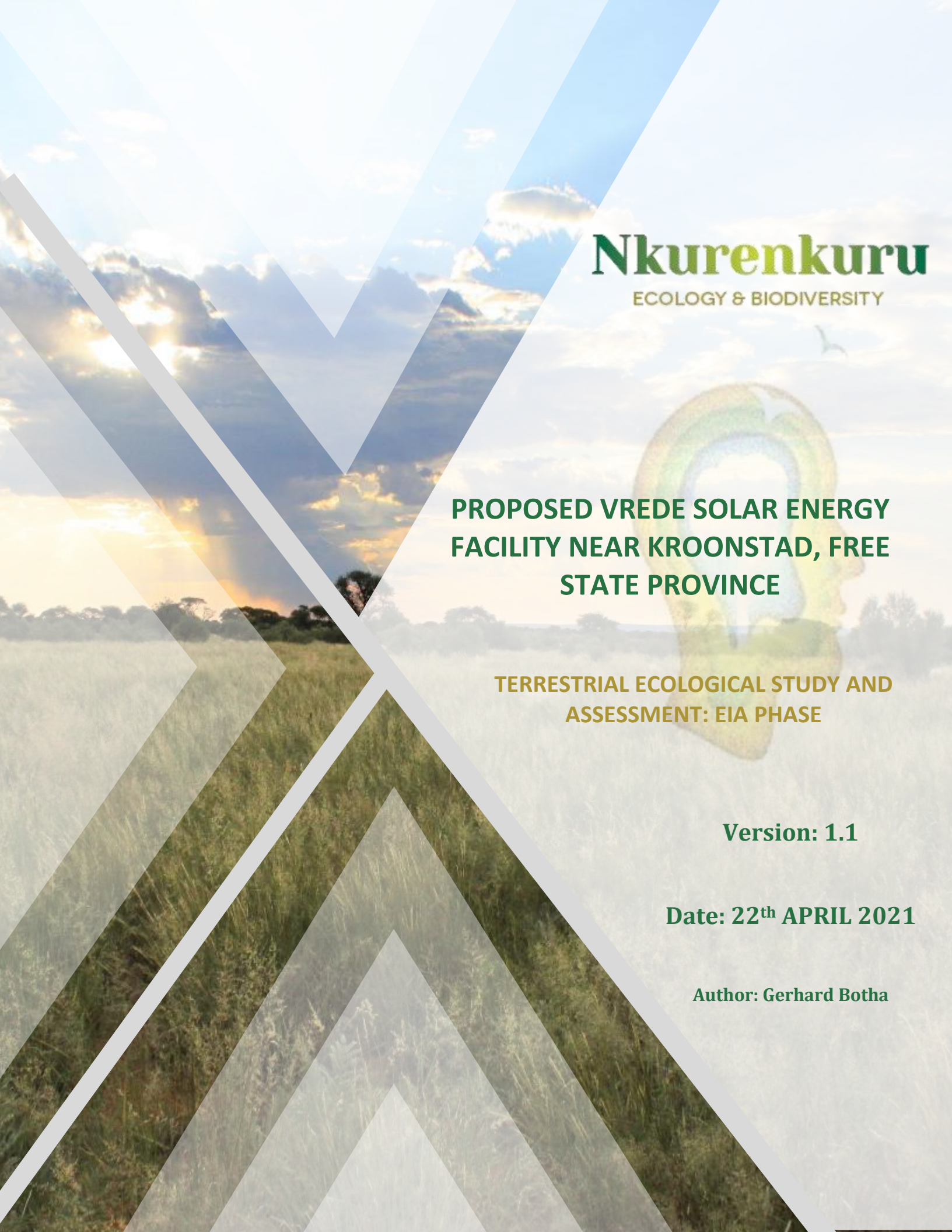

Nkurenkuru
ECOLOGY & BIODIVERSITY

PROPOSED VREDE SOLAR ENERGY FACILITY NEAR KROONSTAD, FREE STATE PROVINCE

TERRESTRIAL ECOLOGICAL STUDY AND ASSESSMENT: EIA PHASE

Version: 1.1

Date: 22th APRIL 2021

Author: Gerhard Botha

PROPOSED VREDE SOLAR ENERGY FACILITY NEAR KROONSTAD, FREE STATE PROVINCE

Report Title: Terrestrial Ecological Study and Assessment: EIA Phase

Authors: Mr. Gerhard Botha

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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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April 2021

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PROPOSED VREDE 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 Vrede 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 100 MWac Vrede 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 (Figure 1). The total size of the project area is approximately 263ha whilst the development footprint itself will cover 217ha (inclusive of the 3.3ha sub-station area).

The properties investigated include:
» Remaining extent of the farm Vrede No. 1152 (main & grid site);
» Portion 1 of the farm Uitval No. 1104 (main site);
» Remaining Extent of the farm Gesukkel No. 1153 (grid site); and
» Remaining Extent of the farm Geduld No. 1156 (grid site).

The Vrede SEF is proposed on the following properties:
» Remaining extent of the farm Vrede No. 1152; and
» Portion 1 of the farm Uitval No. 1104.

The grid connection infrastructure is proposed on the following properties:

» Remaining extent of the farm Vrede No. 1152;
» Remaining Extent of the farm Gesukkel No. 1153; and
» Remaining Extent of the farm Geduld No. 1156.

*** Please take not that even though the proposed grid connection has been mentioned above, the assessment of this infrastructure will be done in a separate Environmental Basic Assessment Report. This 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.

Access to the SEF will be via the S172 gravel road which links the farming area with the P99/1 route.

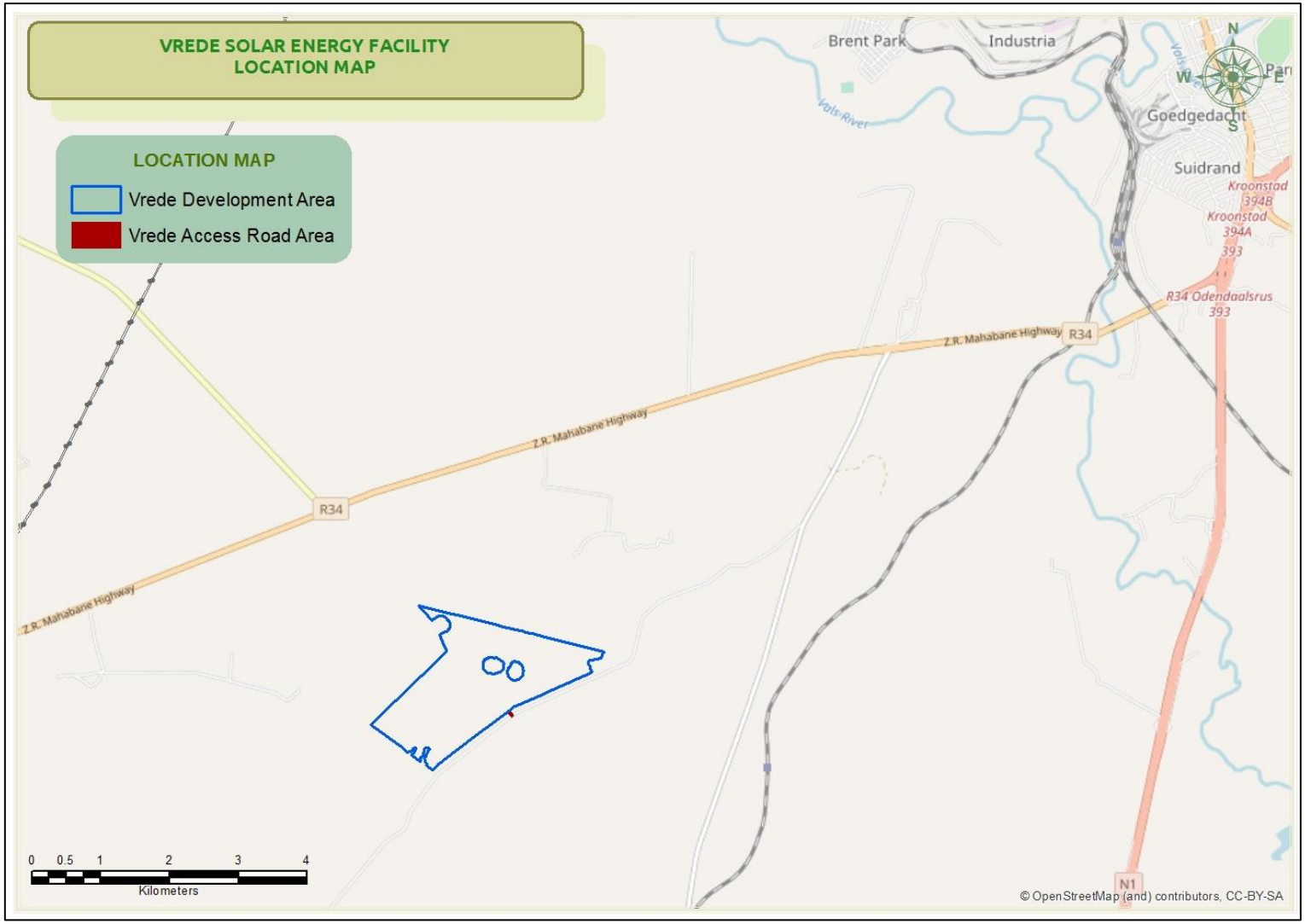


Figure 1: Proposed location of the Vrede SEF

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)
	DWA Eco-regions (GIS Coverage)	Understand the regional biophysical context in which water	DWA (2005)

		resources within the study area occur	
Conservation and Distribution Context	**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)
	Strategic Water Source Areas for Surface Water (SWSA-sw) (GIS Coverage)	Shows the location of the development area relative to areas that contribute significantly to the overall water supply of the country	CSIR (2017)

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.

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 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 ▪ 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).	▪ 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 (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).	▪ 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.

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
	▪ 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: ▪ 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)	▪ Habitat with exceptionally high diversity (richness or turnover). ▪ Habitat with unique species composition and narrow distribution. ▪ Ecosystem providing high value ecosystem goods and services.
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 3). 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 approximately 60% of the entire development area is located on cultivated fields (dryland), whist approximately 35% of the project site can be regarded as a natural form of grassland. Furthermore, approximately 4% of the project site is covered by wetlands.

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.

The results of a spatial analysis, which were also confirmed during the field work, were as follows, and are illustrated in Figure 4:

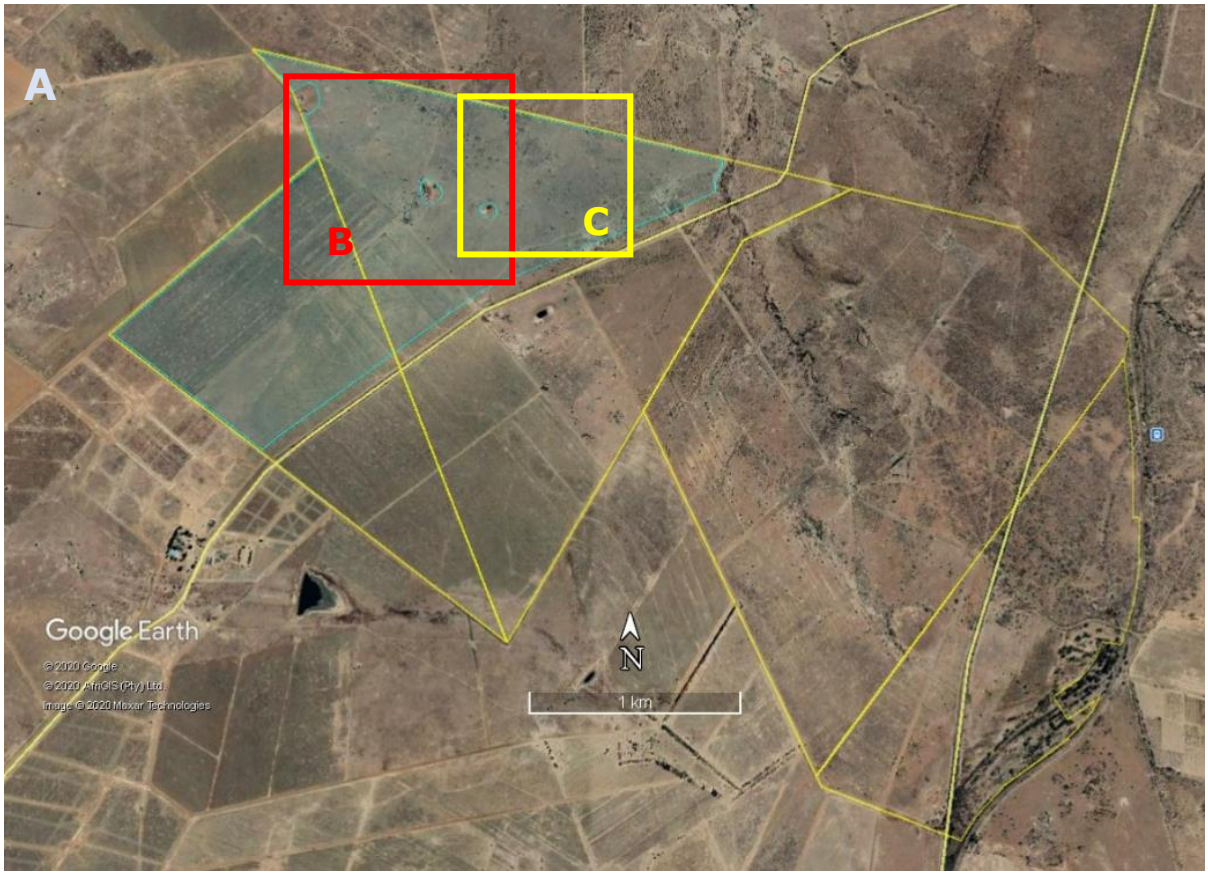
Land cover and land-use changes often indicate major impacts on biodiversity, especially if those changes show the loss of natural habitat due to urban sprawl, cultivation, etc.

The affected properties are predominantly used for agricultural purposes, in the past mainly for dryland cultivation, and to a lesser extent for livestock farming (predominantly cattle). However, cultivation practices have been abandoned within the project area for a relative long period of time. Game farming have also become much more prominent within the

region over the last decade (wide variety of game species including rare antelope and big game such as buffalo).

Currently (and for a long period of time), no cultivation activities are taking place. Approximately 60% of the development area appears to be fallow lands, most recently abandoned (<20 years) and is now used as pastures for cattle. Historically cultivated land (> 30 years), covers an area of approximately 18% (of the development area) and appears to have been re-established by grasses and low shrubs (plagioclimax grassland), with the only evidence, from available spatial data, being feint ploughing contour lines (Figure 2). These areas are also now likely being utilised as grazing. Subsequently, approximately 78% of the development area has been, at some point in time, subjected to ploughing (soil and vegetation disturbance) and cultivation. Only approximately 20% natural veld remain comprising of grasslands with varying coverage/density of shrubs.

Furthermore, natural wetland features cover approximately 2% of the project area, comprising mostly of valley-bottom and depression wetlands. Small earth dam structures have been created within some of the wetlands, in an attempt to concentrate and store surface water for longer periods of time within these wetland features.



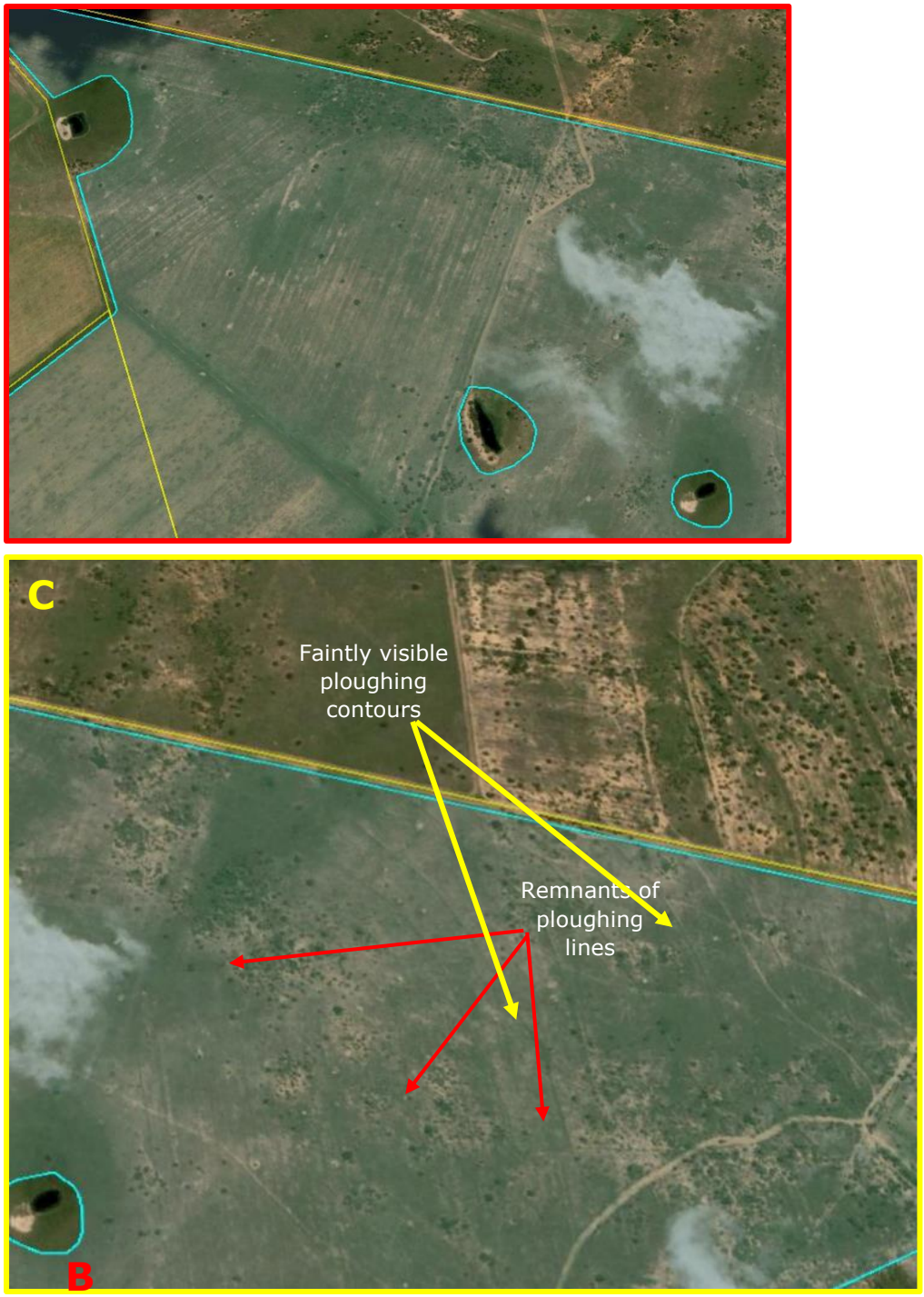


Figure 2 (A-C) Evidence of historical cultivation (>10years) within areas that have been mapped as natural grassland within the Free State Province Land Cover dataset as well as within the Critical Biodiversity Area data sets.

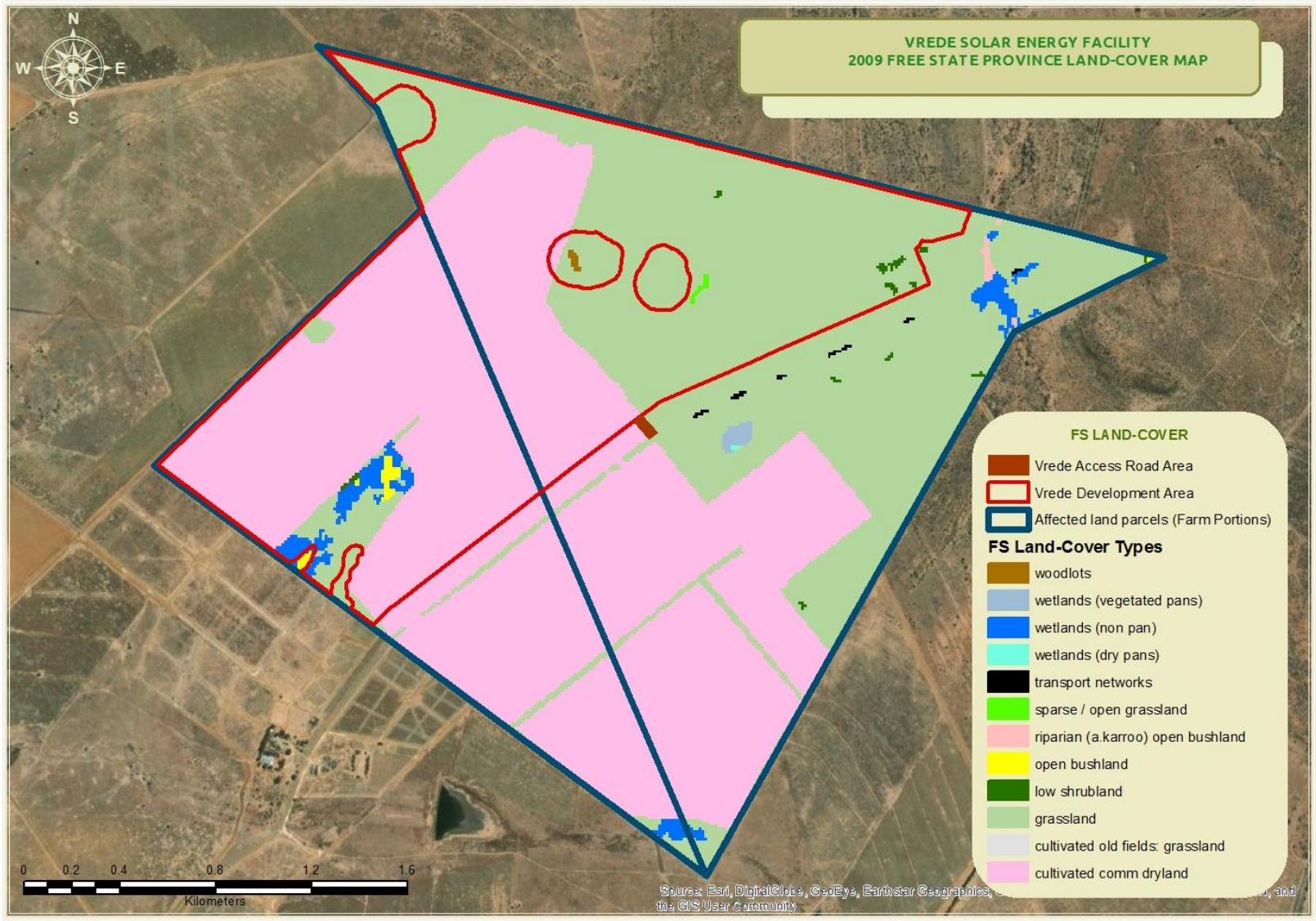


Figure 3: 2009 Free State Province Land-Cover Map (note: cultivated land illustrated here has since been abandoned and is now utilised as pastures for cattle farming, as was confirmed during the site visit).

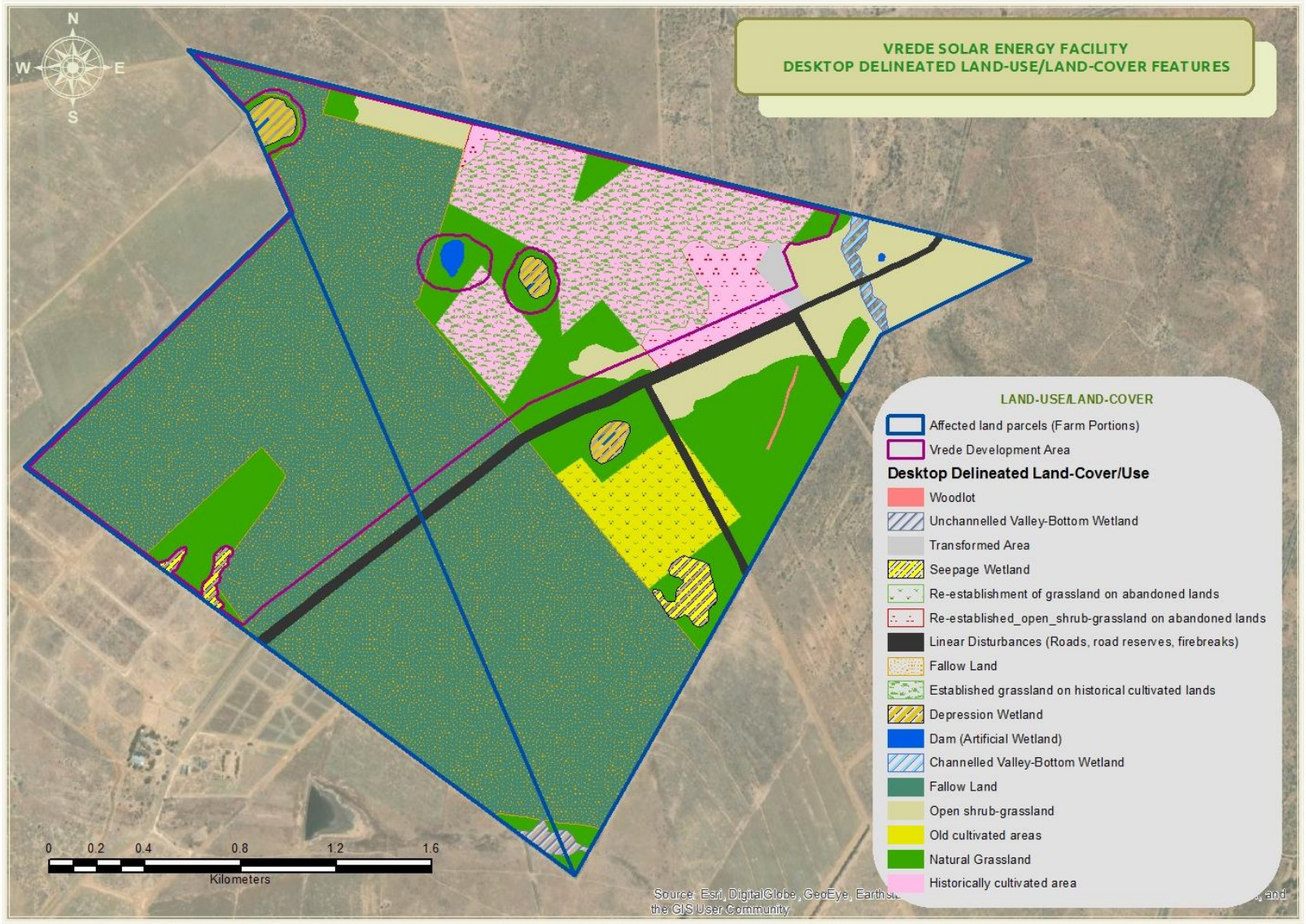


Figure 4: Desktop delineated land-cover features (these features were confirmed during the field work).

Regional/Local Biophysical Setting

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				
DWA Ecoregions	Level 1	Level 2		DWA, 2005
	Highveld	11.08		
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> Plains-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*			Mucina & Rutherford, (2006, & 2018)

	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.	
BODATSA Data	Regional: Total Species Observed	2020-08-02_231620030-BRAHMSOnlineData
	491	
	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	

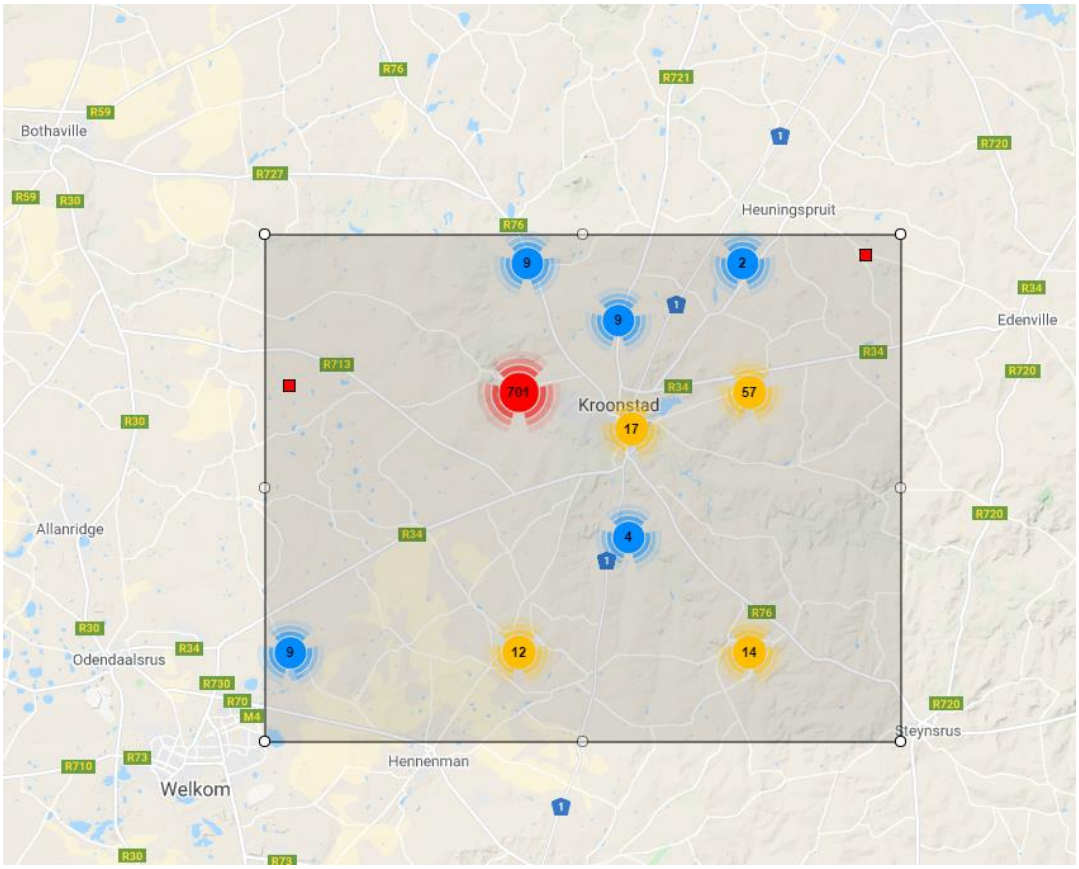


Figure 5: Extracted area and sample locations from POSA. Extracted data was used to compile a plant species list of species that may potentially occur within the project site and provide an indication of potential conservation important species that may be found within the area.

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	Outside of Focus Area: ± 2km south of a Free State Highveld Focus Area	Not Classified
	Protected Areas and Conservation Areas (PACA) Database	South African Conservation Area (SACA)	Well outside of any SACA:	Not Classified
		South African Protected Area (SAPA)	Located adjacent, south of Boslaagte Private Nature Reserve	Boslaagte Private Nature Reserve
	Vegetation Types	Vaal-Vet Sandy Grassland	Vegetation of Study Area	Endangered
		Central Free State Grassland	Vegetation of Study Area	Least Threatened
	Threatened Ecosystems	Vaal-Vet Sandy Grassland Ecosystem	Ecosystems of Study Area	Endangered
	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 CONSERVATION PLANNING CONTEXT	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. No ESA1 located within the SEF development area.	ESA
		Critical Biodiversity Areas CBA1	Natural areas of Vaal-Vet Sandy Grassland which are regarded as irreplaceable and essential in meeting the biodiversity conservation targets as set out for the Free State Province North-eastern and north-western portions of SEF	CBA1

			development area falls within CBAs	

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 outside of any Focus Area (Figure 6) with the closest focus area located approximately 2km to the north (Free State Highveld Focus Area). Subsequently, no NPAES Focus Areas will be impacted by the development.

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 adjacent to the north of the proposed SEF footprint (Figure 6). Such nature reserves are typically well cordoned off with game fences, often with some electrified wires, 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. Some disturbance of the nature reserves' fauna may however occur along the boundary fence during the construction phase and periods of maintenance during the operational phase. Most animals will likely merely move away from the area near the disturbance and will likely move back as the movement and noise declines. This potential impact was assessed in this report and recommendations and mitigation measures provided as required, in order to reduce the impact of noise and human movement on the fauna of the nature reserve.

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)
Vaal-Vet Sandy Grassland	24%	0.3%	65.2%	Endangered	Endangered
Central Free State Grassland	24%	0.8%	23.5%	Least Concerned	Not Listed

According to current layout the bulk of the SEF footprint is located within the endangered Vaal-Vet Sandy Grassland (Figure 6), with only a small portion of the north-eastern corner falling within the Central Free State Grassland. However, as described earlier (Land cover and Land Use Section), approximately 78% of the development footprint is located within transformed areas whist only 20% of the footprint is located in what appears to be grassland largely consistent to that of Vaal-Vet Sandy Grassland. Furthermore, during the field survey it was found that only approximately 10% of the project area resembles a slightly impacted form of Vaal-Vet Sandy Grassland

During the survey and assessment, it was determined that most of these areas identified as Natural Vaal-Vet Sandy Grassland have been historically subjected to cultivation and vegetation transformation, with small patches of remaining natural vegetation, resembling natural, untransformed Vaal-Vet Sandy Grassland. These patches of natural grassland, collectively, only cover an area of less than 15% of the proposed projects site, furthermore, most of these patches of natural Vaal-Vet Sandy Grassland along the northern boundary will be avoided, according the development layout. Although the development will impact 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 transformed habitats.

At species level:

No Plant SCC have been historically observed within the development site, according to available plant species lists of the area; however, a few provincially protected species have been observed namely;

- *Aloe davyana* (a single species, just outside of the development footprint),
- *Boophone disticha,*
- *Schizocarpus nervosus,*
- *Amorcharis conranica* (the plants observed were associated with the wetland habitats and as these habitats will be avoided, these species will not be impacted).

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.

Due to the small extent of natural grassland remaining within the SEF footprint, as well as the fractured nature of these patches of natural grassland, it is unlikely that the development will have a significant impact on this vegetation/ecosystem type.

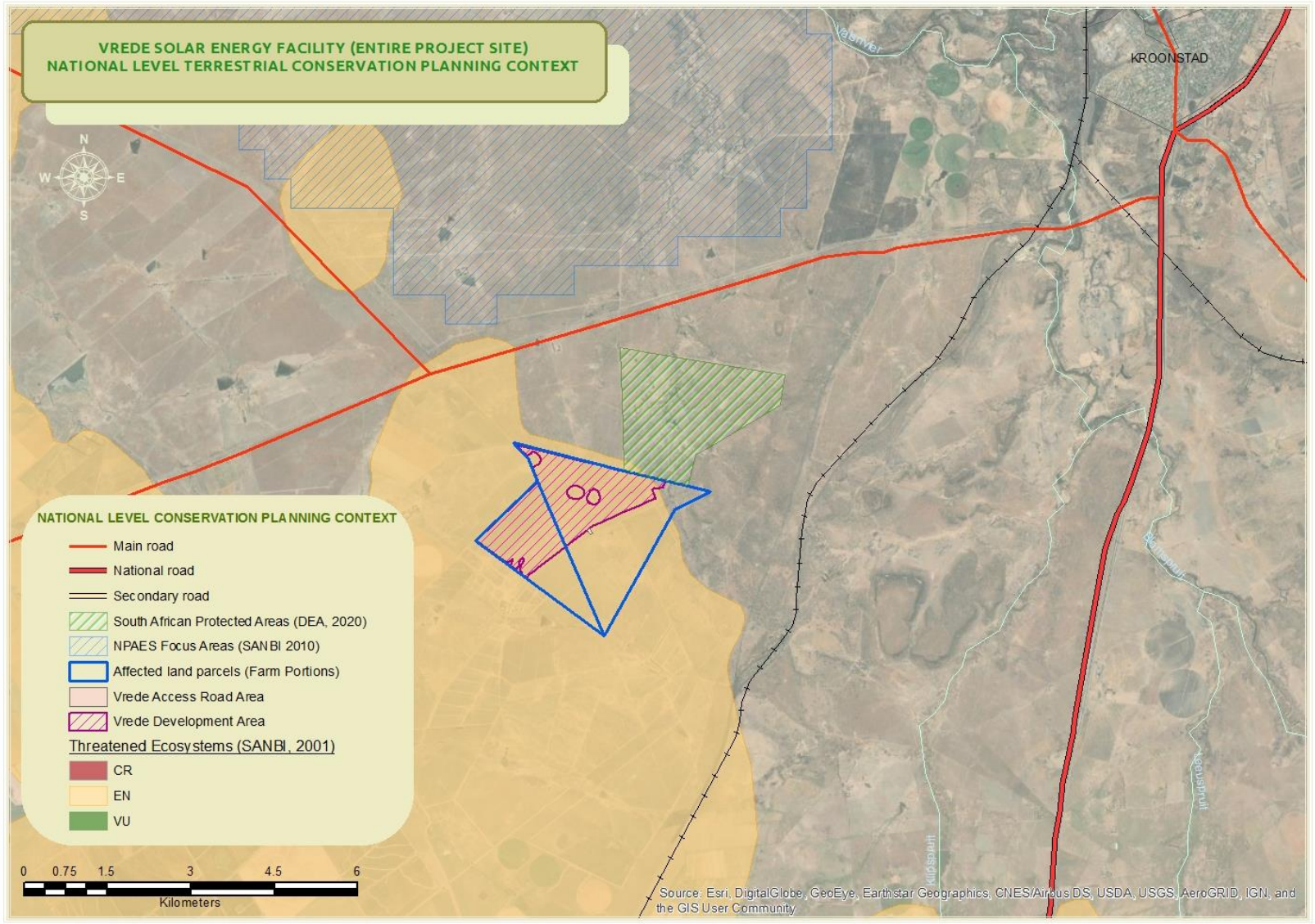


Figure 6: National Level Terrestrial Conservation Planning Context

Critical Biodiversity Areas and Broad Scale Ecological Processes

The SEF development area occurs 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 majority of the development area occurs within degraded areas whilst the north-eastern and north-western portions of the footprint is located within CBA1 (Figure 8). No ESA1 or 2 sites occur within the development footprint.

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).

Critical Biodiversity Areas 1

The CBAs located within the development area, have been classified as such due to fact that these areas are regarded as irreplaceable as they are potentially essential in meeting the targets set for the conservation of the endangered Vaal-Vet Sandy Grassland. However, during the field survey, it was found that large portions that have been classified as CBAs were in fact historical cultivated areas that have been left fallow for an extensive period of time allowing for succession to take place to a stage where these areas are now covered with a relative stable grass and shrub cover. Subsequently, natural/original Vaal-Vet Sandy Grassland are only confined to a few isolated patches. Due to the small extent and patchy distribution of this endangered vegetation type within the SEF footprint, it is unlikely that this development will have an impact on the status of the remaining natural Vaal-Vet Sandy Grassland.

National Freshwater Ecosystem Priority Areas (2011) Database

The National Freshwater Ecosystems Priority Areas (NFEPA) (2011) database provides strategic spatial priorities for conserving South Africa's freshwater ecosystems and supports the sustainable use of water resources. The spatial priority areas are known as Freshwater Ecosystem Priority Areas (FEPAs).

FEPAs were identified based on:

» Representation of ecosystem types and flagship free-flowing rivers.
» Maintenance of water supply areas in areas with high water yield.
» Identification of connected ecosystems.
» Preferential identification of FEPAs that overlapped with"
  - Any free-flowing river
  - Priority estuaries identified in the National Biodiversity Assessment 2011.
  - Existing protected areas and focus areas for protected area expansion identified in the National Protected Area Expansion Strategy.

A review of the NFEPA coverage for the development area revealed that no River FEPAs are located within the development area of the project. Furthermore, the NFEPA coverage for the development area shows no Wetland FEPAs contained therein.

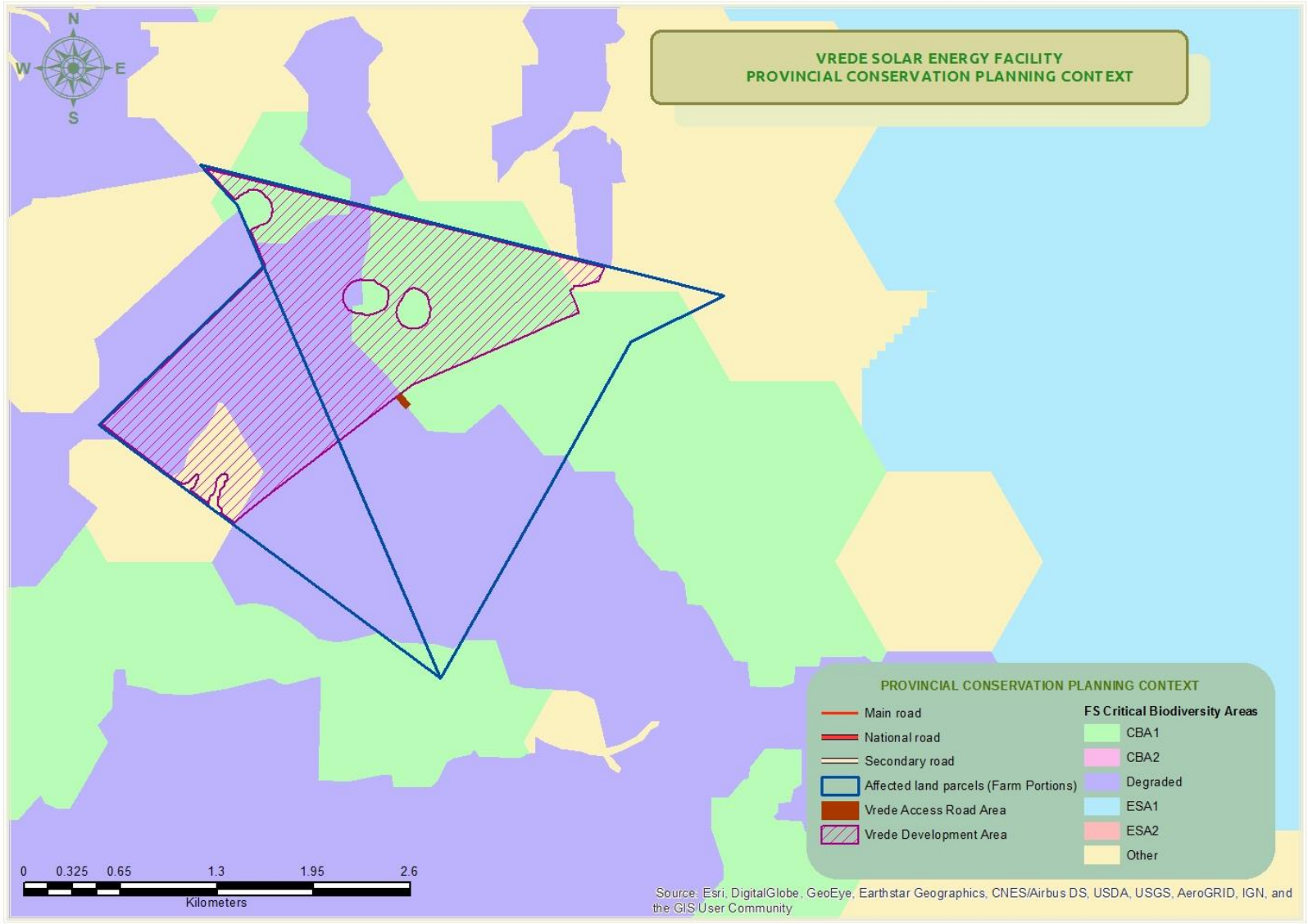


Figure 7: Provincial Level Conservation Planning Context – CBA Map (Free State Province Biodiversity Conservation Assessment).

Regional Terrestrial Ecological Overview

Vegetation Overview

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 overall project area is situated within two vegetation types, namely the Vaal-Vet Sandy Grassland (Gh10) and Central Free State Grassland (Gh6) according to Mucina & Rutherford (2006) (Figure 9). The proposed SEF footprint is however almost solely situated within one vegetation type, the Vaal-Vet Sandy Grassland with only a small portion extending into the Central Free State Grassland.

C. Vaal Vet Sandy Grassland

The Vaal Vet Sandy Grassland vegetation type is found in North-West and Free State Provinces. This vegetation type typically comprises of plains-dominated landscape with some scattered, slightly irregular undulating plains and hills. Mainly low-tussock grasslands with an 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 and/or erratic rainfall (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 Vaal Vet Sandy Grassland.

Graminoids: *Anthephora pubescens* (d), *Aristida congesta* (d), *Chloris virgata* (d), *Cymbopogon caesius* (d), *Cynodon dactylon* (d), *Digitaria argyrograpta* (d), *Elionurus muticus* (d), *Eragrostis chloromelas* (d), *E. lehmanniana* (d), *E. plana* (d*), E. trichophora* (d), *Heteropogon contortus* (d), *Panicum gilvum* (d), *Setaria sphacelata* (d), *Themeda triandra* (d), *Tragus berteronianus* (d), *Brachiaria serrata*, *Cymbopogon pospischilii, Digitaria eriantha, Eragrostis curvula, E. obtusa, E. superba, Panicum coloratum, Pogonarthria squarrosa, Trichoneura grandiglumis, Triraphis andropogonoides* (Mucina & Rutherford, 2006).

Herbs**:** *Stachys spathulata* (d), *Barleria macrostegia*, *Berkheya onopordifolia* var. *onopordifolia*, *Chamaesyce inaequilatera*, *Geigeria aspera* var. *aspera*, *Helichrysum caespititium*, *Hermannia depressa, Hibiscus pusillus, Monsonia burkeana, Rhynchosia adenodes, Selago densiflora, Vernonia oligocephala* (Mucina & Rutherford, 2006).

Geophytic Herbs: *Bulbine narcissifolia, Ledebouria marginata*.

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

Low Shrubs: *Felicia muricata* (d), *Pentzia globosa* (d), *Anthospermum rigidum* subsp. *pumilum, Helichrysum dregeanum*, *H. paronychioides, Ziziphus zeyheriana* (Mucina & Rutherford, 2006).

Endemic Taxon Herb: *Lessertia phillipsiana*.

D. 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).

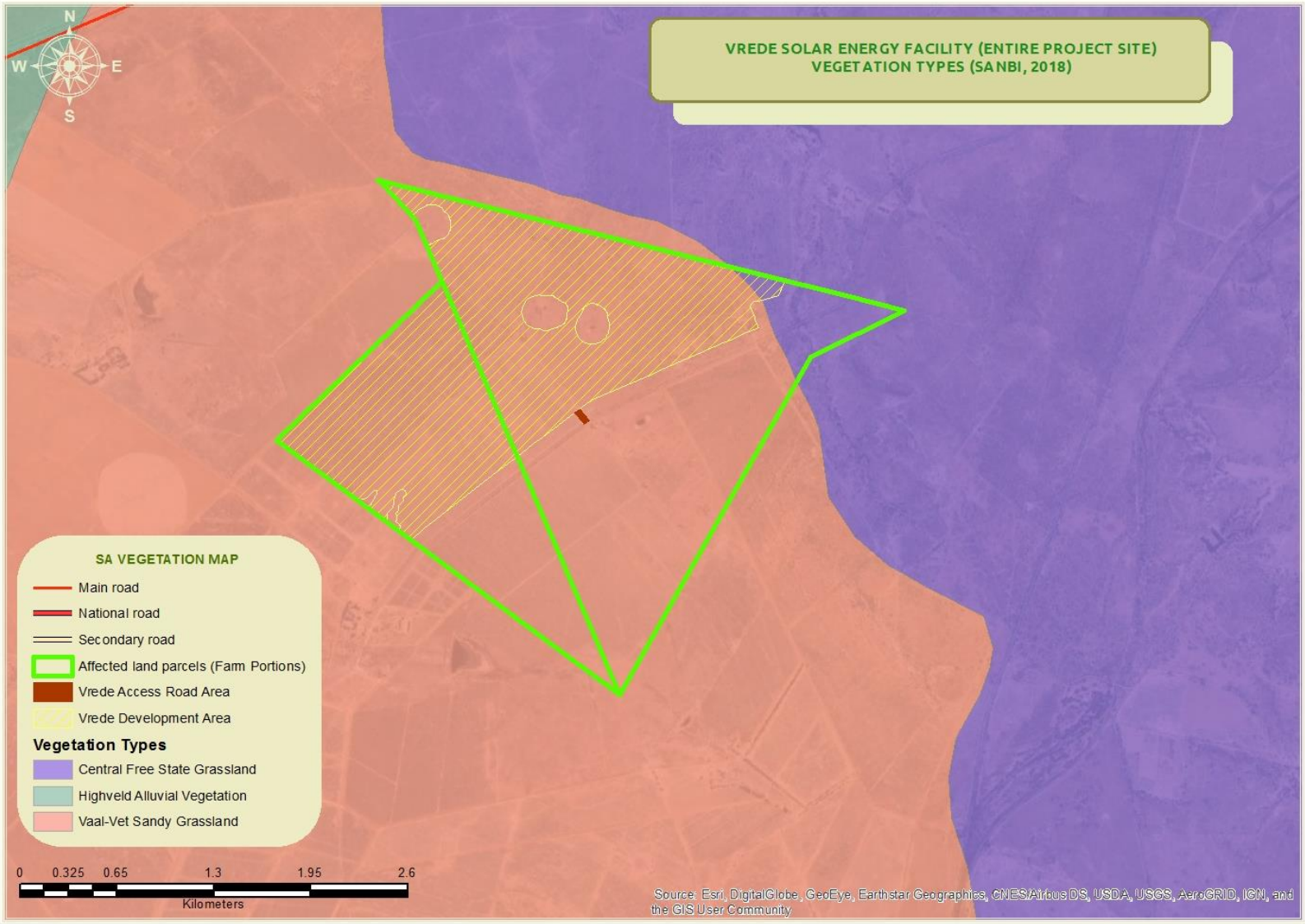


Figure 8: Vegetation Types (SANBI, 2018)

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	Unlikely
Atelerix frontalis	South African Hedgehog	NT	LC	High
Felis nigripes	Black-footed Cat	VU	VU	Low
Hydrictis maculicollis	Spotted-necked Otter	VU	NT	Unlikely
Leptailurus serval	Serval	NT	LC	High
Lycaon pectus	African Wild Dog	EN	EN	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	Moderate

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.

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 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 development 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 grassland areas, the likelihood of occurrence for this species is rated as 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 development 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 development 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 development area and the likelihood of occurrence of this species is therefore considered to be Moderate.

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 likelihood of finding the species in the development area is High.

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 (20) 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 development 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 development 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	High
Chamaesaura aenea	Coppery Grass Lizard	NT	LC	Moderate

5. SITE SPECIFIC TERRESTRIAL ECOLOGICAL ANALYSIS

Fine Scale Vegetation Patterns (Habitats)

In this section, the different habitats and vegetation patterns observed within the study site are described. 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 development area (including the proposed development footprint) is provided in Figure 9.

On the basis of the major (first-level) division obtained by TWINSPAN classification, the entire phytosociological table was divided into two smaller tables/clusters, one containing the releves/plots representing the moist bottomland habitats and associated vegetation types and the other containing those releves representing the grassland habitats and their associated vegetation types.

Within the moist bottomlands, three habitat types were identified namely, depression wetlands, valley bottom wetland with riparian fringe and the seepage wetland feeding into the valley bottom wetland. Furthermore, vegetation units within these habitat types are associated with the different hydro-geomorphological zones.

In terms of the grassland habitats, three habitat types can be distinguished namely, severely disturbed/transformed grassland, thornveld grassland, and pure grassland. Within the thornveld grassland two vegetation units were identified namely dense bottomland thornveld and secondary sparse woody grassland, whilst the pure grassland can be divided into secondary grassland and primary grassland.

A. Depression Wetland Habitat:

This unit is associated with temporary saturated zone and is covered by a relative dense, medium tall vegetation cover, dominated by moisture loving (mostly facultative wetland plants) graminoids and forbs. In some areas historical cultivation have encroached into these areas. Grazing by livestock is also a significant impact.

Three depression wetlands have been identified within the development area (within the north-western half), with two depression wetlands, surrounded by the development footprint. These wetland features are fairly similar in terms of hydrology, geomorphology and vegetation coverage.

a) *Utricularia stellaris – Eleocharis limosa* Permanent Saturated and Seasonally Inundated Vegetation Unit

This unit is associated with an area artificially/anthropogenically deepened within the depression wetland features in an attempt to store surface water for longer periods of time (water resource for cattle). Consequently, these areas are normally inundated with water for extended periods through the wet season into late autumn early winter. The water level may be as deep as 1.1 m. These "pools" comprise mostly of floating and submerged hydrophytic sedges and forbs. Trampling by cattle along the edges of these "pools" are a significant impact.

b) *Paspalum distichum – Leptochloa fusca* Permanent Saturated and Temporary Inundated Vegetation Unit

This unit is associated with an area of the depression wetlands which is permanently inundated, but will only be inundated following sufficient rainfall events, with inundation being short lived afterwards. This vegetation unit comprise mostly of submerged grasses and sedges. Trampling by cattle within this zone/vegetation unit is regarded as the most significant impact.

c) *Cyperus denudatus – Echinochloa holubii* Permanent Saturated and Seasonally Saturated Vegetation Unit

This unit is typically only seasonally saturated and comprise a dense, relative tall, moisture loving grass and forb cover. Again, trampling by cattle, within this zone/vegetation unit is regarded as the most significant impact.

d) *Eragrostis chloromelas – Eragrostis plana* Temporary Saturated Vegetation Unit

This unit is associated with temporary saturated zone and is covered by a relative dense, medium tall vegetation cover, dominated by moisture loving (mostly facultative wetland plants) graminoids and forbs. In some areas historical cultivation have encroached into these areas. Grazing by livestock is also a significant impact to the function and ecological contribution of this unit.

B. Valley Bottom Wetland and associated Riparian Fringe:

This habitat is located outside of the development footprint, however due to the close proximity to the development footprint, and the fact that a portion of the wetland's catchment falls within the development footprint, it was deemed worth of inclusion in this assessment/study.

a) *Marsilea macrocarpa – Leersia hexandra* Permanent Saturated Pools

These small localised pools occur within the channel of the valley bottom wetland and is a result of a combination of trampling and soil erosion. These micro-depressions collect and store water during the wet season and is dominated by a combination of floating and submerged (obligate) hydrophytic forbs, grasses and sedges.

b) *Haplocarpa scaposa – Cynodon dactylon Seasonally Saturated Channels*

The channel of the valley-bottom wetland is seasonally saturated and dominated by moderate to low growing obligate and facultative wetland grasses. Erosion and trampling are a frequent found within these channels.

c) *Senecio inornatus – Paspalum diladatum* Temporary Saturated Grassland

This vegetation unit is associated with the overbank spill areas and grassy riparian fringes and is normally only saturated for a short period of time following sufficient precipitation events. This vegetation unit is characterized by a dense, moderate to tall grass cover. The alien plant, *Paspalum dilatatum* is a prominent species within this habitat unit.

d) *Gleditsia triacanthos – Searsia pyriodes* Riparian Woodland Fringe

The vegetation unit has a patchy distribution along the peripheries of the valley-bottom wetland. The density, height and composition of the woody and herb layer varies immensely. Within the affected property and the adjacent property to the north, the riparian fringe is characterized by a fairly tall riparian fringe dominated by the Category 1b Invasive Alien Plant, *Gleditsia triacanthos*. Under natural conditions *Searsia pyrioides* and *Acacia (Vachellia) karroo* will be the dominating woody species.

C. Seepage Wetland:

This habitat is also located outside of the development footprint, however due to the close proximity to the development footprint, and the fact that a portion of the wetland's catchment falls within the development footprint, it was deemed worth of inclusion in this assessment/study.

This seepage wetland is located to the west of the valley-bottom wetland and feed into the downslope valley-bottom wetland. This seepage wetland is largely ground fed due to a change in topography and underlying, shallow geology.

a) *Pennisetum sphacelatum – Eragrostis planiculmis* Seasonally Saturated Grassland

This vegetation unit is characterised by a relative tall moisture loving grass cover and is seasonally saturated. Disturbances within this unit includes an existing telephone line that traverses this vegetation unit with some pylons constructed within the boundaries of this habitat unit.

b) *Themeda triandra – Eragrostis plana* Temporary Saturated Grassland

This vegetation unit is characterised by a medium tall grass cover (mainly facultative wetland grasses) and is only saturated for a short period of time following sufficient precipitation events. Disturbances within this unit includes an existing telephone line that traverses this vegetation unit with some pylons constructed within the boundaries of this habitat unit.

D. Disturbed Grassland:

a) *Verbena aristigera – Cynodon dactylon* 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.

E. Thornveld:

a) *Asparagus laricinus – Acacia (Vachellia) karroo* Bottomland Thornveld

This is a primary vegetation unit and is situated in the lower lying terrestrial lands along the valley flats, fringing the seepage and valley-bottom wetlands. Overgrazing has resulted in the encroachment of *Asparagus laricinus* as well as shrubby forms of *A. karroo*.

b) *Helichrysum dregeanum – Acacia (Vachellia) karroo* Secondary Sparse Woody Grassland

This vegetation unit can also be regarded as a plagioclimax unit that has established and stabilised on old cultivated areas (>30years). This unit can be characterized by a fairly open grassland comprising of Increase II, Climax grasses. Trees and shrubs are typically clustered together and are highly varying in terms of density, and height.

F. Pure Grassland:

Even though, the term pure has been given to this habitat type, forbs and shrubs are still present within this habitat, however grasses dominate the overall coverage.

a) *Helichrysum rugulosum – Digitaria eriantha* Secondary Grassland (Pasture)

This vegetation unit can also be regarded as a plagioclimax unit that has established (seeded) and stabilised on old cultivated areas (<30years).

b) *Vernonia oligocephala – Eragrostis chloromelas* Primary Grassland

This vegetation unit resemble a natural form of Vaal-Vet Sandy Grassland and patches of these grasslands have remained due to the fact that these areas are not suitable for cultivation. Even though, *Themeda triandra* is till relative prominent, some retrogression has occurred from *T. triandra*, to *P. coloratum* and *E. chloromelas*, indicating that these areas have been subjected to long term grazing, with periodical overgrazing.

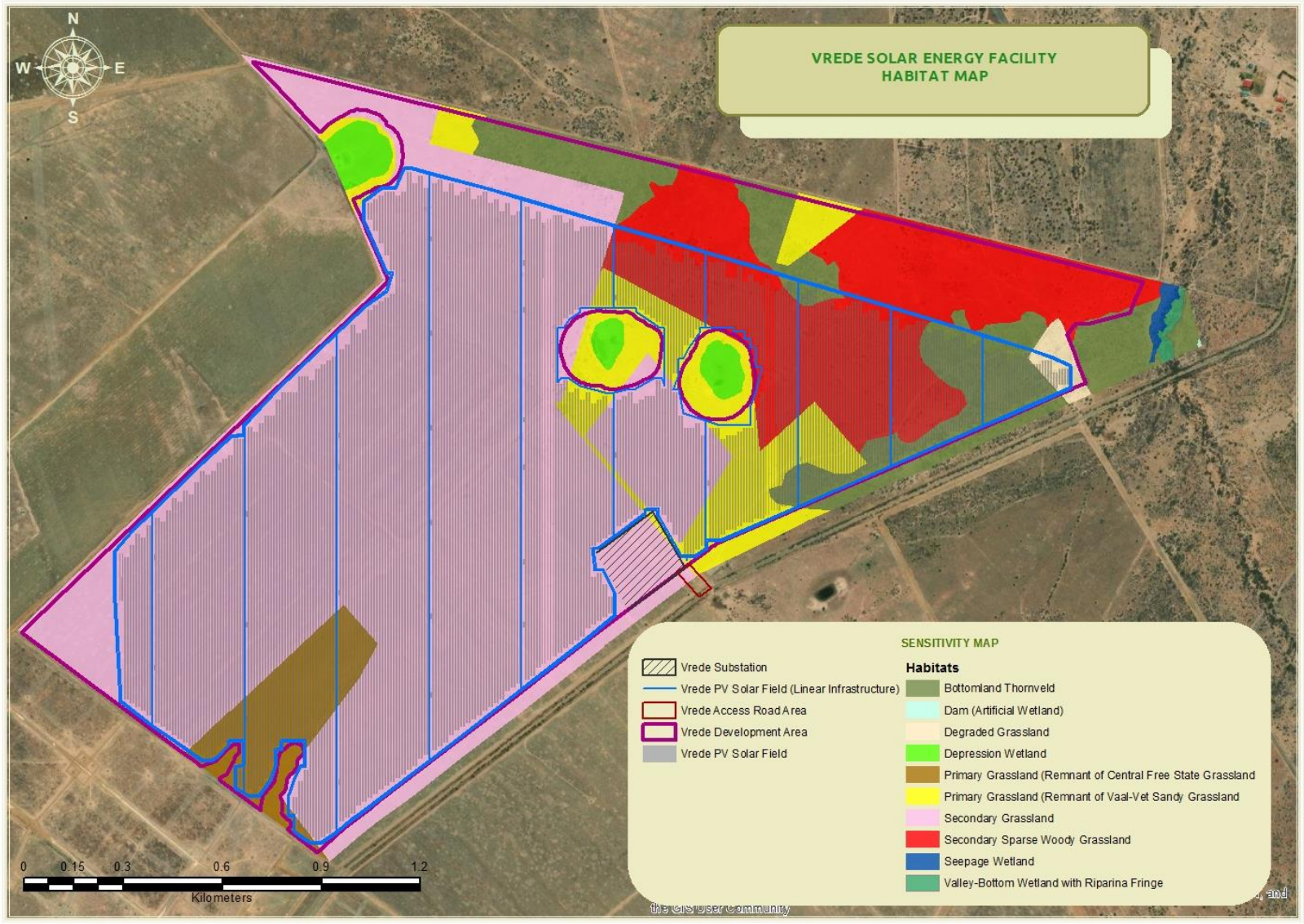


Figure 9: Delineated habitat units.

Depression Wetlands

Habitat and Land use			
Substrate	Greyish clay to clayey loam soils, Soils tend to moderately in depth. These depression wetlands are primarily surface water fed with some subsurface water input. All three hydro-morphological zones are present with the temporary saturated zone being the largest in extent. As mentioned, portions of the depressions have been, artificially, made deeper in an attempt to store water for longer periods of time. These areas are now inundated for extended periods of time during the wet season	**Disturbance**	Trampling and grazing through cattle. May become excessive in portions of these habitats and may lead to soil compaction and a loss in vegetation cover. Artificial deepening of a section of the depression wetlands and the stockpiling of the removed soil. Establishment of Invasive Alien Plants: *Verbena bonariensis, V. offincialis*
Species Richness	70 species of which 13 are alien plants and 7 are indigenous weeds	**Conservation value:**	High Mostly natural moist grassland. Provide valuable ecosystem functions and services.
Ecosystem function	Accumulation and filtering of runoff before water seeps into ground water Seasonal surface water » Seasonal availability of associated biota (most notably invertebrates) that serve as important food sources for especially reptiles and birds Seasonal grazing on peripheries of depressions during periods of higher moisture Below-ground storage and channelling of water	**Sensitivity:**	Very High – No-Go Area
Need for rehabilitation	Manage grazing within these depression wetlands		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
High shrubs and trees	1.5 - 4	0
Low Shrubs	0.2 – 1	0 - 3

Graminoids	0.3 –1.4	80 - 90
Forbs	0.1 – 1.2	10 - 20
Permanent Saturated & Seasonally Inundated Zone		
Diagnostic Species	*Eleocharis limosa, Aponogeton rehmannii, Utricularia stellaris, Potamogeton crispus*	
Dominant Species	*Persicaria decipiens, Paspalum distichum*	
Permanent Saturated & Temporary Inundated Zone		
Diagnostic Species	*Paspalum distichum, Leptochloa fusca*	
Dominant Species	*Persicaria decipeins, Eleocharis limosa*	
Seasonal Saturated Zone		
Diagnostic Species	*Echinochloa holubii, Eragrostis planiculmis, Helichrysum aureonitens, Cyperus denudatus*	
Dominant Species	*Leptochloa fusca, Gnaphalium filagopsis, Verbena bonariensis, V. officinalis, Setaria incrassata*	
Temporary Saturated Zone		
Diagnostic Species	*Eragrostis plana, Eragrostis chloromelas, Themeda triandra*	
Dominant Species	*Helichrysum aureonitens, Verbena officinalis, Cynodon dactylon, Eragrostis curvula, Panicum coloratum, Gomphocarpus fruticosus, Arctotis arctoides, Conyza bonariensis, Eragrostis gummiflua*	

Growth Form	Family	Species	Status	Depression Wetland			
				Permanent Saturated & Seasonally Inundated	Permanent Saturated & Temporarily Inundated	Seasonal Saturated	Temporary Saturated
Creeping Forb	Fabaceae	*Rhynchosia minima*					X
Creeping Forb	Fabaceae	*Rhynchosia totta var. totta*					X
Darf Shrub	Asteraceae	*Felicia muricata*	Potential Encroacher				X
Dwarf Shrub	Asteraceae	*Seriphium plumosum*	Potential Encroacher				X
Forb	Apocynaceae	*Gomphocarpus fruticosus subsp. Fruticosus*	Weed				X
Forb	Aponogetonaceae	*Aponogeton rehmannii*		X			

Forb	Asteraceae	*Arctotis arctoides*					X
Forb	Asteraceae	*Aster squamatus*	Alien Plant				X
Forb	Asteraceae	*Berkheya onopordifolia*					X
Forb	Asteraceae	*Berkheya radula*				X	
Forb	Asteraceae	*Cirsium vulgare*	Category 1b Invasive Alien Plant				X
Forb	Asteraceae	*Conyza bonariensis*	Alien Plant				X
Forb	Asteraceae	*Gnaphalium filagopsis*				X	X
Forb	Asteraceae	*Helichrysum aureonitens*				X	X
Forb	Asteraceae	*Helichrysum rugulosum*	Weed		X		X
Forb	Asteraceae	*Pseudognaphalium luteo-album*	Alien Plant			X	
Forb	Asteraceae	*Schkuhria pinnata*	Alien Plant				X
Forb	Asteraceae	*Senecio inornatus*				X	
Forb	Asteraceae	*Tagetes minuta*	Alien Plant				X
Forb	Asteraceae	*Zinnia peruviana*	Alien Plant				X
Forb	Campanulaceae	*Wahlenbergia denticulata*					X
Forb	Caryophyllaceae	*Pollichia campestris*					X
Forb	Fabaceae	*Crotalaria distans subsp. Distans*					X
Forb	Geraniaceae	*Monsonia burkeana*					X
Forb	Lentibulariaceae	*Utricularia stellaris*		X			
Forb	Malvaceae	*Hermannia coccocarpa*					X
Forb	Malvaceae	*Hibiscus pusillus*					X
Forb	Malvaceae	*Hibiscus trionum*	Alien Plant				X
Forb	Malvaceae	*Sida cordifolia*	Weed				X
Forb	Oxalidaceae	*Oxalis obliquifolia*	Weed			X	X
Forb	Polygonaceae	*Persicaria amphibia*	Alien Plant	X			
Forb	Polygonaceae	*Persicaria decipiens*		X	X	X	
Forb	Potamogetonaceae	*Potamogeton crispus*		X			
Forb	Rubiaceae	*Kohautia caespitosa*	Weed				X
Forb	Verbenaceae	*Lippia javanica*					X
Forb	Verbenaceae	*Verbena aristigera*	Alien Plant				X
Forb	Verbenaceae	*Verbena bonariensis*	Category 1b Invasive Alien Plant			X	X
Forb	Verbenaceae	*Verbena officinalis*	Category 1b Invasive Alien Plant			X	X
Geophyte	Amaryllidaceae	*Ammocharis coranica*	Protected				X
Geophyte	Hyacinthaceae	*Albuca spp.*				X	X
Geophyte	Hyacinthaceae	*Schizocarphus nervosus*	Protected				X
Geophyte	Hypoxidaceae	*Hypoxis hemerocallidea*					X
Graminoid	Cyperaceae	*Cyperus denudatus var. denudatus*				X	X
Graminoid	Cyperaceae	*Eleocharis limosa*		X	X	X	
Graminoid	Cyperaceae	*Kylinga erecta var. erecta*				X	

Graminoid	Cyperaceae	*Schoenoplectus muricinux*				X	
Graminoid	Poaceae	*Aristida junciformis*					X
Graminoid	Poaceae	*Cymbopogon pospischilii*					X
Graminoid	Poaceae	*Cynodon dactylon*	Weed			X	X
Graminoid	Poaceae	*Echinochloa holubii*			X	X	X
Graminoid	Poaceae	*Eragrostis chloromelas*					X
Graminoid	Poaceae	*Eragrostis curvula*				X	X
Graminoid	Poaceae	*Eragrostis gummiflua*					X
Graminoid	Poaceae	*Eragrostis micrantha*			X		
Graminoid	Poaceae	*Eragrostis plana*				X	X
Graminoid	Poaceae	*Eragrostis planiculmis*			X	X	X
Graminoid	Poaceae	*Leersia hexandra*		X			
Graminoid	Poaceae	*Leptochloa fusca*			X	X	
Graminoid	Poaceae	*Panicum coloratum*				X	X
Graminoid	Poaceae	*Panicum maximum*					X
Graminoid	Poaceae	*Paspalum dilatatum*	Alien Plant			X	
Graminoid	Poaceae	*Paspalum distichum*		X	X		
Graminoid	Poaceae	*Setaria incrassata*				X	X
Graminoid	Poaceae	*Setaria pallide-fusca*				X	X
Graminoid	Poaceae	*Sporobolus africanus*			X		X
Graminoid	Poaceae	*Themeda triandra*				X	X
Graminoid	Poaceae	*Urochloa panicoides*	Weed				X
Shrub	Asparagaceae	*Asparagus laricinus*	Potential Encroacher				X
Shrub	Fabaceae	*Acacia (Vachellia) karroo*	Potential Encroacher				X
Succulent Dwarf Shrub	Aizoaceae	*Delosperma floribundum*					X

Valley-bottom Wetland

Habitat and Land use			
Substrate	Dark to lighter grey, vertic soils Valley-bottom wetlands predominantly surface water fed. Input from runoff (diffuse flow from the slopes as well as contained flow within the higher lying drainage channels) and precipitation. Water input also from the seepage wetland.	**Disturbance**	Trampling and grazing through cattle. May become excessive in portions of these habitats and may lead to channel and gully erosion. Moderate to high levels of Alien plant and weed invasion Establishment of Invasive Alien Plants: *Verbena bonariensis, V. offincialis, Gleditsia triacanthos*

Species Richness	57 species of which 12 are alien plants and 6 are indigenous weeds	**Conservation value:**	High Mostly natural moist grassland. Provide valuable ecosystem functions and services.
Ecosystem function	Vegetation as grazing and stabilisation of soils, accumulated and slows down runoff from higher lying areas, maximises infiltration of runoff into soils and filtering of runoff before it seeps further into lower-lying river systems, creates unique habitat for flora and fauna	**Sensitivity:**	Very High – No-Go Area
Need for rehabilitation	Manage grazing within these wetland habitats. Rehabilitation of eroded areas. Management of IAPs		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
High shrubs and trees	1.8 - 4	2
Low Shrubs	0.2 – 1.7	8
Grass	0.1 – 0.9	70 - 80
Forbs	0.01 – 1.5	10 - 20
Permanent Saturated Pools		
Diagnostic Species	*Marsilea macrocarpa, Schonoplectus muricinux, Leersia hexandra*	
Dominant Species	*Persicaria decipeins, Paspalum distichum, Echinchloa holubii*	
Seasonally Saturated Channels		
Diagnostic Species	*Verbena officinalis, Paspalum dilatatum, Cynodon dactylon, Haplocarpa scaposa*	
Dominant Species	*Cypersus eragrostis,*	
Temporary Saturated Zone		
Diagnostic Species	*Paspalum dilatatum, Echinochloa holubii*	
Dominant Species	*Verbena officinalis, Eragrostis plana, Setaria incrassata, Seatria pallide-fusca, Eragrostis planiculmis, Pennisetum sphacelatum, Sporobolus africanus*	

Growth Form	Family	Species	Status	Permanent Saturated Pools	Seasonally Saturated Channels	Temporary Saturated Grassland

Forb	Verbenaceae	*Verbena officinalis*	Category 1b Invasive Alien Plant	X	X	X
Graminoid	Poaceae	*Paspalum dilatatum*	Alien Plant	X	X	X
Forb	Polygonaceae	*Persicaria decipiens*		X	X	
Graminoid	Cyperaceae	*Cyperus eragrostis*	Alien Plant	X	X	
Graminoid	Poaceae	*Cynodon dactylon*	Weed	X	X	
Graminoid	Poaceae	*Paspalum distichum*		X	X	
Forb	Verbenaceae	*Verbena bonariensis*	Category 1b Invasive Alien Plant	X		X
Graminoid	Poaceae	*Echinochloa holubii*		X		X
Fern	Marsileaceae	*Marsilea macrocarpa*		X		
Graminoid	Cyperaceae	*Schoenoplectus muricinux*		X		
Graminoid	Poaceae	*Leersia hexandra*		X		
Forb	Asteraceae	*Berkheya radula*			X	X
Forb	Asteraceae	*Conyza bonariensis*	Alien Plant		X	X
Forb	Dipsacaceae	*Scabiosa columbaria*			X	X
Graminoid	Poaceae	*Eragrostis micrantha*			X	X
Graminoid	Poaceae	*Eragrostis plana*			X	X
Graminoid	Poaceae	*Setaria incrassata*			X	X
Graminoid	Poaceae	*Setaria pallide-fusca*			X	X
Shrub	Asparagaceae	*Asparagus laricinus*	Potential Encroacher		X	X
Creeping Forb	Convolvulaceae	*Dichondra micrantha*	Weed		X	
Forb	Apiaceae	*Ciclospermum leptophyllum*	Alien Plant		X	
Forb	Asteraceae	*Haplocarpha scaposa*			X	
Forb	Malvaceae	*Sida dregei*			X	
Forb	Onagraceae	*Oenothera rosea*	Alien Plant		X	
Forb	Orobanchaceae	*Buchnera reducta*			X	
Forb	Ranunculaceae	*Ranunculus multifidus*			X	
Forb	Scrophulariaceae	*Mimulus gracilis*			X	
Forb	Verbenaceae	*Verbena aristigera*	Alien Plant		X	
Geophyte	Amaryllidaceae	*Ammocharis coranica*	Protected		X	
Graminoid	Cyperaceae	*Cyperus congestus*	Weed		X	
Graminoid	Cyperaceae	*Cyperus longus var. longus*			X	
Graminoid	Poaceae	*Sporobolus fimbriatus*			X	
Shrub	Anacardiaceae	*Searsia pyroides*			X	
Tree	Fabaceae	*Gleditsia triacanthos*	Category 1b Invasive Alien Plant		X	
Forb	Apocynaceae	*Gomphocarpus fruticosus subsp. Fruticosus*	Weed			X
Forb	Apocynaceae	*Xysmalobium undulatum*				X

Forb	Asteraceae	*Aster squamatus*	Alien Plant			X
Forb	Asteraceae	*Berkheya onopordifolia*				X
Forb	Asteraceae	*Cirsium vulgare*	Category 1b Invasive Alien Plant			X
Forb	Asteraceae	*Cotula anthemoides*				X
Forb	Asteraceae	*Senecio inornatus*				X
Forb	Asteraceae	*Tagetes minuta*	Alien Plant			X
Forb	Convolvulaceae	*Cuscuta australis*	Outside of range			X
Forb	Malvaceae	*Sida cordifolia*	Weed			X
Forb	Oxalidaceae	*Oxalis obliquifolia*	Weed			X
Graminoid	Poaceae	*Digitaria eriantha*				X
Graminoid	Poaceae	*Eragrostis chloromelas*				X
Graminoid	Poaceae	*Eragrostis curvula*				X
Graminoid	Poaceae	*Eragrostis obtusa*				X
Graminoid	Poaceae	*Eragrostis planiculmis*				X
Graminoid	Poaceae	*Hyparrhenia hirta*				X
Graminoid	Poaceae	*Panicum coloratum*				X
Graminoid	Poaceae	*Pennisetum sphacelatum*				X
Graminoid	Poaceae	*Setaria verticillata*				X
Graminoid	Poaceae	*Sporobolus africanus*				X
Graminoid	Poaceae	*Themeda triandra*				X
Shrub	Fabaceae	*Acacia (Vachellia) karroo*	Potential Encroacher			X

Woody Riparian Fringe

Habitat and Land use			
Substrate	Dark, vertic soils	**Disturbance**	High levels of Alien plant and weed invasion Establishment of Invasive Alien Plants: *Gleditsia triacanthos*
Species Richness	40 species of which 10 are alien plants and 7 are indigenous weeds	**Conservation value:**	High Relative high diversity, Unique habitat.
Ecosystem function	Grazing and Browsing, Unique habitat, niche and source of food for animals, Provides some stabilization of wetland fringes.	**Sensitivity:**	Very High – No-Go Area
Need for rehabilitation	Rehabilitation of eroded areas. Management of IAPs		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
High shrubs and trees	1.8 - 4	60
Low Shrubs	0.2 – 1.7	35
Grass	0.1 – 0.9	15-25
Forbs	0.01 – 1.5	25 - 55
Diagnostic Species	*Celtis africana, Searsia pyrioides, Sida dregei, Pavonia senegalensis, Pentharrhinum insipidum, Gleditsia triacanthos*	
Dominant Species	*Ziziphus mucronata, Acacia karoo, Asparagus laricinus, Setaria verticillata, Cynodon dactylon, Bidens bipinnata, Achyranthes aspera*	

Growth Form	Family	Species	Status	Riparian Fringe
Climbing Forb	Apocynaceae	*Pentharrhinum insipidum*		X
Climbing Shrub	Ranunculaceae	*Clematis brachiata*		X
Creeping Forb	Convolvulaceae	*Dichondra micrantha*	Weed	X
Forb	Amaranthaceae	*Achyranthes aspera*	Weed	X
Forb	Amaranthaceae	*Amaranthus viridus*	Alien Plant	X
Forb	Amaranthaceae	*Atriplex semibacata*	Weed	X
Forb	Apiaceae	*Ciclospermum leptophyllum*	Alien Plant	X
Forb	Asteraceae	*Bidens bipinnata*	Alien Plant	X
Forb	Asteraceae	*Conyza bonariensis*	Alien Plant	X
Forb	Asteraceae	*Haplocarpha scaposa*		X
Forb	Asteraceae	*Tagetes minuta*	Alien Plant	X
Forb	Asteraceae	*Zinnia peruviana*	Alien Plant	X
Forb	Chenopodiaceae	*Chenopodium album*	Weed	X
Forb	Lamiaceae	*Stachys hyssopoides*		X
Forb	Lamiaceae	*Teucrium trifidum*		X
Forb	Malvaceae	*Pavonia senegalensis*		X
Forb	Malvaceae	*Sida cordifolia*	Weed	X
Forb	Malvaceae	*Sida dregei*		X
Forb	Solanaceae	*Solanum nigrum*		X
Forb	Verbenaceae	*Verbena aristigera*	Alien Plant	X
Graminoid	Cyperaceae	*Cyperus congestus*	Weed	X
Graminoid	Poaceae	*Cynodon dactylon*	Weed	X
Graminoid	Poaceae	*Panicum maximum*		X
Graminoid	Poaceae	*Paspalum dilatatum*	Alien Plant	X
Graminoid	Poaceae	*Setaria incrassata*		X
Graminoid	Poaceae	*Setaria pallide-fusca*		X
Graminoid	Poaceae	*Setaria verticillata*		X
Graminoid	Poaceae	*Sporobolus fimbriatus*		X
Shrub	Anacardiaceae	*Searsia pyroides*		X
Shrub	Asparagaceae	*Asparagus laricinus*	Potential Encroacher	X
Shrub	Asparagaceae	*Asparagus setaceus*		X
Shrub	Boraginaceae	*Ehretia rigida*		X
Shrub	Celastraceae	*Gymnosporia heterophylla*		X
Shrub	Ebenaceae	*Diospyros lycioides*		X

Shrub	Rosaceae	*Cotoneaster franchettii*	Category 1b Invasive Alien Plant	X
Tree	Anacardiaceae	*Searsia lancea*		X
Tree	Fabaceae	*Acacia (Vachellia) karroo*		X
Tree	Fabaceae	*Gleditsia triacanthos*	Category 1b Invasive Alien Plant	X
Tree	Rhamnaceae	*Ziziphus mucronata*		X
Tree	Ulmaceae	*Celtis africana*		X

Seepage Wetland

Habitat and Land use			
Substrate	Dark to lighter grey, clay to clay loam soils Seepage contain a lower permeability layer underlain by impermeable strata (bed rock). Subsequently input is from groundwater seepage, precipitation and surface runoff. Groundwater may be restricted by lower permeability layer.	**Disturbance**	Trampling and grazing through cattle. May become excessive in portions of these habitats and may lead to channel and gully erosion. Moderate levels of overgrazing and trampling. Presence powerline pylons within wetland. Moderate levels of Alien plant and weed invasion Establishment of Invasive Alien Plants: *Verbena bonariensis, V. offincialis, V. bonariensis*
Species Richness	74 species of which 12 are alien plants and 6 are indigenous weeds	**Conservation value:**	High Mostly natural moist grassland. Provide valuable ecosystem functions and services.
Ecosystem function	Vegetation as grazing and stabilisation of soils, accumulated and slows down runoff from higher lying areas, maximises infiltration of runoff into soils and filtering of runoff before it seeps further into lower-lying river systems, creates unique habitat for flora and fauna	**Sensitivity:**	Very High – No-Go Area
Need for rehabilitation	Manage grazing within these wetland habitats. Management of IAPs		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
High shrubs and trees	1.8 - 4	1
Low Shrubs	0.2 – 1.7	8
Grass	0.1 – 0.9	70 - 80
Forbs	0.01 – 1.5	10 - 20

Seasonally Saturated Grassland	
Diagnostic Species	*Eragrostis planiculmis, Pennisetum spacelatum, Setaria incrassata*
Dominant Species	*Senecio inornatus, Eragrostis plana, Paspalum dilatatum, Themeda triandra, Setaria pallide-fusca, Sporobolus africanus*
Temporary Saturated Grassland	
Diagnostic Species	*Themeda triandra*
Dominant Species	*Cypersus eragrostis,*
Temporary Saturated Zone	
Diagnostic Species	*Paspalum dilatatum, Echinochloa holubii*
Dominant Species	*Verbena officinalis, Eragrostis plana, Setaria incrassata, Seatria pallide-fusca, Eragrostis planiculmis, Pennisetum sphacelatum, Sporobolus africanus*

Growth Form	Family	Species	Status	Seasonally Saturated Grassland	Temporary Saturated Grassland
Forb	Asteraceae	*Berkheya radula*		X	X
Forb	Asteraceae	*Senecio inornatus*		X	X
Forb	Asteraceae	*Senecio pentactinus*		X	X
Graminoid	Poaceae	*Eragrostis plana*		X	X
Graminoid	Poaceae	*Eragrostis planiculmis*		X	X
Graminoid	Poaceae	*Paspalum dilatatum*	Alien Plant	X	X
Graminoid	Poaceae	*Pennisetum sphacelatum*		X	X
Graminoid	Poaceae	*Themeda triandra*		X	X
Shrub	Asparagaceae	*Asparagus laricinus*	Potential Encroacher	X	X
Forb	Apocynaceae	*Xysmalobium undulatum*		X	
Forb	Asteraceae	*Cotula anthemoides*		X	
Forb	Asteraceae	*Haplocarpha scaposa*		X	
Forb	Dipsacaceae	*Scabiosa columbaria*		X	
Forb	Malvaceae	*Hibiscus trionum*	Alien Plant	X	
Forb	Onagraceae	*Oenothera rosea*	Alien Plant	X	
Forb	Ranunculaceae	*Ranunculus multifidus*		X	
Forb	Solanaceae	*Datura stramonium*	Category 1b Invasive Alien Plant	X	

Forb	Verbenaceae	*Verbena bonariensis*	Category 1b Invasive Alien Plant	X	
Forb	Verbenaceae	*Verbena officinalis*	Category 1b Invasive Alien Plant	X	
Graminoid	Poaceae	*Echinochloa holubii*		X	
Graminoid	Poaceae	*Setaria incrassata*		X	
Graminoid	Poaceae	*Setaria pallide-fusca*		X	
Graminoid	Poaceae	*Sporobolus africanus*		X	
Dwarf Shrub	Asteraceae	*Felicia muricata*	Potential Encroacher		X
Forb	Asteraceae	*Aster squamatus*	Alien Plant		X
Forb	Asteraceae	*Berkheya pinnatifida*			X
Forb	Asteraceae	*Bidens bipinnata*	Alien Plant		X
Forb	Asteraceae	*Cirsium vulgare*	Category 1b Invasive Alien Plant		X
Forb	Asteraceae	*Conyza bonariensis*	Alien Plant		X
Forb	Asteraceae	*Gazania krebsiana*			X
Forb	Asteraceae	*Helichrysum aureonitens*			X
Forb	Asteraceae	*Schkuhria pinnata*	Alien Plant		X
Forb	Oxalidaceae	*Oxalis obliquifolia*	Weed		X
Forb	Solanaceae	*Solanum nigrum*			X
Forb	Verbenaceae	*Verbena aristigera*	Alien Plant		X
Graminoid	Poaceae	*Chloris virgata*	Weed		X
Graminoid	Poaceae	*Cynodon dactylon*	Weed		X
Graminoid	Poaceae	*Eragrostis chloromelas*			X
Graminoid	Poaceae	*Eragrostis lehmanniana*			X
Graminoid	Poaceae	*Eragrostis micrantha*			X
Graminoid	Poaceae	*Eragrostis obtusa*			X
Graminoid	Poaceae	*Panicum coloratum*			X
Graminoid	Poaceae	*Tragus berteronianus*	Weed		X
Shrub	Anacardiaceae	*Searsia pyroides*			X
Shrub	Fabaceae	*Acacia (Vachellia) karroo*	Potential Encroacher		X
Succulent Shrub	Cactaceae	*Opuntia ficus-indica*	Category 1b Invasive Alien Plant		X
Tree	Anacardiaceae	*Searsia lancea*			X

Highly disturbed/transformed Grassland

Habitat and Land use			
Substrate	Loam to loamy-clay soils of varying depths, mostly moderately deep. Some fine gravel and grit may be present in some areas	**Disturbance**	Severely trampled areas, Mowed areas (fire breaks) Kraals Water and feeding points High abundance of weeds and alien plants
Species Richness	57 species of which 14 are alien plants and 15 are indigenous weeds	**Conservation value:**	Low

Ecosystem function	Permanent vegetation cover for stabilising, maintaining and nourishing soil as well as for slowing down runoff to increase infiltration into the soil. Vegetation as grazing (low potential due to moderate to low palatability of dominant grasses and weeds).	**Sensitivity:**	Low
Need for rehabilitation	Clearing of weeds and alien invasive species		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
High shrubs and trees	1.8 - 4	0
Low Shrubs	0.2 – 1.5	0-6
Grass	0.1 – 0.7	60-80
Forbs	0.01 – 1.5	30-20
Diagnostic Species	*Celtis africana, Searsia pyrioides, Sida dregei, Pavonia senegalensis, Pentharrhinum insipidum, Gleditsia triacanthos*	
Dominant Species	*Ziziphus mucronata, Acacia karoo, Asparagus laricinus, Setaria verticillata, Cynodon dactylon, Bidens bipinnata, Achyranthes aspera*	

Growth Form	Family	Species	Status	Disturbed Grassland
Creeping Forb	Amaranthaceae	Alternanthera pungens	Weed	X
Creeping Forb	Convolvulaceae	Dichondra micrantha	Weed	X
Creeping Forb	Nyctaginaceae	Boerhavia diffusa	Weed	X
Creeping Forb	Zygophyllaceae	Tribulus terrestris	Weed	X
Dwarf Shrub	Asteraceae	Felicia muricata	Potential Encroacher	X
Dwarf Shrub	Chenopodiaceae	Salsola kali	Category 1b Alien Invasive Plant	X
Dwarf Shrub	Fabaceae	Indigofera cryptantha		X
Dwarf Shrub	Scrophulariaceae	Selago densiflora		X
Forb	Amaranthaceae	Amaranthus thunbergii	Weed	X
Forb	Amaranthaceae	Amaranthus viridus	Alien Plant	X
Forb	Amaranthaceae	Atriplex semibacata	Weed	X
Forb	Asteraceae	Arctotis arctoides		X
Forb	Asteraceae	Berkheya onopordifolia		X
Forb	Asteraceae	Berkheya pinnatifida		X
Forb	Asteraceae	Bidens bipinnata	Alien Plant	X
Forb	Asteraceae	Cirsium vulgare	Category 1b Invasive Alien Plant	X
Forb	Asteraceae	Conyza bonariensis	Alien Plant	X
Forb	Asteraceae	Cotula podocephala		X
Forb	Asteraceae	Helichrysum rugulosum	Weed	X
Forb	Asteraceae	Nidorela residifolia		X
Forb	Asteraceae	Schkuhria pinnata	Alien Plant	X
Forb	Asteraceae	Tagetes minuta	Alien Plant	X
Forb	Asteraceae	Tripteris aghillana	Weed	X

Forb	Asteraceae	Xanthium spinosum	Category 1b Invasive Alien Plant	X
Forb	Campanulaceae	Wahlenbergia denticulata		X
Forb	Commelinaceae	Commelina africana		X
Forb	Geraniaceae	Monsonia burkeana		X
Forb	Lamiaceae	Stachys hyssopoides		X
Forb	Malvaceae	Hermannia depressa		X
Forb	Malvaceae	Sida cordifolia	Weed	X
Forb	Rubiaceae	Kohautia caespitosa	Weed	X
Forb	Scrophulariaceae	Aptosimum procumbens		X
Forb	Solanaceae	Datura stramonium	Category 1b Invasive Alien Plant	X
Forb	Verbenaceae	Verbena aristigera	Alien Plant	X
Forb	Verbenaceae	Verbena officinalis	Category 1b Invasive Alien Plant	X
Graminoid	Poaceae	Aristida adscensionis		X
Graminoid	Poaceae	Aristida congesta	Weed	X
Graminoid	Poaceae	Brachiaria eruciformis		X
Graminoid	Poaceae	Chloris virgata	Weed	X
Graminoid	Poaceae	Cynodon dactylon	Weed	X
Graminoid	Poaceae	Digitaria eriantha		X
Graminoid	Poaceae	Eragrostis chloromelas		X
Graminoid	Poaceae	Eragrostis curvula		X
Graminoid	Poaceae	Eragrostis gummiflua		X
Graminoid	Poaceae	Eragrostis lehmanniana		X
Graminoid	Poaceae	Eragrostis trichophora		X
Graminoid	Poaceae	Hyparrhenia hirta		X
Graminoid	Poaceae	Paspalum dilatatum	Alien Plant	X
Graminoid	Poaceae	Pogonarthria squarrosa		X
Graminoid	Poaceae	Setaria pallide-fusca		X
Graminoid	Poaceae	Themeda triandra		X
Graminoid	Poaceae	Tragus berteronianus	Weed	X
Graminoid	Poaceae	Urochloa panicoides	Weed	X
Shrub	Asparagaceae	Asparagus laricinus	Potential Encroacher	X
Shrub	Fabaceae	Acacia (Vachellia) karroo	Potential Encroacher	X
Succulent Forb	Portulacaceae	Portulaca quadrifida	Alien Plant	X
Tree	Oleaceae	Fraxinus spp.	Alien Plant	X

Bottomland Thornveld

Habitat and Land use			
Substrate	Moderately-shallow, greyish Clay to clay-loam soils	**Disturbance**	Overgrazing over a long period of time which has led to the encroachment of *Acacia karroo* shrubs and *Asparagus laricinus*. Establishment of IAPs: *Opuntia ficus-indica*
Species Richness	75 species of which 11 are alien plants and 5 are indigenous weeds	**Conservation value:**	Moderate

Ecosystem function	Grazing, maintenance of pollinator populations, vegetation cover necessary for soil conservation, stabilisation of soils, accumulates and slows down runoff, maximises infiltration of runoff into soils and filtering of runoff before it seeps further into lower-lying wetland systems, habitat for flora and fauna limited to high typographical positions.	**Sensitivity:**	Medium
Need for rehabilitation	Clearing of weeds and alien invasive species		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
High shrubs and trees	1.8 - 4	15-20
Low Shrubs	0.2 – 1.5	50-70
Grass	0.1 – 1	80
Forbs	0.01 – 1.5	5-10
Diagnostic Species	*Cymbopogon pospischilii, Eragrostis gummiflua, Asparagus laricinus, Ehretia rigida, Gymnosporia heterophylla, Acacia karroo (Shrub), Delosperma floribundum, Acacia karroo (tree)*	
Dominant Species	*Opuntia ficus-indica, Themeda triandra, Eragrostis obtusa, Eragrostis lehmanniana, Eragrostis chloromelas, Clematis brachiata, Pentharrhinum insipidum*	

Growth Form	Family	Species	Status	Bottomland Thornveld
Climbing Forb	Apocynaceae	*Pentharrhinum insipidum*		X
Climbing Shrub	Ranunculaceae	*Clematis brachiata*		X
Creeping Forb	Fabaceae	*Rhynchosia minima*		X
Dwarf Shrub	Asteraceae	*Pentzia incana*	Potential Encroacher	X
Dwarf Shrub	Asteraceae	*Seriphium plumosum*	Potential Encroacher	X
Forb	Acanthaceae	*Blepharis integrifolia*		X
Forb	Acanthaceae	*Crabbea acaulis*		X
Forb	Amaranthaceae	*Atriplex semibacata*	Weed	X
Forb	Asteraceae	*Arctotis arctoides*		X
Forb	Asteraceae	*Berkheya onopordifolia*		X
Forb	Asteraceae	*Berkheya pinnatifida*		X
Forb	Asteraceae	*Bidens bipinnata*	Alien Plant	X
Forb	Asteraceae	*Conyza bonariensis*	Alien Plant	X
Forb	Asteraceae	*Gazania krebsiana*		X
Forb	Asteraceae	*Schkuhria pinnata*	Alien Plant	X
Forb	Asteraceae	*Tagetes minuta*	Alien Plant	X
Forb	Asteraceae	*Tripteris aghillana*	Weed	X
Forb	Asteraceae	*Vernonia olgiocephala*		X
Forb	Asteraceae	*Zinnia peruviana*	Alien Plant	X

Forb	Campanulaceae	*Wahlenbergia virgata*		X
Forb	Convolvulaceae	*Cuscuta australis*	Outside of range	X
Forb	Fabaceae	*Indigofera deleoides*		X
Forb	Geraniaceae	*Monsonia burkeana*		X
Geophyte	Hypoxidaceae	*Hypoxis argentea*		X
Forb	Lamiaceae	*Teucrium trifidum*		X
Forb	Malvaceae	*Corchorus aspelnifolius*		X
Forb	Malvaceae	*Hermannia coccocarpa*		X
Forb	Malvaceae	*Hermannia depressa*		X
Forb	Malvaceae	*Hibiscus aethipicus*		X
Forb	Malvaceae	*Hibiscus pusillus*		X
Forb	Malvaceae	*Hibiscus trionum*	Alien Plant	X
Forb	Malvaceae	*Sida cordifolia*	Weed	X
Forb	Malvaceae	*Sida dregei*		X
Forb	Verbenaceae	*Lippia javanica*		X
Forb	Verbenaceae	*Verbena aristigera*	Alien Plant	X
Forb	Verbenaceae	*Verbena officinalis*	Category 1b Invasive Alien Plant	X
Geophyte	Hypoxidaceae	*Hypoxis hemerocallidea*		X
Geoxylic Suffrutex	Rhamnaceae	*Ziziphus zeyheriana*		X
Graminoid	Poaceae	*Aristida congesta*	Weed	X
Graminoid	Poaceae	*Cymbopogon pospischilii*		X
Graminoid	Poaceae	*Cynodon dactylon*	Weed	X
Graminoid	Poaceae	*Digitaria eriantha*		X
Graminoid	Poaceae	*Elionurus muticus*		X
Graminoid	Poaceae	*Eragrostis biflora*		X
Graminoid	Poaceae	*Eragrostis chloromelas*		X
Graminoid	Poaceae	*Eragrostis gummiflua*		X
Graminoid	Poaceae	*Eragrostis lehmanniana*		X
Graminoid	Poaceae	*Eragrostis obtusa*		X
Graminoid	Poaceae	*Eragrostis superba*		X
Graminoid	Poaceae	*Eragrostis trichophora*		X
Graminoid	Poaceae	*Panicum coloratum*		X
Graminoid	Poaceae	*Panicum maximum*		X
Graminoid	Poaceae	*Setaria pallide-fusca*		X
Graminoid	Poaceae	*Setaria verticillata*		X
Graminoid	Poaceae	*Themeda triandra*		X
Graminoid	Poaceae	*Trichoneura grandiglumis*		X
Shrub	Asparagaceae	*Asparagus laricinus*	Potential Encroacher	X
Shrub	Asparagaceae	*Asparagus setaceus*		X
Shrub	Boraginaceae	*Ehretia rigida*		X
Shrub	Celastraceae	*Gymnosporia heterophylla*		X
Shrub	Ebenaceae	*Diospyros lycioides*		X
Shrub	Fabaceae	*Acacia (Vachellia) karroo*	Potential Encroacher	X
Shrub	Malvaceae	*Grewia flava*		X
Succulent Dwarf Shrub	Aizoaceae	*Delosperma cooperi*		X
Succulent Dwarf Shrub	Aizoaceae	*Delosperma floribundum*		X
Succulent Forb	Asphodelaceae	*Bulbine capitata*		X
Succulent Shrub	Agavaceae	*Agave americana*	Category 2 Alien Invasive Plant	X
Succulent Shrub	Cactaceae	*Opuntia ficus-indica*	Category 1b Invasive Alien Plant	X
Succulent Shrub	Cactaceae	*Opuntia humifusa*	Category 1b Alien Invasive Plant	X
Tree	Anacardiaceae	*Searsia lancea*		X
Tree	Fabaceae	*Acacia (Vachellia) karroo*		X
Tree	Rhamnaceae	*Ziziphus mucronata*		X
Shrub	Solanaceae	*Lycium ferocissimum*		X
Graminoid	Poaceae	*Setaria spp.*		X

Forb	Asteraceae	*Helichrysum dregeanum*		X

Secondary Sparse Woody Grassland

Habitat and Land use			
Substrate	Greyish to brown clay-loam soil	**Disturbance**	Historical cultivated area. Overgrazing. Establishment of IAPs: *Opuntia ficus-indica* and *Verbena officinalis*
Species Richness	82 species of which 7 are alien plants and 7 are indigenous weeds	**Conservation value:**	Low
Ecosystem function	Grazing, maintenance of pollinator populations, vegetation cover necessary for soil conservation, stabilisation of soils, accumulates and slows down runoff, maximises infiltration of runoff into soils, habitat for flora and fauna	**Sensitivity:**	Low
Need for rehabilitation	Clearing of weeds and alien invasive species		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
High shrubs and trees	1.8 - 4	0.5-10
Low Shrubs	0.2 – 1.5	10-15
Grass	0.1 – 1	80
Forbs	0.01 – 1.5	10-20
Diagnostic Species	*Cynodon dactylon, Digitaria eriantha, Eragrostis chloromelas, Panicum coloratum, Acacia karroo (Shrub)*	
Dominant Species	*Acacia karoo (Tree), Themeda triandra, Heteropogon contortus, Eragrostis lehmanniana, Eragrostis gummiflua, Aristida congesta, Monsonia burkeana, Nidorela residifolia, Helichrysum rugulosum, Arctotis arctoides,*	

Growth Form	Family	Species	Status	Secondary (Plagioclimax) Sparse Woody Grassland
Climbing Forb	Apocynaceae	*Pentharrhinum insipidum*		X

Climbing Shrub	Ranunculaceae	*Clematis brachiata*		X
Creeping Forb	Fabaceae	*Rhynchosia minima*		X
Creeping Forb	Fabaceae	*Rhynchosia totta var. totta*		X
Dwarf Shrub	Asteraceae	*Felicia muricata*	Potential Encroacher	X
Dwarf Shrub	Asteraceae	*Pentzia incana*	Potential Encroacher	X
Forb	Acanthaceae	*Crabbea acaulis*		X
Forb	Amaranthaceae	*Achyranthes aspera*	Weed	X
Forb	Asteraceae	*Arctotis arctoides*		X
Forb	Asteraceae	*Berkheya onopordifolia*		X
Forb	Asteraceae	*Berkheya pinnatifida*		X
Forb	Asteraceae	*Bidens bipinnata*	Alien Plant	X
Forb	Asteraceae	*Conyza bonariensis*	Alien Plant	X
Forb	Asteraceae	*Dicoma anomala subsp. Circioides*		X
Forb	Asteraceae	*Gazania krebsiana*		X
Forb	Asteraceae	*Helichrysum nudifolium*		X
Forb	Asteraceae	*Helichrysum rugulosum*	Weed	X
Forb	Asteraceae	*Nidorela residifolia*		X
Forb	Asteraceae	*Tagetes minuta*	Alien Plant	X
Forb	Asteraceae	*Tripteris aghillana*	Weed	X
Forb	Asteraceae	*Zinnia peruviana*	Alien Plant	X
Forb	Campanulaceae	*Wahlenbergia denticulata*		X
Forb	Campanulaceae	*Wahlenbergia virgata*		X
Forb	Caryophyllaceae	*Pollichia campestris*		X
Forb	Commelinaceae	*Commelina africana*		X
Forb	Convolvulaceae	*Convolvulus sagittatus*		X
Forb	Convolvulaceae	*Cuscuta australis*	Outside of range	X
Forb	Fabaceae	*Chamaecrista comosa*		X
Forb	Fabaceae	*Indigofera deleoides*		X
Forb	Geraniaceae	*Monsonia burkeana*		X
Geophyte	Hypoxidaceae	*Hypoxis argentea*		X
Forb	Lamiaceae	*Stachys hyssopoides*		X
Forb	Lamiaceae	*Teucrium trifidum*		X
Forb	Malvaceae	*Hermannia coccocarpa*		X
Forb	Malvaceae	*Hermannia depressa*		X
Forb	Malvaceae	*Hibiscus pusillus*		X
Forb	Malvaceae	*Pavonia senegalensis*		X
Forb	Malvaceae	*Sida cordifolia*	Weed	X
Forb	Malvaceae	*Sida dregei*		X
Forb	Pedaliaceae	*Sesamum triphyllum*	Weed	X
Forb	Scrophulariaceae	*Aptosimum procumbens*		X
Forb	Scrophulariaceae	*Jamesbrittenia aurantiaca*		X
Forb	Verbenaceae	*Lippia javanica*		X
Forb	Verbenaceae	*Verbena aristigera*	Alien Plant	X
Forb	Verbenaceae	*Verbena officinalis*	Category 1b Invasive Alien Plant	X
Geophyte	Agavaceae	*Chlorophytum fasciculatum*		X
Geophyte	Amaryllidaceae	*Boophone disticha*	Protected	X
Geophyte	Hyacinthaceae	*Schizocarphus nervosus*	Protected	X
Geophyte	Hypoxidaceae	*Hypoxis hemerocallidea*		X
Geophyte	Hypoxidaceae	*Hypoxis rigidula*		X
Geoxylic Suffrutex	Rhamnaceae	*Ziziphus zeyheriana*		X
Graminoid	Poaceae	*Aristida adscensionis*		X
Graminoid	Poaceae	*Aristida congesta*	Weed	X
Graminoid	Poaceae	*Cynodon dactylon*	Weed	X
Graminoid	Poaceae	*Digitaria eriantha*		X
Graminoid	Poaceae	*Elionurus muticus*		X

Graminoid	Poaceae	*Eragrostis chloromelas*		X
Graminoid	Poaceae	*Eragrostis curvula*		X
Graminoid	Poaceae	*Eragrostis gummiflua*		X
Graminoid	Poaceae	*Eragrostis lehmanniana*		X
Graminoid	Poaceae	*Eragrostis obtusa*		X
Graminoid	Poaceae	*Eragrostis plana*		X
Graminoid	Poaceae	*Eragrostis superba*		X
Graminoid	Poaceae	*Eragrostis trichophora*		X
Graminoid	Poaceae	*Heteropogon contortus*		X
Graminoid	Poaceae	*Panicum coloratum*		X
Graminoid	Poaceae	*Setaria pallide-fusca*		X
Graminoid	Poaceae	*Sporobolus fimbriatus*		X
Graminoid	Poaceae	*Themeda triandra*		X
Shrub	Asparagaceae	*Asparagus laricinus*	Potential Encroacher	X
Shrub	Asparagaceae	*Asparagus setaceus*		X
Shrub	Celastraceae	*Gymnosporia heterophylla*		X
Shrub	Ebenaceae	*Diospyros lycioides*		X
Shrub	Fabaceae	*Acacia (Vachellia) karroo*	Potential Encroacher	X
Succulent Forb	Asphodelaceae	*Bulbine capitata*		X
Succulent Forb	Asphodelaceae	*Bulbine narcissifolia*		X
Succulent Shrub	Cactaceae	*Opuntia ficus-indica*	Category 1b Invasive Alien Plant	X
Tree	Anacardiaceae	*Searsia lancea*		X
Tree	Fabaceae	*Acacia (Vachellia) karroo*		X
Tree	Rhamnaceae	*Ziziphus mucronata*		X
Graminoid	Poaceae	*Setaria spp.*		X
Forb	Asteraceae	*Helichrysum dregeanum*		X

Secondary Grassland

Habitat and Land use			
Substrate	Orange to light brown, loamy-sand. Moderate soil depth	**Disturbance**	Historical cultivated area. Pasture Establishment of IAPs: *Verbena officinalis*
Species Richness	62 species of which 9 are alien plants and 10 are indigenous weeds	**Conservation value:**	Low
Ecosystem function	Grazing, vegetation cover necessary for soil conservation, stabilisation of soils, accumulates and slows down runoff, maximises infiltration of runoff into soils, habitat for flora and fauna.	**Sensitivity:**	Low
Need for rehabilitation	Clearing of weeds and alien invasive species		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
High shrubs and trees	1.8 - 4	3
Low Shrubs	0.2 – 1.5	5-10
Grass	0.1 – 1	80
Forbs	0.01 – 1.5	10-20
Diagnostic Species	*Helechrysum rugulosum, Digitaria eriantha, Eragrostis chloromelas, Eragrostis curvula*	
Dominant Species	*Verbena officinalis, Conyza bonariensis, Berkheya onopordifolia, Seriphium plumosum, Felicia muricata, Cynodon dactylon, Eragrostis lehmanniana, Panicum coloratum, Helichrysum dregeanum*	

Growth Form	Family	Species	Status	Secondary (Plagioclimax) Grassland
Creeping Forb	Amaranthaceae	*Alternanthera pungens*	Weed	X
Creeping Forb	Fabaceae	*Rhynchosia minima*		X
Dwarf Shrub	Asteraceae	*Felicia muricata*	Potential Encroacher	X
Dwarf Shrub	Asteraceae	*Pentzia incana*	Potential Encroacher	X
Dwarf Shrub	Asteraceae	*Seriphium plumosum*	Potential Encroacher	X
Dwarf Shrub	Scrophulariaceae	*Selago densiflora*		X
Forb	Amaranthaceae	*Achyranthes aspera*	Weed	X
Forb	Amaranthaceae	*Amaranthus thunbergii*	Weed	X
Forb	Asteraceae	*Arctotis arctoides*		X
Forb	Asteraceae	*Berkheya onopordifolia*		X
Forb	Asteraceae	*Berkheya pinnatifida*		X
Forb	Asteraceae	*Bidens bipinnata*	Alien Plant	X
Forb	Asteraceae	*Conyza bonariensis*	Alien Plant	X
Forb	Asteraceae	*Cotula podocephala*		X
Forb	Asteraceae	*Helichrysum rugulosum*	Weed	X
Forb	Asteraceae	*Nidorela residifolia*		X
Forb	Asteraceae	*Pseudognaphalium luteo-album*	Alien Plant	X
Forb	Asteraceae	*Schkuhria pinnata*	Alien Plant	X
Forb	Asteraceae	*Tagetes minuta*	Alien Plant	X
Forb	Asteraceae	*Tripteris aghillana*	Weed	X
Forb	Campanulaceae	*Wahlenbergia undulata*		X
Forb	Campanulaceae	*Wahlenbergia virgata*		X
Forb	Caryophyllaceae	*Pollichia campestris*		X
Forb	Chenopodiaceae	*Chenopodium album*	Weed	X
Forb	Fabaceae	*Indigofera deleoides*		X
Forb	Geraniaceae	*Monsonia burkeana*		X
Forb	Malvaceae	*Hermannia depressa*		X
Forb	Malvaceae	*Hibiscus aethipicus*		X
Forb	Malvaceae	*Hibiscus trionum*	Alien Plant	X
Forb	Malvaceae	*Sida cordifolia*	Weed	X
Forb	Scrophulariaceae	*Aptosimum procumbens*		X
Forb	Scrophulariaceae	*Jamesbrittenia aurantiaca*		X
Forb	Solanaceae	*Solanum nigrum*		X
Forb	Verbenaceae	*Lippia javanica*		X
Forb	Verbenaceae	*Verbena aristigera*	Alien Plant	X

Forb	Verbenaceae	*Verbena officinalis*	Category 1b Invasive Alien Plant	X
Geophyte	Amaryllidaceae	*Boophone disticha*	Protected	X
Geophyte	Hypoxidaceae	*Hypoxis hemerocallidea*		X
Graminoid	Cyperaceae	*Cyperus usitatus*	Weed	X
Graminoid	Poaceae	*Aristida congesta*	Weed	X
Graminoid	Poaceae	*Cynodon dactylon*	Weed	X
Graminoid	Poaceae	*Digitaria eriantha*		X
Graminoid	Poaceae	*Eragrostis chloromelas*		X
Graminoid	Poaceae	*Eragrostis curvula*		X
Graminoid	Poaceae	*Eragrostis gummiflua*		X
Graminoid	Poaceae	*Eragrostis lehmanniana*		X
Graminoid	Poaceae	*Eragrostis plana*		X
Graminoid	Poaceae	*Eragrostis racemosa*		X
Graminoid	Poaceae	*Eragrostis superba*		X
Graminoid	Poaceae	*Eragrostis trichophora*		X
Graminoid	Poaceae	*Heteropogon contortus*		X
Graminoid	Poaceae	*Hyparrhenia hirta*		X
Graminoid	Poaceae	*Panicum coloratum*		X
Graminoid	Poaceae	*Themeda triandra*		X
Shrub	Asparagaceae	*Asparagus setaceus*		X
Shrub	Boraginaceae	*Ehretia rigida*		X
Shrub	Fabaceae	*Acacia (Vachellia) karroo*	Potential Encroacher	X
Succulent Dwarf Shrub	Aizoaceae	*Delosperma floribundum*		X
Succulent Forb	Portulacaceae	*Portulaca quadrifida*	Alien Plant	X
Tree	Fabaceae	*Acacia (Vachellia) karroo*		X
Graminoid	Poaceae	*Setaria spp.*		X
Forb	Asteraceae	*Helichrysum dregeanum*		X

Primary Grassland

Habitat and Land use			
Substrate	Light brown, loamy-sand to loamy-clay. Moderate to shallow soil depth	**Disturbance**	Habitat fracturing, Long term grazing with periods of overgrazing. Establishment of IAPs: *Verbena officinalis*
Species Richness	44 species of which 3 are alien plants and 4 are indigenous weeds	**Conservation value:**	High: Natural patches of grassland resembling Vaal-Vet Sandy Grassland
Ecosystem function	Grazing, vegetation cover necessary for soil conservation, stabilisation of soils, accumulates and slows down runoff, maximises infiltration of runoff into soils, habitat for flora and fauna.	**Sensitivity:**	High: Natural patches of grassland resembling Vaal-Vet Sandy Grassland
Need for rehabilitation	Clearing of weeds and alien invasive species		

Vegetation structure		
Layer	**Height (m)**	**Cover (%)**
High shrubs and trees	1.8 - 4	3
Low Shrubs	0.2 – 1.5	5-10
Grass	0.1 – 1	80
Forbs	0.01 – 1.5	10-20
Diagnostic Species	*Vernonia oligocephala, Eragrostis chloromelas. Themeda triandra, Panicum coloratum*	
Dominant Species	*Heteropogon contortus, Hermannia depressa, Teucrium trifidum, Berkheya onopordifolia, Arctotis arctoides, Felicia muricata, Lippia javanica,*	

Growth Form	Family	Species	Status	Primary Grassland
Climbing Forb	Apocynaceae	*Pentharrhinum insipidum*		X
Creeping Forb	Fabaceae	*Rhynchosia minima*		X
Dwarf Shrub	Asteraceae	*Felicia muricata*	Potential Encroacher	X
Dwarf Shrub	Fabaceae	*Indigofera cryptantha*		X
Forb	Acanthaceae	*Crabbea acaulis*		X
Forb	Amaranthaceae	*Achyranthes aspera*	Weed	X
Forb	Asteraceae	*Arctotis arctoides*		X
Forb	Asteraceae	*Berkheya onopordifolia*		X
Forb	Asteraceae	*Conyza bonariensis*	Alien Plant	X
Forb	Asteraceae	*Dicoma zeyheri*		X
Forb	Asteraceae	*Helichrysum rugulosum*	Weed	X
Forb	Asteraceae	*Tagetes minuta*	Alien Plant	X
Forb	Asteraceae	*Vernonia olgiocephala*		X
Forb	Campanulaceae	*Wahlenbergia virgata*		X
Forb	Fabaceae	*Chamaecrista comosa*		X
Forb	Fabaceae	*Indigofera deleoides*		X
Forb	Geraniaceae	*Monsonia burkeana*		X
Forb	Lamiaceae	*Stachys hyssopoides*		X
Forb	Lamiaceae	*Teucrium trifidum*		X
Forb	Malvaceae	*Hermannia depressa*		X
Forb	Malvaceae	*Hibiscus aethipicus*		X
Forb	Malvaceae	*Pavonia senegalensis*		X
Forb	Scrophulariaceae	*Aptosimum procumbens*		X
Forb	Scrophulariaceae	*Jamesbrittenia aurantiaca*		X
Forb	Scrophulariaceae	*Striga asiatica*		X
Forb	Verbenaceae	*Lippia javanica*		X
Forb	Verbenaceae	*Verbena officinalis*	Category 1b Invasive Alien Plant	X
Geophyte	Amaryllidaceae	*Boophone disticha*	Protected	X
Geophyte	Hyacinthaceae	*Schizocarphus nervosus*	Protected	X
Geophyte	Hypoxidaceae	*Hypoxis hemerocallidea*		X
Graminoid	Poaceae	*Aristida congesta*	Weed	X
Graminoid	Poaceae	*Cynodon dactylon*	Weed	X
Graminoid	Poaceae	*Elionurus muticus*		X
Graminoid	Poaceae	*Eragrostis chloromelas*		X
Graminoid	Poaceae	*Eragrostis curvula*		X
Graminoid	Poaceae	*Heteropogon contortus*		X

Graminoid	Poaceae	*Panicum coloratum*		X
Graminoid	Poaceae	*Themeda triandra*		X
Shrub	Asparagaceae	*Asparagus laricinus*	Potential Encroacher	X
Shrub	Fabaceae	*Acacia (Vachellia) karroo*	Potential Encroacher	X
Succulent Dwarf Shrub	Aizoaceae	*Delosperma floribundum*		X
Succulent Forb	Asphodelaceae	*Aloe davyana*	Protected	X
Tree	Fabaceae	*Acacia (Vachellia) karroo*		X
Dwarf Shrub	Solanaceae	*Lycium horridum*		X

Plant Species of Conservation Concern (SCC)

During the survey no plant SCC was recorded. However, three provincially protected species were recorded, as listed within the Free State Nature Conservation Bill (2007), namely; Aloe *davyana, Boophone disticha, Schizocarpus nervosus and Ammocharis coranica*. 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 6th – 10th of April 2020 (end of wet season).

Overall, mammal diversity in the project area was moderate, with eleven (11) mammal species being physically recorded based on direct observations, camera trap photographs, Sherman traps, and/or the presence of visual tracks & signs. These 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 (as mentioned by the landowner).

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
Gerbilliscus brantsii	Highveld Gerbil	LC	LC
Rhabdomys pumilio	Four-Striped Grass Mouse	LC	LC
Mastomys coucha	Southern Multimammate Mouse	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

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. However, what was surprising, was that only one species of *Mastomys coucha* (Southern Multimammate Mouse) was caught whilst *Rhabdomys pumilio* (Four Striped-Grass Mouse) was fairly regularly trapped. It is feasible, that due to very high rainfall leading up to the sample period (and thus very high productivity of vegetation, insects and seeds), it is possible that the abundance of resources prohibited trapping success, although this does not dimmish the reliability of the data gathered.

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. Primary Grassland and Secondary (Plagioclimax) Sparse Woody Grassland

These habitats provide excellent 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. Within the development site, these habitats represent, combined, the second largest mammalian habitat. The grasses in these habitats are very dense and of fair forage value. 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. However, it must be reiterated that the poor and unusually low trapping success has likely deprived the habitat of its predicted total diversity. Overall diversity, connectivity and sensitivity of these areas can be regarded as Moderate.

B. Secondary Grassland (Pastures)

These are old cultivated lands that have been anthropogenically re-seed to serve as forage (pastures) for livestock. These "planted" grasslands are the prevailing land use. Although

the grass layer was excellent, the fairly species poor nature of the habitat reduces habitat and foraging potential in comparison with the above described habitats. The softer substrate is however more optimal for fossorial or burrowing species such as mole rats, mongooses, Suids (pig species) and porcupines. The overall diversity, connectivity and sensitivity of these areas were Low.

C. 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. The overall diversity, connectivity and sensitivity of these areas were Low.

D. Wetland Habitats

Wetlands occur naturally or have been somewhat modified throughout the study area and support surrounding agricultural practices. The vegetation around these habitats is wetland associated and include dense long grasses. This provides structural complexity and potential breeding/foraging habitat for mammal species. The overall diversity, connectivity and sensitivity of these areas were Moderate to High.

E. Bottomland Thornveld

This habitat also provides good refugia and forage for small mammal species, which in turn form the basis for the trophic food chain. This habitat is also regarded as a fairly important breeding and foraging sites for mammal species. The grasses in these habitats are moderately dense and of fair forage value. However, some encroaching of shrubs and small trees have had an impact on the total grass coverage. Positive effects are from moderate-high structural complexity and fairy strong foraging potential and overall, the species diversity for these areas was moderate-low, with species from most trophic levels present. Overall diversity, connectivity and sensitivity of these areas can be regarded as Moderate.

Herpetofauna

This section represents the results from the field survey conducted from the 6th – 10th of April 2020 (end of wet season).

Herpetofauna diversity was considered to be moderate-low with three (3) reptile species and one (1) 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

6. COMBINED HABITAT SENSITIVITY

The following sensitivity map (Figure 10) has been compiled combining the results obtained from the field survey as well as available geo-spatial information.

Very High Sensitivity

» All Wetland Features: Wetland features that feed into important downstream watercourses, are associated with natural grassland resembling Vaal-Vet Sandy Grassland and hens worth being classified as CBA1, provide various unique habitats and niches (contribute to habitat and species diversity), are a potential suitable habitat for *Pyxicephalus adspersus* – Giant Bullfrog (Near Threatened), and fulfil vital ecological functions and services such as flood attenuation, stream flow augmentation, erosion control and the enhancement of water quality (sediment trapping, removal and storage of phosphates, nitrates and toxicants).

- General Development Recommendations:
  This part of the Vaal-Vet Sandy Grassland, apart from being part of a listed threatened ecosystem and containing a few protected species, fulfils a relatively important role in the wider ecosystem. It accumulates and significantly reduces the speed of all runoff coming from higher-lying areas. The vegetation filters this water, retaining nutrients, detritus, and possible pollutants that could leach out of higher-lying cultivation areas. The discharge of these substances into lower-lying river systems could lead to eutrophication and a rise in aquatic weeds, and thus to cumulative impacts of the development should this portion of the vegetation be destroyed.

  The area, even if small, must therefore be treated as a No-Go zone, and it is recommended that a buffer of at least 30 m either side be left intact to prevent

any degradation of this area (This buffer areas around the wetlands are regarded as Highly Sensitive features).

High Sensitivity

» Primary Grassland: Primary grassland features that are representative of slightly degraded (overgrazed) form of Vaal-Vet Sandy Grassland (Endangered), and which are located within the CBA1 areas as delineated by DESTEA. These remaining "CBA1" areas were however, during the site visit, confirmed to be slightly degraded (as a result of longer grazing with periods of overgrazing), and mostly small, fractured, patches surrounded by historically cultivated areas. Subsequently these patches of primary grassland can rather be regarded as Ecological Support Areas.

- General Development Recommendations:
  Due to the patchiness and fractured/isolated nature of these primary grasslands, development within these areas are regarded as acceptable. However, where these patches of primary grassland can be avoided, such an attempt should be made.

» 30m buffer areas around wetland features: This buffer area is recommended around the identified wetland features in order to prevent any degradation of the wetland features. These buffer areas should also be regarded as No-Go Zones as these areas are crucial for the maintenance of the functions and services provided by the wetland features.

- General Development Recommendations:
  These buffer areas should be regarded as No-Go areas.

Medium Sensitivity

» Primary Grassland resembling natural Central Free State Grassland, and Bottom Thornveld: All natural primary vegetation features located outside of CBAs or which represent Central Free State Grassland have also been classified as medium sensitive.

- General Development Recommendations:
  Development within these habitats are acceptable.

  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 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.

» Re-established grassland on historical cultivated areas: These areas have been left fallow for an extended period of time and the re-establishment of mostly indigenous vegetation have been allowed to such an extent that the vegetation can be regarded as stable (plagioclimax), providing most of the functions and services associated with natural grassland.

- General Development Recommendations:
  It is expected that most of the PV arrays of the proposed development will be situated on these secondary grasslands. To prevent the onset of accelerated erosion, it is recommended that where possible 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 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.

Low Sensitivity

» All transformed and disturbed area: 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.

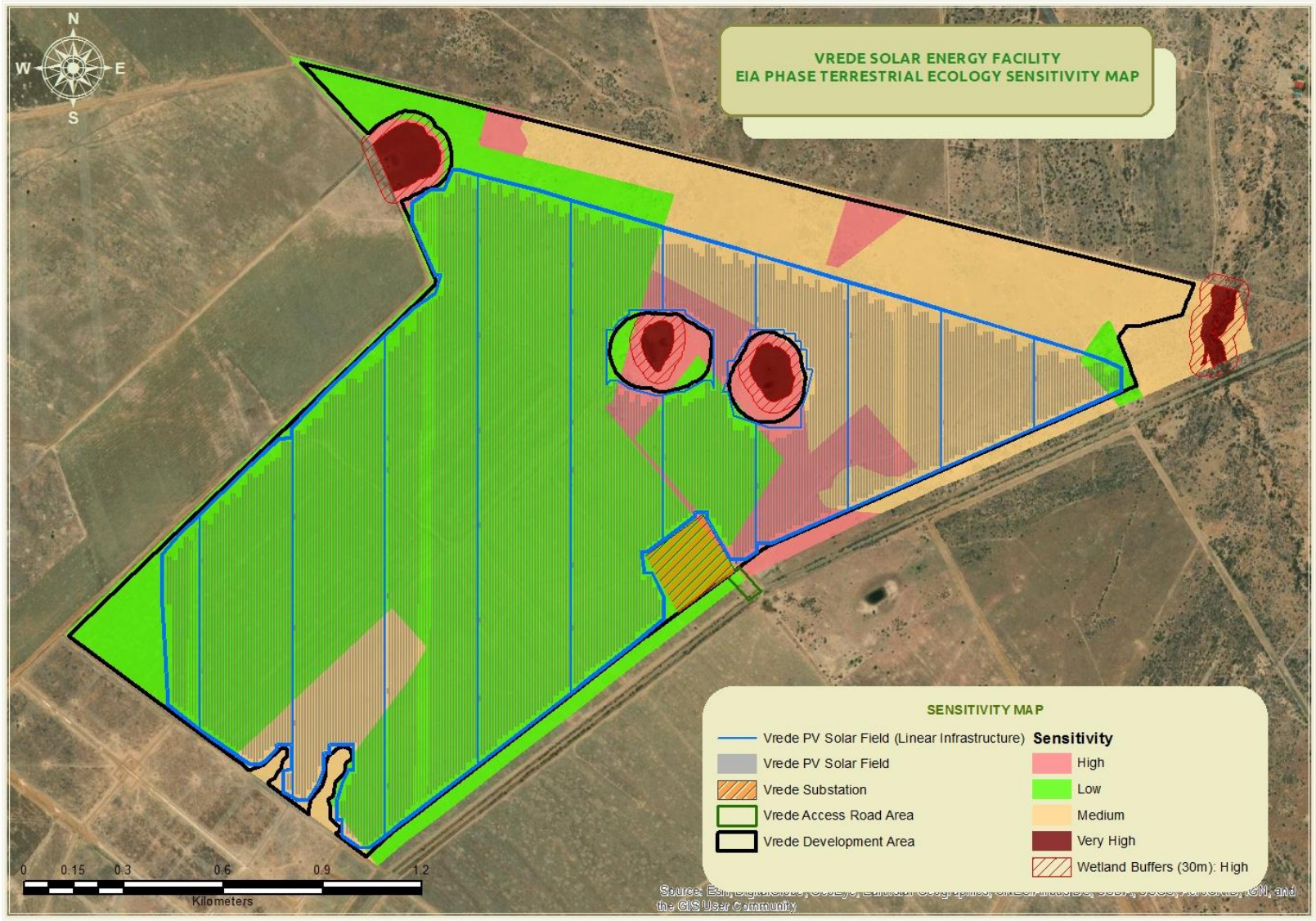


Figure 10: EIA Phase Terrestrial Ecology Sensitivity Map.

7. ASSESSMENT OF PROPOSED IMPACTS

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 Vrede Solar Energy Facility illustrated below in Figure 11. 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 low.

In terms of the cumulative impact on the endangered Vaal-Vet Sandy Grassland, small fractured portions of this vegetation type are located within the Vrede Solar Energy Facility's project footprint with most of these areas being avoided within the proposed layout, whilst the proposed 75 MW PV Solar farm located to the south west of the proposed Vrede Solar Energy Facility is entirely located within this vegetation type. The cumulative impact of these developments on the Vaal-Vet Sandy Grassland is subsequently expected to be minimal and will not impact the conservation status and targets of this vegetation type.

Conclusion on cumulative impacts due to the proposed, and surrounding developments:

» Minimal transformation of intact, sensitive habitats. These impacts could 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 low sensitivity area with most 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, small ephemeral to larger intermittent drainage lines, wetlands, rivers and this could also have detrimental effects on the larger lower 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 Critical Biodiversity and may fracture and disrupt the connectivity of these CBAs, impacting the Province's ability to meet its conservation targets.

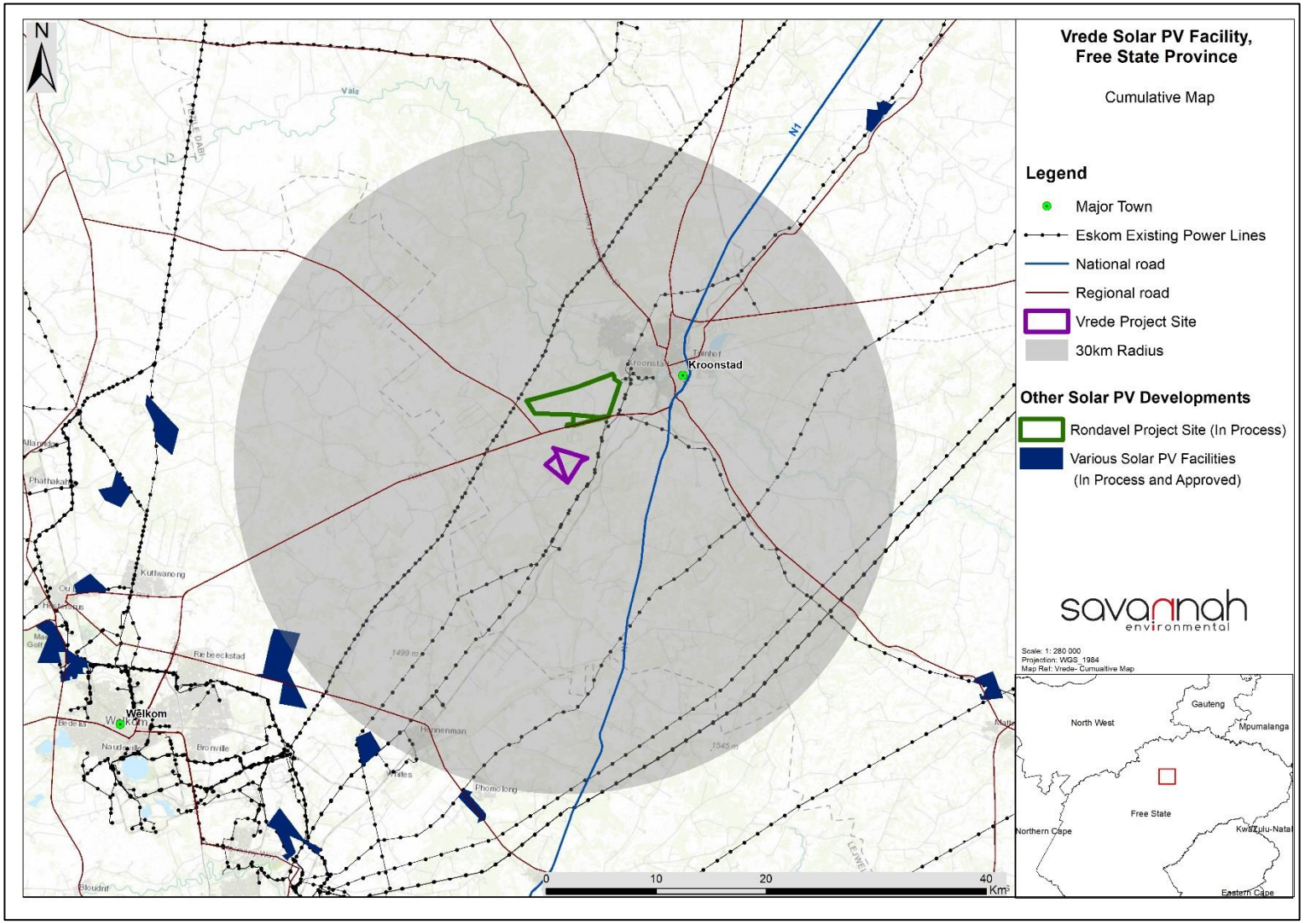


Figure 11: Location Map of the proposed Vrede Solar Energy Facility relative to the other solar facilities planned within a radius of 30 km.

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 function. 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 largely historically transformed through cultivation practices, and long-term grazing pressure. Only limited elements of original/natural Vaal-Vet Sandy Grassland remain within the proposed project site and is mostly fractured/isolated patches. As such, these small patches of Vaal-Vet Sandy Grassland within the project site will contributing minimal to the conservation of this threatened vegetation type. It is expected that the impact will be mostly local (concentrated within the proposed development area and within the immediate surrounding areas).
» 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 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 any freshwater features present 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.
» Approximately 35% of the development area is situated within a CBA1, mainly due to its location within the endangered Vaal-Vet Sandy Grassland Ecosystem. However, during this study it was determined that most of these areas identified as Natural Vaal-Vet Sandy Grassland have been historically subjected to cultivation and vegetation transformation, with small patches of remaining natural vegetation, resembling natural, untransformed Vaal-Vet Sandy Grassland. These patches of natural grassland, collectively, only cover an area of less than 15% of the proposed projects site, furthermore, most of these patches of natural Vaal-Vet Sandy Grassland along the northern boundary will be avoided, according the development layout. The loss of and transformation of these intact CBA1 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*

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 217ha, located mostly in an area transformed through historical cultivation practices and 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.

Approximately 30% of the project site is situated within a CBA1, mainly due to its location within the Vaal-Vet Sandy Grassland which is classified as an Endangered Ecosystem (Mucina & Rutherford, 2006 and National Ecosystem List, GN1002 of 2011). However, during this study it was determined that most of these areas identified as Natural Vaal-Vet Sandy Grassland have been historically subjected to cultivation and vegetation transformation, with small patches of remaining natural vegetation, resembling natural, untransformed Vaal-Vet Sandy Grassland. These patches of natural grassland, collectively, only cover an area of less than 15% of the proposed projects site, furthermore, most of these patches of natural Vaal-Vet Sandy Grassland along the northern boundary will be avoided, according the development layout. Although the development will impact 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 transformed habitats.

Sensitive habitat types such riparian fringes, seepages and other wetland habitat types is avoided (including buffer areas around these habitats) 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;

- *Aloe davyana* (a single species, just outside of the development footprint),
- *Boophone disticha,*
- *Schizocarpus nervosus,*
- *Amorcharis conranica* (the plants observed were associated with the wetland habitats and as these habitats will be avoided, these species will not be impacted).

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 very little faunal activity was observed. Species confirmed within the affected farm properties include:

- Small mammals: such as Scrub Hare (*Lepus saxatilis*), Cape Porcupine (*Hystrix africaeaustralis*), African Mole-rat (*Cryptomys hottentotus*), Highveld Gerbil (*Gerbilliscus brantsii*), Four-striped Grass Mouse (*Rhabdomys pumilio*), Southern Multimammate Mouse (*Mastomys coucha*), South African Ground Squirrel (*Xerus inauris*), Black-backed Jackal (*Canis mesomelas*), Yellow Mongoose (*Cynictis penicillata*), Common Duiker (*Sylvicapra grimmia*) and Steenbok (*Raphicerus campestris*).

  Common Warthog (*Phacochoerus africanus*) were quite regularly observed, especially via the camera traps. These species have been introduced into the area and have increased in numbers and are now a thriving community within the area.

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

  The current landowner also confirmed rare sightings of Kudu (*Tragelaphus strepsiceros*), Brown Hyaena (*Hyaena brunnea*), Aardwolf (*Proteles cristatus*), Aardvark (*Orycteropus afer*) and Caracal (*Caracal caracal*).

Very few reptilian species were confirmed within the project site including: Thin-tailed Legless Skink (*Acontias gracilicauda*) - Endemic, Wahlberg's Snake-eyed Skink (*Afroablepharus wahlbergii*) and Peters' Thread Snake (*Leptotyphlops scutifrons*).

Although it was expected that the affected farm portions would comprise of a few amphibian species due to the various moist habitat types, only Boettger's Caco (*Cacosternum boettgeri*) was confirmed.

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 EO 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.

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, Salsola kali, Verbena officinalis, V. bonariensis, Cirsium vulgare, 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 Vrede 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 Vrede 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 Vrede Solar Energy 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 7. *Impacts on critical biodiversity areas and broad-scale ecological processes*

Approximately 30% of the project site is situated within a CBA1, mainly due to its location within the endangered Vaal-Vet Sandy Grassland Ecosystem. However, during this study it was determined that most of these areas identified as Natural Vaal-Vet Sandy Grassland have been historically subjected to cultivation and vegetation transformation, with small patches of remaining natural vegetation, resembling natural, untransformed Vaal-Vet Sandy Grassland. These patches of natural grassland, collectively, only cover an area of less than 15% of the proposed projects site, furthermore, most of these patches of natural Vaal-Vet Sandy Grassland along the northern boundary will be avoided, according the development layout. The loss of and transformation of these intact CBA1 areas could impacting the Province's ability to meet its conservation targets.

Impacts on these Critical Biodiversity Areas can be maintained to an absolute minimum by restricting the development to disturbed and transformed areas within the CBA's. By furthermore implementing effective mitigation measures the functionality of these areas and connectivity between these areas may be maintained.

It was determined during the field survey that, due to the on-site conditions and the nature of the development, the status of the CBAs as a whole will not be significantly affected by the development within this area due to the current transformed condition of the veld as well as the low diversity and potential for movement of faunal species between the various habitats. As such, using the criteria to determine the type of CBA (as specified in Table 5) the landscape encompassing the affected farm properties should rather be classified as an Ecological Support Area (ESA).

Impact 8. *Potential cumulative impacts due to nearby renewable energy developments (solar energy facilities).*

The affected farm property is situated less than 16.6 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 Vrede 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. » Since a large proportion of the identified conservation-worthy species at the site are geophytic and succulent species (e.g. *Aloe davyana, Schizocarphus nervosus* and *Boophone disticha*), the potential for successful translocation is high. Before construction commences individuals of listed species within the development footprint that would be affected, should be counted and marked and translocated where deemed necessary 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 within demarcated construction areas 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 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 unauthorised 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 (1)	Local (1)
Duration	Medium-term (3)	Short-term (1)
Magnitude	Minor (3)	Minor (2)
Probability	Probable (3)	Probable (3)
Significance	**Low (21)**	**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 at the within the power line servitude must occur and could be conducted simultaneously with erosion monitoring as per Eskom Standards. » 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 during operation 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 (2)	Local (1)
Duration	Long-term (4)	Short-term (0)
Magnitude	High (8)	Low (1)
Probability	Highly Probable (4)	Improbable (2)
Significance	**Medium (56)**	**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 (1)	Low (4)
Probability	Improbable (2)	Improbable (2)
Significance	**Low (12)**	**Low (22)**
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 Critical Biodiversity Areas and 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 3: *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 the Vaal-Vet Sandy 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 CBA'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 (1)	Low (4)
Probability	Very Improbable (1)	Improbable (2)
Significance	**Low (6)**	**Low (20)**
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 development area falls within two vegetation types namely; Vaal-Vet Sandy Grassland and Central Free State Grassland. However, the proposed development footprint is located mostly within the Vaal-Vet Sandy Grassland with a small portion extending into the Central Free State Grassland. Vaal-Vet Sandy Grassland is listed as an endangered ecosystem whilst the Central Free State Grassland 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 combined terrestrial ecological sensitivity map of the site has been compiled based on the findings of this study (refer to Figure 11).

The sensitive areas identified, are as follow:

Very High Sensitivity

» All Wetland Features: Wetland features that feed into important downstream watercourses, are associated with natural grassland resembling Vaal-Vet Sandy Grassland and hens worth being classified as CBA1, provide various unique habitats and niches (contribute to habitat and species diversity), are a potential suitable habitat for *Pyxicephalus adspersus* – Giant Bullfrog (Near Threatened), and fulfil vital ecological functions and services such as flood attenuation, stream flow augmentation, erosion control and the enhancement of water quality (sediment trapping, removal and storage of phosphates, nitrates and toxicants). The areas, even if small, must therefore be treated as No-Go zones.

» Natural Primary Grassland: Natural grassland features that are representative of Vaal-Vet Sandy Grassland (Endangered), are located within CBA1, and provide potential habitat for species of conservation concern, especially *Smaug gigantius* – Sungazer (Vulnerable).

High Sensitivity

» Natural Primary Grassland: Primary grassland features that are representative of slightly degraded (overgrazed) form of Vaal-Vet Sandy Grassland (Endangered), and which are located within the CBA1 areas as delineated by DESTEA. These remaining

"CBA1" areas were however, during the site visit, confirmed to be slightly degraded (as a result of longer grazing with periods of overgrazing), and mostly small, fractured, patches surrounded by historically cultivated areas. Subsequently these patches of primary grassland can rather be regarded as Ecological Support Areas. Furthermore, these areas provide potential habitat for species of conservation concern, especially *Smaug gigantius* – Sungazer (Vulnerable). Development within these primary grassland patches, located within the proposed development area, is regarded as acceptable, with the strict implementation of the provided mitigation measures.

» 30m buffer areas around wetland features: This buffer area is recommended around the identified wetland features in order to prevent any degradation of the wetland features. These buffer areas should also be regarded as No-Go Zones as these areas are crucial for the maintenance of the functions and services provided by the wetland features.

Medium Sensitivity

» Primary Grassland resembling natural Central Free State Grassland, and Bottom Thornveld: All natural primary vegetation features located outside of CBAs or which represent Central Free State Grassland have been classified as medium sensitive. Development within these habitats are acceptable.

» Re-established grassland on historical cultivated areas: These areas have been left fallow for an extended period of time and the re-establishment of mostly indigenous vegetation have been allowed to such an extent that the vegetation can be regarded as stable (plagioclimax), providing most of the functions and services associated with natural grassland. Development within these habitats are acceptable.

Low Sensitivity

» All transformed and disturbed area: 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.

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 Vrede 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

&

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).