing season (average frost incidence of 43 days a year).

A summary of the biophysical features and the setting of the project site and surroundings are summarised in Table 4.

Table 4: Summary of the biophysical setting of the proposed SEF footprint.

Biophysical Aspect	Desktop Biophysical Details		Source
Physiography			
Landscape Description	A relative flat plains-dominated landscape with a small isolated koppies/outcrop located north-east of the development footprint. As already described, large tracts of land have been transformed for cultivation purposes. These plains are typically dominated by low-tussock grasslands with a prominent karroid element. Shrubby trees, such as Acacia karroo (also known as Vachellia karroo) may also be a common feature, especially near watercourses and wetland areas. Depression wetlands are a common feature within this landscape, as well as valley-bottom wetlands (usually channelled), which tend to drain in a north-eastern/eastern direction towards the Blomspruit River.		Google Earth
Dominant Land Type	Bd21		ARC
Dominant Terrain Type	Symbol	Description	ARC
	A2	Level plains or plateaus with a local relief between 30-90m	
Geomorphic Province	Southern Highveld		Partridge et al., 2010
Geology	Mudrock and subordinate sandstone of the Adelaide Subgroup (Beaufort Group). Occasional dolerite sills may also be present.		ARC & SA Geological Dataset
Soils (General)	Soils with a plinthic catena characterised by loamy red yellow and greyish sand with a high base status		ARC
Prominent Soil Forms	Avalon, Westleigh, Valsrivier. The lower lying areas such as depressions, valley bottom wetlands and watercourses are typically characterised by Dundee, Bonheim and Valsrivier soil types		ARC
Susceptibility to Wind Erosion	Class	Description	ARC
	3a (Wind), & 1 (Water)	Land with moderate wind erosion susceptibility and a low susceptibility to water erosion. Generally, level to gently sloping. Soils have a favourable erodibility index.	
Climate			
Köppen-Geiger Climate Classification	BSk (Cold semi-arid climate)		Climate-data.org
Mean annual temperature	16.6°C		Climate-data.org
Warmest Month & Av. Temp.	January: 22.4°C		Climate-data.org
Coldest Month & Av. Temp.	June: 8.8°C		Climate-data.org
Rainfall Seasonality	Mid-summer (January – February)		DWAF, 2007
Mean annual precipitation	545 mm		Schulze, 1997
Mean annual runoff	10.3 mm up to 25.8mm		Schulze, 1997
Mean annual evaporation	1 600 – 1 700 mm		Schulze, 1997
Surface Hydrology			
Wetland vegetation group	Dry Highveld Grassland (Group 3 & 4)		CSIR, 2011

Water management area	Middle Vaal WMA (09)			DWA
Quaternary catchment	Name (Symbol)			DWA
	C60H (Primary), C60G & C60F			
Main collecting river(s) in the catchment	Tributaries of the Vals River including Blomespruit to the east and Otterspruit to the west.			CSIR, 2011
Closest river to the project site	Tributary of the Otterspruit (~3.8km to the west).			Google Earth
Geomorphic Class	Symbol	Description	Slope (%)	CSIR, 2011
	V4	Upper foothills	0.005 – 0.019	
	V4, V2	Lower foothills	0.001 - 0.005	
	Description			
	Watercourses to the west correspond more with Lower Foothill systems, whist the watercourses to the east are more typical of Upper Foothill systems. » Upper Foothill systems tend to be moderately steep streams dominated by bedrock or boulders. Reach types may include plain-bed, pool-riffle or pool-rapid reach types. Length of pools and riffles/rapids are usually similar. Narrow flood plain of sand, gravel or cobble often present. » Lower Foothill systems typically have lower gradient mixed bed alluvial channels with sand and gravel dominating the bed, locally may be bedrock controlled. Reach types typically include pool-riffle or pool-rapid, sand bars common in pools. Pools of significantly greater extent than rapids or riffles. Flood plan often present.			
Vegetation Overview				
Biome	Grassland Biome (Dry Highveld Grassland Bioregion)			Mucina & Rutherford, 2018
Vegetation Types	» Western portion of the project site including the SEF footprint: Vaal-Vet Sandy Grassland. » Eastern portion of the project site including north-eastern most corner of the SEF footprint: Central Free State Grassland			Mucina & Rutherford, 2018
Vegetation & Landscape Feature	<u>Vaal-Vet Sandy Grassland:</u> Plainns-dominated landscape with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands with and abundant karroid element. Dominance of *Themeda triandra* is an important feature of this vegetation unit. Locally low cover of *T. triandra* and the associated increase in *Elionurus muticus, Cymbopogon pospischilii* and *Aristida congesta* is attributed to heavy grazing. <u>Central Free State Grassland</u>: Undulating plains supporting short grassland, in natural condition dominated by *Themeda triandra* while *Eragrostis curvula* and *E. chloromelas* become dominant in degraded habitats. Dwarf karoo bushes establish in severely degraded clayey bottomlands. Overgrazed and trampled low-lying areas with heavy clayey soils are prone to *Acacia karroo* (also known as *Vachellia karroo*) encroachment.			Mucina & Rutherford, 2006 & 2018
BODATSA Data	Regional: Total Species Observed			

	491	2020-08-02_231620030-BRAHMSOnlineData
	Indigenous Flora	
	419	
	Non-indigenous Flora	
	52	
	South African Endemic Flora	
	29	
	Threatened Flora	
	Data Deficient: 1 Species; Endangered: 1 Species Not Evaluated: 19 Species	

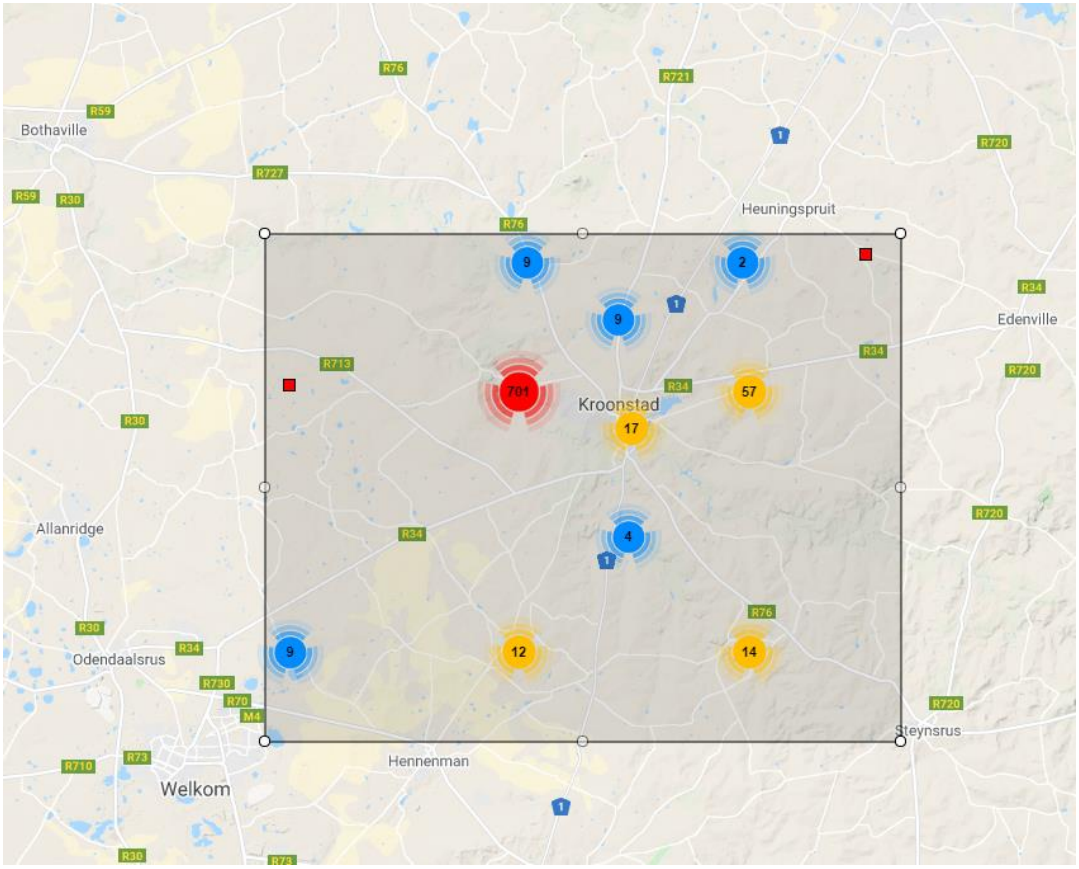

Figure 3: Extracted area and sample locations from POSA. Extracted data was used to compile a plant species list of species that may potentially occur within the project site and provide an indication of potential conservation important species that may be found within the area.

Conservation Planning / Context

Understanding the conservation context and importance of the study area and surroundings is important to inform decision making regarding the management of the aquatic resources in the area. In this regard, national, provincial, and regional conservation planning information available and was used to obtain an overview of the study site (Table 5).

Table 5: Summary of the conservation context details for the study area.

Conservation Planning Dataset		Relevant Conservation Feature	Location in Relationship to Project Site	Conservation Planning Status
NATIONAL LEVEL CONSERVATION PLANNING CONTEXT	National Protected Areas Expansion Strategy	Focus Area	Located within the Free State Highveld Focus Area	Free State Highveld Focus Area
	Protected Areas and Conservation Areas (PACA) Database	South African Conservation Area (SACA)	Well outside of any SACA:	Not Classified
		South African Protected Area (SAPA)	Outside of any SAPA: Located approximately 1.4 km from a Private Nature Reserve	Not Classified
	Strategic Water Source Areas for groundwater (SWSA-gw)	Areas with high groundwater availability and of national importance	Located within the Kroonstad SWSA-gw	Located within important groundwater recharge area.
	Vegetation Types	Central Free State Grassland	Vegetation of Study Area	Least Threatened
	Threatened Ecosystems	Central Free State Grassland	Ecosystems of Study Area	Not listed
	National Freshwater Ecosystem Priority Area	River FEPA	Located outside of any River FEPAs	Not Classified
		Wetland FEPA	No Wetland FEPAs located within project site.	Not Classified
PROVINCIAL AND REGIONAL LEVEL	NCBSP: Critical Biodiversity Areas	Ecological Support Areas ESA1	Corridors/linkages between the upland (terrestrial) areas and important water resource features such as the Vals and Blomspruit Rivers.	ESA

National Protected Areas Expansion Strategy

Focus areas for land-based protected area expansion are large, intact, and unfragmented areas of high importance for biodiversity representation and ecological persistence, suitable for the creation or expansion of large protected areas. Focus Areas present the best opportunities for meeting the ecosystem-specific protected area targets set in the NPAES and were designed with a strong emphasis on climate change resilience and requirements

for protecting freshwater ecosystems. These areas should not be seen as future boundaries of protected areas, as in many cases only a portion of a particular focus area would be required to meet the protected area targets set in the NPAES.

According to the NPAES spatial data (Holness, 2010), the entire project site is located within the Free State Highveld Focus Area (Figure 4). Subsequently, the potential impact of this development on the ability for this Focus Area to fulfil its function in the future will be assessed during this impact assessment.

Protected Areas and Conservation Areas (PACA) database

The South African Protected Areas Database (SAPAD) contains spatial data for the conservation estate of South Africa. It includes spatial and attribute information for both formally protected areas and areas that have less formal protection. Data is collected by parcels which are aggregated to protected area level.

The definition of protected areas used in this document follows the definition of a protected area as defined in the National Environmental Management: Protected Areas Act, (Act 57 of 2003). Chapter 2 of the National Environmental Management: Protected Areas Act, 2003 sets out the "System of Protected Areas", which consists of the following kinds of protected areas –

» Special nature reserves,
» National parks,
» Nature reserves and
» Protected environments (1-4 declared in terms of the National Environmental Management: Protected Areas Act, 2003);
» World heritage sites declared in terms of the World Heritage Convention Act;
» Marine protected areas declared in terms of the Marine Living Resources Act;
» Specially protected forest areas, forest nature reserves, and forest wilderness areas declared in terms of the National Forests Act, 1998 (Act No. 84 of 1998); and
» Mountain catchment areas declared in terms of the Mountain Catchment Areas Act, 1970 (Act No. 63 of 1970).

The types of conservation areas that are currently included in the database are the following:

» Biosphere reserves
» Ramsar sites
» Stewardship agreements (other than nature reserves and protected environments)
» Botanical gardens
» Transfrontier conservation areas
» Transfrontier parks

» Military conservation areas
» Conservancies

Taken together, protected areas and conservation areas make up the conservation estate.

According to the PACA database, no Conservation Areas are located in close proximity to the project site, however the Boslaagte Private Nature Reserve is listed as a National Protected Area. This nature reserve is located approximately 1.4km to the south of the proposed SEF footprint (Figure 4). Such nature reserves are typically well cordoned off with game fences, often with some electrified wires, furthermore the R34 route (major road) is located between these two areas, as such it is unlikely that this development will have a significant impact on the nature reserve as well as its associated fauna and flora.

National Level of Conservation Priorities (Threatened Ecosystems)

The vegetation types of South Africa have been categorised according to their conservation status which is, in turn, assessed according to the degree of transformation and rates of conservation. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. On a national scale these thresholds are, as depicted in the table below, determined by the best available scientific approaches (Driver *et al*. 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver *et al*. 2005).

Table 6: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement.

Habitat remaining (%)			
	80–100	least threatened	LT
	60–80	vulnerable	VU
	*BT–60	endangered	EN
	0–*BT	critically endangered	CR

The National List of Ecosystems that are Threatened and in need of protection (GN1002 of 2011), published under the National Environment Management: Biodiversity Act (Act No. 10 of 2004), lists national vegetation types that are afforded protection on the basis of rates of transformation. The threshold for listing in this legislation is higher than in the scientific literature, which means there are fewer ecosystems listed in the National Ecosystem List versus in the scientific literature.

Table 7: Conservation status of the vegetation type occurring in and around the study area.

Vegetation Type	**Target (%)**	**Conserved (%)**	**Transformed (%)**	**Conservation Status**	
				Driver *et al*., 2005; Mucina & Rutherford, 2006	National Ecosystem List (NEM:BA)
Central Free State Grassland	24%	0.8%	23.5%	Least Concerned	Not Listed

According to current layout the entire SEF footprint is located within the Least Concerned Central Highveld Grassland (Figure 4).

The presence, extent and condition of the remaining natural grasslands will be determined and assessed during this assessment. Furthermore, the potential impact of the development on this vegetation types and its attributed conservation target will be assessed (in isolation and cumulative with other similar projects). Due to the fact that this vegetation unit still comprise of large 'natural' (untransformed) areas and due to the relatively small extent of the SEF footprint, this development will not likely have an impact on the conservation status of this vegetation type.

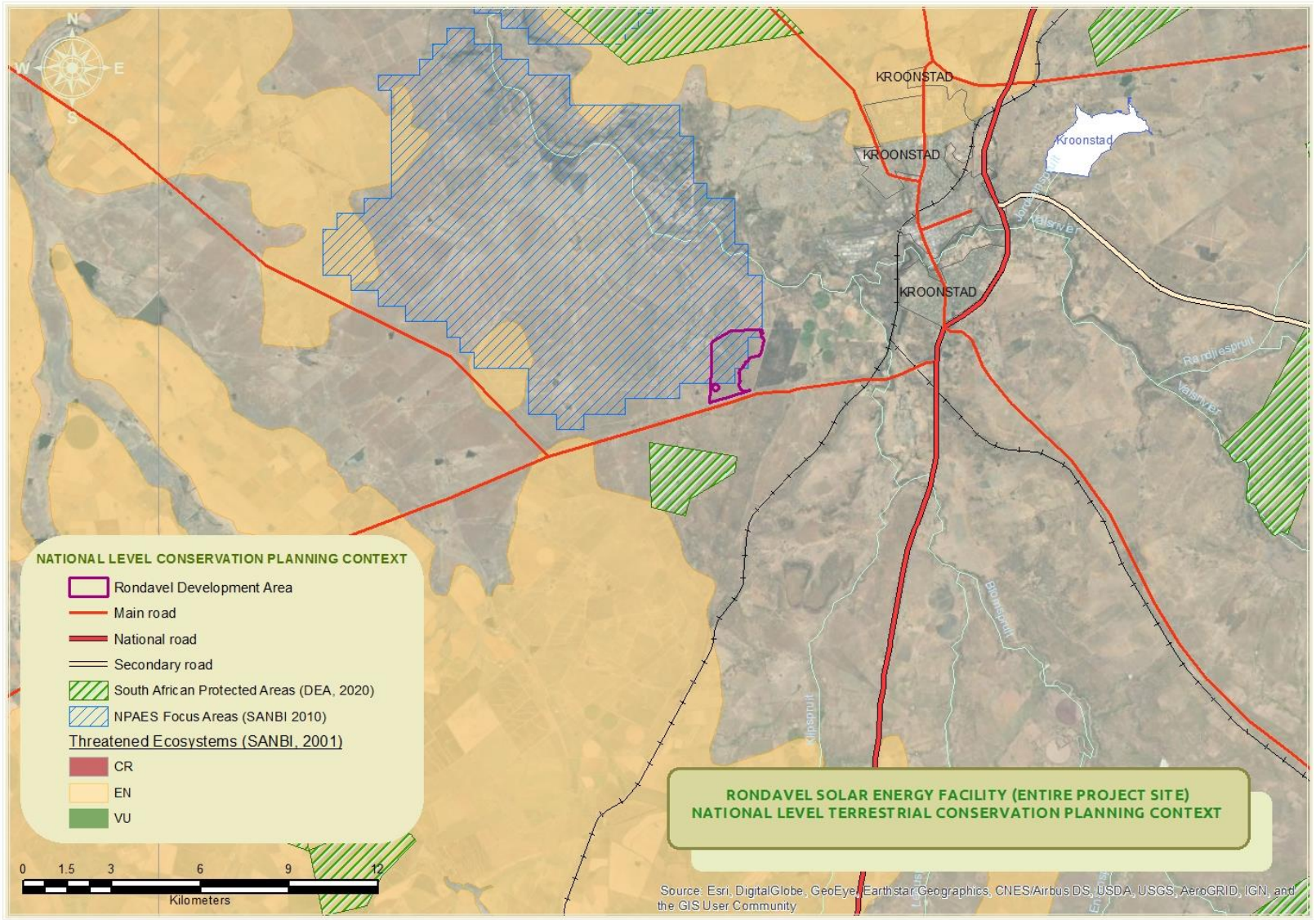

Figure 4: National Level Terrestrial Conservation Planning Context

Critical Biodiversity Areas and Broad Scale Ecological Processes

The SEF footprint falls within the planning domain of the Free State Province Biodiversity Conservation Assessment which maps Critical Biodiversity Areas and Ecological Support Areas within the Free State Province. The entirety of the footprint falls within an ESA1 (Figure 5).

Typically, natural features are classified according to the different categories on the basis of the following criteria's:

» **Critical Biodiversity Areas (CBAs)** that contain three types of areas:
  - Irreplaceable areas, which are essential in meeting targets set for the conservation of biodiversity in Free State.
  - Areas that are important for the conservation of biodiversity in Free State.
  - Conserved areas, which include all existing level 1 and 2 protected areas.

Level 1 and Level 2 protected areas are proclaimed in terms of relevant legislation (National Environmental Management Protected Areas Act, 2003 (Act No 57 of 2003) specifically for the protection of biodiversity (or for the purposes of nature conservation).

» **Ecological Support Areas (ESAs).** ESAs are an imperative part of the Free State Biodiversity Plan to ensure sustainability in the long term. ESAs are part of the entire hierarchy of biodiversity, but it is not possible to include all biodiversity features in them. Landscape features associated with ESAs (termed spatial surrogates for ESAs) that are essential for the maintenance and generation of biodiversity in sensitive areas, and therefore that require sensitive management were incorporated into Biodiversity Plan.

Critical Biodiversity Areas
No CBAs are located within the SEF's proposed footprint.

Ecological Support Areas 1
The entire footprint is located within an ESA1. The ESA 1 functions as a linkage/corridor (comprising of natural vegetation) between the major freshwater resource features (Vals and Blomspruit watercourses and associated tributaries) and their fringing terrestrial habitats. Due to the large extent of this ESA1, and the availability of ample natural to near natural areas between the Vals River and the fringing terrestrial habitats, within the surrounding area, the development will unlikely have an impact on this ESA, and its ability to function as an important corridor.

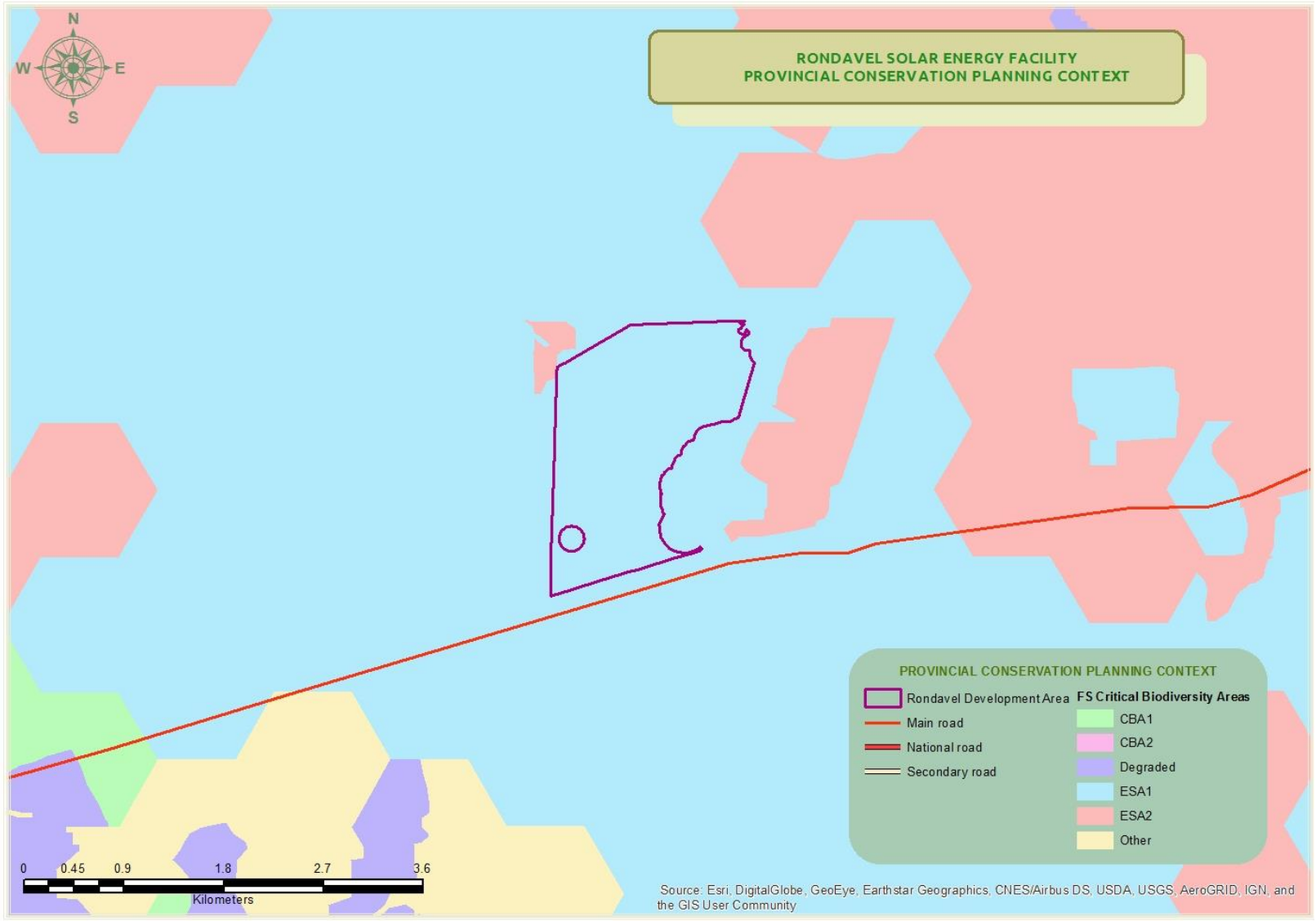

Figure 5: Provincial Level Conservation Planning Context – CBA Map (Free State Province Biodiversity Conservation Assessment).

Regional Terrestrial Ecological Overview

Vegetation Overview

Broad Vegetation Types

Broad Vegetation Types

The overall project area is situated within the grassland biome. This biome is centrally located in southern Africa, and adjoins all except the desert, fynbos and succulent Karoo biomes (Mucina & Rutherford, 2006). Major macroclimatic traits that characterise the grassland biome include:

- Seasonal precipitation; and
- The minimum temperatures in winter (Mucina & Rutherford, 2006).

The grassland biome is found chiefly on the high central plateau of South Africa, and the inland areas of KwaZulu-Natal and the Eastern Cape. The topography is flat and rolling but includes the escarpment itself. Altitude varies from near sea level to 2 850 m above sea level.

Grasslands are dominated by a single layer of grasses. The amount of cover depends on rainfall and the degree of grazing. The grassland biome experiences summer rainfall and dry winters with frost (and fire), which are unfavourable for tree growth. Thus, trees are typically absent, except in a few localized habitats. Geophytes (bulbs) are often abundant. Frosts, fire and grazing maintain the grass dominance and prevent the establishment of trees.

The grassland biome comprises many different vegetation types. The entirety of the SEF footprint is located within the Central Free State Grassland vegetation type (Gh6) according to Mucina & Rutherford (2006) (Figure 6).

A. Central Free State Grassland

The Central Free State Grassland vegetation type is found in the Free State and marginally into Gauteng Province. This vegetation type typically comprises of undulating plains supporting short grassland, in natural condition dominated by *Themeda triandra* while *Eragrostis curvula and E. chloromelas* become dominant in degraded habitats. Dwarf karoo bushes establish in severely degraded clayey bottomlands. Overgrazed and trampled low-lying areas with heavy clayey soils are prone to *Acacia karroo* encroachment (Mucina & Rutherford, 2006).

Important Plant Taxa

Important plant taxa are those species that have a high abundance, a frequent occurrence or are prominent in the landscape within a particular vegetation type (Mucina & Rutherford, 2006). The following species are important in the Central Free State Grassland.

Graminoids: *Aristida adscensionis* (d), *A. congesta* (d), *Cynodon dactylon* (d), *Eragrostis chloromelas* (d), *E. curvula* (d), *E. plana* (d), *Panicum coloratum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus koelerioides* (d), *Agrostis lachnantha*, *Andropogon appendiculatus, Aristida bipartita, A. canescens, Cymbopogon pospischilii, Cynodon transvaalensis, Digitaria argyrograpta, Elionurus muticus, Eragrostis lehmanniana, E. micrantha, E. obtusa, E. racemosa, E. trichophora, Heteropogon contortus, Microchloa caffra, Setaria incrassata, Sporobolus discosporus* (Mucina & Rutherford, 2006).

Herbs: *Berkheya onopordifolia* var. *onopordifolia, Chamaesyce inaequilatera, Conyza pinnata, Crabbea acaulis, Geigeria aspera* var. *aspera, Hermannia depressa, Hibiscus pusillus, Pseudognaphalium luteo-album, Salvia stenophylla, Selago densiflora, Sonchus dregeanus* (Mucina & Rutherford, 2006).

Geophytic Herbs: *Oxalis depressa, Raphionacme dyeri* (Mucina & Rutherford, 2006).

Succulent Herb: *Tripteris aghillana var. integrifolia* (Mucina & Rutherford, 2006).

Low Shrubs: *Felicia muricata* (d), *Anthospermum rigidum* subsp. *pumilum, Helichrysum dregeanum, Melolobium candicans, Pentzia globosa* (Mucina & Rutherford, 2006).

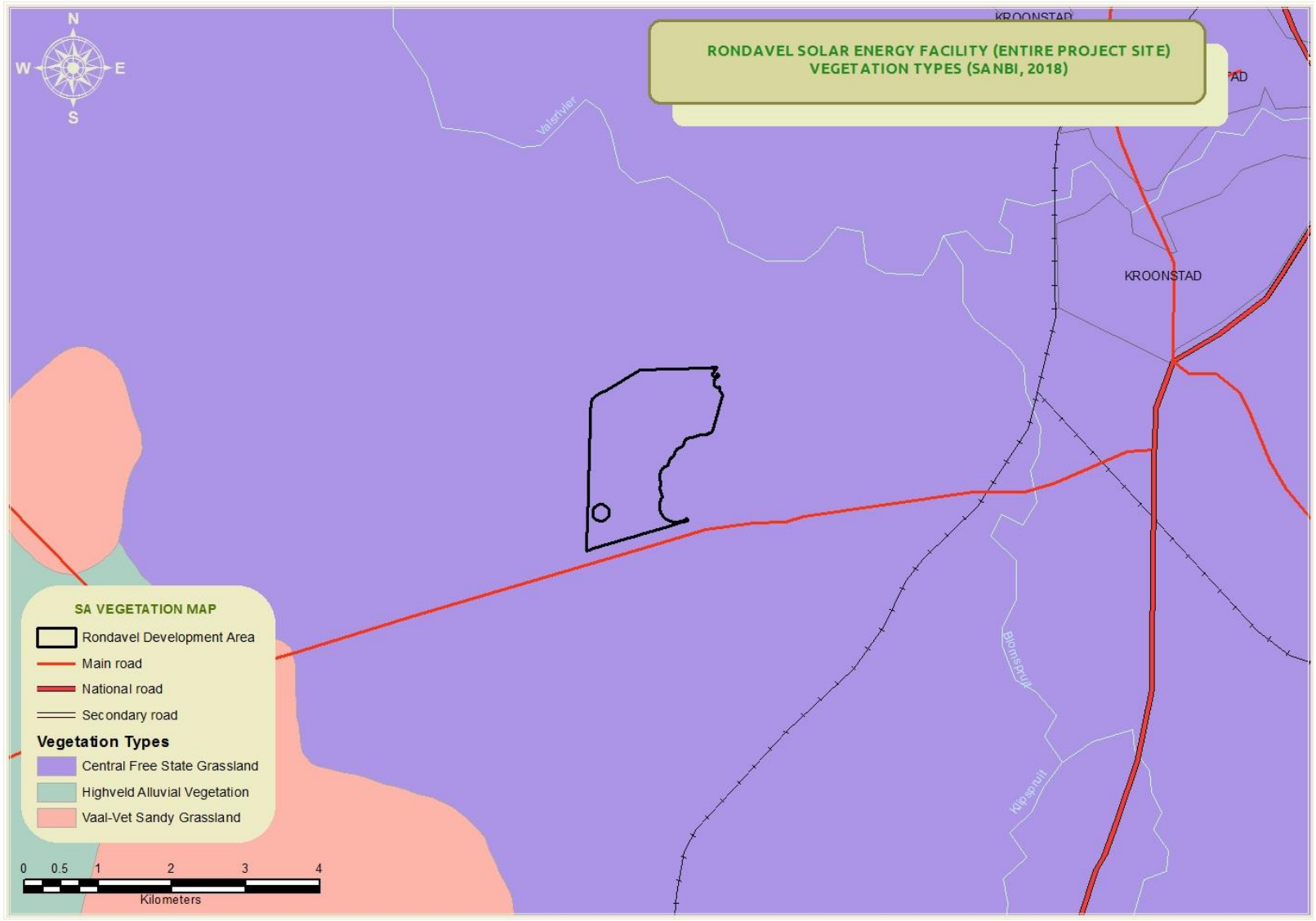

Figure 6: Vegetation Types (SANBI, 2018)

Plant Species of Conservation Concern Previously recorded within the Region

Based on the Plants of Southern Africa (BODATSA-POSA, 2020) database, 491 plant species are expected to occur in the region that includes the project area (relevant quarter degree grid). Figure 5 shows the extent of the grid that was used to compile the expected species list based on the Plants of Southern Africa (BODATSA-POSA, 2020) database. The list of expected plant species is provided in Appendix 1. Of the 491-plant species, only one species is listed as being a Species of Conservation Concern (SCC) namely *Anacampseros recurvata* subsp. *buderiana*. It is likely that this individual has been wrongfully identified as this species is Endemic to the quartz plains and outcrops of the Richtersveld. As such the Likelihood of Occurrence for this species within the project area is highly unlikely.

Faunal Overview

Mammals

The IUCN Red List Spatial Data lists 73 mammal species that could be expected to occur within the vicinity of the project site (Appendix 2). Of these species, 8 are medium to large conservation dependant species, such as *Ceratotherium simum* (Southern White Rhinoceros) and *Equus quagga* (Plains Zebra) that, in South Africa, are generally restricted to protected areas such as game reserves. These species are not expected to occur in the development area and are removed from the expected SCC list. Of the remaining 65 small to medium sized mammal species, ten (10) are listed as being of conservation concern on a regional or global basis (Table 8).

The list of potential species includes:

- One (1) that is listed as Endangered (EN) on a regional basis;
- Four (4) that are listed as Vulnerable (VU) on a regional basis; and
- Five (5) that are listed as Near Threatened (NT) on a regional scale.

Table 8: List of mammal species of conservation concern that may occur in the project area as well as their global and regional conservation statuses (IUCN, 2017; SANBI, 2016)

Species	Common Name	Conservation Status		Likelihood of Occurrence
		Red Data	IUCN	
Anonyx capensis	Cape Clawless Otter	NT	NT	Low
Atelerix frontalis	South African Hedgehog	NT	LC	Very High
Felis nigripes	Black-footed Cat	VU	VU	Low
Hydrictis maculicollis	Spotted-necked Otter	VU	NT	Very Low
Leptailurus serval	Serval	NT	LC	Very High
Lycaon pectus	African Wild Dog	EN	EN	Very Low
Mystromys albicaudatus	White-tailed Rat	VU	EN	Moderate
Panthera pardus	Leopard	VU	VU	Low
Parahyaena brunnea	Brown Hyena	NT	NT	Moderate

Species	Common Name	Conservation Status		Likelihood of Occurrence
		Red Data	IUCN	
Poecilogale albinucha	African Striped Weasel	NT	LC	High

Aonyx capensis (Cape Clawless Otter) is the most widely distributed otter species in Africa (IUCN, 2017). This species is predominantly aquatic, and it is seldom found far from water. Based on the absence of any perennial rivers or wetlands within the project area the likelihood of occurrence of this species occurring in the project area is considered to be unlikely. However, during years of exceptional high rainfall and flooding, such species may move potentially move up and down between the lower portion of the valley bottom-wetland, located to the east of the development footprint, and the Vals River to the north of the development footprint, in search of food. However, the potential for this species to move up along this wetland, all the way to the development footprint, is regarded as unlikley .

Atelerix frontalis (South African Hedgehog) has a tolerance of a degree of habitat modification and occurs in a wide variety of semi-arid and sub-temperate habitats (IUCN, 2017). Based on the Red List of Mammals of South Africa, Lesotho and Swaziland (2016), *A. frontalis* populations are decreasing due to the threats of electrocution, veld fires, road collisions, predation from domestic pets and illegal harvesting. Although the species is cryptic and therefore not often seen, there is suitable habitat in the development area and therefore the likelihood of occurrence is rated as very high.

Felis nigripes (Black-footed cat) is endemic to the arid regions of southern Africa. This species is naturally rare, has cryptic colouring is small in size and is nocturnal. These factors have contributed to a lack of information on this species. The habitat in the project area can be considered suitable for the species, however due to regular human activity within the area the likelihood of occurrence is rated as low.

Hydrictis maculicollis (Spotted-necked Otter) inhabits freshwater habitats where water is, unpolluted, and rich in small to medium sized fishes (IUCN, 2017). No suitable habitat is available in the development area for this species and therefore the likelihood of occurrence is Unlikely.

Leptailurus serval (Serval) occurs widely through sub-Saharan Africa and is commonly recorded from most major national parks and reserves (IUCN, 2017). The Serval's status outside reserves is not certain, but they are inconspicuous and may be common in suitable habitat as they are tolerant of farming practices provided there is cover and food available. In sub-Saharan Africa, they are found in habitat with well-watered savanna long-grass environments and are particularly associated with reedbeds and other riparian vegetation types. Due to the presence of some natural terrestrial- and wetland grassland areas, the likelihood of occurrence for this species is rated as Very High.

Lycaon pictus (African Wild Dog) is categorised as Endangered on both a regional and an international scale. Population size is continuing to decline as a result of ongoing habitat fragmentation, conflict with human activities, and infectious disease. African Wild Dogs are generalist predators, occupying a range of habitats including short-grass plains, semi-desert, bushy savannas and upland forest. This species mainly occurs in recognised protected areas but a few free ranging groups can still be found in South Africa. The likelihood of occurrence in the project area is rated as low.

Panthera pardus (Leopard) has a wide distributional range across Africa and Asia, but populations have become reduced and isolated, and they are now extirpated from large portions of their historic range (IUCN, 2017). Impacts that have contributed to the decline in populations of this species include continued persecution by farmers, habitat fragmentation, increased illegal wildlife trade, excessive harvesting for ceremonial use of skins, prey base declines and poorly managed trophy hunting (IUCN, 2017). Although known to occur and persist outside of formally protected areas, the densities in these areas are considered to be low. The likelihood of occurrence in the development area is regarded as Low.

Parahyaena brunnea (Brown Hyaena) is endemic to southern Africa. This species occurs in dry areas, generally with annual rainfall less than 100 mm, particularly along the coast, semidesert, open scrub and open woodland savanna. Given its known ability to persist outside of formally protected areas the likelihood of occurrence of this species in the project area is moderate to good. This species is known to persist outside of protected areas and even within agricultural lands and as such the likelihood of occurrence is regarded as Moderate.

Poecilogale albinucha (African Striped Weasel) is usually associated with savanna habitats, although it probably has a wider habitat tolerance (IUCN, 2017). Due to its secretive nature, it is often overlooked in many areas where it does occur. There is sufficient habitat for this species in the project area and the likelihood of occurrence of this species is therefore considered to be High.

Reptiles

Based on the IUCN Red List Spatial Data (IUCN, 2017) and the ReptileMap database provided by the Animal Demography Unit (ADU, 2017) twenty-eight (28) reptile species are expected to occur in the project area (Appendix 3). Two reptile species of conservation concern is expected to be present in the project area, namely *Smaug giganteus* (Sungazer or Ouvolk) and *Chamaesaura aenea* (Coppery Grass Lizard) (Table 9).

Smaug giganteus (Sungazer or 'Ouvolk') is categorised as Vulnerable on both a regional and an international scale. It is endemic to South Africa, where it is found only in the grasslands of the northern Free State and the southwestern parts of Mpumalanga (IUCN, 2017). Habitat loss due to agriculture is a continuing threat. Large portions of the grassland habitat are underlain by coal beds of varying quality and extent, and exploitation of coal for fuel has and will result in further habitat loss. The landowner confirmed the presence of Sungazer within the adjacent property (more open, grassland), however this reptile species is absent from the development area. This was confirmed during the site visit and according to potential habitat available the likelihood of populations of Sungazers establishing within the development area, if kept natural, is Low.

Chamaesaura aenea (Coppery Grass Lizard) is categorised as near threatened on both an international and a regional scale. A population reduction of over 20% in the last 18 years (three generations) is inferred from the transformation of large parts of the Grassland Biome. They are threatened by transformation of land for crop farming and plantations, overgrazing by livestock, infrastructural development, frequent anthropogenic fires and use of pesticides. The likelihood of occurrence in the development area is rated as Moderate.

Amphibians

Based on the IUCN Red List Spatial Data (IUCN, 2017) and the AmphibianMap database provided by the Animal Demography Unit (ADU, 2017) twenty (16) amphibian species are expected to occur in the project area (Appendix 4).

One amphibian species of conservation concern could be present in the project area according to the above-mentioned sources, namely *Pyxicephalus adspersus* (Giant Bullfrog) (Table 9).

The Giant Bull Frog (*Pyxicephalus adspersus*) is a species of conservation concern that may possibly occur in the project area. The Giant Bull Frog is listed as near threatened on a regional scale. It is a species of drier savannahs. It is fossorial for most of the year, remaining buried in cocoons. They emerge at the start of the rains, and breed in shallow, temporary waters in pools, pans and ditches (IUCN, 2017). There appears to be moderate suitable habitat for this species in the project area and therefore the likelihood of occurrence is regarded as Moderate.

Table 9: List of herpetofaunal species of conservation concern that may occur in the project area as well as their global and regional conservation statuses (IUCN, 2017; SANBI, 2016)

Species	Common Name	Conservation Status		Likelihood of Occurrence
		Red Data	IUCN	
Amphibians				
Pyxicephalus adspersus	Giant Bullfrog	VU	VU	Moderate
Reptiles				
Smaug giganteus	Sungazer	NT	NT	Low
Chamaesaura aenea	Coppery Grass Lizard	NT	LC	Moderate

5. SITE SPECIFIC TERRESTRIAL ECOLOGICAL ANALYSIS

Floristic Analysis

In this section, the different habitats and vegetation patterns observed within the study site (including the proposed power line servitude) are described.

As mentioned, the combination of releve (plot) and timed meander floristic sampling for conduction species biodiversity and assemblage analysis, is highly efficient, especially in terms of detecting SCC, AIPs and determining their density, distribution and associations/interactions with other flora.

In terms of releve sampling, the Zurich-Montpellier (Braun-Blanquet) school of total floristic compositions was followed. Total floristic coverage was sampled within 30 plots, which were randomly placed, but in a stratified manner within floristic uniform areas (pre-defined). Minimum plot sizes were determined, at site and was based on physiognomic-physiographic unit sampled. For dry and moist grassland, wetland, trampled and disturbed weed units plot sizes of $16m^2$ were selected whist $25m^2$ plot sizes were selected for the scrub communities, and $100m^2$ plot sizes for the riparian and thicket units. These plot sizes are in accordance with the sizes recommended by Brown *et a*. (2013).

As these are field-based observations taken directly from the site, they are of greater reliability and pertinence than the results of the National Vegetation Map which is at a coarse scale and does not represent the detail of the site adequately. The habitat map derived for the study area (including the proposed development site) is provided in Figure 7.

Vegetation of the study area is historically consisted of Central Free State Grassland. At a finer scale four phytosociological studies of the Kroonstad area and surroundings, were conducted in the past and which has relevance to the project area:

» Kooij, M.S., Scheepers, J.C., Bredenkamp, G.J. and Theron, G.K. 1991. *The Vegetation of the Kroonstad Area, Orange Free State I: Vlei and Bottomland Communities*. S.Afr.J.Bot. **57(4).** Pg. 213-219.
» Kooij, M.S., Scheepers, J.C., Bredenkamp, G.J. and Theron, G.K. 1992. *The Vegetation of the Kroonstad Area: A Description of the Grassland Communities*. S.Afr.J.Bot. ***58(3).*** Pg. 155-164.
» Fuls, E.R., Bredenkamp, G.J. and Van Rooyen, N. 1992. The hydrophilic vegetation of the Vredefort-Kroonstad-Lindley-Heilbron Area, Northern Orange Free State Province. S.Afr.J.Bot. **58(4).** Pg. 231-235.
» Fuls, E.R., Bredenkamp, G.J. and Van Rooyen, N. 1992. Plant Communities of the Rocky Outcrops of the Northern Orange Free State South Africa. *Vegetatio*. **103.** Pg. 79-92.

According to these studies, the vegetation of the project area contains similarities to:

» Rocky dolerite outcrops:
  o *Diheteropogon amplectens – Aristida diffusa – Aristida canescens* Sub association.
» Riparian wetland:
  o *Acacia karroo – Celtis africana* Ravine Thornveld
» Grass Wetland:
  o *Echinocloa holubii – Cyperus longus* Wetland
» Shrubland/Thornveld:
  o *Acacia karroo – Melica decumbens* Bottomland Thornveld
  o *Acacia karroo – Eragrostis chloromelas* Upland Thornveld

At the time of the vegetation survey, the herbaceous as well as geophytic layer was well developed and as such the time of the survey is regarded optimal. However, it is highly possible that a few additional species, can be expected to emerge outside of the period within which the survey was conducted. This is confirmed by preliminary statistical analysis of the survey data:

Number of (indigenous) species observed:	149
Second-order jack-knife estimate:	167
Number of weeds and alien invasive species excluded from statistics:	40

The 207 species that could be expected to be present in the project area is only a rough estimate and has been used as a comparative tool to help assess the conservation value and sensitivities of habitats. A list of species that has been recorded in the wider area on the SANBI database is provided in Appendix 2.

Of the 189 species recoded within the project area, basal cover throughout the study area was largely dominated by grass species. A total of 52 grass species were recorded, although the bulk of the project area were largely dominated by only few of these species.

The overall dominance of Increaser II, Climax and Sub-Climax species (28 species) are indicative of a heavy, long term grazing regime which as resulted in the decline of palatable decreaser species, and which has been replaced by less palatable, densely tufted grasses. Forb species were also fairly abundant within the project area with 74 species recorded. Dwarf shrubs, tall shrubs and small trees, even though low in diversity, within the project area (dwarf shrubs: 8 species; shrubs: 8 species and small trees: 5 species), were also significantly present within the project area.

Of the 189 species recorded within the development area, none were SCC, however three provincially protected species were recorded namely; *Boophone disticha, Crinum bulbispermum* and *Olea europaea* subsp. *africana*. Only tree individuals of *O. europaea* was recorded within the project area, just above the sheet ledge to the west of the project site. *Boophone disticha* was mainly recorded along the upper eastern slope and the plateau, however *B. disticha* was sparsely scattered throughout this area, with a population size. *Crinum bulbispermum* was fairly regularly observed within the channels of the valley-bottom wetlands and the wetland areas fringing the channels, especially around the edges of the pools. The local population of *C. bulbispermum* will not be impacted by the proposed development as the wetland area, with which this species is associated with, will be avoided.

Fine Scale Vegetation Patterns (Habitats)

The project area can be described as a low lying, gentle undulating landscape with a mostly convex land shape (low hill), however along the eastern boundary the land shape becomes concave with the lower area or bottom land section containing a valley bottom wetland habitat which drains into a northern direction towards the Vals River. The average slope of the area is around 2.7% with an average elevation gain/loss of 18m. The following land unit were identified within the project area; low sheet and ledge outcrops (predominantly sandstone) along the eastern and western slopes and summit/plateau of the hill, dolerite outcrop to the south east and a bottomland/valley flat, predominantly along the eastern boundary. The soils of the project area tend to be predominantly shallow to moderately deep with the occasional deeper soil pocket. The bottomlands/valley flats are dominated by cay (vertic) and clay-loam soils which may overlay lithic material or hard rock. The dolerite outcrop is covered by a shallow soil layer which may be absent. The soil tends to be gritty, sandy loam with an abundance of surface rock, gravel and stones. The remaining portion of the project area is covered by a fairly shallow sandy loam to sandy clay loam layer (clay loam is also present in a few areas), overlying lithic material and hard rock. Surface rock and bedrock are typically present along the edge of the plateau/summit and upper slopes.

On the basis of the major (first-level) division obtained by TWINSPAN classification, the entire phytosociological table was divided into three smaller tables/clusters, one containing

the releves/plots representing the moist bottomland habitats and associated vegetation types, those releves representing the shrub-grassland and their associated vegetation types and those releves associated with the highly degraded and transformed grassland. The second division divided the bottomland habitats according to the prominence of woody species, and distinguished the woody riparian wetland from the grass and forb dominated wetland areas which was further divided (3rd division of bottomland habitats) along a moisture gradient differentiating between the communities associated with the different hydro-geomorphological zones. In terms of the upland shrub-grassland, three additional divisions were made; namely the vegetation cluster with strongly associated with the shrub, *Asparagus laricinus,* the vegetation cluster associated with the grass, *Aristida diffusa* and the vegetation cluster associated with severely degraded and .

According to associations/habitats, communities and sub-communities where identified within the project area.

» **Association 1**: Channel valley-bottom wetland and associated riparian fringe

  - Association 1 A: Grass and forb dominated wetland areas

    - Community 1.A.1: *Cyperus eragrostis – Marsilea macrocarpa* Permanent Inundated Channels
    - Community 1.A.2: *Paspalum diladatum – Persicaria decipeins* Seasonal Saturated Channels
    - Community 1.A.3: *Eragrostis planiculmis – Echinochloa holubii* Seasonal Saturated Wetland Terrace
    - Community 1A.4: *Eragrostis plana – Eragrostis chloromelas* Temporary Saturated Wetland Terrace

  - Association 1 B: Riparian wetland

    - Community 1.B: *Searsia pyroides – Celtis africana* Riparian Woodland

» **Association 2**: Upland shrub-grassland

    - Community 2.1: *Acacia karroo – Asparagus laricinus* Shrub Grassland on Low Lying Hills and Plains.
    - Community 2.1: *Acacia karroo – Aristida diffusa* Shrub Grassland of Dolerite Outcrops.

» **Association 3**: Severely Degraded and Transformed Grassland

    - Community 3: *Acacia karroo – Asparagus laricinus* Shrub Grassland on Low Lying Hills and Plains.

- Community 2.1: *Acacia karroo – Aristida diffusa* Shrub Grassland of Dolerite Outcrops.

A. Shrub Grassland on Low Lying Hills and Plains:

The majority of the develpment areas vegetation cover can be described as a low shrub grassland with a highly varying (height and density) woody component. The lower vegetative layer is also varying in terms of the grass – forb – dwarf shrub relationship. The woody component is dominated by *Acacia* (*Vachellia karroo*) and *Asparagus laricinus, although Gymnosporia heterophylla, Searsia lancea, S. pyroides and Diospyros lycioides* were also relatively frequently observed. The plateau, eastern slope and dolerite ridge tend to be more open with the woody coverage varying between 25-40%. The shrub layer is quite low and seldomly exceeds 4m. The western portion of the project area (gentle westerly slope) is much more densely covered by low growing shrubs with an average coverage of between 40% and 60% and with a maximum coverage of 70%. The lower strata are typically dominated by medium tall (1.3 – 1.5m) grass species such as *Eragrostis chloromelas, Themeda triandra, Eragrostis trichophora, E. obtusa*, and *Aristida congesta*. Other common grass species of the area includes; *Cynodon hirsutus, C. dactylon, Elionurus muticus, Panicum coloratum, Eragrostis lehmanniana* and *E. gummiflua, E. barbinodis, E. curvula, E. superba* and *Sporobolus ioclados*. Coverage of the grass layer may vary between 55 and 80%. The forb and dwarf shrub layer are also well represented within the area and is characterized by *Barleria obtusa, Pentzia globosa, Berkheya pinnatifida, Bidens pilosa, Monsonia burkeana, Achyranthes aspera, Tagetes minuta* and *Indigofera comosa*. Other common forbs and dwarf shrubs includes; *Crabbea acaulis, Geigeria aspera, Nidorella resedifolia, Tagetes minuta, Zinnia peruviana, Hermannia depressa, Hibiscus pusillus, Physalis viscosa, Lippia javanica, Delosperma floribundum, Kalanchoe rotundifolia, Portulaca oleraceae,* and *Felicia muricata.* No SCC were recorded within the area, however the provincially protected *Boophone disticha* and *Olea europaea* subsp. *africana* was recorded. In terms of weeds and invasive alien plants, *Bidens Pilosa, Tagetes minuta* and *Zinnia peruviana* were the most frequent recorded. The invasive alien succulent plant *Opuntia ficus-indica* was also frequently encountered. Other noteworthy invasive alien and weedy plants recorded includes; *Schkuhria pinnata, Physalis viscosa, Verbena aristigera, Opuntia humifusa* and *Portulaca oleraceae*.

As described above, this area has been subjected to a relative long term, heavy grazing regime and has resulted in the replacement and reduction in the coverage of palatable decreaser grass species, with less palatable Increaser II and II species and has allowed for the encroachment of woody (*Acacia karroo* and especially *Asparagus laricinus*) and karroid species (*Pentzia globosa, Felicia muricata* and *Indigofera comosa*).

Bredenkamp et al. (1991) states that continued grazing and harvester termite infestation, within the north eastern Free State Province results in the dominance shift, successively from *Themeda triandra* to *Panicum coloratum* and to *Eragrostis chloromelas* and then finally

to *Sporobolus ioclados var. usitatus*. They furthermore state that these stages in the retrogression of originally good stands of *Themeda* veld are not, at first, accompanied by marked reduction in basal cover as prominence is assumed by one grass at the expense of another. However, the productivity and palatability of the pasture drops steadily with retrogression. Despite its high basal cover and palatability, *Panicum coloratum* produces a smaller mass of herbage than *Themeda triandra*. *Eragrostis chloromelas* produce relatively small quantities of forage of indifferent to poor quality. *Sporobolus ioclados var. usitatus* may have a high basal cover, but it produces little herbage. Together with species of *Cynodon* and *Aristida*, dominance by *Sporobolus ioclados* var. *usitatus* represents the last perennial grass stage before the veld commences to break down to a critical level of denudation and degradation. This critical threshold level is heralded by the incursion of short-lived grasses, karoo bushes and weeds, such as *Aristida* species, *Chloris virgata, Tragus racemosus, Pentzia globosa, Chrysocoma ciliata. Chamaesyces inequilatera* and *Nidorella resedifolia*. If site degradation continues beyond this critical threshold, it may be extremely difficult or impossible to reverse the trend, except by applying costly measures. According to the above statement, the project area is in moderately to advanced stage of retrogression (disturbance), however a moderately stable vegetation cover still persists allowing services and functions to continue albeit in a modified and somewhat restricted manner.

B. Shrub Grassland on Dolerite Outcrops:

Towards the south eastern corner of the development area, a relative low dolerite outcrop persists. Soils tend to be very sallow and are mostly of a sandy loam to sandy clay loam texture with some gravel and overlies hard rock and lithic material. An abundance of surface rocks and boulders cover the entire area. This outcrop is covered by a dry open grassland. The woody component is still quite prominent and is characterized by low growing trees and shrubs covering between 15 and 30% of the total surface area. The dominant tree/shrub species is *Acacia karroo*. Other noteworthy trees/shrubs are *Gymnosporia heterophylla* and *Searsia pyroides.* As in the case of the previous described habitat/vegetation assemblage, the grass layer of the rocky outcrop shows signs of moderate degradation (overgrazing) and is dominated by wiry, tufted, medium to short (0.7m) grasses such as *Aristida congesta, A diffusa, Eragrostis lehmanniana, E. chloromelas* and *E. superba*. Other graminoids frequently observed within this habitat was *Eragrostis racemosa, E. curvula, Heteropogon contortus, Panicum coloratum, Themeda triandra, Enneapogon desvauxii* and *Triraphis andropogonoides*. The grass layer is the dominant layer of this habitat and may cover between 70 and 80% of this habitat, of which the combination of *A. diffusa, E. lehmanniana*, *E. superba and A. congesta* make up between 55 and 70%. Even though this habitat type is characterized by numerous dwarf shrubs and forbs, it is especially weed and alien plants, such as *Bidens pilosa, Zinnia peruviana* and *Helichrysum rugulosum*, that are prominent. The forb layer rarely exceeds 30% and is typically between 15 and 20%. Other noteworthy forbs and dwarf shrubs include, *Pentzia incana, Achyranthes aspera, Monsonia burkeana, Corchorus confuses,*

Hermannia depressa, Hibiscus aethiopicus, H. pusillus, Felicia muricata and *Indigofera comosa*.

No SCC were recorded within the area, however the provincially protected *Orbea lutea* was recorded. In terms of weeds and invasive alien plants, *Bidens pilosa, Tagetes minuta, Schkuhria pinnata, Portulaca oleraceae* and *Zinnia peruviana* were the most frequent recorded.

C. Highly Transformed and Disturbed Grassland:

This vegetation unit is associated with fire breaks, access roads, kraals, watering and feeding points for cattle and areas where the vegetation has been recently disturbed. This unit comprise of a mixture of short grasses and forb, of which most are regarded as weeds such as *Cynodon dactylon, Urochloa panicoides, Aristida congesta, Eragrostis barbinodis, Eragrostis lehmannana, Verbena aristigera, Conyza bonariensis, Nidorela resedifolia, Schkuhria pinnata, Tagetes minuta, Bidens pilosa* and *Physalis viscosa.* Other species frequently observed within this grassland were; Cotula podocephala, Corchorus confuses, *Atriplex semibacata, Felicia muricata, Indgofera comosa,* I*. daleoides, Eragrostis chloromelas, E. superba,* and *E. trichophora*

No SCC were recorded within the development area.

D. Valley-Bottom Wetlands

Please take note that the identified wetlands are excluded from the development area and subsequently direct impacts on these wetlands have been avoided.

The valley-bottom areas to the east contains natural wetland features fed predominantly by overland flow (surface flow) from the surrounding hills and slopes. These water inputs are then drained, predominantly as contained surface flow along a primary channel, in a northern direction towards the Vals River. These channelled valley bottom wetlands are of a seasonal to temporary nature (saturation), however a few patches of permanent saturated area exist and is mainly associated with the instream dams and other micro-depression found along the channel. These micro-depressions and the dam features are typically, seasonally inundated, however the larger dams may be inundated for extended periods of time. The soils of these wetlands tend to be moderately deep, dark grey to dark grey brown and are typically either clayey (vertic soils) or clay-loam (duplex soils). Shallower portions, typically overly lithic material. This wetland features are relative heterogenous and is a result of the varying saturation zones and the varying geomorphology of the wetland. This has resulted in a mosaic pattern expressed by the vegetation communities.

No SCC were observed within the wetland habitat, however Crinum bulbispermum, a geophyte provincially protected, has been recorded at relative frequent intervals along the channels of the wetland features.

Both of these wetlands (located outside of the development area) have undergone some form of modification with the larger of the two wetlands being the most significantly impacted. Modifications to the wetlands include:

Larger Valley-Bottom Wetland Feature

» The hydrological character has been moderately impacted mainly in terms of water distribution and retention.
    - The most significant factor contributing to these modifications/alterations are the modification to the existing channel.
    - Especially the channel located north of the proposed development area has been significantly modified through erosion, which has widened and deepened the channel within this section. This has resulted in more confined flows and a reduction in lateral and overbank flow into the adjacent habitat areas.
    - Within the development area erosion and trampling by livestock has resulted in localised deepening of the channel, creating pools which will retain surface water for longer periods of time and reduce potential overbank and lateral flow into the adjacent portions of the wetland (as a result of the lowering of the channel below the adjacent wetland areas.
» Numerous small to medium-small gravel dams have been constructed within the watercourse impacting/impeding the natural flow of water along the wetland.
    - The R34 crossing has also slightly impacted local water distribution.
    - Hardened surfaces within the catchment is regarded is relative low (R34 and a few gravel roads) and along with the fact that a fairly dense vegetation is still present within the catchment, means that water inputs and flooding patterns have likely not been significantly modified (although the elevation of the R34 may impact surface flow somewhat at a local scale).
» The effects of instream dam construction, channel erosion (widening and deepening) as well as infilling has had a significant impact on the geomorphological integrity of the wetland and has resulted in moderate modification to the natural geomorphology of the channelled valley bottom wetland.
» The integrity of the vegetation structure has been moderately impacted.
    - Grazing, trampling and erosion of the channel resulted in a general reduction in the vegetation coverage. Apart from a reduction in coverage, an alteration to the species composition has also occurred, to some extent, with micro-depression found along the channel (a result of trampling and erosion) now comprising of floating and submerged forbs and some sedges, the remaining channel is now characterized mainly by low growing grasses and a few sedges

as well as some bare patches. Historically, these channels were likely covered by a much denser and taller sedge and grass cover.
- Natural vegetation within portions of the seasonal and temporary saturated zones have been completely taken over by the alien plant *Paspalum dilatatum*.
- The invasive alien plant (IAP); *Verbena officinalis* is a common feature within the temporary saturated zone.
- Other IAPs recorded within the wetland include; *Cirsium vulgare; Xantium spinosum, Xantium strumarium* and *Verbena bonariensis*.
- Furthermore, *Asparagus laricinus*, and to a lesser extent *Acacia (Vachellia) karroo*, have become slightly encroaching within the temporary saturated zone (some locations).

Small Valley-Bottom Wetland Feature

» The hydrological character has been slightly to moderately impacted, also mainly with regards to water distribution and retention.
  - Similarly, to CVB wetland 1 the most significant factor contributing to these modifications/alterations are the modification to the existing channel which has been exposed to trampling and erosion, deepening and slightly widening some portions of the channel. This in turn has resulted in more confined flows and a reduction in lateral and overbank flow into the adjacent habitat areas.
  - Modifications/alterations within the catchment is minimal, with some hardened surfaces, and as such water input and flooding peaks has mainly remained natural.
» The effects of instream channel erosion (widening and deepening) and trampling have resulted in the moderate modification of the natural geomorphological integrity of the wetland.

» Modifications to the vegetation structure and composition are probably the most significant impact to this wetland feature and is mainly as a result of the modification of the geomorphology (soil disturbance through erosion and trampling).
  - Grazing, trampling and erosion of the channel has resulted in a general reduction in vegetation coverage. Apart from a reduction in coverage, an alteration to the species composition has also occurred, to some extent, with micro-depression found along the channel (a result of trampling and erosion) now comprising of floating and submerged forbs and some sedges, the remaining channel is now characterized mainly by low growing grasses and a few sedges as well as some bare patches. Historically, these channels were likely covered by a much denser and taller sedge and grass cover.
  - The alien plant, *P. dilatatum* has established itself, especially within the seasonal and temporary saturated portion of the wetland, forming local dense stands.
  - IAPs recorded within the wetland include; *Cirsium vulgare; Xantium spinosum, Xantium strumarium* and *Verbena bonariensis, V. officinalis*.

- Furthermore, *Asparagus laricinus*, and *Acacia (Vachellia) karroo*, have become slightly encroaching in temporary saturated zone (some locations).

i. Permanent saturated zones (Channels):

This hydro-geomorphological zone occurs as small, discontinuous patches, along the channel of the CVB wetlands where they form where there is a local drop in elevation (micro-depressions) along the channel, mainly created by a form of disturbance such as trampling, erosion and dam construction. These areas tend to collect and store surface water for moderately long periods of time (few months during the wet season). Soils tend to be dark to light grey clay to clay loam. The vegetation of these areas tends to be sparse and poor in diversity dominated by floating and submerged hydrophytic forbs and graminoids (Forbs: 15 – 30%; Grasses: 40 – 55% and Sedges: 10 – 20%) such as *Paspalum distichum, Persicaria decipiens* and *Schoenoplectus muricinux*. Other plants species frequently observed included; *Marsilea macrocarpa, Cyperus Eragrostis, Falkia oblonga* and *Leersia hexandra*.

ii. Seasonal saturated zone (Channels):

This hydro-geomorphological zone occurs as small, discontinuous patches, along the channel of the CVB wetlands where they form where there is a local drop in elevation (micro-depressions) along the channel, mainly created by a form of disturbance such as trampling, erosion and dam construction. These areas tend to collect and store surface water for moderately long periods of time (few months during the wet season). Soils tend to be dark to light grey clay to clay loam. The vegetation of these areas tends to be sparse and poor in diversity dominated by floating and submerged hydrophytic forbs and graminoids (Forbs: 15 – 30%; Grasses: 40 – 55% and Sedges: 10 – 20%) such as *Paspalum distichum, Persicaria decipiens* and *Schoenoplectus muricinux*. Other plants species frequently observed included; *Marsilea macrocarpa, Cyperus Eragrostis, Falkia oblonga* and *Leersia hexandra*.

iii. Seasonal saturated zone (terrace):

Seasonal saturated zones fringing the channels tend to be narrow, however favourable underlying geology and local topography may result in larger seasonal saturated zone as was found to the north of the project area (near the north-eastern boundary of the project area) where the wetland had a fairly broad seasonal zone. The smaller CVB wetland contains a narrow seasonal zone throughout its extent. This zone is dominated by a tall, dense wet grassland (80-90%) on grey to dark grey brown clay to clay-loam soils, and is characterised by *Eragrostis planiculmis, Paspalum dilatatum, Setaria nigrirostris, Eragrostis micrantha* and *Echinochloa holubii*. Other key species include; *Berkheya radula, Haplocarpha scaposa, Verbena bonariensis, Cyperus longus, Setaria pallide-fusca* and *Sporobolus africanus*

iv. Temporary saturated zone (terrace):

The temporary saturated zone covers the largest extent of these wetland features and is characterized by a medium to medium-short mixed moisture grassland comprising a mixture of facultative wetland and facultative upland species. The grass component forms the dominant cover (70-90%). The highest diversity of plant species was recorded within this area with 53 species observed within this zone. This higher plant species diversity is a result of the transitional location of this zone resulting elements of both the wetland and terrestrial being present. Where the seasonal zone transitions into the temporary zone the grass layer tends to be taller with similarities with the seasonal zone and include species such as; *Echinochloa holubii, Eragrostis micrantha, Eragrostis plans, Paspalum dilatatum* and *Setaria nigririostris*. As one moves to the outer edge the grass cover becomes a bit shorter and comprise a mixture of wetland and terrestrial plants such as *Themeda triandra, Eragrostis plana, Cynodon dactylon, Eragrostis chloromelas, E. gummiflua, Panicum coloratum, Sporobolus africanus* and *Eragrostis micrantha*. The forb layer also slightly increases in coverage towards the outer boundary and is characterized with *Verbena officinalis, Berkheya radula, Helichrysum aureonitens, Tagetes minuta, Monsonia burkeana*, *Buchnera reducta* and *Hermannia depressa*. Shrubs such as *Lycium laricinus* and *Acacia karroo*, are also scattered through sections of this zone and may in, some isolated localities become slightly encroaching.

v. Riparian Woodland:

Elevated (high terrace areas with a convex shape) areas along the channels and outer fringes of the wetland boundaries, where saturation is very seldom. However, saturation of soils occurs sufficient enough for the display of wetland indicators. Soils tend to be moderately deep, dark clay (vertic) to loam clay with fairly high concentrations of organic material and typically overly lithic material. The riparian habitat does not form a continuous plant community but display a patchy distribution, varying greatly in size, height, and vegetation structure. The tree and tall shrub layer are the dominant canopy cover (70 – 95%), whist the forb/herb layer forms the dominant ground cover (up to 40%). Low straggling and climbing shrubs forbs are also a prominent feature within these areas and may cover up to 40% of a plant releve within this habitat. Where the tree/tall shrub canopy becomes more open, grass species becomes a more significant feature. The tree/tall shrub layer is dominated by *Acacia karroo, Diospyros lycioides, Ziziphus mucronata, Asparagus laricinus* and *Searsia pyrioides*, whist the forb layer is characterized by *Achyranthes aspera, Bidens Pilosa, Tagetes minuta, Pavonia senegalensis*, and *Sida dregei.* Common straggling and climbing forbs and shrubs include; *Pentharrhinum insipidum* and *Asparagus cooperi*. Occasionally the tree layer thins out and these areas are then typically dominated by *Searsia pyrioides* and *Asparagus laricinus* and to a lesser extent shrubby growth forms of *Acacia karroo*. Within these areas the grass coverage increases with the lower plant strata characterized by, *Cynodon dactylon, Themeda triandra, Sporobolus fimbriatus, Setaria*

verticillata, Paspalum dilatatum and *Eragrostis plana*. Other common species recorded within this habitat includes: *Sida cordifolia, Solanum lichtensteinii, Verbena aristigera, Ehretia rigida, Gymnosporia heterophylla* and *Celtis africana.*

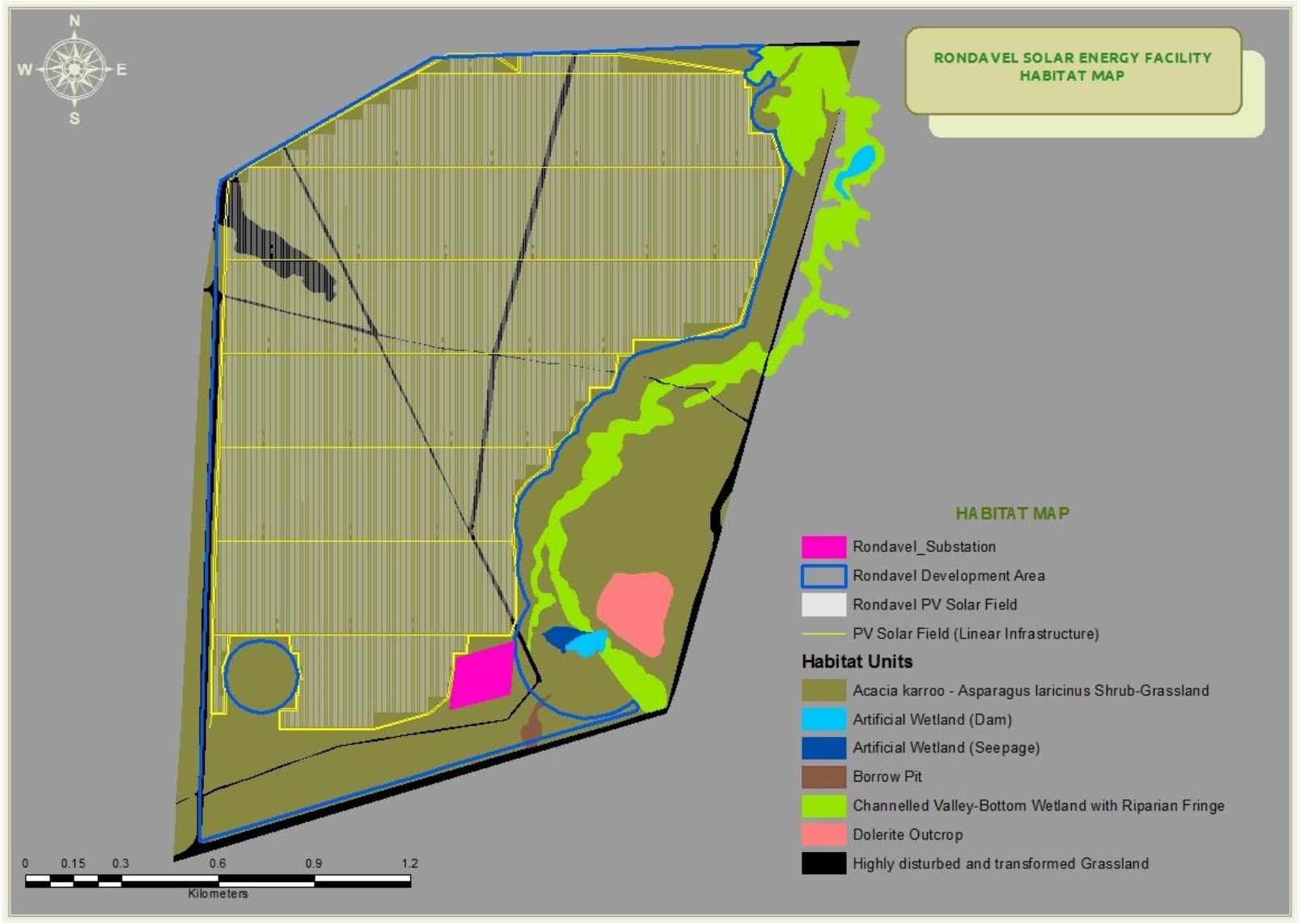

Figure 7: Delineated habitat units.

Plant Species of Conservation Concern (SCC)

During the survey no plant SCC was recorded within the development area. However, four provincially protected species were recorded, as listed within the Free State Nature Conservation Bill (2007), namely; *Boophone disticha, Crinum bulbispermum, Orbea lutea* and *Olea europaea subsp. africana.* It is recommended that a pre-construction walk-through is done by a registered botanical specialist, prior to the start of the construction phase, during which, these protected plants are identified and mapped. This information should then be used to apply for the necessary floral permits (from DESTEA) in order to gain permission for the removal, relocation, disturbance or destruction of these species

Mammals

This section represents the results from the field survey conducted from the 18th – 20th of March 2021 and the 10th of April 2021 (end of wet season).

Overall, mammal diversity in the project area was moderate, with eleven (18) mammal species being physically recorded based on direct observations, camera trap photographs, Sherman traps, and/or the presence of visual tracks & signs. Of these 18 species four species are have been introduced into the area (highlighted in blue below). This data represent strong evidence as to a moderate diverse and functional mammal assemblage populating the study area. No species of SCC were observed in the project area, but due to the habitat type it is very likely that other SCC's could occur here. Two provincially protected species were observed namely Aardwolf (*Proteles cristatus*) and Aardvark (*Orycteropus afer*).

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Lepus saxatilis	Scrub Hare	LC	LC
Hystrix africaeaustralis	Cape Porcupine	LC	LC
Cryptomys hottentotus	African Mole-rat	LC	LC
Proteles cristatus	Aardwolf	LC	LC
Rhabdomys pumilio	Four-Striped Grass Mouse	LC	LC
Otomys angoniensis	Angoni Vlei Rat	LC	LC
Mastomys coucha	Southern Multimammate Mouse	LC	LC
Tiny musk shrew	*Crocidura fuscomurina*	LC	LC
Xerus inauris	South African Ground Squirrel	LC	LC
Canis mesomelas	Black-back Jacal	LC	LC
Cynictis penicillata	Yellow Mongoose	LC	LC
Sylvicapra grimmia	Common Duiker	LC	LC
Raphicerus campestris	Steenbok	LC	LC
Phacochoerus africanus	Warthog	LC	LC

Orycteropus afer	Aardvark	LC	LC
Equus quagga	Plains Zebra	LC	LC
Tragelaphus strepsiceros	Greater Kudu	LC	LC
Kobus ellipsiprymnus	Waterbuck	LC	LC
Tragelaphus angasii	Nyala	LC	LC

As mentioned in the methods section above, extensive wet season trapping took place in along three transects which traversed all of the habitats present at site with the rank moist grass vegetation associated with the wetlands deemed as the most preferable habitat for small mammals. This was indeed the case with regular trapping of rodents, especially along the edges of the wetland habitats, extending into the dry grassland (normally near low shrubs) fringing these wetlands. Both *Mastomys coucha* (Southern Multimammate Mouse) and *Rhabdomys pumilio* (Four Striped-Grass Mouse) was fairly regularly trapped within these areas.

Mammal Species of Conservation Concern (SCC)

As mentioned, no mammal SCC was recorded. However, due to preferential habitat availability, there is a likelihood for some SCC to inhabit the development site, including South African Hedgehog – *Atelerix frontalis* (Near Threatened), Serval – *Leptailurus serval* (Near Threatened).

Mammal Habitat Analysis

A. *Acacia karoo* - Asparagus laricinus Shrub-Grassland

These habitats provide relative good refugia and forage for small mammal species, which in turn form the basis for the trophic food chain. These grasslands are also regarded as important breeding and foraging sites for mammal species. The entire development footprint will be located within this habitat. The grasses in this habitat is moderately dense and of fair forage value. However, some encroaching of shrubs and small trees have had an impact on the total grass coverage. Moderate-high structural complexity (habitat and niche diversity) and strong foraging potential allows for a moderate species diversity for these areas, with species from most trophic levels present. Overall diversity, connectivity and sensitivity of these areas can be regarded as Moderate.

Species recorded within this area includes:

- Large and Meso Carnivores: Aardwolf, Black-back jackal
- Small Carnivores: Yellow mongoose
- Ungulates: Steenbok, Warthog, Plains Zebra, Waterbuck, Greater kudu
- Fossorial Mammals: African mole-rat
- Small Mammals: Cape porcupine, Scrub hare, Four-striped grass mouse

» Medium Sized Mammals: Aardvark

B. Highly Disturbed/Transformed Grassland

As discussed in the botanical section, this habitat type represents fire breaks, farm tracks access roads and severely trampled areas. The vegetation cover within these areas are either sparse, or frequently mowed, removed. The soils within these areas are also usually hard and compacted. These hard and compacted areas, with a sparse vegetation cover is a preferred habitat for small borrowing mammals such as the South African Ground Squirrel, White-tailed Mongoose and Suids. The almost completely transformed habitat also may provide temporary foraging habitat for meso and small carnivores due to the presence of rodents and other small to medium sized mammals. Larger mammals typically use these areas as routes to and from foraging areas and they seldomly inhabit these areas on a permanent basis. The overall diversity, connectivity and sensitivity of these areas were Low

Species recorded within this area includes:

» Large and Meso Carnivores: Black-back jackal
» Small Carnivores: Yellow mongoose
» Ungulates: Steenbok, Warthog, Plains Zebra, Waterbuck, Greater kudu
» Fossorial Mammals: African mole-rat
» Small Mammals: Scrub hare

C. Dolerite Outcrop

These habitat shows excellent potential for mammal species. Such rocky outcrops are mixed with rocky refugia (which provide structural complexity) to provide a moderately sensitive habitat, especially for small mammals. Species diversity within the rocky grasslands of the project area where however very low and it must be reiterated that the poor and unusual poor Sherman trapping has deprived the habitat of its true potential total diversity. The rock areas also provided excellent refugia for larger species (especially hyrax and porcupines and meso-predators such as black-backed jackal. The associated grasslands surrounding rock refugia provided cover and foraging habitat for potential herbivores such as rabbits, steenbok and duikers. The overall diversity, sensitivity and connectivity to other habitats is considered to be Moderate.

Species recorded within this area includes:

» Large and Meso Carnivores: Black-back jackal
» Ungulates: Steenbok
» Fossorial Mammals: African mole-rat
» Small Mammals: Scrub hare

D. Wetlands with riparian fringes

Wetlands occur naturally or have been somewhat modified throughout the study area and support surrounding agricultural practices. These wetlands along with their vegetation are extremely heterogenous and provides highly structural complexity and breeding/foraging habitats for various mammal species. These wetland features furthermore contribute to habitat heterogeneity within the area and as such increase habitat and niche diversity within the larger area. The highest diversity of smaller mammals where recorded within the temporary and seasonal saturated grassland. These smaller mammal species, e.g. rodents, for the basis of the trophic food chain and sustain the local faunal meso-predators as well as raptors. There was a clear decrease in trapping success (Sherman traps) as one move further from the wetland habitats. Furthermore, these wetland habitats can be regarded as potentially important corridors connecting the Vals River with the higher lying grassland habitats. The overall diversity, connectivity and sensitivity of these areas were Moderate to High

Species recorded within this area includes:

- Large and Meso Carnivores: Black-back jackal
- Small Carnivores: Yellow mongoose
- Ungulates: Steenbok, Warthog, Plains Zebra, Waterbuck, Greater kudu
- Small Mammals: Cape porcupine, Four-striped grass mouse, Tiny musk shrew, Angoni vlei rat and Southern multimammate mouse
- Medium Sized Mammals: Aardvark

Herpetofauna

Herpetofauna diversity was considered to be moderate-low with three (3) reptile species and four (4) amphibian species being observed or recorded in the development site. No species of SCC were observed in the project area.

Species	Common Name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Acontias gracilicauda	Thin-tailed Legless Skink	LC	LC
Afroablepharus wahlbergii	Walhberg's Snake-eyed Skink	LC	LC
Leptotyphlops scutifrons	Peters' Thread Snake	LC	LC
Cacosternum boettgeri	Boettger's Caco	LC	LC
Semnodactylus wealii	Rattling Frog	LC	LC
Xenopus laevis	Common platanna	LC	LC
Tomopterna natalensis	Natal Sand Frog	LC	LC

6. COMBINED HABITAT SENSITIVITY

All Wetland Features High Sensitivity and No-Go Area

Conservation status	**High**
	» Mostly natural moist grassland.
	» Provide valuable ecosystem functions and services.
	» Ecological Support Area
	» FS DTEEA Wetland Policy (Now DESTEA):
	  ○ No net loss of wetlands and functioning
	» No Plant or Animal SCC
	  ○ However, habitat suitability exists for some SCC and the following SCC have a high likelihood of occurrence:
	  ▪ Giant Bullfrog (Pyxicephalus adspersus): Near Threatened
	  ▪ Serval (*Leptailurus serval*): Near Threatened
	  ▪ South African hedgehog (*Atelerix frontalis*): Near Threatened.
	» Provincially protected flora:
	  ○ *Crinum bulbispermum*
	» Endemic Plants & Animals:
	  ○ Rattling frog *(Semnodactylus weallii),* Thin-tailed Legless Skink *(Acocantias gracilicauda)*

Ecosystem function	» Vegetation as grazing and stabilisation of soils, » Accumulate and slows down (seasonal and temporary saturated terrace) runoff from higher lying areas, » Maximises infiltration of runoff into soils and filtering of runoff before it seeps further into lower-lying river systems, » High importance in providing biodiversity maintenance » High importance in terms of water quality enhancement services. Water quality enhancement and maintenance are vital for functionality and services provided by important downstream ecosystems. » Moderate to High sensitivity to external impacts. » Valuable corridor for movement (fauna and likely avifauna) as well as hydrological connectivity with important lower lying aquatic, other wetland ecosystems as well as with surrounding terrestrial habitats.
Stability	» High where the vegetation layer is dense, » Medium to low if soils become bare » Moderate to High sensitivity to external impacts.
Reversibility of degradation	» Habitat will be difficult to recreate after significant modification, rehabilitation of vegetation and ecosystem functionality after disturbance will be problematic and slow
Rating	» ***High sensitivity (No-Go Area)***

General Development Recommendations:

- These areas are excluded from the current development footprint.
- The development footprint should be clearly demarcated and no movement may be allowed outside of the development footprint, especially within the wetland areas.
- The 30m buffer area recommended within the Wetland Specialist Report should be implemented and these buffer areas should be preserved and a natural condition with a stable vegetation cover.
- Monitoring of erosion and invasive alien plants should occur on a regular basis during the construction phase and should be carried out throughout the operational phase, where such features are observed swift actions should be taken in order to remediate these impacts in order to avoid the potential spread of erosion into the wetland areas as well as the establishment of invasive alien plants.

Dolerite Outcrop

Conservation status	**Medium**
	» Mostly natural, dry shrubby grassland.
	» Provide valuable ecosystem functions and services.
	» Ecological Support Area
	» Fairly unique and isolated habitat:
	  o Provide structural complexity (rocky refugia)
	» Contribute to habitat and niche diversity at a local scale
	» No Plant or Animal SCC
	  o However, habitat suitability exists for some SCC and the following SCC have a high likelihood of occurrence:
	  ▪ South African hedgehog (*Atelerix frontalis*): Near Threatened.
	» Provincially protected flora:
	  o *Orbea lutea subsp. lutea*
	  o *Boophone disticha*

Ecosystem function	» Contribute to habitat and niche diversity (local scale) and the maintenance thereof
	» Rocky refugia for habitat sensitive fauna:
	» Stable Vegetation cover for:
	  o Grazing;
	  o Maintenance of pollinator populations,
	  o Soil conservation and stabilisation,
	  o Accumulation and slowing down of runoff;
	  o Maximising of infiltration of runoff into soils
	  o Filtering of runoff;
	  o Buffering for lower lying valley-bottom wetlands against potential disturbances and thus vital for the protection of these sensitive habitats against deterioration.
	» High sensitivity to external impacts.

Stability	» High if habitat is kept intact o Clearing and monitoring of weeds and invasive species. o Erosion control
Reversibility of degradation	» Limited possibility, will require intervention, clearing of invasives needed to improve ecosystem functionality » Much of the original species diversity may be lost if original vegetation is significantly impacted
Rating	» ***Medium Sensitivity***

General Development Recommendations:

» This dolerite outcrop is excluded from the current development footprint.
» The development footprint should be clearly demarcated and no movement may be allowed outside of the development footprint.
» The 30m buffer area recommended within the Wetland Specialist Report should be implemented and these buffer areas should be preserved and a natural condition with a stable vegetation cover.
» Monitoring of erosion and invasive alien plants should occur on a regular basis during the construction phase and should be carried out throughout the operational phase, where such features are observed swift actions should be taken in order to remediate these impacts in order to avoid the potential spread of erosion into the wetland areas as well as the establishment of invasive alien plants.

Acacia karroo – Asparagus laricinus Shrub-Grassland

Conservation status	**Medium** » Moderately degraded grassland o Fairly advanced in terms of retrogression of indigenous grass species. o Encroachment of especially *Asaparagus laricinus* and to a lesser extent *Acacia karroo*. » Moderate invasion of AIPs: o *Opuntia ficus-indica* o *Opuntia humifusa* » However still capable of providing ecosystem functions and services. » Ecological Support Area » Rocky areas: provide structural complexity (rocky refugia) » No Plant or Animal SCC o However, habitat suitability exists for some SCC and the following SCC have a high likelihood of occurrence: ▪ South African hedgehog (*Atelerix frontalis*): Near Threatened. ▪ Serval (*Leptailurus serval*): Near Threatened » Provincially protected flora:

	○ *Boophone disticha* ○ *Olea europaea susp. africana* » Provincially protected fauna: ○ Aardvark *(Orycteropus afer)* ○ Aardwolf *(Proteles cristatus),* ○ Golden starbust baboon spider *(Harpactira hamiltoni)* » Endemic fauna and flora: ○ Golden starbust baboon spider *(Harpactira hamiltoni)* ○ Skaapvygie *(Delospema floribundum)*
Ecosystem function	» Stable Vegetation cover for: ○ Grazing; ○ Maintenance of pollinator populations, ○ Soil conservation and stabilisation, ○ Accumulation and slowing down of runoff; ○ Maximising of infiltration of runoff into soils ○ Filtering of runoff; ○ Buffering for lower lying valley-bottom wetlands against potential disturbances and thus vital for the protection of these sensitive habitats against deterioration. » Moderate sensitivity to external impacts.
Stability	» Medium to high if habitat is kept intact ○ Clearing and monitoring of weeds and invasive species will be necessary. ○ Monitoring and partial clearing of encroaching indigenous woody plants.
Reversibility of degradation	» Habitat will be difficult to recreate after significant modification, » Rehabilitation of vegetation and ecosystem functionality after disturbance will be problematic and slow ○ Clearing of invasives is needed to improve ecosystem functionality » Management and partial clearing of encroaching indigenous woody plants
Rating	» ***Medium Sensitivity***

General Development Recommendations:

» Development within this area is acceptable
» The entire development footprint is located within this habitat.
» To prevent the onset of accelerated erosion, it is recommended that vegetation clearing be limited to clearing high shrubs, all invasive trees and other alien invasives, even if that means that remaining vegetation will be subjected to vehicle damage (from which it can recover over time).
» Grading should only be done where absolutely necessary. If extensive grading will become necessary, it will be advisable to create contour buffer strips to slow down

runoff and prevent erosion, which could develop into gully erosion damaging the development in the long run as well.

- » It is currently not known which species will be able to persist under the shading of PV arrays, but the establishment of the naturally occurring Cynodon dactylon (couch grass), a low creeping grass, can be encouraged. Its dense and deep rooting system will spread to stabilise soil, whilst potentially dense mats could greatly reduce rain splash impact. In addition, its stature and biomass would be too low to present a fire risk.
- » All indigenous shrubs that will be cleared should be shredded and added to the soil as mulch.
- » The development footprint should be clearly demarcated and no movement may be allowed outside of the development footprint.
- » Monitoring of erosion and invasive alien plants should occur on a regular basis during the construction phase and should be carried out throughout the operational phase, where such features are observed swift actions should be taken in order to remediate these impacts in order to avoid the potential spread of erosion into the downslope wetland areas as well as the establishment of invasive alien plants.
- » Alien species, including *Opuntia ficus-indica, O. humifusa and O. aurantiaca*, must be removed entirely from site and not used as mulch to prevent the spread of regenerative material.

Severely Degraded and Transformed Grassland

Conservation status	**LOW** » Severely degraded and transformed grassland associated with access roads, fire breaks and trampled areas around livestock watering and feeding points. » In terms of the fire breaks and most of the farm tracks, a fairly stable vegetation cover persists. » Low diversity of fauna and flora. » No Plant and Animal SCC recorded. » No Provincially Protected Fauna and Flora recorded. » No Endemic Fauna and Flora recorded. » These areas are characterized with numerous weeds and some invasive alien plants.
Ecosystem function	» Permanent vegetation cover for stabilising, maintaining and nourishing soil as well as for slowing down runoff to increase infiltration into the soil.
Stability	» Medium to high if habitat is kept intact o Clearing and monitoring of weeds and invasive species will be necessary. o Erosion control will be important

Reversibility of degradation	» Possible, will require intervention such as erosion control and over sowing, » Clearing of invasives is needed to improve ecosystem functionality
Rating	» ***Low Sensitivity***

General Development Recommendations:

- » Development within this area is acceptable
- » Existing access roads and tracks to be used as far as possible.
- » Monitoring of erosion should occur on a regular basis during the construction phase and should be carried out throughout the operational phase, where such features are observed swift actions should be taken in order to remediate these impacts in order to avoid the potential spread of erosion into the downslope wetland areas.

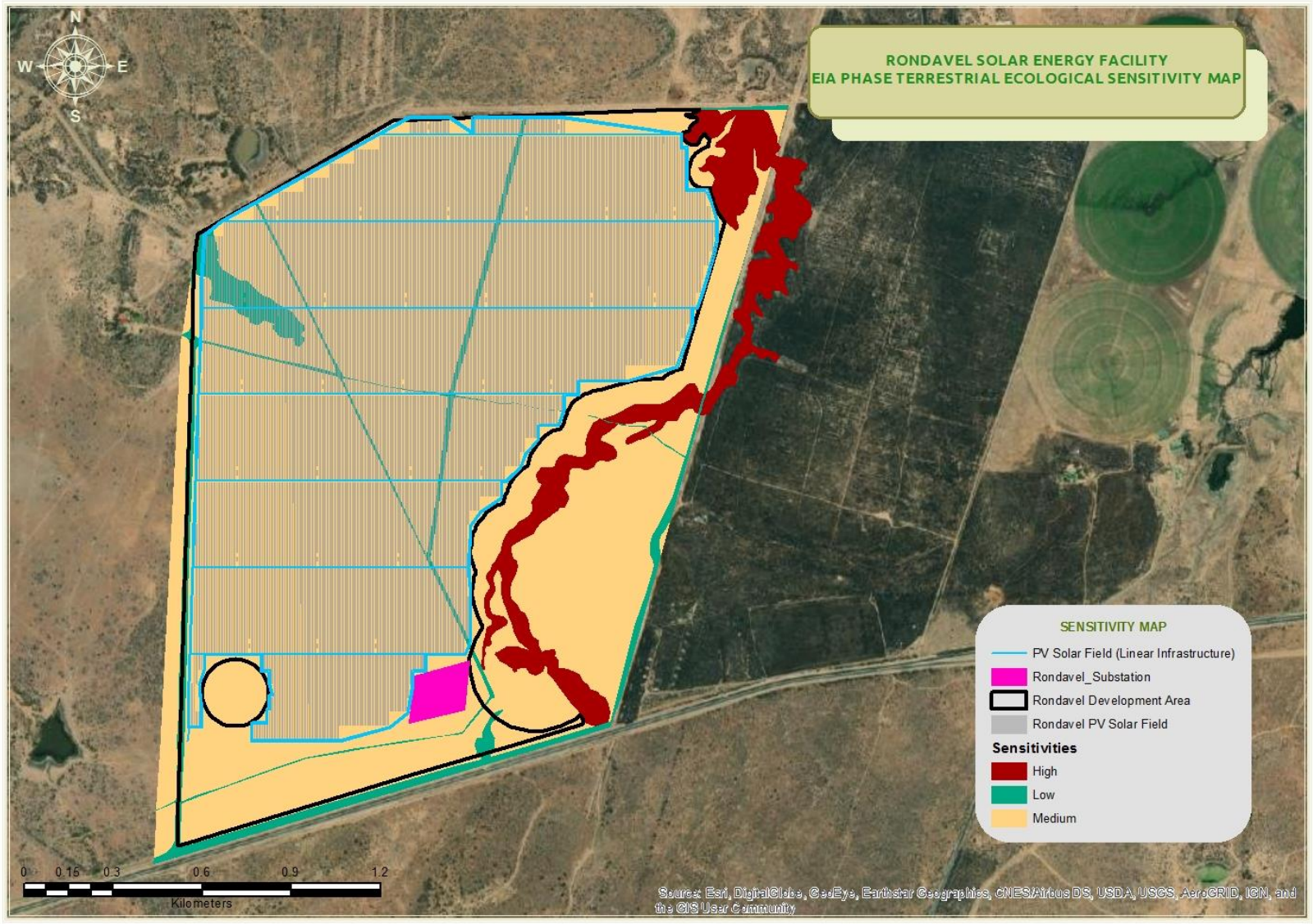

Figure 8: Terrestrial Ecological Importance and Sensitivity Map (Layout 18).

7. ASSESSMENT OF PROPOSED IMPACTS

Two potential options were provided by the client for assessment. Both of these options are relative similar in terms of their potential impacts on the terrestrial biodiversity features. However, the first option (Layout 18) is regarded as slightly more preferable as Layout 19 is located in close proximity to a relative broad seasonal and temporary saturated portion of the wetland area, whilst Layout 18 is located away from this 'more' sensitive area. Due to the fact that these layout options are more or less similar in terms of impacts, only one assessment has been done which is applicable to both options.

Furthermore, impacts regarding the wetland features located in close proximity to the development footprint was not assessed as these impacts were assessed within the freshwater resources study and assessment.

Assumptions

The following assumptions were made for this study:

» A thorough ecological walkthrough of all footprint areas will be conducted to, detect and map all protected species. These results should then be used during the permit application process, for the removal/relocation, destruction and disturbance of these protected species (Relevant authority: Free State Department: Economic, Small Business Development, Tourism and Environmental Affairs – DESEA).

- Such an investigation should be carried out by a suitably qualified botanist prior to commencement of construction, and
- must be carried out at a time when the maximum amount of species is actively growing and thus visible, (preferably between January and March)

» Prior to development and after construction the development footprint will be routinely cleared of all alien invasive plants if detected.

» The construction phase itself will be associated with clearing of vegetation within the development footprint only.

» Where practically possible, the need for grading is expected to be minimal, limited mostly to contour buffer strips and/or small-scale levelling where necessary.

» All removal of vegetation for construction purposes will be done mechanically, without the use of herbicides for indigenous species and in the case of Invasive Alien Plant only were deemed absolutely necessary and with the authorisation of the EO.

» A continuous vegetation layer is the most important aspect of ecosystem functionality within and beyond the project site.

- A weakened or absent vegetation layer not only exposes the soil surface, but also lacks the binding and absorption capacity that creates the buffering functionality of vegetation to prevent or lessen erosion as a result of floods.

» All existing access and service roads will be used as far as possible.

Localised vs. cumulative impacts: some explanatory notes

Ecosystems consist of a mosaic of many different patches. The size of natural patches affects the number, type and abundance of species they contain. At the periphery of patches, influences of neighbouring patches become apparent, known as the 'edge effect'. Patch edges may be subjected to increased levels of heat, dust, desiccation, disturbance, invasion of exotic species and other factors. Edges seldom contain species that are rare, habitat specialists or species that require larger tracts of undisturbed core habitat. Fragmentation due to development reduces core habitat and greatly extends edge habitat, which causes a shift in the species composition, which in turn puts great pressure on the dynamics and functionality of ecosystems (Perlman & Milder 2005).

Cumulative impacts of developments on population viability of species can be reduced significantly if new developments are kept as close as possible to existing developed and/or transformed areas or, where such is not possible, different sections of a development be kept as close together as possible. Thus, new power lines should follow routes of existing servitudes if such exist. Renewable energy facilities, like solar PVs should be constructed as close as possible to existing infrastructure or substations, and if several developments are planned within close proximity, these developments should be situated as close together as possible, not scattered throughout the landscape.

Existing solar energy projects that were considered in terms of their potential cumulative terrestrial ecological impacts that are in an approximate 30 km radius of the Rondavel Solar Energy Facility illustrated below in Figure 9. Only two other PV Solar projects are located within the 30 km radius and as such the cumulative impacts in the area is expected to be relatively low at this point.

Conclusion on cumulative impacts due to this and the surrounding developments:

» Minimal transformation of intact, sensitive habitats. These impacts could potentially compromise the ecological functioning of these habitats and may contribute to the further fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations. This contribution of the proposed project to this impact would be limited due to the fact that the proposed development is situated mostly within a moderate and low sensitivity area with all of the high sensitive areas being avoided.
» Excessive clearing of vegetation can and will influence runoff and stormwater flow patterns and dynamics, which could cause excessive accelerated erosion of plains, and this could also have detrimental effects on the downslope freshwater resource systems.

- Rehabilitation and revegetation of all surfaces disturbed or altered during construction is desirable.
- Runoff from sealed surfaces or surfaces that need to be kept clear of vegetation to facilitate operation of a development needs to be monitored regularly to ensure that erosion control and stormwater management measures are adequate to prevent the degradation of the surrounding environment.

» Large-scale disturbance of indigenous vegetation creates a major opportunity for the establishment of invasive species and the uncontrolled spread of alien invasives into adjacent agricultural land and rangelands.
    - A regular monitoring and eradication protocol must be part of all developments long term management plans.
» The loss of and transformation of intact habitats could compromise the status and ecological functioning of the Ecological Support Areas and may fracture and disrupt the connectivity of these ESAs, impacting the Province's ability to meet its conservation targets.

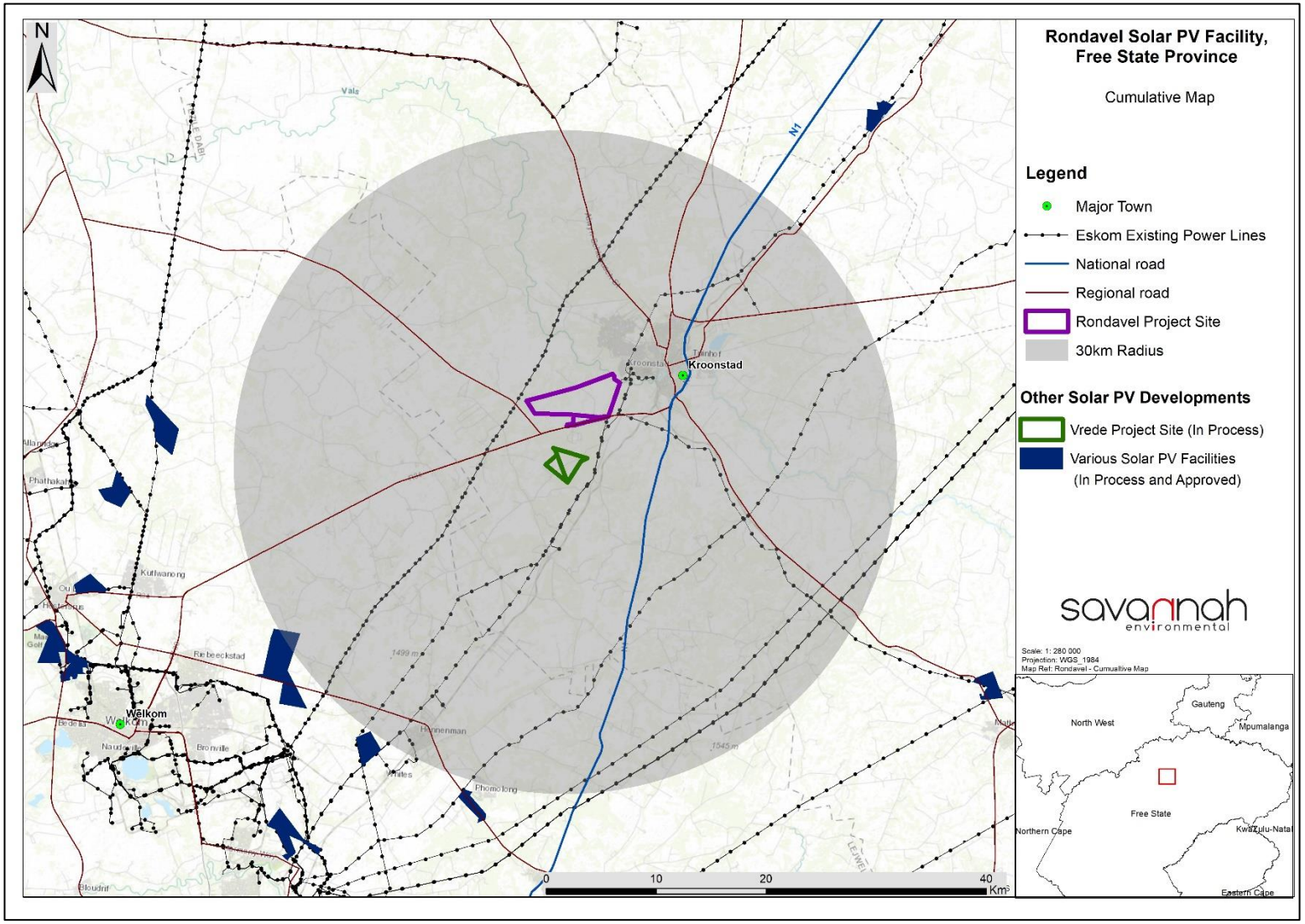

Figure 9: Location Map of the proposed Rondavel Solar Energy Facility relative to the other solar facilities planned within a radius of 30 km.

Identification of Potential Terrestrial Ecological Impacts and Associated Activities

Potential ecological impacts resulting from the proposed development would stem from a variety of different activities and risk factors associated with the construction and operation phases of the project including the following:

Construction Phase

» Human presence and uncontrolled access to the site may result in negative impacts on fauna and flora through poaching of fauna and uncontrolled collection of plants for traditional medicine or other purpose.
» Site clearing and exploration activities for site establishment.
» Vegetation clearing could impact listed plant species. Vegetation clearing would also lead to the loss of vegetation communities and habitats for fauna and avifauna and potentially the loss of faunal as well as avifaunal species, habitats and ecosystems. On a larger and cumulative scale (if numerous and uncontrolled developments are allowed to occur in the future) the loss of these vegetation communities and habitats may potentially lead to a change in the conservation status of the affected vegetation type as well as the ability of this vegetation type and associated features to fulfil its ecological functions. The above impact is most likely to be low due to the fact that most of the development area is situated within an area which has been somewhat degraded due to long term overgrazing.
» Soil compaction and increased erosion risk would occur due to the loss of plant cover and soil disturbance created during the construction phase. This may potentially impact the downstream watercourses, wetlands and aquatic habitats, mainly due to an increase of surface water and silt inflow from the surrounding disturbed areas (these potential impacts on downslope wetland features have been assessed within the freshwater resource study and assessment). These potential impacts may result in a reduction in the buffering capacities of the landscape during extreme weather events.
» Movement of construction vehicles and placement of infrastructure within the boundary of the drainage line may lead to the disturbance of these habitats, removal of vegetation cover and a potential increase in erosion which may eventually spread into downstream areas.
» Invasion by alien plants may be attributed to excessive disturbance to vegetation, creating a window of opportunity for the establishment of these alien invasive species. In addition, regenerative material of alien invasive species may be introduced to the project site by machinery traversing through areas with such plants or materials that may contain regenerative materials of such species.
» Presence and operation of construction machinery on the project site. This will create a physical impact as well as generate noise, potential pollution and other forms of disturbance at the site.

» Increased human presence can lead to poaching, illegal plant harvesting and other forms of disturbance such as fire.

Operation Phase

» The facility will require management and if this is not done effectively, it could impact adjacent intact areas through impacts such as erosion and the invasion of alien plant species.

Decommission Phase

» During decommissioning, the potential impacts will be very similar to that of the Construction Phase, and as such the construction phase impacts assessed below will also be applicable to the decommissioning phase.

Cumulative Impacts

» The loss of vegetation types on a cumulative basis from the broad area may impact the countries' ability to meet its conservation targets.
» Transformation of intact, sensitive habitats could compromise the ecological functioning of these habitats and may contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations.
» The loss of biodiversity may be exacerbated.
» Invasion of exotics and invasive species into the broader area may also potentially be exacerbated.
» The loss of and transformation of the Ecological Support Areas could impacting the Province's ability to meet its conservation targets.

The impacts identified above are assessed below, during the construction, operation and decommissioning phases of the facility as well as before and after mitigation.

The entire development area was considered, including all project (and related) infrastructure as detailed in Chapter 1 of this report.
The majority of impacts associated with the development would occur during the construction phase as a result of the disturbance associated with the operation of heavy machinery at the site and the presence of construction personnel. The major risk factors and contributing activities associated with the development are identified and briefly outlined and summarised below before the impacts are assessed. These are not necessarily a reflection of the impacts that would occur, but rather a discussion on overall potential impacts and/or extent of these potential impacts that would occur if mitigation measures are not considered and/ or sensitive areas not avoided. The assessment of these impacts is outlined in the following section.

***Impact 1**. Potential impacts on vegetation and listed or protected plant species*

As already mentioned, the most likely and significant impact will be on the vegetation located within the development area and development footprint of the proposed facility. The proposed development may lead to a direct loss of vegetation. Some loss of vegetation is an inevitable consequence of the development. However, the footprint of the development is confined to an area of approximately 182 ha, located mostly in a moderately degraded due to long term overgrazing and bush encroachment.

At Vegetation Level:

Consequences of the impact occurring may include:

- general loss of habitat for sensitive species;
- loss in variation within sensitive habitats due to loss of portions of it;
- general reduction in biodiversity;
- increased fragmentation (depending on location of impact);
- disturbance to processes maintaining biodiversity and ecosystem goods and services; and
- loss of ecosystem goods and services.

Although the development will impact the vegetation type at a small, local scale, it is highly unlikely that this development will impact on the status of this vegetation type (impact on a regional scale) as the majority of the development will occur, as mentioned, within mostly degraded habitats.

Sensitive habitat types such channelled valley bottom wetland habitat types are avoided within the current layout and subsequently these areas will not be threatened by the development.

At species level:

No Plant SCC were observed within the development site; however, a few provincially protected species have been observed namely;

» *Orbea lutea,*
» *Olea europaea subs. africana*
» *Boophone disticha,*

Such species are especially vulnerable to infrastructure development due to the fact that they cannot move out of the path of the construction activities, but are also affected by overall loss of habitat.

The nature and extent of impacts on vegetation can be evaluated, and the impacts can be largely mitigated through avoidance of identified sensitive areas and listed species, by

allowing a minimum clearance of vegetation (restricted to the absolute necessary areas), or allowing for search and rescue of individuals where this is viable.

***Impact 2**. Direct Faunal impacts*

Faunal species will primarily be affected by the overall loss of habitat. Increased levels of noise, disturbance, potential pollution and human presence will be detrimental to fauna. Sensitive and shy fauna would move away from the area during the construction phase as a result of the noise and human activities present, while some slow-moving species and species confined and dependant on specified habitats would not be able to avoid the construction activities and might be at risk. Some mammals and reptiles would be vulnerable to illegal collection or poaching during the construction phase as a result of the large number of construction personnel that are likely to be present. This impact is highly likely to occur during the construction phase and could also potentially occur with resident fauna within the facility after construction.

Threatened species (red data species) include those listed as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species and possible extinction. This may arise if the proposed infrastructure is located where it will impact on such individual or populations. Consequences may include:

- fragmentation of populations of affected species;
- reduction in the area of occupancy of affected species; and
- loss of genetic variation within the affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species' overall survival.

As already mentioned, faunal diversity within the development area, and most likely also within the surrounding environment, is largely limited due to the fragmented condition of the landscape as well as the anthropogenic activities within the area (cultivation practices, farm and game fences and small grazing camps, roads etc). Larger mammals are typically livestock. "Natural" fauna that have historically occurred in area have been largely affected by the above-mentioned impacts and most species now found within the area are highly adaptable, tolerant species with some being capable and small enough to move between these fragments of near-natural "islands". Within the affected farm properties moderate faunal activity was observed.

During the construction phase noise generated may however cause some temporary disturbances although it is expected that this will not deter these species.

Disturbance of faunal species can be maintained to a minimum and low significance by implementing effective mitigation measures. Livestock and "agricultural" game will most likely be relocated to other camps with some smaller species such as sheep, goat and smaller antelope species (Steenbok and Duiker) which can potentially be allowed to roam and graze the development footprint. Most of the natural occurring species are mobile and will most likely move away from the development area during construction phase with some species likely to return during the operation phase. Less mobile species such as tortoises, snakes and potential amphibian species should be looked out for and where encountered should either be relocated as recommended by the ECO or be left undisturbed if the development will not affect the species (e.g. toads and frogs of nearby wetland habitats).

Impact 3. *Soil erosion and associated degradation of ecosystems*

This impact along with the loss of vegetation is probably the most significant impact that may occur due to the proposed development. Soil erosion is a frequent risk associated with solar facilities on account of the vegetation clearing and disturbance associated with the construction phase of the development and may continue occurring throughout the operation phase. Service roads and installed infrastructure will generate increased direct runoff during intense rainfall events and may exacerbate the loss of topsoil and the effects of erosion. These eroded materials may enter the nearby watercourses and may potentially impact these systems through siltation and change in chemistry and turbidity of the water. Current erosion observed within the affected farm properties was low to moderate-low.

With effective mitigation measures in place including regular monitoring of the occurrence, spread and potential cumulative effects of erosion may be limited to an absolute minimum.

Impact 4. *Alien Plant Invasions*

Major factors contributing to invasion by alien invader plants includes habitat disturbance and associated destruction of indigenous vegetation. Consequences of this may include:

- change in the vegetation structure leading to change in various habitat characteristics and loss of indigenous vegetation;
- replacement of palatable species with unpalatable species therefore reducing the grazing capacity of the area;
- change in the plant species composition;
- change in soil chemistry properties;
- loss of sensitive habitats (e.g. downstream watercourses and wetlands);
- loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
- fragmentation of sensitive habitats;
- change in flammability of vegetation, depending on alien species; and

- impairment of wetland function.

The affected farm properties have been invaded by especially herbaceous and dwarf shrubby invasive alien plants, *Opuntia ficus-indica, O. humifusa, O. aurantiaca, Verbena officinalis, Xanthium spinosum, Datura stramonium* etc. These species will most certainly be a threat during the construction phase and throughout the operation phase and will require regular and careful attention. With affective and meticulous mitigation measures in place this can be achieved.

Impact 5. *Reduced ability to meet conservation obligations and targets*

In terms of the cumulative impact on the endangered Vaal-Vet Sandy Grassland, small fractured portions of this vegetation type are located within the Rondavel Solar Energy Facility's project footprint with some of these areas (along the northern boundary being avoided within the proposed layout. Furthermore, within the 30 km radius surrounding the Rondavel Solar Energy Facility, there are only two other PV solar facilities proposed with only one of these facilities located within the Vaal-Vet Sandy Grassland namely the proposed 75 MW PV Solar farm located to the south west of the proposed Rondavel Solar Energy Facility, as well as the planned 100MW Vrede Solar PV Facility. The cumulative impact of these developments on the Vaal-Vet Sandy Grassland is subsequently expected to be minimal and will not impact/compromise the integrity and ecological functioning of this vegetation unit and furthermore, will not impact the conservation status and targets set out for this vegetation type.

Impact 6. *Impacts on broad-scale ecological processes*

The proposed development will impact a portion of an ESA as well as, at a local scale, impact on habitat loss and the potential ability to meet future conservation targets. However, during this study it was determined that most of the development footprint is located within transformed and degraded habitats, with the sensitive habitats, providing important ecological services and functions, being avoided. Subsequently, the loss of and transformation of this portion of the ESA and associated habitats will not result in an impact on the Province's ability to meet its conservation targets.

Impact 7. *Potential cumulative impacts due to nearby renewable energy developments (solar energy facilities).*

The affected farm property is situated less than 13.3 km south west of the town of Kroonstad. The bulk of the surrounding land is mostly in transformed state (under cultivation or has been cultivated at some stage within the last few years), remaining pockets of land which are not arable are utilized mainly for cattle grazing, or recently for game farming (scarce large game).

» Further solar developments in the immediate surroundings (30km radius from proposed development:
  - 75 MW Photovoltaic Solar Farm, a 132kV power line and associated infrastructure on the Remaining Extent of the Farm Uitkyk No. 509, the Remaining Extent of the Farm Helderwater No. 494 and Portion 1 of the Farm Doornpan No. 426 (approximately 27.23km to the south-west),
  - 100MW Rondavel Solar Energy Facility, located approximately 3.43km to the north-east.

Conclusion on cumulative impacts due to surrounding developments:

» It is highly unlikely that a cumulative effect of loss of high biodiversity areas could arise from the Rondavel Solar Energy Facility in combination with the other renewable energy projects in the surrounding environment for the following reasons:
  - The landscape between these developments are highly fractured and isolated from one another, especially due to the extensive areas under cultivated. Subsequently, potential faunal migration routes are absent between these developments and is not considered significant from a cumulative perspective due to existing degradation.

Assessment of Impacts

The impacts identified above are assessed below, during the construction and operation phases of the facility as well as before and after mitigation.

Impact 1: *Potential Impacts on vegetation and listed protected plant species (Construction Phase)*

Impact Nature: Impacts on vegetation and listed or protected plant species would occur due to the construction of the facility and associated infrastructure. This impact is regarded as the most likely and significant impact and may lead to direct loss of vegetation including listed and protected species.

The most likely consequences include:

» local loss of habitat (to an extent as a natural ground covering will be maintained where possible);
» very small and local disturbance to processes maintaining local biodiversity and ecosystem goods and services; and
» a potential loss of a few local protected species.

The development footprint itself is primarily homogenous in terms of habitat types and vegetation cover thus providing for easier and more accurate calculation of potential impacts, more effective recommendations and implementation of management and mitigation measures, and furthermore lowering the impact and beta diversity.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)

Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (2)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (44)**	**Low (21)**
Status	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Preconstruction walk-through of the final development footprint for protected species that would be affected and that can be translocated. » Before construction commences individuals of listed provincially protected plant species within the development footprint that would be affected, should be counted and marked and translocated where deemed necessary and possible by the ecologist conducting the pre-construction walk-through survey, and according to the recommended ratios. Permits from the relevant provincial authorities, i.e. the Free State Department: Economic, Small Business Development, Tourism and Environmental Affairs, will be required to relocate and/or disturb listed plant species. » Any individuals of protected species affected by and observed within the development footprint during construction should be translocated under the supervision of the Contractor's Environmental Officer (EO). » Pre-construction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes awareness to no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimising wildlife interactions, remaining within demarcated construction areas etc. » Demarcate all areas to be cleared with construction tape or similar material where practical. However, caution should be exercised to avoid using material that might entangle fauna. » Contractor's EO to provide supervision and oversight of vegetation clearing activities and other activities which may cause damage to the environment, especially at the initiation of the project, when the majority of vegetation clearing is taking place. » Ensure that laydown areas, construction camps and other temporary use areas are located in areas of low and medium sensitivity and are properly fenced or demarcated as appropriate and practically possible.	

	» All vehicles to remain on demarcated roads and no unnecessary driving in the veld outside these areas should be allowed. » Regular dust suppression during construction, if deemed necessary, especially along access roads. » No plants may be translocated or otherwise uprooted or disturbed for rehabilitation or other purpose without express permission from the ECO and or Contractor's EO. » No fires should be allowed on-site.
Residual Impacts	Due to the shade effect of the solar panels some transformation of vegetation is likely to occur underneath the panels. As this area is already, to some extent, in a transformed state, further transformation due to the shading effect is **not likely to be significant**. However, any transformations caused by the development will take a very long time to restore and as such is regarded as a residual impact.

Impact 2. *Potential Faunal Impacts (Construction Phase, Decommission Phase and during maintenance – Operational Phase).*

Impact Nature: Increased levels of noise, pollution, disturbance and human presence during construction/operation/decommissioning will be detrimental to fauna. Sensitive and shy fauna would move away from the area during the construction/operation/decommissioning phase as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the construction activities and might be killed. Some impact on fauna is highly likely to occur during construction/operation/decommissioning.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (21)**	**Low (15)**
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Noise and disturbance during the construction, decommission and during maintenance phases cannot be avoided but would be transient in nature and with appropriate mitigation; no long-term impacts from the construction phase can be expected.	
Mitigation	» Site access should be controlled and no unauthorized persons should be allowed onto the site. » Any fauna directly threatened by the associated activities should be removed to a safe location by a suitably qualified person.	

	» The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the demarcated site. » Fires should not be allowed on site. » All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. » All construction vehicles should adhere to a low speed limit (30km/h) to avoid collisions with susceptible species such as snakes and tortoises. » Construction vehicles limited to a minimal footprint on site (no movement outside of the earmarked footprint).
Residual Impacts	The altered development area will contain a lower diversity of habitat types and niches for faunal species, however faunal diversity was in any way confirmed to be limited and as such this potential residual impact can be **regarded as low**.

Impact 3: *Potential increased erosion risk during construction operation and decommission.*

Impact Nature: During construction/decommission, there will be a lot of disturbed and loose soil at the site which will render the area vulnerable to erosion. Erosion is one of the greater risk factors associated with the development and it is therefore critically important that proper erosion control structures are built and maintained over the lifespan of the project.		
	Without Mitigation	**With Mitigation**
Extent	Local and surrounding properties (2)	Local (1)
Duration	Long-term (4)	Short-term (1)
Magnitude	Moderate (5)	Minor (2)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (44)**	**Low (12)**
Status	Negative	Negative
Reversibility	Low – if erosion has reached severe levels the impacts will not be remedied easily	High
Irreplaceable loss of resources	Potential loss of important resources.	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Any erosion problems observed along access roads or any hardened/engineered surface should be rectified immediately and monitored thereafter to ensure that they do not re-occur.	

	» All bare areas (due to the project activities should be re-vegetated with locally occurring species, to bind the soil and limit erosion potential where applicable. » Re-instate as much of the eroded area to its pre-disturbed, "natural" geometry (no change in elevation and any banks not to be steepened) where possible. » Roads and other disturbed areas should be regularly monitored for erosion problems and problem areas should receive follow-up monitoring by the EO to assess the success of the remediation. » Topsoil must be removed and stored separately from subsoil. Topsoil must be reapplied where appropriate as soon as possible in order to encourage and facilitate rapid regeneration of the natural vegetation on cleared areas. » Practical phased development and vegetation clearing must be practiced so that cleared areas are not left un-vegetated and vulnerable to erosion for extended periods of time.
Residual Impacts	The loss of fertile soil and soil capping resulting in areas which cannot fully rehabilitate itself with a good vegetation cover. With appropriate avoidance and mitigation residual impacts will be **very low**.

Impact 4: *Potential increased alien plant invasion during construction*

Impact Nature: Increased alien plant invasion is one of the greatest risk factors associated with this development. The disturbed and bare ground that is likely to be present at the site during and after construction would leave the site vulnerable to alien plant invasion for some time if not managed. Furthermore, the National Environmental Management Biodiversity Act (Act No. 10 of 2004), as well as the Conservation of Agricultural Resources Act, (Act No. 43 of 1983) requires that listed alien species are controlled in accordance with the Act.

	Without Mitigation	**With Mitigation**
Extent	Local - Regional (3)	Local (1)
Duration	Permanent (5)	Short-term (1)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Highly Probable (4)
Significance	**High (70)**	**Low (24)**
Status	Negative	Neutral – Slightly Negative
Reversibility	Not Possible	Medium
Irreplaceable loss of resources	Potential loss of important resources due to the replacement of natural vegetation by invading alien plants	No

Can impacts be mitigated?	Yes.
Mitigation	» A site-specific eradication and management programme for alien invasive plants must be implemented during construction. » Regular monitoring by the operation and maintenance team for alien plants must occur and could be conducted simultaneously with erosion monitoring. » When alien plants are detected, these must be controlled and cleared using the recommended control measures for each species to ensure that the problem is not exacerbated or does not re-occur and increase to problematic levels. » Clearing methods must aim to keep disturbance to a minimum. » No planting or importing any listed invasive alien plant species (all Category 1a, 1b and 2 invasive species) to the site for landscaping, rehabilitation or any other purpose must be undertaken.
Cumulative Impacts	Cumulative impacts within the surrounding environment due to the spread and settlement of alien invasive species beyond the initial disturbed area would lead to the replacement of natural indigenous vegetation and spread into natural grazing land etc.
Residual Impacts	If the above recommended mitigation measures are strictly implemented and some re-establishment and rehabilitation of natural vegetation is allowed the residual impact will be very low.

Impact 5: *Altered runoff patterns due to rainfall interception by PV panel infrastructure and compacted areas resulting in high levels of erosion (Operational Phase)*

Impact Nature: Disturbance created during construction could take several years to fully stabilise and the presence of an extensive area of hardened surface will generate a lot of runoff which will pose a significant erosion risk, if not managed. Erosion is one of the greater risk factors associated with this type of development, and it is therefore essential that proper erosion control structures are built and maintained over the lifespan of the project.		
	Without Mitigation	**With Mitigation**
Extent	Local and surrounding properties (3)	Local (1)
Duration	Long-term (4)	Short-term (0)
Magnitude	High (8)	Low (1)
Probability	Highly Probable (4)	Improbable (2)
Significance	**High (60)**	**Low (4)**
Status	Negative	Neutral – Slightly Negative
Reversibility	Low – if erosion has reached severe levels the impacts will not be remedied easily.	High

Irreplaceable loss of resources	Potential loss of important resources.	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Regular monitoring of the site (minimum of twice annually) to identify possible areas of erosion is recommended, particularly after large summer thunder storms have been experienced. » The higher level of shading anticipated from PV panels may prevent or slow down the re-establishment of some desirable species, therefore re-establishment should be monitored and species composition adapted if vegetation fails to establish sufficiently. » Alternatively, soil surfaces where no revegetation seems possible will have to be covered with gravel or small rock fragments to increase porosity of the soil surface, slow down runoff and prevent wind- and water erosion. » Monitor the area below and around the panels regularly after larger rainfall events to determine where erosion may be initiated and then mitigate by modifying the soil micro-topography and revegetation efforts accordingly. » Due to the nature and larger runoff surfaces of the PV panels, the development area should be adequately landscaped and rehabilitated to contain expected accelerated erosion. » Runoff may have to be specifically channeled or storm water adequately controlled to prevent localised rill and gully erosion. » Any erosion problems observed should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur. » Roads and other disturbed areas should be regularly monitored for erosion problems and problem areas should receive follow-up monitoring to assess the success of the remediation.	
Residual Impacts	The loss of fertile soil and soil capping resulting in areas which cannot fully rehabilitate itself with a good vegetation cover. With appropriate avoidance and mitigation residual impacts will be **very low**.	

Impact 6: *Reduced ability to meet conservation obligations and targets (Cumulative Impact).*

Impact Nature: The loss of unprotected vegetation types on a cumulative basis from the broader area impacts the countries' ability to meet its conservation targets		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**

Extent	Local (1)	Regional (3)
Duration	Long Term (4)	Long-Term (4)
Magnitude	Small (0)	Minor (2)
Probability	Very Improbable (1)	Improbable (2)
Significance	**Low (5)**	**Low (18)**
Status	Slightly Negative	Slightly Negative
Reversibility	Low	Low
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas. » An open space management plan should be developed for the site, which should include management of biodiversity within the fenced area, as well as that in the adjacent rangeland. » Reduce the footprint of the facility within sensitive habitat types as much as possible.	

Impact 7: *Impacts on Broad-Scale Ecological Processes (Cumulative Impact)*

Impact Nature: Transformation of intact habitat could potentially compromise ecological processes of CBAs as well as ecological functioning of important habitats and would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Local (1)	Regional (2)
Duration	Long Term (4)	Long Term (4)
Magnitude	Small (1)	Low (4)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (12)**	**Low (20)**
Status	Neutral – Slightly Negative	Slightly Negative
Reversibility	Low	Low
Irreplaceable loss of resources	No	Likely
Can impacts be mitigated?	Yes, to a large extent	

Mitigation	» The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas. » An open space management plan should be developed for the site, which should include management of biodiversity within the fenced area, as well as that in the adjacent rangeland. » Reduce the footprint of the facility within sensitive habitat types as much as possible. » Small to medium sized mammals can be allowed to move between the development area and surrounding areas by creating artificial passageways underneath boundary fences (this is optional and may be implemented by developer if deemed necessary).

Impact 8: *Cumulative impacts due to nearby renewable energy developments (Cumulative Impact)*

Impact Nature: Cumulative loss of habitats (including sensitive habitats) and further increase in the fractured nature of the landscape may lead to the loss of features responsible for maintaining biodiversity and providing ecosystem goods and services and may potentially lead to;

» A change in the status of Central Free State Grassland, subsequently also reducing the ability to meet national conservation obligations and targets;
» A reduction in biodiversity and even the loss of some species from the area;
» Fracturing and isolation of landscapes may cut off important migration routes and prevent genetic variability thus reducing "genetic health" which may in turn lead to weaker species incapable to adapt and react to potential environmental changes and consequently also to a reduction in biodiversity and the extinction of some species from certain areas.
» The loss of ESA's which may lead to the province, being incapable to meet their required biodiversity pattern a process targets.
» The loss of important corridors essential for some species to allow for movement between important habitat types crucial for the survival of these species.

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Local (1)	Regional (2)
Duration	Long Term (4)	Long Term (4)
Magnitude	Small (0)	Minor (2)
Probability	Very Improbable (1)	Improbable (2)
Significance	**Low (5)**	**Low (16)**
Status	Neutral	Slightly Negative
Reversibility	Low	Low

Irreplaceable loss of resources	No	Likely
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas. » An open space management plan should be developed for the site, which should include management of biodiversity within the fenced area, as well as that in the adjacent rangeland. » Reduce the footprint of the facility within sensitive habitat types as much as possible. » Small to medium sized mammals can be allowed to move between the development area and surrounding areas by creating artificial passageways underneath boundary fences (this is optional and may be implemented by developer if deemed necessary).	

8. CONCLUSION AND RECOMMENDATIONS

The study area falls within the Central Free State Grassland. This grassland type is not listed as a threatened ecosystem.

Nkurenkuru Ecology and Biodiversity undertook a terrestrial ecological (fauna and flora) study for an environmental impact assessment of the target areas where the establishment of the solar energy facility and associated infrastructure is proposed to be located and provide a professional opinion on terrestrial ecological issues pertaining to the target area to aid in future decisions regarding the proposed project.

A site visit was conducted on the 18th to 20th of March and the 10th of March. On-site cognitions were regarded as preferable (optimal) for such a survey and as such the data collected can be regarded reliable and satisfactory.

A combined terrestrial ecological sensitivity map of the site has been compiled based on the findings of this study (refer to Figures 9 - 10).

The sensitive areas identified, are as follow:

High Sensitivity and No-Go Area:

» Channelled valley-bottom wetland and associated riparian fringe: These wetland features feed into important downstream watercourses (Vals River), provide valuable ecosystem functions and services, are regarded as important conservation areas (FS

DESTEA No Wetland Loss Policy), and are sensitive to external impacts. These wetland features are excluded from the development footprint.

Medium Sensitivity

» Dolerite Outcrop: Mostly natural, dry, shrubby grassland that provides a fairly unique habitat for fauna within the area (rocky refugia). This habitat is sensitive to external impacts.

» *Acacia karoo – Asparagus laricinus* Shrub-Grassland: Moderately degraded shrub-grassland. It is clear from the baseline data collected that this area has been significantly impacted by long term overgrazing which has resulted in the transformation of the grass layer and has allowed for the encroachment of especially *Asparagus laricinus* and to a lesser extent *Acacia karroo*. However, a stable vegetation cover within the area still allows for some functioning and service provision and is vital for soil stabilisation.

Low Sensitivity

» Highly Transformed and Disturbed Grassland: This includes access roads and disturbed road shoulders, farm roads, fire breaks, trampled and overgrazed grassland, woodlots and small plantations as well as fallow and old cultivated areas. Development within these habitats are acceptable. The entire development is largely situated within this habitat. Development within this habitat is regarded as acceptable.

Overall, no significant terrestrial ecological flaws that could pose a problem to the proposed PV Facility development were identified during the EIA phase assessment. All impacts were determined low negative with the implementation of mitigation measures, with no remaining high or moderate significance impacts determined for the project post-mitigation. In addition, all cumulative impacts were determined low in isolation as well as low in the broader project context. The proposed development is therefore supported from a terrestrial ecological on condition that the mitigation measures provide in this report are implemented.

The most significant potential impacts expected to occur with the development of the proposed Rondavel SEF are:

» Reduction of a stable vegetation cover and associated below-ground biomass that currently increases soil surface porosity, water infiltration rates and thus improves the soil moisture availability. Without the vegetation, the soil will be prone to extensive surface capping, leading to accelerated erosion and further loss of organic material and soil seed reserves from the local environment.

» Disturbed vegetation in the study area carries a high risk of invasion by alien invasive plants, which may or may not be present in the study area or nearby. The control and continuous monitoring and eradication of alien invasive plants will form and integral part of the environmental management of the facility from construction up to decommissioning.

General Development Recommendations

» To prevent the onset of accelerated erosion, it is recommended that vegetation clearing be limited where possible to clearing high shrubs, all invasive trees and other alien invasives, even if that means that remaining vegetation will be subjected to vehicle damage (from which it can recover over time). Grading should only be done where absolutely necessary and to mitigate existing erosion channels. If extensive grading will become necessary, it will be advisable to create contour buffer strips to slow down runoff and prevent erosion, which could develop into gully erosion damaging the development in the long run as well.
» It is currently not known which species will be able to persist under the shading of PV arrays, but the establishment of the naturally occurring *Cynodon dactylon* (couch grass), a low creeping grass, should be encouraged. Its dense and deep rooting system will spread to stabilise soil, whilst potentially dense mats could greatly reduce rain splash impact. In addition, its stature and biomass would be too low to present a fire risk.
» All indigenous shrubs that will be cleared should be shredded and added to the soil as mulch.
» Alien species must be removed entirely from site and not used as mulch to prevent the spread of regenerative material.

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10. APPENDICES

Appendix 1: Listed Plant Species

List of plant species of conservation concern which are known to occur in the vicinity of study area. The list is derived from the POSA website (*NE – Note Evaluated).

Family	Taxon	IUCN	Ecology
Acanthaceae	*Blepharis integrifolia (L.f.) E.Mey. ex Schinz var. integrifolia*	LC	Indigenous
Acanthaceae	*Justicia orchioides L.f. subsp. glabrata Immelman*	LC	Indigenous; Endemic
Acanthaceae	*Blepharis subvolubilis C.B.Clarke*	LC	Indigenous
Acanthaceae	*Barleria macrostegia Nees*	LC	Indigenous
Acanthaceae	*Dicliptera leistneri K.Balkwill*	LC	Indigenous; Endemic
Acanthaceae	*Crabbea acaulis N.E.Br.*	LC	Indigenous
Acanthaceae	*Dicliptera clinopodia Nees*	LC	Indigenous
Acanthaceae	*Dyschoriste burchellii (Nees) Kuntze*	LC	Indigenous
Agavaceae	*Chlorophytum fasciculatum (Baker) Kativu*	LC	Indigenous
Aizoaceae	*Chasmatophyllum musculinum (Haw.) Dinter & Schwantes*	LC	Indigenous
Aizoaceae	*Ruschia sp.*		
Aizoaceae	*Hereroa glenensis (N.E.Br.) L.Bolus*	LC	Indigenous; Endemic
Aizoaceae	*Delosperma mahonii (N.E.Br.) N.E.Br.*	LC	Indigenous
Aizoaceae	*Braunsia apiculata (Kensit) L.Bolus*	LC	Indigenous; Endemic
Aizoaceae	*Delosperma sp. L.Bolus*		
Alliaceae	*Tulbaghia acutiloba Harv.*	LC	Indigenous
Alliaceae	*Tulbaghia sp.*		
Amaranthaceae	*Salsola glabrescens Burtt Davy*	LC	Indigenous
Amaranthaceae	*Amaranthus hybridus L. subsp. hybridus var. hybridus*		Not indigenous; Naturalised
Amaranthaceae	*Chenopodium album L.*		Not indigenous; Naturalised; Invasive
Amaranthaceae	*Sericorema sericea (Schinz) Lopr.*	LC	Indigenous
Amaranthaceae	*Aerva leucura Moq.*	LC	Indigenous
Amaranthaceae	*Guilleminea densa (Humb. & Bonpl. ex Schult.) Moq.*		Not indigenous; Naturalised; Invasive
Amaranthaceae	*Alternanthera pungens Kunth*		Not indigenous; Naturalised
Amaranthaceae	*Salsola kali L.*		Not indigenous; Naturalised; Invasive
Amaranthaceae	*Sericorema remotiflora (Hook.f.) Lopr.*	LC	Indigenous
Amaranthaceae	*Dysphania carinata (R.Br.) Mosyakin & Clemants*		Not indigenous; Naturalised; Invasive
Amaranthaceae	*Amaranthus thunbergii Moq.*	LC	Indigenous
Amaranthaceae	*Atriplex semibaccata R.Br.*		Not indigenous; Naturalised; Invasive
Amaryllidaceae	*Gethyllis transkarooica D.Mull.-Doblies*	LC	Indigenous
Amaryllidaceae	*Boophone disticha (L.f.) Herb.*	LC	Indigenous

Amaryllidaceae	*Nerine hesseoides L.Bolus*	LC	Indigenous; Endemic
Amaryllidaceae	*Ammocharis coranica (Ker Gawl.) Herb.*	LC	Indigenous
Amaryllidaceae	*Nerine laticoma (Ker Gawl.) T.Durand & Schinz*	LC	Indigenous
Amaryllidaceae	*Crinum bulbispermum (Burm.f.) Milne-Redh. & Schweick.*	LC	Indigenous
Amaryllidaceae	*Brunsvigia radulosa Herb.*	LC	Indigenous
Amaryllidaceae	*Haemanthus montanus Baker*	LC	Indigenous
Anacampserotaceae	*Anacampseros recurvata Schonland subsp. buderiana (Poelln.) Gerbaulet*	EN	Indigenous; Endemic
Anacampserotaceae	*Anacampseros ustulata E.Mey. ex Fenzl*	LC	Indigenous; Endemic
Anacampserotaceae	*Anacampseros sp.*		
Anacardiaceae	*Smodingium argutum E.Mey. ex Sond.*	LC	Indigenous; Endemic
Anacardiaceae	*Searsia rigida (Mill.) F.A.Barkley var. rigida*	LC	Indigenous; Endemic
Anacardiaceae	*Searsia pyroides (Burch.) Moffett var. pyroides*	LC	Indigenous
Anacardiaceae	*Searsia lancea (L.f.) F.A.Barkley*	LC	Indigenous
Apiaceae	*Deverra burchellii (DC.) Eckl. & Zeyh.*	LC	Indigenous
Apiaceae	*Conium chaerophylloides (Thunb.) Sond.*	LC	Indigenous
Apocynaceae	*Raphionacme hirsuta (E.Mey.) R.A.Dyer*	LC	Indigenous
Apocynaceae	*Stenostelma capense Schltr.*	LC	Indigenous
Apocynaceae	*Xysmalobium brownianum S.Moore*	LC	Indigenous
Apocynaceae	*Araujia sericifera Brot.*		Not indigenous; Naturalised; Invasive
Apocynaceae	*Orbea lutea (N.E.Br.) Bruyns subsp. lutea*	LC	Indigenous
Apocynaceae	*Cordylogyne globosa E.Mey.*	LC	Indigenous
Apocynaceae	*Brachystelma foetidum Schltr.*	LC	Indigenous
Apocynaceae	*Brachystelma ramosissimum (Schltr.) N.E.Br.*	LC	Indigenous
Apocynaceae	*Asclepias aurea (Schltr.) Schltr.*	LC	Indigenous
Apocynaceae	*Asclepias gibba (E.Mey.) Schltr. var. media N.E.Br.*	LC	Indigenous
Apocynaceae	*Asclepias gibba (E.Mey.) Schltr. var. gibba*	LC	Indigenous
Apocynaceae	*Asclepias stellifera Schltr.*	LC	Indigenous
Aponogetonaceae	*Aponogeton junceus Lehm.*	LC	Indigenous
Asparagaceae	*Asparagus laricinus Burch.*	LC	Indigenous
Asparagaceae	*Asparagus suaveolens Burch.*	LC	Indigenous
Asparagaceae	*Asparagus bechuanicus Baker*	LC	Indigenous
Asparagaceae	*Asparagus cooperi Baker*	LC	Indigenous
Asparagaceae	*Asparagus setaceus (Kunth) Jessop*	LC	Indigenous
Asphodelaceae	*Trachyandra asperata Kunth var. asperata*	LC	Indigenous
Asphodelaceae	*Bulbine abyssinica A.Rich.*	LC	Indigenous
Asphodelaceae	*Aloe subspicata (Baker) Boatwr. & J.C.Manning*		Indigenous
Asphodelaceae	*Bulbine asphodeloides (L.) Spreng.*	LC	Indigenous
Asphodelaceae	*Trachyandra asperata Kunth var. basutoensis (Poelln.) Oberm.*	LC	Indigenous
Asphodelaceae	*Trachyandra saltii (Baker) Oberm. var. saltii*	LC	Indigenous
Asphodelaceae	*Trachyandra asperata Kunth var. nataglencoensis (Kuntze) Oberm.*	LC	Indigenous
Asphodelaceae	*Trachyandra saltii (Baker) Oberm.*		Indigenous
Asphodelaceae	*Bulbine capitata Poelln.*	LC	Indigenous

Asphodelaceae	*Aloe grandidentata Salm-Dyck*	LC	Indigenous
Asphodelaceae	*Bulbine narcissifolia Salm-Dyck*	LC	Indigenous
Asphodelaceae	*Trachyandra laxa (N.E.Br.) Oberm. var. rigida (Suess.) Roessler*	LC	Indigenous
Asphodelaceae	*Bulbine frutescens (L.) Willd.*	LC	Indigenous
Asphodelaceae	*Trachyandra asperata Kunth var. macowanii (Baker) Oberm.*	LC	Indigenous
Asteraceae	*Tagetes minuta L.*		Not indigenous; Naturalised; Invasive
Asteraceae	*Litogyne gariepina (DC.) Anderb.*	LC	Indigenous
Asteraceae	*Osteospermum spinescens Thunb.*	LC	Indigenous
Asteraceae	*Pseudognaphalium luteoalbum (L.) Hilliard & B.L.Burtt*	LC	Not indigenous; cryptogenic
Asteraceae	*Nolletia ciliaris (DC.) Steetz*	LC	Indigenous
Asteraceae	*Erigeron bonariensis L.*		Not indigenous; Naturalised; Invasive
Asteraceae	*Helichrysum rugulosum Less.*	LC	Indigenous
Asteraceae	*Senecio consanguineus DC.*	LC	Indigenous
Asteraceae	*Tolpis capensis (L.) Sch.Bip.*	LC	Indigenous
Asteraceae	*Dicoma macrocephala DC.*	LC	Indigenous
Asteraceae	*Felicia muricata (Thunb.) Nees subsp. muricata*	LC	Indigenous
Asteraceae	*Platycarphella parvifolia (S.Moore) V.A.Funk & H.Rob.*	LC	Indigenous; Endemic
Asteraceae	*Dicoma anomala Sond. subsp. anomala*	LC	Indigenous
Asteraceae	*Dimorphotheca zeyheri Sond.*	LC	Indigenous
Asteraceae	*Acanthospermum glabratum (DC.) Wild*		Not indigenous; Naturalised
Asteraceae	*Arctotis venusta Norl.*	LC	Indigenous
Asteraceae	*Denekia capensis Thunb.*	LC	Indigenous
Asteraceae	*Zinnia peruviana (L.) L.*		Not indigenous; Naturalised; Invasive
Asteraceae	*Hilliardiella capensis (Houtt.) H.Rob., Skvarla & V.A.Funk*		Indigenous
Asteraceae	*Helichrysum pumilio (O.Hoffm.) Hilliard & B.L.Burtt subsp. pumilio*	LC	Indigenous; Endemic
Asteraceae	*Seriphium plumosum L.*		Indigenous
Asteraceae	*Haplocarpha scaposa Harv.*	LC	Indigenous
Asteraceae	*Helichrysum dregeanum Sond. & Harv.*	LC	Indigenous
Asteraceae	*Tarchonanthus camphoratus L.*	LC	Indigenous
Asteraceae	*Pentzia globosa Less.*	LC	Indigenous
Asteraceae	*Conyza podocephala DC.*		Indigenous
Asteraceae	*Helichrysum nudifolium (L.) Less. var. nudifolium*	LC	Indigenous
Asteraceae	*Nidorella resedifolia DC. subsp. resedifolia*	LC	Indigenous
Asteraceae	*Pentzia viridis Kies*	LC	Indigenous; Endemic
Asteraceae	*Hilliardiella elaeagnoides (DC.) Swelank. & J.C.Manning*		Indigenous
Asteraceae	*Lasiospermum pedunculare Lag.*	LC	Indigenous; Endemic
Asteraceae	*Senecio laevigatus Thunb. var. laevigatus*	LC	Indigenous; Endemic
Asteraceae	*Bidens pilosa L.*		Not indigenous; Naturalised
Asteraceae	*Senecio asperulus DC.*	LC	Indigenous
Asteraceae	*Sonchus oleraceus L.*		Not indigenous; Naturalised; Invasive

Asteraceae	*Gazania krebsiana Less. subsp. arctotoides (Less.) Roessler*	LC	Indigenous
Asteraceae	*Osteospermum leptolobum (Harv.) Norl.*	LC	Indigenous; Endemic
Asteraceae	*Arctotis arctotoides (L.f.) O.Hoffm.*	LC	Indigenous
Asteraceae	*Schkuhria pinnata (Lam.) Kuntze ex Thell.*		Not indigenous; Naturalised
Asteraceae	*Pentzia calcarea Kies*	LC	Indigenous
Asteraceae	*Oncosiphon piluliferus (L.f.) Kallersjo*	LC	Indigenous
Asteraceae	*Hertia ciliata (Harv.) Kuntze*	LC	Indigenous
Asteraceae	*Eriocephalus karooicus M.A.N.Mull.*	LC	Indigenous; Endemic
Asteraceae	*Cotula australis (Spreng.) Hook.f.*	LC	Indigenous
Asteraceae	*Geigeria burkei Harv. subsp. burkei var. burkei*	NE	Indigenous
Asteraceae	*Xanthium spinosum L.*		Not indigenous; Naturalised; Invasive
Asteraceae	*Helichrysum zeyheri Less.*	LC	Indigenous
Asteraceae	*Galinsoga parviflora Cav.*		Not indigenous; Naturalised
Asteraceae	*Cotula anthemoides L.*	LC	Indigenous
Asteraceae	*Geigeria aspera Harv. var. aspera*	LC	Indigenous
Asteraceae	*Helichrysum argyrosphaerum DC.*	LC	Indigenous
Asteraceae	*Berkheya radula (Harv.) De Wild.*	LC	Indigenous
Asteraceae	*Geigeria brevifolia (DC.) Harv.*	LC	Indigenous
Asteraceae	*Xanthium strumarium L.*		Not indigenous; Naturalised; Invasive
Asteraceae	*Berkheya onopordifolia (DC.) O.Hoffm. ex Burtt Davy var. onopordifolia*	LC	Indigenous
Asteraceae	*Cineraria erodioides DC. var. erodioides*	LC	Indigenous
Asteraceae	*Cotula sp.*		
Asteraceae	*Ifloga glomerata (Harv.) Schltr.*	LC	Indigenous
Asteraceae	*Helichrysum caespititium (DC.) Harv.*	LC	Indigenous
Asteraceae	*Senecio reptans Turcz.*	LC	Indigenous; Endemic
Asteraceae	*Osteospermum scariosum DC. var. scariosum*	NE	Indigenous
Asteraceae	*Lactuca inermis Forssk.*	LC	Indigenous
Asteraceae	*Gnaphalium confine Harv.*	LC	Indigenous
Asteraceae	*Gnaphalium filagopsis Hilliard & B.L.Burtt*	LC	Indigenous
Asteraceae	*Osteospermum muricatum E.Mey. ex DC. subsp. muricatum*	LC	Indigenous
Asteraceae	*Artemisia afra Jacq. ex Willd. var. afra*	LC	Indigenous
Asteraceae	*Felicia fascicularis DC.*	LC	Indigenous
Asteraceae	*Arctotis microcephala (DC.) Beauverd*	LC	Indigenous
Boraginaceae	*Heliotropium lineare (A.DC.) Gurke*	LC	Indigenous
Boraginaceae	*Trichodesma angustifolium Harv. subsp. angustifolium*	LC	Indigenous
Boraginaceae	*Ehretia alba Retief & A.E.van Wyk*	LC	Indigenous
Boraginaceae	*Anchusa riparia A.DC.*	LC	Indigenous
Boraginaceae	*Lappula heteracantha Ledeb.*		Not indigenous; Naturalised
Boraginaceae	*Anchusa capensis Thunb.*	LC	Indigenous
Boraginaceae	*Anchusa azurea Mill.*		Not indigenous; Naturalised
Boraginaceae	*Lithospermum cinereum A.DC.*	LC	Indigenous

Brassicaceae	*Rorippa nudiuscula Thell.*	LC	Indigenous
Brassicaceae	*Capsella bursa-pastoris (L.) Medik.*		Not indigenous; Naturalised
Brassicaceae	*Lepidium africanum (Burm.f.) DC. subsp. africanum*	LC	Indigenous
Brassicaceae	*Sisymbrium orientale L.*		Not indigenous; Naturalised
Campanulaceae	*Wahlenbergia denticulata (Burch.) A.DC. var. denticulata*	LC	Indigenous
Campanulaceae	*Wahlenbergia undulata (L.f.) A.DC.*	LC	Indigenous
Campanulaceae	*Wahlenbergia androsacea A.DC.*	LC	Indigenous
Caryophyllaceae	*Pollichia campestris Aiton*	LC	Indigenous
Caryophyllaceae	*Corrigiola litoralis L. subsp. litoralis var. litoralis*	NE	Indigenous
Caryophyllaceae	*Dianthus micropetalus Ser.*	LC	Indigenous
Caryophyllaceae	*Silene burchellii Otth ex DC. subsp. modesta J.C.Manning & Goldblatt*	LC	Indigenous
Celastraceae	*Gymnosporia buxifolia (L.) Szyszyl.*	LC	Indigenous
Colchicaceae	*Colchicum melanthioides (Willd.) J.C.Manning & Vinn. subsp. melanthioides*	LC	Indigenous
Colchicaceae	*Colchicum burkei (Baker) J.C.Manning & Vinn.*	LC	Indigenous
Commelinaceae	*Commelina africana L. var. lancispatha C.B.Clarke*	LC	Indigenous
Commelinaceae	*Commelina livingstonii C.B.Clarke*	LC	Indigenous
Commelinaceae	*Commelina benghalensis L.*	LC	Indigenous
Commelinaceae	*Commelina africana L. var. africana*	LC	Indigenous
Convolvulaceae	*Ipomoea oblongata E.Mey. ex Choisy*	LC	Indigenous
Convolvulaceae	*Convolvulus boedeckerianus Peter*	LC	Indigenous; Endemic
Convolvulaceae	*Convolvulus dregeanus Choisy*	LC	Indigenous; Endemic
Convolvulaceae	*Seddera capensis (E.Mey. ex Choisy) Hallier f.*	LC	Indigenous
Convolvulaceae	*Convolvulus sagittatus Thunb.*	LC	Indigenous
Convolvulaceae	*Ipomoea bolusiana Schinz*	LC	Indigenous
Convolvulaceae	*Falkia oblonga Bernh. ex C.Krauss*	LC	Indigenous
Convolvulaceae	*Ipomoea oenotheroides (L.f.) Raf. ex Hallier f.*	LC	Indigenous
Crassulaceae	*Crassula capitella Thunb. subsp. nodulosa (Schonland) Toelken*	LC	Indigenous
Crassulaceae	*Crassula deltoidea Thunb.*	LC	Indigenous
Crassulaceae	*Crassula natalensis Schonland*	LC	Indigenous
Crassulaceae	*Crassula vaillantii (Willd.) Roth*		Not indigenous; Naturalised
Crassulaceae	*Crassula lanceolata (Eckl. & Zeyh.) Endl. ex Walp. subsp. lanceolata*	LC	Indigenous
Crassulaceae	*Crassula lanceolata (Eckl. & Zeyh.) Endl. ex Walp. subsp. transvaalensis (Kuntze) Toelken*	LC	Indigenous
Crassulaceae	*Kalanchoe rotundifolia (Haw.) Haw.*	LC	Indigenous
Cucurbitaceae	*Cucumis myriocarpus Naudin subsp. myriocarpus*	LC	Indigenous
Cucurbitaceae	*Coccinia sessilifolia (Sond.) Cogn.*	LC	Indigenous
Cyperaceae	*Cyperus esculentus L. var. esculentus*	LC	Indigenous
Cyperaceae	*Kyllinga alba Nees*	LC	Indigenous
Cyperaceae	*Cyperus usitatus Burch.*	LC	Indigenous
Cyperaceae	*Cyperus congestus Vahl*	LC	Indigenous
Cyperaceae	*Cyperus semitrifidus Schrad.*	LC	Indigenous
Cyperaceae	*Cyperus marginatus Thunb.*	LC	Indigenous

Cyperaceae	*Cyperus eragrostis Lam.*		Not indigenous; Naturalised
Cyperaceae	*Afroscirpoides dioeca (Kunth) Garcia-Madr.*		Indigenous
Cyperaceae	*Kyllinga erecta Schumach. var. erecta*	LC	Indigenous
Cyperaceae	*Cyperus uitenhagensis (Steud.) C.Archer & Goetgh.*	LC	Indigenous
Cyperaceae	*Cyperus obtusiflorus Vahl var. flavissimus (Schrad.) Boeckeler*	LC	Indigenous
Cyperaceae	*Cyperus longus L. var. tenuiflorus (Rottb.) Boeckeler*	NE	Indigenous
Cyperaceae	*Isolepis setacea (L.) R.Br.*	LC	Indigenous
Cyperaceae	*Eleocharis dregeana Steud.*	LC	Indigenous
Cyperaceae	*Cyperus rupestris Kunth var. rupestris*	LC	Indigenous
Cyperaceae	*Bulbostylis humilis (Kunth) C.B.Clarke*	LC	Indigenous
Cyperaceae	*Scleria sp.*		
Cyperaceae	*Schoenoplectus muricinux (C.B.Clarke) J.Raynal*	LC	Indigenous
Cyperaceae	*Cyperus difformis L.*	LC	Indigenous
Cyperaceae	*Schoenoplectus decipiens (Nees) J.Raynal*	LC	Indigenous
Cyperaceae	*Cyperus denudatus L.f.*	LC	Indigenous
Cyperaceae	*Cyperus fastigiatus Rottb.*	LC	Indigenous
Cyperaceae	*Bulbostylis hispidula (Vahl) R.W.Haines subsp. pyriformis (Lye) R.W.Haines*	LC	Indigenous
Ebenaceae	*Diospyros lycioides Desf. subsp. lycioides*	LC	Indigenous
Elatinaceae	*Bergia pentheriana Keissl.*	LC	Indigenous
Equisetaceae	*Equisetum ramosissimum Desf. subsp. ramosissimum*	LC	Indigenous
Erpodiaceae	*Erpodium beccarii Mull.Hal.*		Indigenous
Euphorbiaceae	*Euphorbia pseudotuberosa Pax*	LC	Indigenous
Euphorbiaceae	*Euphorbia striata Thunb.*	LC	Indigenous
Euphorbiaceae	*Euphorbia inaequilatera Sond. var. inaequilatera*	NE	Indigenous
Euphorbiaceae	*Euphorbia clavarioides Boiss.*	LC	Indigenous
Euphorbiaceae	*Euphorbia prostrata Aiton*	NE	Not indigenous; Naturalised
Euphorbiaceae	*Euphorbia natalensis Bernh. ex Krauss*	LC	Indigenous
Fabaceae	*Senna italica Mill. subsp. arachoides (Burch.) Lock*	LC	Indigenous
Fabaceae	*Listia heterophylla E.Mey.*	LC	Indigenous
Fabaceae	*Indigofera zeyheri Spreng. ex Eckl. & Zeyh.*	LC	Indigenous
Fabaceae	*Chamaecrista biensis (Steyaert) Lock*	LC	Indigenous
Fabaceae	*Rhynchosia holosericea Schinz*	LC	Indigenous
Fabaceae	*Indigofera torulosa E.Mey. var. angustiloba (Baker f.) J.B.Gillett*	LC	Indigenous; Endemic
Fabaceae	*Indigofera cryptantha Benth. ex Harv. var. cryptantha*	LC	Indigenous
Fabaceae	*Dolichos angustifolius Eckl. & Zeyh.*	LC	Indigenous
Fabaceae	*Sesbania transvaalensis J.B.Gillett*	LC	Indigenous
Fabaceae	*Vachellia karroo (Hayne) Banfi & Galasso*	LC	Indigenous
Fabaceae	*Lessertia frutescens (L.) Goldblatt & J.C.Manning subsp. frutescens*	LC	Indigenous
Fabaceae	*Crotalaria distans Benth. subsp. distans*	LC	Indigenous
Fabaceae	*Trifolium africanum Ser. var. africanum*	NE	Indigenous
Fabaceae	*Melolobium calycinum Benth.*	LC	Indigenous

Fabaceae	*Rhynchosia confusa Burtt Davy*	NE	Indigenous
Fabaceae	*Eriosema salignum E.Mey.*	LC	Indigenous
Fabaceae	*Indigofera filipes Benth. ex Harv.*	LC	Indigenous
Fabaceae	*Erythrina zeyheri Harv.*	LC	Indigenous
Fabaceae	*Lotononis sparsiflora (E.Mey.) B.-E.van Wyk*	LC	Indigenous
Fabaceae	*Crotalaria burkeana Benth.*	LC	Indigenous
Fabaceae	*Indigofera alternans DC. var. alternans*	LC	Indigenous
Fabaceae	*Argyrolobium molle Eckl. & Zeyh.*	LC	Indigenous; Endemic
Fabaceae	*Crotalaria virgulata Klotzsch subsp. grantiana (Harv.) Polhill*	LC	Indigenous
Fabaceae	*Rhynchosia totta (Thunb.) DC. var. totta*	LC	Indigenous
Fabaceae	*Argyrolobium collinum Eckl. & Zeyh.*	LC	Indigenous
Fabaceae	*Rhynchosia minima (L.) DC. var. prostrata (Harv.) Meikle*	NE	Indigenous
Fabaceae	*Elephantorrhiza elephantina (Burch.) Skeels*	LC	Indigenous
Fabaceae	*Zornia milneana Mohlenbr.*	LC	Indigenous
Fabaceae	*Melolobium obcordatum Harv.*	LC	Indigenous
Fabaceae	*Leobordea divaricata Eckl. & Zeyh.*	LC	Indigenous
Fabaceae	*Crotalaria sphaerocarpa Perr. ex DC. subsp. sphaerocarpa*	LC	Indigenous
Fabaceae	*Medicago laciniata (L.) Mill. var. laciniata*	NE	Not indigenous; Naturalised
Fabaceae	*Lessertia frutescens (L.) Goldblatt & J.C.Manning subsp. microphylla (Burch. ex DC.) J.C.Manning & Boatwr.*	LC	Indigenous
Fabaceae	*Vicia sp.*		
Fabaceae	*Rhynchosia nervosa Benth. ex Harv. var. nervosa*	LC	Indigenous
Fabroniaceae	*Fabronia pilifera Hornsch.*		Indigenous
Fagaceae	*Quercus robur L.*		Not indigenous; Cultivated; Naturalised; Invasive
Fagaceae	*Quercus acutissima Carruth.*		Not indigenous; Cultivated; Naturalised
Gentianaceae	*Sebaea exigua (Oliv.) Schinz*	LC	Indigenous
Geraniaceae	*Pelargonium sidoides DC.*	LC	Indigenous
Geraniaceae	*Monsonia angustifolia E.Mey. ex A.Rich.*	LC	Indigenous
Gisekiaceae	*Gisekia pharnaceoides L. var. pharnaceoides*	LC	Indigenous
Hyacinthaceae	*Drimia capensis (Burm.f.) Wijnands*	LC	Indigenous; Endemic
Hyacinthaceae	*Albuca sp.*		
Hyacinthaceae	*Albuca prasina (Ker Gawl.) J.C.Manning & Goldblatt*		Indigenous
Hyacinthaceae	*Ledebouria cooperi (Hook.f.) Jessop*	LC	Indigenous
Hyacinthaceae	*Massonia jasminiflora Burch. ex Baker*	LC	Indigenous
Hyacinthaceae	*Albuca shawii Baker*	LC	Indigenous
Hyacinthaceae	*Ledebouria marginata (Baker) Jessop*	LC	Indigenous
Hyacinthaceae	*Albuca virens (Ker Gawl.) J.C.Manning & Goldblatt subsp. virens*	LC	Indigenous
Hyacinthaceae	*Drimia intricata (Baker) J.C.Manning & Goldblatt*	LC	Indigenous
Hyacinthaceae	*Eucomis autumnalis (Mill.) Chitt. subsp. clavata (Baker) Reyneke*	NE	Indigenous
Hyacinthaceae	*Ledebouria ovatifolia (Baker) Jessop*		Indigenous

Hyacinthaceae	*Dipcadi ciliare (Eckl. & Zeyh. ex Harv.) Baker*	LC	Indigenous; Endemic
Hyacinthaceae	*Schizocarphus nervosus (Burch.) Van der Merwe*	LC	Indigenous
Hyacinthaceae	*Dipcadi marlothii Engl.*	LC	Indigenous
Hyacinthaceae	*Dipcadi viride (L.) Moench*	LC	Indigenous
Hyacinthaceae	*Ornithogalum juncifolium Jacq. var. juncifolium*	NE	Indigenous
Hyacinthaceae	*Drimia multisetosa (Baker) Jessop*	LC	Indigenous
Hyacinthaceae	*Albuca setosa Jacq.*	LC	Indigenous
Hyacinthaceae	*Lachenalia ensifolia (Thunb.) J.C.Manning & Goldblatt*	LC	Indigenous; Endemic
Hyacinthaceae	*Ledebouria sp.*		
Hyacinthaceae	*Drimia sp.*		
Hyacinthaceae	*Drimia elata Jacq. ex Willd.*	DD	Indigenous
Hydrocharitaceae	*Lagarosiphon muscoides Harv.*	LC	Indigenous
Hypoxidaceae	*Hypoxis iridifolia Baker*	LC	Indigenous
Hypoxidaceae	*Hypoxis hemerocallidea Fisch., C.A.Mey. & Ave-Lall.*	LC	Indigenous
Hypoxidaceae	*Hypoxis rigidula Baker var. rigidula*	LC	Indigenous
Hypoxidaceae	*Hypoxis argentea Harv. ex Baker var. argentea*	LC	Indigenous
Iridaceae	*Lapeirousia plicata (Jacq.) Diels subsp. foliosa Goldblatt & J.C.Manning*		Indigenous
Iridaceae	*Gladiolus permeabilis D.Delaroche subsp. edulis (Burch. ex Ker Gawl.) Oberm.*	LC	Indigenous
Iridaceae	*Duthieastrum linifolium (E.Phillips) M.P.de Vos*	LC	Indigenous; Endemic
Iridaceae	*Tritonia laxifolia (Klatt) Benth. ex Baker*	LC	Indigenous
Iridaceae	*Gladiolus dalenii Van Geel subsp. dalenii*	LC	Indigenous
Iridaceae	*Moraea pallida (Baker) Goldblatt*	LC	Indigenous
Iridaceae	*Moraea simulans Baker*	LC	Indigenous
Kewaceae	*Kewa bowkeriana (Sond.) Christenh.*	LC	Indigenous
Lamiaceae	*Salvia runcinata L.f.*	LC	Indigenous
Lamiaceae	*Mentha longifolia (L.) Huds. subsp. polyadena (Briq.) Briq.*	LC	Indigenous
Lamiaceae	*Teucrium trifidum Retz.*	LC	Indigenous
Lamiaceae	*Salvia stenophylla Burch. ex Benth.*		Indigenous
Lamiaceae	*Salvia verbenaca L.*	LC	Not indigenous; Naturalised; Invasive
Lamiaceae	*Stachys hyssopoides Burch. ex Benth.*	LC	Indigenous
Lamiaceae	*Stachys spathulata Burch. ex Benth.*	LC	Indigenous
Leskeaceae	*Pseudoleskeopsis claviramea (Mull.Hal.) Ther.*		Indigenous
Linderniaceae	*Linderniella nana (Engl.) Eb.Fisch., Schaferh. & Kai Mull.*		Indigenous
Lobeliaceae	*Lobelia sonderiana (Kuntze) Lammers*	LC	Indigenous
Malvaceae	*Grewia flava DC.*	LC	Indigenous
Malvaceae	*Corchorus asplenifolius Burch.*	LC	Indigenous
Malvaceae	*Hermannia depressa N.E.Br.*	LC	Indigenous
Malvaceae	*Sphaeralcea bonariensis (Cav.) Griseb.*		Not indigenous; Naturalised
Malvaceae	*Hibiscus calyphyllus Cav.*	LC	Indigenous
Malvaceae	*Hibiscus trionum L.*		Not indigenous; Naturalised
Malvaceae	*Sida chrysantha Ulbr.*	LC	Indigenous

Malvaceae	*Hermannia sp.*		
Malvaceae	*Pavonia burchellii (DC.) R.A.Dyer*	LC	Indigenous
Malvaceae	*Hermannia quartiniana A.Rich.*	LC	Indigenous
Malvaceae	*Hibiscus pusillus Thunb.*	LC	Indigenous
Malvaceae	*Hermannia oblongifolia (Harv.) Hochr.*	LC	Indigenous; Endemic
Malvaceae	*Malva parviflora L. var. parviflora*		Not indigenous; Naturalised
Malvaceae	*Hibiscus microcarpus Garcke*	LC	Indigenous
Marsileaceae	*Marsilea sp.*		
Marsileaceae	*Marsilea macrocarpa C.Presl*	LC	Indigenous
Nyctaginaceae	*Commicarpus plumbagineus (Cav.) Standl. var. plumbagineus*	LC	Indigenous
Nyctaginaceae	*Commicarpus pentandrus (Burch.) Heimerl*	LC	Indigenous
Oleaceae	*Menodora africana Hook.*	LC	Indigenous
Oleaceae	*Ligustrum lucidum W.T.Aiton*		Not indigenous; Cultivated; Naturalised; Invasive
Ophioglossaceae	*Ophioglossum sp.*		
Orchidaceae	*Eulophia ovalis Lindl. var. ovalis*	LC	Indigenous
Orchidaceae	*Habenaria epipactidea Rchb.f.*	LC	Indigenous
Oxalidaceae	*Oxalis latifolia Kunth*		Not indigenous; Naturalised; Invasive
Oxalidaceae	*Oxalis depressa Eckl. & Zeyh.*	LC	Indigenous
Pedaliaceae	*Pterodiscus speciosus Hook.*	LC	Indigenous
Phrymaceae	*Mimulus gracilis R.Br.*	LC	Indigenous
Phyllanthaceae	*Phyllanthus maderaspatensis L.*	LC	Indigenous
Phyllanthaceae	*Phyllanthus parvulus Sond. var. parvulus*	LC	Indigenous
Plantaginaceae	*Veronica anagallis-aquatica L.*	LC	Indigenous
Plantaginaceae	*Plantago major L.*		Not indigenous; Naturalised
Plantaginaceae	*Plantago lanceolata L.*	LC	Indigenous
Poaceae	*Eragrostis trichophora Coss. & Durieu*	LC	Indigenous
Poaceae	*Eragrostis pseudobtusa De Winter*	NE	Indigenous; Endemic
Poaceae	*Pogonarthria squarrosa (Roem. & Schult.) Pilg.*	LC	Indigenous
Poaceae	*Dactyloctenium aegyptium (L.) Willd.*	LC	Indigenous
Poaceae	*Anthephora pubescens Nees*	LC	Indigenous
Poaceae	*Eragrostis curvula (Schrad.) Nees*	LC	Indigenous
Poaceae	*Sporobolus fimbriatus (Trin.) Nees*	LC	Indigenous
Poaceae	*Urochloa mosambicensis (Hack.) Dandy*	LC	Indigenous
Poaceae	*Digitaria sanguinalis (L.) Scop.*	NE	Not indigenous; Naturalised
Poaceae	*Agrostis lachnantha Nees var. lachnantha*	LC	Indigenous
Poaceae	*Eragrostis gummiflua Nees*	LC	Indigenous
Poaceae	*Hyparrhenia dregeana (Nees) Stapf ex Stent*	LC	Indigenous
Poaceae	*Eragrostis lehmanniana Nees var. lehmanniana*	LC	Indigenous
Poaceae	*Ehrharta erecta Lam. var. erecta*	LC	Indigenous
Poaceae	*Eustachys paspaloides (Vahl) Lanza & Mattei*	LC	Indigenous
Poaceae	*Eragrostis micrantha Hack.*	LC	Indigenous

Poaceae	*Digitaria tricholaenoides Stapf*	LC	Indigenous
Poaceae	*Aristida congesta Roem. & Schult. subsp. barbicollis (Trin. & Rupr.) De Winter*	LC	Indigenous
Poaceae	*Echinochloa colona (L.) Link*	LC	Indigenous
Poaceae	*Cynodon hirsutus Stent*	LC	Indigenous
Poaceae	*Cymbopogon caesius (Hook. & Arn.) Stapf*	LC	Indigenous
Poaceae	*Eragrostis obtusa Munro ex Ficalho & Hiern*	LC	Indigenous
Poaceae	*Aristida adscensionis L.*	LC	Indigenous
Poaceae	*Cymbopogon pospischilii (K.Schum.) C.E.Hubb.*	NE	Indigenous
Poaceae	*Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. sphacelata*	LC	Indigenous
Poaceae	*Echinochloa holubii (Stapf) Stapf*	LC	Indigenous
Poaceae	*Helictotrichon turgidulum (Stapf) Schweick.*	LC	Indigenous
Poaceae	*Eragrostis sp.*		
Poaceae	*Andropogon appendiculatus Nees*	LC	Indigenous
Poaceae	*Eragrostis chloromelas Steud.*	LC	Indigenous
Poaceae	*Panicum sp.*		
Poaceae	*Melinis repens (Willd.) Zizka subsp. repens*	LC	Indigenous
Poaceae	*Brachiaria eruciformis (Sm.) Griseb.*	LC	Indigenous
Poaceae	*Eleusine coracana (L.) Gaertn. subsp. africana (Kenn.-O'Byrne) Hilu & de Wet*	LC	Indigenous
Poaceae	*Chloris virgata Sw.*	LC	Indigenous
Poaceae	*Panicum stapfianum Fourc.*	LC	Indigenous
Poaceae	*Panicum schinzii Hack.*	LC	Indigenous
Poaceae	*Eragrostis racemosa (Thunb.) Steud.*	LC	Indigenous
Poaceae	*Aristida junciformis Trin. & Rupr. subsp. junciformis*	LC	Indigenous
Poaceae	*Bromus sp.*		
Poaceae	*Phalaris canariensis L.*	NE	Not indigenous; Naturalised
Poaceae	*Panicum coloratum L.*	LC	Indigenous
Poaceae	*Tragus berteronianus Schult.*	LC	Indigenous
Poaceae	*Sporobolus tenellus (Spreng.) Kunth*	LC	Indigenous
Poaceae	*Paspalum distichum L.*	LC	Not indigenous; Naturalised; Invasive
Poaceae	*Tragus koelerioides Asch.*	LC	Indigenous
Poaceae	*Setaria nigrirostris (Nees) T.Durand & Schinz*	LC	Indigenous
Poaceae	*Eragrostis superba Peyr.*	LC	Indigenous
Poaceae	*Tragus racemosus (L.) All.*	LC	Indigenous
Poaceae	*Aristida stipitata Hack. subsp. graciliflora (Pilg.) Melderis*	LC	Indigenous
Poaceae	*Enneapogon scoparius Stapf*	LC	Indigenous
Poaceae	*Digitaria argyrograpta (Nees) Stapf*	LC	Indigenous
Poaceae	*Trachypogon spicatus (L.f.) Kuntze*	LC	Indigenous
Poaceae	*Elionurus muticus (Spreng.) Kunth*	LC	Indigenous
Poaceae	*Hemarthria altissima (Poir.) Stapf & C.E.Hubb.*	LC	Indigenous
Poaceae	*Themeda triandra Forssk.*	LC	Indigenous
Poaceae	*Aristida congesta Roem. & Schult. subsp. congesta*	LC	Indigenous

Poaceae	*Aristida diffusa Trin. subsp. burkei (Stapf) Melderis*	LC	Indigenous
Poaceae	*Eragrostis biflora Hack. ex Schinz*	LC	Indigenous
Poaceae	*Eragrostis capensis (Thunb.) Trin.*	LC	Indigenous
Poaceae	*Aristida bipartita (Nees) Trin. & Rupr.*	LC	Indigenous
Poaceae	*Phragmites australis (Cav.) Steud.*	LC	Indigenous
Poaceae	*Hyparrhenia hirta (L.) Stapf*	LC	Indigenous
Poaceae	*Digitaria eriantha Steud.*	LC	Indigenous
Poaceae	*Setaria incrassata (Hochst.) Hack.*	LC	Indigenous
Poaceae	*Enneapogon cenchroides (Licht. ex Roem. & Schult.) C.E.Hubb.*	LC	Indigenous
Poaceae	*Sporobolus oxyphyllus Fish*	LC	Indigenous; Endemic
Poaceae	*Echinochloa crus-galli (L.) P.Beauv.*	LC	Indigenous
Poaceae	*Avena sativa L.*	NE	Not indigenous; Naturalised; Invasive
Poaceae	*Sporobolus sp.*		
Poaceae	*Urochloa panicoides P.Beauv.*	LC	Indigenous
Poaceae	*Brachiaria serrata (Thunb.) Stapf*	LC	Indigenous
Poaceae	*Leersia hexandra Sw.*	LC	Indigenous
Poaceae	*Setaria sphacelata (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. torta (Stapf) Clayton*	LC	Indigenous
Poaceae	*Melica decumbens Thunb.*	LC	Indigenous
Poaceae	*Eragrostis lappula Nees*	LC	Indigenous
Poaceae	*Cynodon transvaalensis Burtt Davy*	LC	Indigenous
Poaceae	*Cynodon dactylon (L.) Pers.*	LC	Indigenous
Poaceae	*Setaria sp.*		
Poaceae	*Cymbopogon dieterlenii Stapf ex E.Phillips*	LC	Indigenous
Poaceae	*Triraphis andropogonoides (Steud.) E.Phillips*	LC	Indigenous
Poaceae	*Pennisetum villosum R.Br. ex Fresen.*	NE	Not indigenous; Naturalised; Invasive
Poaceae	*Eragrostis plana Nees*	LC	Indigenous
Polygalaceae	*Polygala hottentotta C.Presl*	LC	Indigenous
Polygonaceae	*Persicaria hystricula (J.Schust.) Sojak*	LC	Indigenous
Polygonaceae	*Persicaria lapathifolia (L.) Delarbre*		Not indigenous; Naturalised; Invasive
Polygonaceae	*Rumex lanceolatus Thunb.*	LC	Indigenous
Polygonaceae	*Rumex sagittatus Thunb.*	LC	Indigenous
Potamogetonaceae	*Potamogeton pectinatus L.*	LC	Indigenous
Potamogetonaceae	*Potamogeton crispus L.*	LC	Indigenous
Ranunculaceae	*Ranunculus multifidus Forssk.*	LC	Indigenous
Ranunculaceae	*Clematis brachiata Thunb.*	LC	Indigenous
Ranunculaceae	*Ranunculus trichophyllus Chaix*	LC	Indigenous
Rhamnaceae	*Ziziphus zeyheriana Sond.*	LC	Indigenous
Rhamnaceae	*Ziziphus mucronata Willd. subsp. mucronata*	LC	Indigenous
Ricciaceae	*Riccia angolensis Steph.*		Indigenous
Rubiaceae	*Anthospermum rigidum Eckl. & Zeyh. subsp. rigidum*	LC	Indigenous
Rubiaceae	*Cordylostigma virgatum (Willd.) Groeninckx & Dessein*		Indigenous

Rubiaceae	*Kohautia amatymbica Eckl. & Zeyh.*	LC	Indigenous
Rubiaceae	*Vangueria pygmaea Schltr.*	LC	Indigenous
Rubiaceae	*Galium capense Thunb. subsp. capense*	LC	Indigenous
Rubiaceae	*Nenax microphylla (Sond.) T.M.Salter*	LC	Indigenous
Rubiaceae	*Rubia petiolaris DC.*	LC	Indigenous
Ruscaceae	*Eriospermum porphyrium Archibald*	LC	Indigenous
Ruscaceae	*Eriospermum schinzii Baker*	LC	Indigenous
Salicaceae	*Salix mucronata Thunb. subsp. mucronata*	LC	Indigenous
Santalaceae	*Thesium costatum A.W.Hill var. costatum*	LC	Indigenous
Santalaceae	*Thesium hirsutum A.W.Hill*	LC	Indigenous; Endemic
Scrophulariaceae	*Aptosimum elongatum (Hiern) Engl.*	LC	Indigenous
Scrophulariaceae	*Gomphostigma virgatum (L.f.) Baill.*	LC	Indigenous
Scrophulariaceae	*Jamesbrittenia sp.*		
Scrophulariaceae	*Jamesbrittenia atropurpurea (Benth.) Hilliard subsp. atropurpurea*	LC	Indigenous
Scrophulariaceae	*Selago sp.*		
Scrophulariaceae	*Aptosimum procumbens (Lehm.) Steud.*	LC	Indigenous
Scrophulariaceae	*Buddleja saligna Willd.*	LC	Indigenous
Scrophulariaceae	*Nemesia fruticans (Thunb.) Benth.*	LC	Indigenous
Scrophulariaceae	*Chaenostoma patrioticum (Hiern) Kornhall*	LC	Indigenous
Solanaceae	*Lycium ferocissimum Miers*	LC	Indigenous
Solanaceae	*Solanum elaeagnifolium Cav.*		Not indigenous; Naturalised; Invasive
Solanaceae	*Datura ferox L.*		Not indigenous; Naturalised; Invasive
Solanaceae	*Solanum rostratum Dunal*		Not indigenous; Naturalised
Solanaceae	*Solanum lichtensteinii Willd.*	LC	Indigenous
Solanaceae	*Solanum supinum Dunal*		Indigenous
Solanaceae	*Lycium arenicola Miers*	LC	Indigenous
Solanaceae	*Nicotiana glauca Graham*		Not indigenous; Naturalised; Invasive
Solanaceae	*Solanum retroflexum Dunal*	LC	Indigenous
Solanaceae	*Cestrum parqui L'Her.*		Not indigenous; Naturalised; Invasive
Solanaceae	*Lycium horridum Thunb.*	LC	Indigenous
Solanaceae	*Solanum campylacanthum Hochst. ex A.Rich.*		Indigenous
Solanaceae	*Lycium schizocalyx C.H.Wright*	LC	Indigenous
Solanaceae	*Withania somnifera (L.) Dunal*	LC	Indigenous
Solanaceae	*Lycium pilifolium C.H.Wright*	LC	Indigenous
Solanaceae	*Lycium hirsutum Dunal*	LC	Indigenous
Solanaceae	*Datura stramonium L.*		Not indigenous; Naturalised; Invasive
Talinaceae	*Talinum caffrum (Thunb.) Eckl. & Zeyh.*	LC	Indigenous
Thymelaeaceae	*Lasiosiphon capitatus (L.f.) Burtt Davy*	LC	Indigenous
Thymelaeaceae	*Lasiosiphon burchellii Meisn.*	LC	Indigenous
Thymelaeaceae	*Lasiosiphon kraussianus (Meisn.) Meisn.*		Indigenous
Typhaceae	*Typha capensis (Rohrb.) N.E.Br.*	LC	Indigenous

Ulmaceae	*Ulmus parvifolia Jacq.*		Not indigenous; Cultivated; Naturalised; Invasive
Vahliaceae	*Vahlia capensis (L.f.) Thunb. subsp. capensis*	LC	Indigenous
Vahliaceae	*Vahlia capensis (L.f.) Thunb. subsp. vulgaris Bridson var. linearis E.Mey. ex Bridson*	NE	Indigenous
Verbenaceae	*Lippia scaberrima Sond.*	LC	Indigenous
Verbenaceae	*Lantana rugosa Thunb.*	LC	Indigenous
Verbenaceae	*Verbena officinalis L.*		Not indigenous; Naturalised
Verbenaceae	*Glandularia aristigera (S.Moore) Tronc.*		Not indigenous; Naturalised; Invasive
Verbenaceae	*Chascanum pinnatifidum (L.f.) E.Mey. var. pinnatifidum*	LC	Indigenous
Verbenaceae	*Verbena brasiliensis Vell.*		Not indigenous; Naturalised; Invasive
Xyridaceae	*Xyris gerrardii N.E.Br.*	LC	Indigenous
Zygophyllaceae	*Tribulus terrestris L.*	LC	Indigenous

Appendix 2: Listed of Mammals

List of Mammals which potentially occur at the project site.

Species	Common name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Aethomys ineptus	Tete Veld Rat	LC	LC
Aethomys namaquensis	Namaqua rock rat	LC	LC
Alcelaphus buselaphus	Hartebeest	LC	LC
Antidorcas marsupialis	Sclater's Shrew	LC	LC
Aonyx capensis	Cape Clawless Otter	NT	NT
Atelerix frontalis	South Africa Hedgehog	NT	LC
Atilax paludinosus	Water Mongoose	LC	LC
Canis mesomelas	Black-backed Jackal	LC	LC
Caracal caracal	Caracal	LC	LC
Ceratotherium simum	White Rhinoceros	NT	NT
Connochaetes gnou	Black Wildebeest	LC	LC
Connochaetes taurinus	Blue Wildebeest	LC	LC
Crocidura cyanea	Reddish-grey Musk Shrew	LC	LC
Cryptomys hottentotus	Common Mole-rat	LC	LC
Cynictis penicillata	Yellow Mongoose	LC	LC
Damaliscus pygargus	Blesbok	LC	LC
Desmodillus auricularis	Short-tailed Gerbil	LC	LC
Diceros bicornis	Black Rhinoceros	EN	CR

Eidolon helvum	African Straw-colored Fruit Bat	LC	NT
Elephantulus myurus	Eastern Rock Sengi	LC	LC
Eptesicus hottentotus	Long-tailed Serotine Bat	LC	LC
Felis nigripes	Black-footed Cat	VU	VU
Felis silvestris	African Wildcat	LC	LC
Genetta genetta	Small-spotted Genet	LC	LC
Gerbilliscus brantsii	Highveld Gerbil	LC	LC
Gerbilliscus leucogaster	Bushveld Gerbil	LC	LC
Herpestes sanguineus	Slender Mongoose	LC	LC
Hydrictis maculicollis	Spotted-necked Otter	VU	NT
Hystrix africaeaustralis	Cape Porcupine	LC	LC
Ichneumia albicauda	White-tailed Mongoose	LC	LC
Ictonyx striatus	Striped Polecat	LC	LC
Leptailurus serval	Serval	NT	LC
Lepus capensis	Cape Hare	LC	LC
Lepus saxatilis	Scrub Hare	LC	LC
Lepus victoriae	African Savanna Hare	LC	LC
Lycaon pictus	African Wild Dog	EN	EN
Mastomys coucha	Multimammate Mouse	LC	LC
Mellivora capensis	Honey Badger	LC	LC

Appendix 3: Listed of Reptiles

Reptile species expected to occur in the project area

Species	Common name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Acontias gracilicauda	Thin-tailed Legless Skink	LC	LC
Afroedura nivaria	Drankensberg Flat Gecko	LC	LC
Agama aculeata distanti	Eastern Ground Agama	LC	LC
Agama atra	Southern Rock Agama	LC	LC
Aparallactus capensis	Black-headed Centipede-eater	LC	LC
Boaedon capensis	Brown House Snake	LC	LC
Chamaeleo dilepis	Common Flap-neck Chameleon	LC	LC
Chamaesaura aenea	Coppery Grass Lizard	NT	NT
Dasypeltis scabra	Common egg eater	LC	LC
Duberria lutrix	Common Slug-eater	LC	LC
Elapsoidea sundevallii sundevallii	Sundevall's Garter Snake	LC	Unlisted
Hemachatus haemachatus	Rinkhals	LC	LC

Lamprophis aurora	Aurora House Snake	LC	LC
Lygodactylus capensis capensis	Common Dwarf Gecko	LC	Unlisted
Pachydactylus capensis	Cape Gecko	LC	Unlisted
Panaspis wahlbergii	Wahlberg's Snake-eyed Skink	LC	Unlisted
Prosymna ambigua	Angolan Shovel-snout	Unlisted	LC
Prosymna sundevallii	Sundevall's Shovel-snout	LC	LC
Psammophis crucifer	Cross-marked Grass Snake	LC	LC
Psammophylax rhombeatus rhombeatus	Spotted Grass Snake	LC	Unlisted
Psammophylax tritaeniatus	Striped Grass Snake	LC	LC
Pseudaspis cana	Mole Snake	LC	Unlisted
Smaug giganteus	Giant Dragon Lizard	VU	VU
Stigmochelys pardalis	Leopard Tortoise	LC	LC
Thelotornis capensis	Southern Twig Snake	LC	LC
Trachylepis capensis	Cape Skink	LC	Unlisted
Trachylepis punctatissima	Speckled Rock Skink	LC	LC
Trachylepis varia	Variable Skink	LC	LC
Varanus niloticus	Water Monitor	LC	Unlisted

Appendix 4: Listed of Amphibians

Amphibian species expected to occur in the project area

Species	Common name	Conservation Status	
		Regional (SANBI, 2016)	IUCN (2017)
Amietia angolensis	Angola River Frog	LC	LC
Amietia delalandii	Delalande's River Frog	LC	Unlisted
Amietia fuscigula	Cape River Frog	LC	LC
Breviceps adspersus	Bushveld Rain Frog	LC	LC
Cacosternum boettgeri	Common Caco	LC	LC
Kassina senegalensis	Bubbling Kassina	LC	LC
Phrynobatrachus natalensis	Snoring Puddle Frog	LC	LC
Poyntonophrynus vertebralis	Southern Pygmy Toad	LC	LC
Pyxicephalus adspersus	Giant Bullfrog	NT	LC
Schismaderma carens	African Red Toad	LC	LC
Schismaderma carens	Red Toad	LC	LC
Sclerophrys capensis	Raucous Toad	LC	LC
Sclerophrys gutturalis	Guttural Toad	LC	LC
Sclerophrys poweri	Power's Toad	LC	LC
Semnodactylus wealii	Rattling Frog	LC	LC
Strongylopus fasciatus	Striped Stream Frog	LC	LC

Tomopterna cryptotis	Tremelo Sand Frog	LC	LC
Tomopterna natalensis	Natal Sand Frog	LC	LC
Tomopterna tandyi	Tandy's Sand Frog	LC	LC
Xenopus laevis	Common Platanna	LC	LC

Appendix 5. Specialist CV.

CURRICULUM VITAE:

Gerhard Botha

Name:	:	Gerhardus Alfred Botha
Date of Birth	:	11 April 1986
Identity Number	:	860411 5136 088
Postal Address	:	PO Box 12500 Brandhof 9324
Residential Address	:	3 Jock Meiring Street Park West Bloemfontein 9301
Cell Phone Number	:	084 207 3454
Email Address	:	gabotha11@gmail.com
Profession/Specialisation	:	Ecological and Biodiversity Consultant
Nationality:	:	South African
Years Experience:	:	8
Bilingualism	:	Very good – English and Afrikaans

Professional Profile:

Gerhard is a Managing Director of Nkurenkuru Ecology and Biodiversity (Pty) Ltd. He has a BSc Honours degree in Botany from the University of the Free State Province and is currently completing a MSc Degree in Botany. He began working as an environmental specialist in 2010 and has since gained extensive experience in conducting ecological and biodiversity assessments in various development field, especially in the fields of conventional as well as renewable energy generation, mining and infrastructure development. Gerhard is a registered Professional Natural Scientist (Pr. Sci. Nat.)

Key Responsibilities:

Specific responsibilities as an Ecological and Biodiversity Specialist include, inter alia, professional execution of specialist consulting services (including flora, wetland and fauna studies, where required), impact assessment reporting, walk through surveys/ground-truthing to inform final design, compilation of management plans, compliance monitoring and audit reporting, in-house ecological awareness training to on-site personnel, and the development of project proposals for procuring new work/projects.

Skills Base and Core Competencies

- Research Project Management
- Botanical researcher in projects involving the description of terrestrial and coastal ecosystems.
- Broad expertise in the ecology and conservation of grasslands, savannahs, karroid wetland, and aquatic ecosystems.
- Ecological and Biodiversity assessments for developmental purposes (BAR, EIA), with extensive knowledge and experience in the renewable energy field (Refer to Work Experiences and References)
- Over 3 years of avifaunal monitoring and assessment experience.
- Mapping and Infield delineation of wetlands, riparian zones and aquatic habitats (according to methods stipulated by DWA, 2008) within various South African provinces of KwaZulu-Natal, Mpumalanga, Free State, Gauteng and Northern Cape Province for inventory and management purposes.
- Wetland and aquatic buffer allocations according to industry best practice guidelines.
- Working knowledge of environmental planning policies, regulatory frameworks, and legislation
- Identification and assessment of potential environmental impacts and benefits.
- Assessment of various wetland ecosystems to highlight potential impacts, within current and proposed landscape settings, and recommend appropriate mitigation and offsets based on assessing wetland ecosystem service delivery (functions) and ecological health/integrity.
- Development of practical and achievable mitigation measures and management plans and evaluation of risk to execution
- Qualitative and Quantitative Research
- Experienced in field research and monitoring
- Working knowledge of GIS applications and analysis of satellite imagery data
- Completed projects in several Provinces of South Africa and include a number of projects located in sensitive and ecological unique regions.

Education and Professional Status

Degrees:

- *2015:* Currently completing a M.Sc. degree in Botany (Vegetation Ecology), University of the Free State, Bloemfontein, RSA.
- *2009:* B.Sc. Hons in Botany (Vegetation Ecology), University of the Free State, Bloemfontein, RSA.
- *2008:* B.Sc. in Zoology and Botany, University of the Free State, University of the Free State, Bloemfontein, RSA.

Courses:

- *2013*: Wetland Management (ecology, hydrology, biodiversity, and delineation) – University of the Free State accredited course.
- *2014*: Introduction to GIS and GPS (Code: GISA 1500S) – University of the Free State accredited course.

Professional Society Affiliations:

- The South African Council of Natural Scientific Professions: Pr. Sci. Nat. Reg. No. 400502/14 (Botany and Ecology).

Employment History

- December 2017 – Current: Nkurenkuru Ecology and Biodiversity (Pty) Ltd
- 2016 – November 2017: ECO-CARE Consultancy

- *2015 - 2016*: Ecologist, Savannah Environmental (Pty) Ltd
- *2013 – 2014*: Working as ecologist on a freelance basis, involved in part-time and contractual positions for the following companies
    - Enviroworks (Pty) Ltd
    - GreenMined (Pty) Ltd
    - Eco-Care Consultancy (Pty) Ltd
    - Enviro-Niche Consulting (Pty) Ltd
    - Savannah Environmental (Pty) Ltd
    - Esicongweni Environmental Services (EES) cc
- *2010 - 2012*: Enviroworks (Pty) Ltd

Publications

Publications:

- Botha, G.A. & Du Preez, P.J. 2015. A description of the wetland and riparian vegetation of the Nxamasere palaeo-river's backflooded section, Okavango Delta, Botswana. S. *Afr. J. Bot*., **98**: 172-173.

Congress papers/posters/presentations:

- Botha, G.A. 2015. A description of the wetland and riparian vegetation of the Nxamasere palaeo-river's backflooded section, Okavango Delta, Botswana. 41st Annual Congress of South African Association of Botanists (SAAB). Tshipise, 11-15 Jan. 2015.
- Botha, G.A. 2014. A description of the vegetation of the Nxamasere floodplain, Okavango Delta, Botswana. 10st Annual University of Johannesburg (UJ) Postgraduate Botany Symposium. Johannesburg, 28 Oct. 2014.

Other

- Guest speaker at IAIAsa Free State Branch Event (29 March 2017)
- Guest speaker at the University of the Free State Province: Department of Plant Sciences (3 March 2017):

References:

- Christine Fouché
  Manager: GreenMined (Pty) LTD
  Cell: 084 663 2399
- Professor J du Preez
  Senior lecturer: Department of Plant Sciences
  University of the Free State
  Cell: 082 376 4404

Appendix 6. Specialist's Work Experience and References

WORK EXPERIENCES

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References

Gerhard Botha

ECOLOGICAL RELATED STUDIES AND SURVEYS

Date Completed	Project Description	Type of Assessment/Study	Client
2019	Sirius Three Solar PV Facility near Upington, Northern Cape	Ecological Assessment (Basic Assessment)	Aurora Power Solutions
2019	Sirius Four Solar PV Facility near Upington, Northern Cape	Ecological Assessment (Basic Assessment)	Aurora Power Solutions
2019	Lichtenburg 1 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Lichtenburg 2 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Lichtenburg 3 100MW Solar PV Facility, Lichtenburg, North-West Province	Ecological Assessment (Scoping and EIA Phase Assessments)	Atlantic Renewable Energy Partners
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Ecological Assessment (Basic Assessment)	Moeding Solar
2019	Expansion of the Raumix Aliwal North Quarry, Eastern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	GreenMined
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Faunal and Flora Rescue and Protection Plan	Zevobuzz
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Zevobuzz
2018	Proposed Kruisvallei Hydroelectric Power Generation Scheme in the Ash River, Free State Province	Ecological Assessment (Basic Assessment)	Zevobuzz
2018	Proposed Zonnebloem Switching Station (132/22kV) and 2X Loop-in Loop-out Power Lines (132kV), Mpumalanga Province	Ecological Assessment (Basic Assessment)	Eskom
2018	Clayville Thermal Plant within the Clayville Industrial Area, Gauteng Province	Ecological Comments Letter	Savannah Environmental
2018	Iziduli Emoyeni Wind Farm near Bedford, Eastern Cape Province	Ecological Assessment (Re-assessment)	Emoyeni Wid Farm Renewable Energy
2018	Msenge Wind Farm near Bedford, Eastern Cape Province	Ecological Assessment (Re-assessment)	Amakhala Emoyeni Renewable Energy

2017	H2 Energy Power Station near Kwamhlanga, Mpumalanga Province	Ecological Assessment (Scoping and EIA phase assessments)	Eskom
2017	Karusa Wind Farm (Phase 1 of the Hidden Valley Wind Energy Facility near Sutherland, Northern Cape Province)	Ecological Assessment (Re-assessment)	ACED Renewables Hidden Valley
2017	Soetwater Wind Farm (Phase 2 of the Hidden Valley Wind Energy Facility near Sutherland, Northern Cape Province)	Ecological Assessment (Re-assessment)	ACED Renewables Hidden Valley
2017	S24G for the unlawful commencement or continuation of activities within a watercourse, Honeydew, Gauteng Province	Ecological Assessment	Savannah Environmental
2016 - 2017	Noupoort CSP Facility near Noupoort, Northern Cape Province	Ecological Assessment (Scoping and EIA phase assessments)	Cresco
2016	Buffels Solar 2 PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Kabi Solar
2016	Buffels Solar 1 PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Kabi Solar
2016	132kV Power Line and On-Site Substation for the Authorised Golden Valley II Wind Energy Facility near Bedford, Eastern Cape Province	Ecological Assessment (Basic Assessment)	Terra Wind Energy
2016	Kalahari CSP Facility: 132kV Ferrum–Kalahari–UNTU & 132kV Kathu IPP–Kathu 1 Overhead Power Lines, Kathu, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Kathu Solar Park
2016	Kalahari CSP Facility: Access Roads, Kathu, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Kathu Solar Park
2016	Karoshoek Solar Valley Development – Additional CSP Facility including tower infrastructure associated with authorised CSP Site 2 near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Karoshoek Solar Valley Development –Ilanga CSP 7 and 8 Facilities near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Karoshoek Solar Valley Development –Ilanga CSP 9 Facility near Upington, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Emvelo
2016	Lehae Training Academy and Fire Station, Gauteng Province	Ecological Assessment	Savannah Environmental
2016	Metal Industrial Cluster and Associated Infrastructure near Kuruman, Northern Cape Province	Ecological Assessment (Scoping Assessment)	Northern Cape Department of Economic Development and Tourism
2016	Semonkong Wind Energy Facility near Semonkong, Maseru District, Lesotho	Ecological Pre-Feasibility Study	Savannah Environmental
2015 - 2016	Orkney Solar PV Facility near Orkney, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Genesis Eco-Energy
2015 - 2016	Woodhouse 1 and Woodhouse 2 PV Facilities near Vryburg, North West Province	Ecological Assessment (Scoping and EIA phase assessments)	Genesis Eco-Energy
2015	CAMCO Clean Energy 100kW PV Solar Facility, Thaba Eco Lodge near Johannesburg, Gauteng Province	Ecological Assessment (Basic Assessment)	CAMCO Clean Energy
2015	CAMCO Clean Energy 100kW PV Solar Facility, Thaba Eco Lodge near Johannesburg, Gauteng Province	Ecological Assessment (Basic Assessment)	CAMCO Clean Energy

2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Aurora Power Solutions
2015	Sirius 2 Solar PV Project near Upington, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Invasive Plant Management Plan	Aurora Power Solutions
2015	Sirius 2 Solar PV Project near Upington, Northern Cape Province	Invasive Plant Management Plan	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Plant Rehabilitation Management Plan	Aurora Power Solutions
2015	Sirius Phase 2 Solar PV Project near Upington, Northern Cape Province	Plant Rehabilitation Management Plan	Aurora Power Solutions
2015	Sirius 1 Solar PV Project near Upington, Northern Cape Province	Plant Rescue and Protection Plan	Aurora Power Solutions
2015	Sirius Phase 2 Solar PV Project near Upington, Northern Cape Province	Plant Rescue and Protection Plan	Aurora Power Solutions
2015	Expansion of the existing Komsberg Main Transmission Substation near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ESKOM
2015	Karusa Wind Farm near Sutherland, Northern Cape Province)	Invasive Plant Management Plan	ACED Renewables Hidden Valley
2015	Proposed Karusa Facility Substation and Ancillaries near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ACED Renewables Hidden Valley
2015	Eskom Karusa Switching Station and 132kV Double Circuit Overhead Power Line near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ESKOM
2015	Karusa Wind Farm near Sutherland, Northern Cape Province)	Plant Search and Rescue and Rehabilitation Management Plan	ACED Renewables Hidden Valley
2015	Karusa Wind Energy Facility near Sutherland, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	ACED Renewables Hidden Valley
2015	Soetwater Facility Substation, 132kV Overhead Power Line and Ancillaries, near Sutherland, Northern Cape Province	Ecological Assessment (Basic Assessment)	ACED Renewables Hidden Valley
2015	Soetwater Wind Farm near Sutherland, Northern Cape Province)	Invasive Plant Management Plan	ACED Renewables Hidden Valley
2015	Soetwater Wind Energy Facility near Sutherland, Northern Cape Province	Fauna and Flora Pre-Construction Walk-Through Assessment	ACED Renewables Hidden Valley
2015	Soetwater Wind Farm near Sutherland, Northern Cape Province	Plant Search and Rescue and Rehabilitation Management Plan	ACED Renewables Hidden Valley
2015	Expansion of the existing Scottburgh quarry near Amandawe, KwaZulu-Natal	Botanical Assessment (for EIA)	GreenMined Environmental
2015	Expansion of the existing AFRIMAT quarry near Hluhluwe, KwaZulu-Natal	Botanical Assessment (for EIA)	GreenMined Environmental
2014	Tshepong 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Nyala 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Eland 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Ecological Assessment (Basic Assessment)	BBEnergy
2014	Transalloys circulating fluidised bed power station near Emalahleni, Mpumalanga Province	Ecological Assessment (for EIA)	Trans-Alloys
2014	Umbani circulating fluidised bed power station near Kriel, Mpumalanga Province	Ecological Assessment (Scoping and EIA)	Eskom
2014	Gihon 75MW Solar Farm: Bela-Bela, Limpopo Province	Ecological Assessment (for EIA)	NETWORX Renewables

2014	Steelpoort Integration Project & Steelpoort to Wolwekraal 400kV Power Line	Fauna and Flora Pre-Construction Walk-Through Assessment	Eskom
2014	Audit of protected *Acacia erioloba* trees within the Assmang Wrenchville housing development footprint area	Botanical Audit	Eco-Care Consultancy
2014	Rehabilitation of the N1 National Road between Sydenham and Glen Lyon	Peer review of the ecological report	EKO Environmental
2014	Rehabilitation of the N6 National Road between Onze Rust and Bloemfontein	Peer review of the ecological report	EKO Environmental
2011	Illegally ploughed land on the Farm Wolwekop 2353, Bloemfontein	Vegetation Rehabilitation Plan	EnviroWorks
2011	Rocks Farm chicken broiler houses	Botanical Assessment (for EIA)	EnviroWorks
2011	Botshabelo 132 kV line	Ecological Assessment (for EIA)	CENTLEC
2011	De Aar Freight Transport Hub	Ecological Scoping and Feasibility Study	EnviroWorks
2011	The proposed establishment of the Tugela Ridge Eco Estate on the farm Kruisfontein, Bergville	Ecological Assessment (for EIA)	EnviroWorks
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Vegetation Rehabilitation Plan for illegally cleared areas	NEOTEL
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Invasive Plant Management Plan	NEOTEL
2010 - 2011	National long-haul optic fibre infrastructure network project, Bloemfontein to Beaufort West	Protected and Endangered Species Walk-Through Survey	NEOTEL
2011	Optic Fibre Infrastructure Network, Swartland Municipality	Botanical Assessment (for EIA) - Assisted Dr. Dave McDonald	Dark Fibre Africa
2011	Optic Fibre Infrastructure Network, City of Cape Town Municipality	Botanical Assessment (for EIA) - Assisted Dr. Dave McDonald	Dark Fibre Africa
2010	Construction of an icon at the southernmost tip of Africa, Agulhas National Park	Botanical Assessment (for EIA)	SANPARKS
2010	New boardwalk from Suiderstrand Gravel Road to Rasperpunt, Agulhas National Park	Botanical Assessment (for EIA)	SANPARKS
2010	Farm development for academic purposes (Maluti FET College) on the Farm Rosedale 107, Harrismith	Ecological Assessment (Screening and Feasibility Study)	Agri Development Solutions
2010	Basic Assessment: Barcelona 88/11kV substation and 88kV loop-in lines	Botanical Assessment (for EIA)	Eskom Distribution
2011	Illegally ploughed land on the Farm Wolwekop 2353, Bloemfontein	Vegetation Rehabilitation Plan	EnviroWorks

WETLAND DELINEATION AND HYDROLOGICAL ASSESSMENTS

Date Completed	Project Description	Type of Assessment/Study	Client
In progress	Steynsrus PV 1 & 2 Solar Energy Facilities near Steynsrus, Free State Province	Wetland Assessment	Cronimet Mining Power Solutions
2019	Lichtenburg 1 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Lichtenburg 2 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Lichtenburg 3 100MW Solar PV Facility, Lichtenburg, North-West Province	Surface Hydrological Assessment (Scoping and EIA Phase)	Atlantic Renewable Energy Partners
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Wetland Assessment (Basic Assessment)	Moeding Solar
2018	Kruisvallei Hydroelectric 22kV Overhead Power Line, Clarens, Free State Province	Wetland Assessment (Basic Assessment	Zevobuzz
2017	Nyala 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Wetland Assessment	BBEnergy

2017	Eland 5MW PV facility within Harmony Gold's mining rights areas, Odendaalsrus	Wetland Assessment	BBEnergy
2017	Olifantshoek 10MVA 132/11kV Substation and 31km Power Line	Surface Hydrological Assessment (Basic Assessment)	Eskom
2017	Expansion of the Elandspruit Quarry near Ladysmith, KwaZulu-Natal Province	Wetland Assessment	Raumix
2017	S24G for the unlawful commencement or continuation of activities within a watercourse, Honeydew, Gauteng Province	Aquatic Assessment & Flood Plain Delineation	Savannah Environmental
2017	Noupoort CSP Facility near Noupoort, Northern Cape Province	Surface Hydrological Assessment (EIA phase)	Cresco
2016	Wolmaransstad Municipality 75MW PV Solar Energy Facility in the North West Province	Wetland Assessment (Basic Assessment)	BlueWave Capital
2016	BlueWave 75MW PV Plant near Welkom Free State Province	Wetland Delineation	BlueWave Capital
2016	Harmony Solar Energy Facilities: Amendment of Pipeline and Overhead Power Line Route	Wetland Assessment (Basic Assessment)	BBEnergy

AVIFAUNAL ASSESSMENTS

Date Completed	Project Description	Type of Assessment/Study	Client
2019	Sirius Three Solar PV Facility near Upington, Northern Cape	Avifauna Assessment (Basic Assessment)	Aurora Power Solutions
2019	Sirius Four Solar PV Facility near Upington, Northern Cape	Avifauna Assessment (Basic Assessment)	Aurora Power Solutions
2019	Moeding Solar PV Facility near Vryburg, North-West Province	Avifauna Assessment (Basic Assessment)	Moeding Solar
2018	Proposed Zonnebloem Switching Station (132/22kV) and 2X Loop-in Loop-out Power Lines (132kV), Mpumalanga Province	Avifauna Assessment (Basic Assessment)	Eskom
2017	Olifantshoek 10MVA 132/11kV Substation and 31km Power Line	Avifauna Assessment (Basic Assessment)	Eskom
2016	TEWA Solar 1 Facility, east of Upington, Northern Cape Province	Wetland Assessment (Basic Assessment	Tewa Isitha Solar 1
2016	TEWA Solar 2 Facility, east of Upington, Northern Cape Province	Wetland Assessment	Tewa Isitha Solar 2

ENVIRONMENTAL IMPACT ASSESSMENT

- Barcelona 88/11kV substation and 88kV loop-in lines – BA (for Eskom).
- Thabong Bulk 132kV sub-transmission inter-connector line – EIA (for Eskom).
- Groenwater 45 000 unit chicken broiler farm – BA (for Areemeng Mmogo Cooperative).
- Optic Fibre Infrastructure Network, City of Cape Town Municipality – BA (for Dark Fibre Africa (Pty) Ltd).
- Optic Fibre Infrastructure Network, Swartland Municipality – BA (for Dark Fibre Africa).
- Construction and refurbishment of the existing 66kV network between Ruigtevallei Substation and Reddersburg Substation – EMP (for Eskom).
- Lower Kruisvallei Hydroelectric Power Scheme (Ash river) – EIA (for Kruisvallei Hydro (Pty) Ltd).
- Construction of egg hatchery and associated infrastructure – BA (For Supreme Poultry).

- Construction of the Klipplaatdrif flow gauging (Vaal river) – EMP (DWAF).

ENVIRONMENTAL COMPLIANCE AUDITING AND ECO

- National long haul optic fibre infrastructure network project, Bloemfontein to Laingsburg – ECO (for Enviroworks (Pty) Ltd.).
- National long haul optic fibre infrastructure network project, Wolmaransstad to Klerksdorp – ECO (for Enviroworks (Pty) Ltd.).
- Construction and refurbishment of the existing 66kV network between Ruigtevallei Substation and Reddersburg Substation – ECO (for Enviroworks (Pty) Ltd.).
- Construction and refurbishment of the Vredefort/Nooitgedacht 11kV power line – ECO (for Enviroworks (Pty) Ltd.).
- Mining of Dolerite (Stone Aggregate) by Raumix (Pty) Ltd. on a portion of Portion 0 of the farm Hillside 2830, Bloemfontein – ECO (for GreenMined Environmental (Pty) Ltd.).
- Construction of an Egg Production Facility by Bainsvlei Poultry (Pty) Ltd on Portions 9 & 10 of the farm, Mooivlakte, Bloemfontein – ECO (for Enviro-Niche Consulting (Pty) Ltd.).
- Environmental compliance audit and botanical account of Afrisam's premises in Bloemfontein – Environmental Compliance Auditing (for Enviroworks (Pty) Ltd.).

OTHER PROJECTS:

- Keeping and breeding of lions (*Panthera leo*) on the farm Maxico 135, Ficksburg – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Keeping and breeding of lions (*Panthera leo*) on the farm Mooihoek 292, Theunissen – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Keeping and breeding of wild dogs (*Lycaon pictus*) on the farm Mooihoek 292, Theunissen – Management and Business Plan (for Enviroworks (Pty) Ltd.)
- Existing underground and aboveground fuel storage tanks, TWK AGRI: Pongola – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks on Erf 171, TWK AGRI: Amsterdam – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 14 000 L of fuel (diesel) aboveground on Erf 32, TWK AGRI: Carolina – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 23 000 L of fuel (diesel) above ground on Portion 10 of the Farm Oude Bosch, Humansdorp – Environmental Management Plan (for TWK Agricultural Ltd).
- Proposed storage of 16 000 L of fuel (diesel) aboveground at Panbult Depot – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks, TWK AGRI: Mechanisation and Engineering, Piet Retief – Environmental Management Plan (for TWK Agricultural Ltd).
- Existing underground fuel storage tanks on Portion 38 of the Farm Lothair, TWK AGRI: Lothair – Environmental Management Plan (for TWK Agricultural Ltd).