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ECOLOGY & BIODIVERSITY

WOODHOUSE 1 AND WOODHOUSE 2 GRID CONNECTION SOLUTION

TERRESTRIAL (FAUNA, FLORA AND AVIFAUNA) AND FRESHWATER RESOURCE ECOLOGICAL ASSESSMENT

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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.

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

September 2021

II. STATEMENT OF WORK

» This study has been executed in accordance with and meet the responsibilities in terms of:
  - NEMA, the Environmental Impact Assessment Regulations, 2014 (specifically in terms of regulation 13 of GN No. R. 326);
  - Procedures to be followed for the assessment and minimum criteria for reporting of identified environmental themes in terms of section 24(5)(a) and (h) of the National Environmental Management Act, 1998, when applying for Environmental Authorisation:
    - 2(a): Protocol for the assessment and reporting of environmental impacts on Avifauna species.
    - 3(a): Protocol for the assessment and reporting of environmental impacts on Terrestrial Biodiversity.
    - 3(b): Protocol for the assessment and reporting of environmental impacts on Aquatic Biodiversity.
    - 3(c): Protocol for the assessment and reporting of environmental impacts on terrestrial animal species.
    - 3(d): Protocol for the assessment and reporting of environmental impacts on terrestrial plant species.

REPORT AUTHOR

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

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1. INTRODUCTION

Client

Savannah Environmental (Pty) Ltd. on behalf of Genesis Eco-Energy Developments.

Project

Genesis Eco-Energy Developments is proposing to connect the Woodhouse 1 Solar PV Facility with the Woodhouse 2 Solar PV Facility via a dedicated grid connection solution.

Proposed Activity

Genesis Eco-Energy Developments (Pty) Ltd is proposing the construction of a 132kV power line, switching station and collector substation to connect the authorised Woodhouse Solar 1 PV and Woodhouse Solar 2 PV energy facilities to the Eskom grid via the existing Bophirima Substation (Figure 1 and 2).

The grid connection infrastructure will consist of:

» 132kV switching station (footprint up to 1ha)
» 132kV power line (within 200m wide corridor)
» Collector substation (footprint up to 1ha)
» 22kV underground cables to connect to the Solar PV energy facilities' substations
» Access roads to substation sites and service tracks (up to 4m wide) where no existing roads are available.

Two alternative Collector Substation positions and power line corridors are considered as part of this assessment.

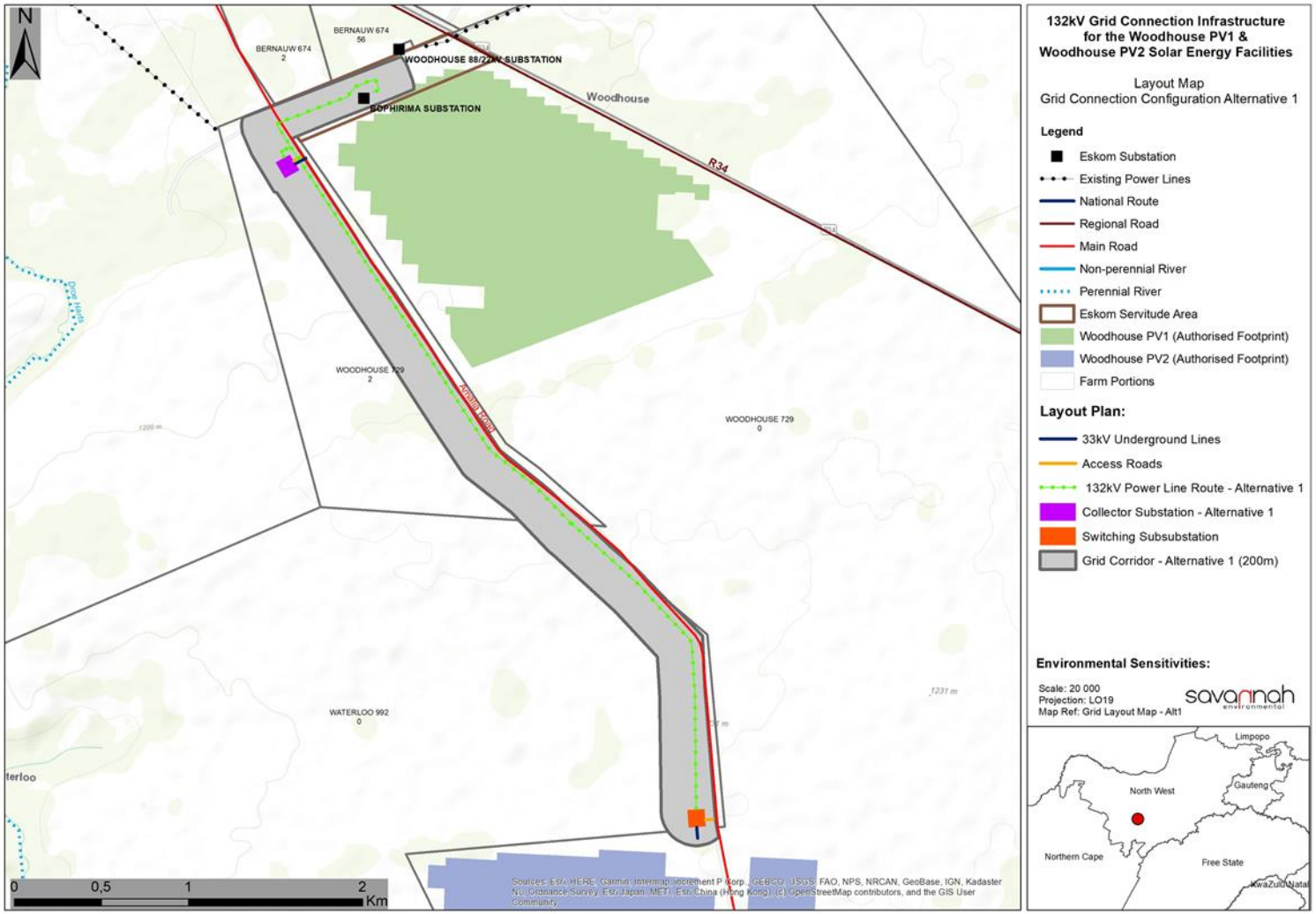

Figure 1: Proposed grid connection configuration alternative 1 (Map provided by Savannah Environmental).

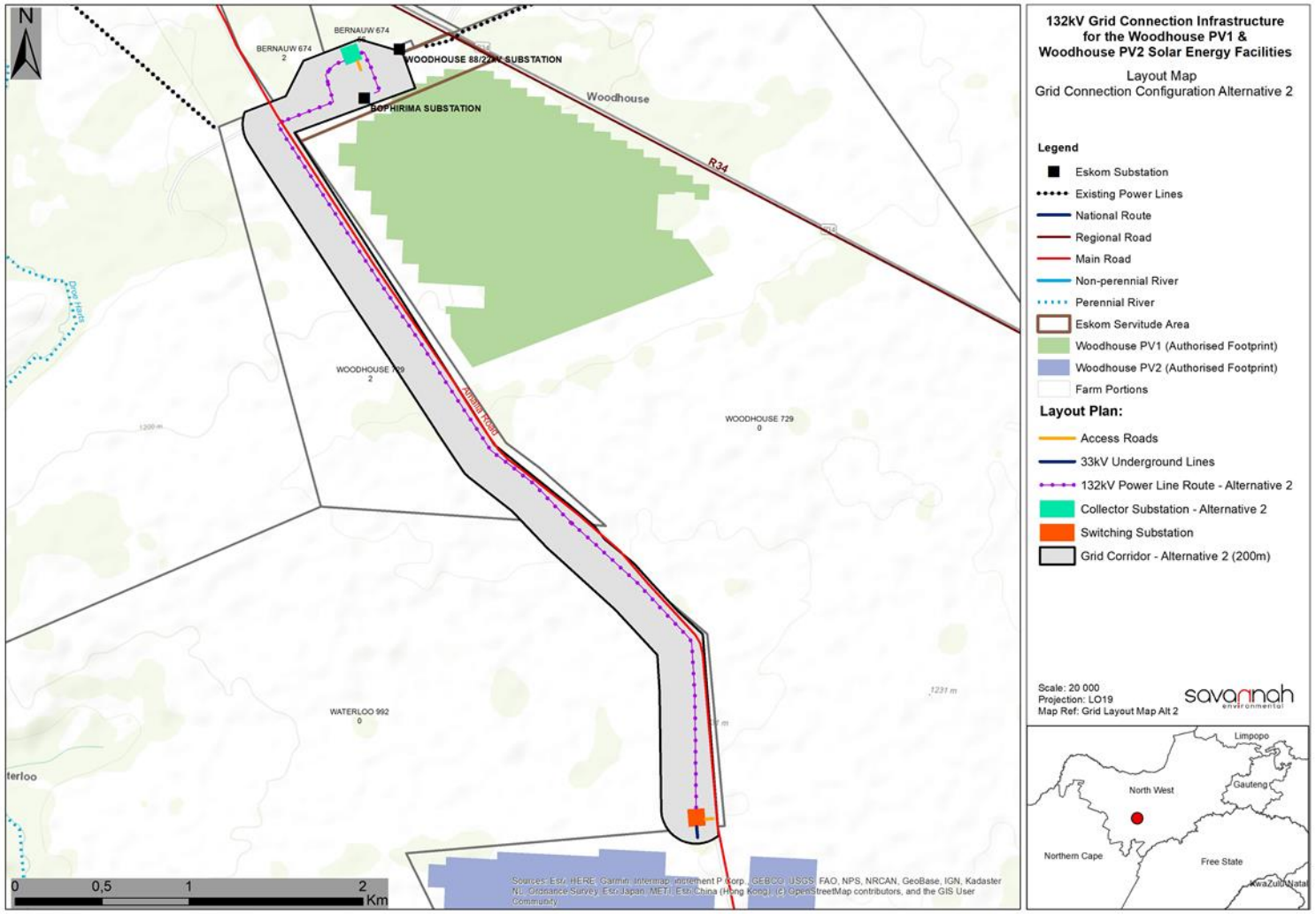

Figure 2: Proposed grid connection configuration alternative 1 (Map provided by Savannah Environmental).

Terms of reference

To conduct a terrestrial (fauna, flora and avifauna) and freshwater resource ecological study for an environmental basic assessment of the target areas where the establishment of the grid connection infrastructure is proposed to be located and provide a professional opinion on 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.

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 Water Act (Act No. 36 of 1998);
» 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 resources within the study area occur	DWA (2005)
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)

TERRESTRIAL ECOLOGY (BIODIVERSITY)

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 2624DD, 2724BB 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.

Faunal Analysis

Literature Study

Data sources from the literature were consulted and used where necessary in the study and include the following:

» Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina and Rutherford 2012) as well as the National List of Threatened Ecosystems (2011), where relevant.
» Bird distribution data of the Southern African Bird Atlas Project obtained from the Animal Demography Unit of the University of Cape Town, in order to ascertain species occurrence within the study area (Harrison et al. 1997).
» The Birds in Reserves Project database was used to augment bird counts data (Animal Demographic Unit 2015).
» The conservation status of all bird species occurring within the quarter degree square determined with the use of The Eskom Red Data book of birds of South Africa, Lesotho and Swaziland (Taylor 2014).
» The Important Bird Areas (IBA) programme according to BirdLife South Africa.
» The conservation status, endemism and biology of all species considered likely to occur within the study area was determined from Hockey et al. (2005) and Taylor et al. (2015).
» The BirdLife South Africa "Guidelines to minimise the impact on birds of Solar Facilities and Associated Infrastructure in South Africa" was incorporated into the report (Smit et al. 2012).
» A review of avian monitoring and mitigation information at existing utility scale solar facilities compiled by Watson et al. (2015) was used to determine the impacts of solar facilities on avian species.
» Appendix A5: Bird Scoping Assessment Report of The Strategic Environmental Assessment of Wind and Solar Photovoltaic Energy in South Africa.
» A review of available published and unpublished literature pertaining to bird interactions with SEFs and their associated power infrastructure, summarising the issues involved and the current level of knowledge in the field. Various information sources including data on the local avifauna of the area and previous studies of bird interactions with SEFs and their associated power infrastructure were be examined.

Data Sources Utilized

» The Southern African Bird Atlas Project 1 (SABAP 1; Harrison et al., 1997) quarter degree squares (QDC) 2724BA (7 cards) and 2724BB (6 cards) as well as the Southern

African Bird Atlas Project 2 (SABAP 2; http://sabap2.adu.org.za/index.php) pentads 2655_2445 (1 card) and 2700_2445 (2 cards) were consulted to determine the bird species likely to occur within the project site and the broader impact zone of the development.

» The conservation status, endemism and biology of all species considered likely to occur within the project site was determined from Hockey et al. (2005) and Taylor et al. (2015).
» The South African National Vegetation Map (Mucina & Rutherford, 2012) was consulted in order to determine the vegetation types and their conservation status that occur within the project site.

Survey Methods

Prior to the site visit, a review of available published and unpublished literature pertaining to bird interactions with solar plants, substations and power lines was undertaken, summarising the issues involved and the current level of knowledge in the field. Various information sources including data on the local avifauna of the area and previous studies of bird interactions with plants, substations and power lines were examined.

A site visit of the project site was conducted from the 20th to the 22nd of July 2021 to determine the *in situ* local avifauna and avian habitats present on site. Walked transects, vehicle transects and vantage point surveys were conducted in various habitats across the site. Not only the development footprint area was surveyed, but a broader area was also inspected (the immediate surrounding environment). The project site was thoroughly surveyed to obtain a first-hand perspective of the proposed project and birdlife and to:

» Quantify aspects of the local avifauna (such as species diversity and abundance);
» Identify important avian features present on site (such as nesting and roosting sites);
» Confirm the presence, abundance, habitat preference and movements of priority species;
» Identify important flyways across the site; and
» Delineate any obvious, highly sensitive, no-go areas to be avoided by the development and associated infrastructure.

Data collection methods included the following:

» Vehicle drive surveys: Vehicle surveys were predominantly done along the farm dirt roads and twin tracks as well as the service road of the existing power line infrastructure and the Transnet Railway.
» Power Line inspection: A portion of the existing –Mercury - Mookodi 400kV power line was surveyed twice daily for the duration of the survey period for any possible raptors or other avifaunal species utilizing the line and pylons for perching. All nests located

within the pylons were identified and monitored for a period of time during sunrise and sunset to determine if the nests are active and which species utilized these nests.

» Walked-transects: Walk-throughs were conducted within the project site as well as study area[1] (refer to Figure 1). These were done along pre-defined areas as well as along random selected areas.

The following equipment were utilized during field work:

» Canon EOS 450D Camera,
» Swarovski SLC 10X42 WB Binoculars,
» Roberts VII Multimedia Android Edition for Data Capturing and Bird Identification,
» Sasol's The Larger Illustrated Guide to Birds of Southern Africa (2005),
» Roberts Bird Guide (2016), and
» A simplified adaption of the Braun-Blanquet Data Form to capture habitat and other environmental data.

The survey was primarily conducted by means of a Checklist survey supplemented with some notes on avifaunal movement (especially regarding the larger avifaunal species as well as identified nesting species and activities with the patches of higher tree covering). The surveys normally started just before sunrise and ended just after sunset in order to record all possible bird activities throughout the day.

Using the data collected during the desktop phase as well as during the site visit, avian micro-habitats and sensitive habitats for avifaunal communities were identified and mapped.

The methodology used during the survey was deemed sufficient as this area was identified (and confirmed on site) as a low sensitive or low risk area within the REDZ map (Avian Impact Sensitivity Map for Solar Developments within Vryburg FA 6; refer to Figure 6). During the site visit sufficient first-hand knowledge of the avian habitats as well avian species present were obtained as well as information regarding the potential impacts that the development will have on the avifaunal character of the area.

FRESHWATER RESOURCES

The delineation and classification of freshwater resources were conducted using the standards and guidelines produced by the Department of Water and Sanitation (DWS) (DWAF, 2005 & 2007) and the South African National Biodiversity Institute (SANBI, 2009). These methods are contained in the attached Appendix 1, which also includes wetland

[1] Study area refers to the area including the project site and surroundings which provides the most accurate representation of available avifaunal habitats as well as diversity of the region whilst taking into account accessibility and time constraint.

definitions, wetland conservation importance, and Present Ecological State (PES) assessment methods used in this report.

In addition to these guidelines, the general approach to freshwater habitat assessment was furthermore based on the proposed framework for wetland assessment as proposed within the Water Research Commission's (WRC) report titled: "Development of a decision-support framework for wetland assessment in South Africa and a Decision-Support Protocol for the rapid assessment of wetland ecological condition" (Ollis et. al., 2014). A schematic illustration of the proposed decision-support framework for wetland assessment in South Africa is provided in Figure 3 below.

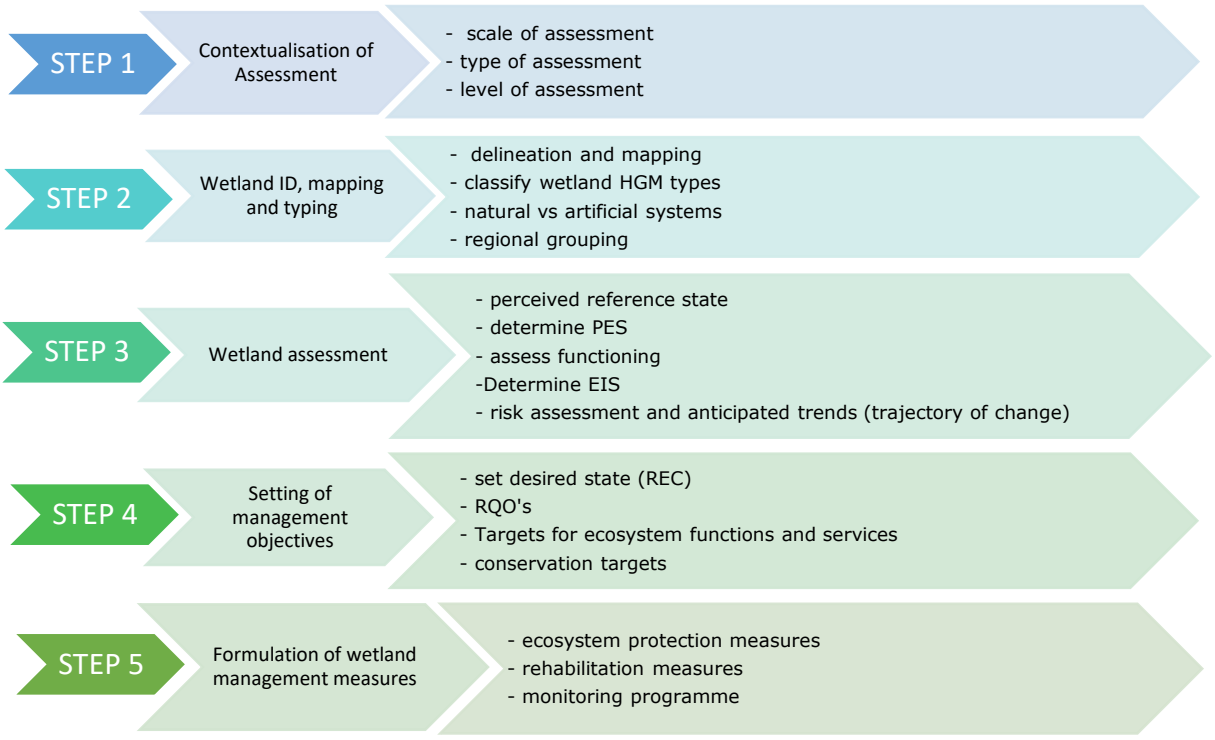

Figure 3: Proposed decision support framework for wetland assessment in South Africa (after Ollis et al., 2014)

Data Scouring and Review

***Vegetation**:*

» Vegetation types and their conservation status were extracted from the South African National Vegetation Map (SANBI, 2018) as well as the National List of Threatened Ecosystems (2011), where relevant.
» Critical Biodiversity Areas for the site and surroundings were extracted (CBA Map obtained from the SANBI Database).

» The IUCN conservation status of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (Version 2017.1).

Ecosystem:

» Freshwater and wetland information were extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011). This includes rivers, wetlands, and catchments defined under the study.
» Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).

Baseline Freshwater Resource Assessment

The methods of data collection, analysis and assessment employed as part of the baseline freshwater habitat assessment are briefly discussed in this section. The assessments undertaken as part of this study are listed in Table 2 below along with the relevant published guidelines and assessment tools / methods / protocols utilised. A more comprehensive description of the methods listed below is included in Appendix 1.

Table 2: Summary of methods used in the assessment of delineated freshwater resources.

Method/Technique	Reference for Methods / Tools Used
Freshwater Resource Delineation	A Practical Field Procedure for Identification and Delineation of Wetland and Riparian Areas' (DWAF, 2005).
Freshwater Resource Classification	National Wetland Classification System for Wetlands and other Aquatic Ecosystems in South Africa (Ollis et al, 2013)
Freshwater Resource Condition/PES	Wetland Management Series: WET-HEALTH. A technique for rapidly assessing wetland health (Macfarlane *et al*. 2008)
Freshwater Resource Functions and Services	Wetland Management Series: WET-EcoServices. A technique for rapidly assessing ecosystem services supplied by wetlands (Kotze *et al.* 2008)
Freshwater Ecological Importance and Sensitivity (EIS)	EIS (Ecological Importance and Sensitivity) assessment tool (DWAF 1999c; Rountree & Malan, 2013)
Buffers for rivers and watercourses	The national Preliminary Guideline for the Determination of Buffer Zones for River, Wetlands and Estuaries (MacFarlane *et al.,* 2014).

Assumptions, Limitations and Gaps in the Information Presented

General Assumptions and Limitations

» This report deals exclusively within a defined area (200m survey corridor) and the impacts upon biodiversity and natural ecosystems in that area and immediate surrounding landscape including all downstream freshwater/aquatic resources that may potentially be impacted and which fall within the Regulated Area (500m) as defined by the DWS.

» All relevant project information provided by the proponent and engineering design team to the ecological specialist was correct and valid at the time that it was provided.
» Additional information used to inform the assessment was limited to data and GIS coverage's available for the NC Province at the time of the assessment.

Sampling Limitations and Assumptions

» While disturbance and transformation of habitats can lead to shifts in the type and extent of ecosystems, it is important to note that the current extent and classification are reported on here.
» The delineation of the outer boundary of riparian areas is based on several indicators, including topography (macro-channel features), the presence of alluvial deposition and vegetation indicators. The boundaries mapped in this specialist report, therefore, represent the approximate boundary of riparian habitat as evaluated by an assessor familiar and well-practiced in the delineation technique.
» The accuracy of the delineation is based solely on the recording of the relevant onsite indicators using a GPS. GPS accuracy will, therefore, influence the accuracy of the mapped sampling points and therefore resource boundaries and an error of 3 – 5m can be expected. All soil/vegetation/terrain sampling points were recorded using a Garmin etrex Touch 35 Positioning System (GPS) and captured using Geographical Information Systems (GIS) for further processing.
» Infield soil and vegetation sampling were only undertaken within a specific focal area in the vicinity of the proposed development, while the remaining water resource/HGM units were delineated at a desktop level with limited accuracy.
» Any freshwater resources that fall outside of the affected catchment (but still within the 500m DWS regulated area) and are not at risk of being impacted by the specific activity were not delineated or assessed. Such features were flagged during a baseline desktop assessment before the site visit.
» Sampling by its nature means that generally not all aspects of ecosystems can be assessed and identified.
» With ecology being dynamic and complex, there is the likelihood that some aspects (some of which may be important) may have been overlooked.
» All vegetation information recorded outside of the immediate development footprint was based on the onsite observations of the author and no formal in-depth vegetation sampling was undertaken (apart from a few focal areas/transects within the riparian zones of the downstream water resources that still fall within the regulated area boundary). Furthermore, the vegetation within these areas' information provided for the areas just outside of the development footprint only gives an indication of the dominant and/or indicator species and only provides a general indication of the composition of the vegetation communities. Thus, the vegetation information provided for these areas is somewhat limited in terms of true botanical applications i.e. accurate and detailed species list, phytosociological classification, and rare / Red Data Species identification.

- This approach for these areas well outside of the development footprint is however regarded as acceptable as the vegetation structure and composition of these areas will not be impacted by the development and vegetation sampling was merely to inform the riparian boundary and transitional zones and to inform the current Ecological Status.

» No formal aquatic faunal survey was undertaken (including macro-invertebrate sampling).
» No water sampling and analysis was undertaken.
» The lists of amphibians, reptiles, and mammals for the study area are based on those observed in the vicinity of the site as well as those likely to occur in the area based on their distribution and habitat preferences. This represents a sufficiently conservative and cautious approach that takes the study limitations into account.

» Probably the most significant potential limitation associated with such a sampling approach is the narrow temporal window of sampling.
- Ideally, a site should be visited several times, during different seasons to ensure that the full complement of plant and animal species present is captured.
- However, this is rarely possible due to time and cost constraints and therefore, the representation of the species sampled at the time of the site visit should be critically evaluated.
- The site was sampled outside of the wet season.
- However, the area received a reasonable fair amount of late autumn rain allowing for some geophytes and graminoids to be fairly well represented (distinguishable) during the time of the inspection
- The footprint was covered in detail with the result that the results are considered highly reliable and it is unlikely that there are any significant species or features present that were not recorded.

Baseline Ecological Assessment – Limitations and Assumptions

» All assessment tools utilised within this study were applied only to the resources and habitats located within the 'survey area/servitude area' and which are at risk of being impacted by the proposed development. Any resource located outside of the servitude area and which is not a risk of being impacted was not assessed.
» It should be noted that the most appropriate assessment tools were selected for the analysis of the specific features and resources that may potentially be impacted by the proposed development. The selection was based on the assessment practitioner's knowledge and experience of these tools and their attributes and shortcomings.
» Furthermore, it should be noted that these assessment techniques and tools are currently the most appropriate currently available tools and techniques to undertake assessments of freshwater resources, the area however rapid assessment tools that rely on qualitative information and expert judgment. While these tools have been subjected to peer review processes, the methodology for these tools is ever-evolving and will likely be further refined in the near future. For the purposes of this assessment,

the assessments were undertaken at rapid levels with somewhat limited field verification. It, therefore, provides an indication of the PES of the portions of the affected systems rather than providing a definitive measure.

» PES and EIS were only determined for the affected/regulated areas even though upstream and downstream as well as catchment impacts were considered (based on available desktop information).

» The PES and EIS assessments undertaken are largely qualitative assessment tools and thus the results are open to professional opinion and interpretation. We have made an effort to substantiate all claims where applicable and necessary.

» The Ecological Importance and Sensitivity (EIS) assessment did not specifically address the finer-scale biological aspects of the rivers such as fauna (amphibians and invertebrates).

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 3: 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).	▪ 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)

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
	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).	
HIGH	Indigenous natural areas that are positive for any of the following: ▪ High intrinsic biodiversity value (moderate/high species richness and/or turnover). ▪ Confirmed habitat highly suitable for species of conservation concern (Those species listed on the IUCN Red List of Threatened Species or South Africa's National Red List website as Critically Endangered, Endangered or Vulnerable according to the IUCN Red List 3.1. Categories and Criteria). ▪ Moderate ability to respond to disturbance (moderate resilience, dominant species of intermediate age). ▪ Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk). ▪ Moderate to high value ecological goods & services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value). These areas/habitats are unsuitable for development due to a very likely impact on species of conservation concern May also contain the following: ▪ 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)	▪ CBA 2 "critical biodiversity areas". ▪ Confirmed habitat where species of conservation concern could potentially occur (habitat is suitable, but no confirmed records). ▪ Habitat containing individuals of extreme age. ▪ Habitat with low ability to recover from disturbance. ▪ Habitat with exceptionally high diversity (richness or turnover). ▪ Habitat with unique species composition and narrow distribution. ▪ Ecosystem providing high value ecosystem goods and services.
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	▪ CBA 2 "corridor areas", ESA 1 and ESA2. ▪ Habitat with moderate diversity (richness or turnover).

Sensitivity	Factors contributing to sensitivity	Examples of qualifying features
	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).	▪ 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 4: 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. CONSERVATION AND FUNCTIONAL IMPORTANCE OF AQUATIC ECOSYSTEMS

Water affects every activity and aspiration of human society and sustains all ecosystems. "Freshwater ecosystems" refer to all inland water bodies whether fresh or saline, including rivers, lakes, wetlands, sub-surface waters, and estuaries (Driver *et al*., 2011). South Africa's freshwater ecosystems are diverse, ranging from sub-tropical in the north-eastern part of the country, to semi-arid and arid in the interior, to the cool and temperate rivers of the fynbos. Wetlands and rivers form a fascinating and essential part of our natural heritage and are often referred to as the "kidneys" and "arteries" of our living landscapes and this is particularly true in semi-arid countries such as South Africa (Nel *et al*., 2013). Rivers and their associated riparian zones are vital for supplying freshwater (South Africa's

most scarce natural resource) and are important in providing additional biophysical, social, cultural, economic, and aesthetic services (Nel *et al*., 2013). The health of our rivers and wetlands is measured by the diversity and health of the species we share these resources with. Healthy river ecosystems can increase resilience to the impacts of climate change, by allowing ecosystems and species to adapt as naturally as possible to the changes and by buffering human settlements and activities from the impacts of extreme weather events (Nel *et al.,* 2013). Freshwater ecosystems are likely to be particularly hard hit by rising temperatures and shifting rainfall patterns, and yet healthy, intact freshwater ecosystems are vital for maintaining resilience to climate change and mitigating its impact on human wellbeing by helping to maintain a consistent supply of water and for reducing flood risk and mitigating the impact of flash floods. We, therefore, need to be mindful of the fact that without the integrity of our natural river systems, there will be no sustained long-term economic growth or life (DEA *et al.,* 2013).

Freshwater ecosystems, including rivers and wetlands, are also particularly vulnerable to anthropogenic or human activities, which can often lead to irreversible damage or longer-term, gradual/cumulative changes to freshwater resources and associated aquatic ecosystems. Since channeled systems such as rivers, streams, and drainage lines are generally located at the lowest point in the landscape; they are often the "receivers" of wastes, sediment, and pollutants transported via surface water runoff as well as subsurface water movement (Driver *et al.,* 2011). This combined with the strong connectivity of freshwater ecosystems means that they are highly susceptible to upstream, downstream, and upland impacts, including changes to water quality and quantity as well as changes to aquatic habitat & biota (Driver *et al.,* 2011). South Africa's freshwater ecosystems have been mapped and classified into National Freshwater Ecosystem Priority Areas (NFEPAs). This work shows that 60% of our river ecosystems are threatened and 23% are critically endangered. The situation for wetlands is even worse: 65% of our wetland types are threatened, and 48% are critically endangered (Driver *et al.,* 2011). Recent studies reveal that less than one-third of South Africa's main rivers are considered to be in an ecologically 'natural' state, with the principal threat to freshwater systems being human activities, including river regulation, followed by catchment transformation (Rivers-Moore & Goodman, 2009). South Africa's freshwater fauna also display high levels of threat: at least one-third of freshwater fish indigenous to South Africa are reported as threatened, and a recent southern African study on the conservation status of major freshwater-dependent taxonomic groups (fishes, molluscs dragonflies, crabs, and vascular plants) reported far higher levels of threat in South Africa than in the rest of the region (Darwall *et al*., 2009). Clearly, urgent attention is required to ensure that representative natural examples of the different ecosystems that make up the natural heritage of this country for current and future generations to come. The degradation of South African rivers and wetlands is a concern now recognized by Government as requiring urgent action and the protection of freshwater resources, including rivers and wetlands, is considered fundamental to the sustainable management of South Africa's water resources in the context of the reconstruction and development of the country.

5. DESKTOP ANALYSIS

Land use and Land Cover

The open savanna grassland and shrublands are mostly used as grazing for livestock, especially cattle, with some presence of small game species. Most of the grazing is unimproved vegetation (natural to semi-natural), apart from a small path of land towards the south of the power line route which is covered by a secondary open tree savannah, covering a historically cultivated area.

Built form within the project site, is minimal and mostly restricted to infrastructure associated with the general land use activity (livestock rearing) which include:

- The provincial dirt road (Amalia Road), which will be used as access to the construction site,
- artificial watering and cattle feeding points;
- fences;
- fire breaks (which can also be used for access);
- twin track and other minor farm roads and;
- Telephone lines.

Other infrastructure within the area includes:

- Bophirima Substation;
- Woodhouse 88/22kV Substation; and
- Waterloo PV Facility

Regional/Local Biophysical Setting

The proposed grid connection infrastructure will connect the Woodhouse 1 Solar PV Facility with the Woodhouse 1 Solar PV. The proposed development will be situated approximately 10 km south east of Vryburg. The identified site falls under the jurisdiction of the Naledi Local Municipality and within the greater Dr Ruth Segomotsi Mompati District Municipality in the North West Province.

Climate and Rainfall

The climate associated with the study area has been derived from recorded and extrapolated climatic data (http://en.climate-data.org/location/10658/) for Vryburg. Rainfall occurs mainly in summer and autumn with very dry winters. Mean annual rainfall

is about 477mm with January being the wettest month, averaging about 89mm, and July being the driest, with an average of only 4mm. The average annual temperature in Vryburg is 17.9°C with January being the warmest (Ave. 24.8°C) and July being the coldest (Ave 9.3°C). Frost is frequent to very frequent in winter (mean frost days: 40).

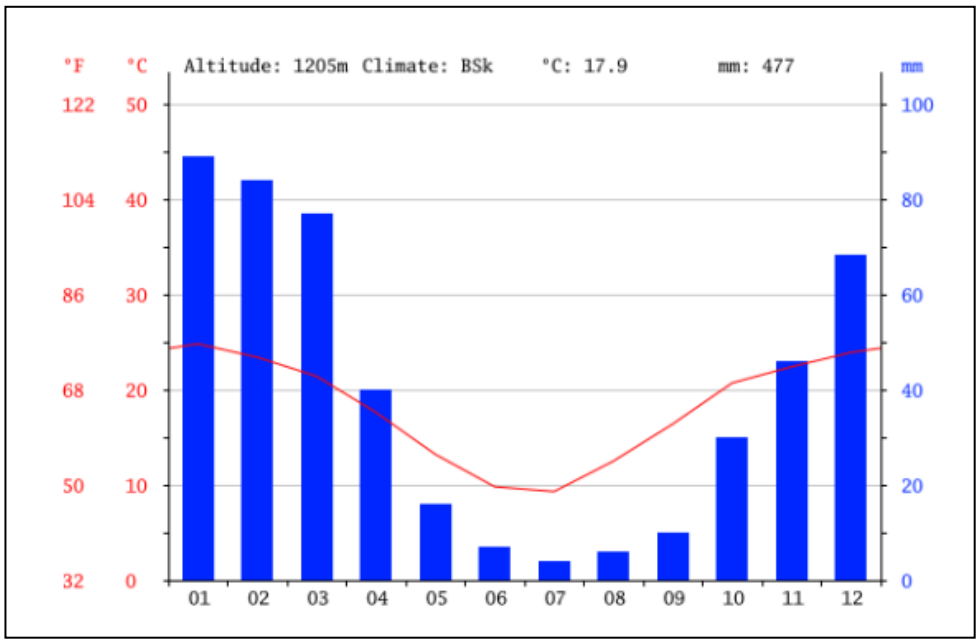

Figure 4: Climate graph of Vryburg (http://en.climate-data.org/location/10658/).

month	1	2	3	4	5	6	7	8	9	10	11	12
mm	89	84	77	40	16	7	4	6	10	30	46	68
°C	24.8	23.4	21.4	17.6	13.2	9.8	9.3	12.5	16.4	20.7	22.4	23.9
°C (min)	17.2	16.3	14.3	9.8	4.4	0.4	-0.3	2.6	7.0	12.0	14.3	16.1
°C (max)	32.4	30.5	28.5	25.5	22.1	19.3	19.0	22.5	25.9	29.5	30.5	31.8
°F	76.6	74.1	70.5	63.7	55.8	49.6	48.7	54.5	61.5	69.3	72.3	75.0
°F (min)	63.0	61.3	57.7	49.6	39.9	32.7	31.5	36.7	44.6	53.6	57.7	61.0
°F (max)	90.3	86.9	83.3	77.9	71.8	66.7	66.2	72.5	78.6	85.1	86.9	89.2

Figure 5: Climate table of Vryburg (http://en.climate-data.org/location/10658/).

Physiography and Soils

Landscape Features

According to Mucina and Rutherford (2006) the region can be described as a flat plateau and is consistent with the landtype classification (AGIS 2007) which classifies the landscape as Class A2 with an average slope of between 0% and 2%.

At a finer scale using a Google elevation profile for the study area and immediate surroundings the area can be described as a plateau.

The development site is situated at elevations of between 1 197m and 1230m above sea level with an average slope of less than 1.5% and maximum south and north slopes of 5.8%; -3.4%. The largest portion of the development site is situated on a relatively flat plateau with gradual slopes towards lower lying areas to the north, south and the north-west. The north and south facing slopes are relatively gradual (Ave northern slope: 2.1% and Ave southern slope: 3.4%), although the north facing slope contain areas (just below plateau edge) which are steeper (Max slope: 5.8 %).

Geology

The study area is underlain by siliciclastic (quartzite) rocks of the Vryburg Formation (Transvaal Supergroup) as well as the Dwyka Group (Karoo Supergroup). Dwyka tillites may be found scattered within these areas.

Soil and Landtypes

Detailed soil information is not available for broad areas of the country. As a surrogate landtype data was used to provide a general description of soil in the study area (landtypes are areas with largely uniform soils, typography and climate). There are two landtypes present in the study area, i.e. the Ae36 and Ag10 landtypes (Land Type Survey Staff, 1987). The largest portion of the development footprint area can be characterised by landtype Ag10, whilst the south and eastern section is characterised by landtype Ae36.

- The Ae group of landtypes refer to red-yellow apedal, freely drained soils. These soils are moderately deep (ave. 500mm – 1200mm) red, freely drained and apedal (structureless). These soils generally occur in areas associated with low to moderate rainfall (300mm – 700mm per annum) in the interior of South Africa and have a high fertility status. A wide range of texture occurs (usually sandy loam to sandy clay loam). Common soil forms are Mispah and Hutton and to a lesser extent, Clovely, Stertkspruit and Rensburg.
- The Ag group of landtypes refer to red-yellow apedal, freely drained soils. These soils are shallow (less than 300mm), red, freely-drained, apedal soils that occur in arid to semi-arid areas associated with low rainfall (less than 500mm per annum), as well as areas underlain by hard to weathered rock. A wide range of textures may occur (usually loamy sand to sandy loam). Stones or rocks are often present on the soil surface. Common soil forms are Mispah, Hutton and rock whilst soil forms such as Glenrosa and Shortlands are sparsely present.

Hydrology

The study area is situated in the catchment areas of the Losase River and the Droë Harts River. A number of non-perennial (most likely) or perennial drainage lines traverse the

affected farm properties most of which flow in a north to south and north-east to south-east direction. Most of these drainage systems are ephemeral tributaries which link up with larger ephemeral streams to eventually terminate into either the Losase River or the Droë Harts River. According to NFEPA wetland classification, only one wetland depression is located in close proximity to the development site (Figure 6).

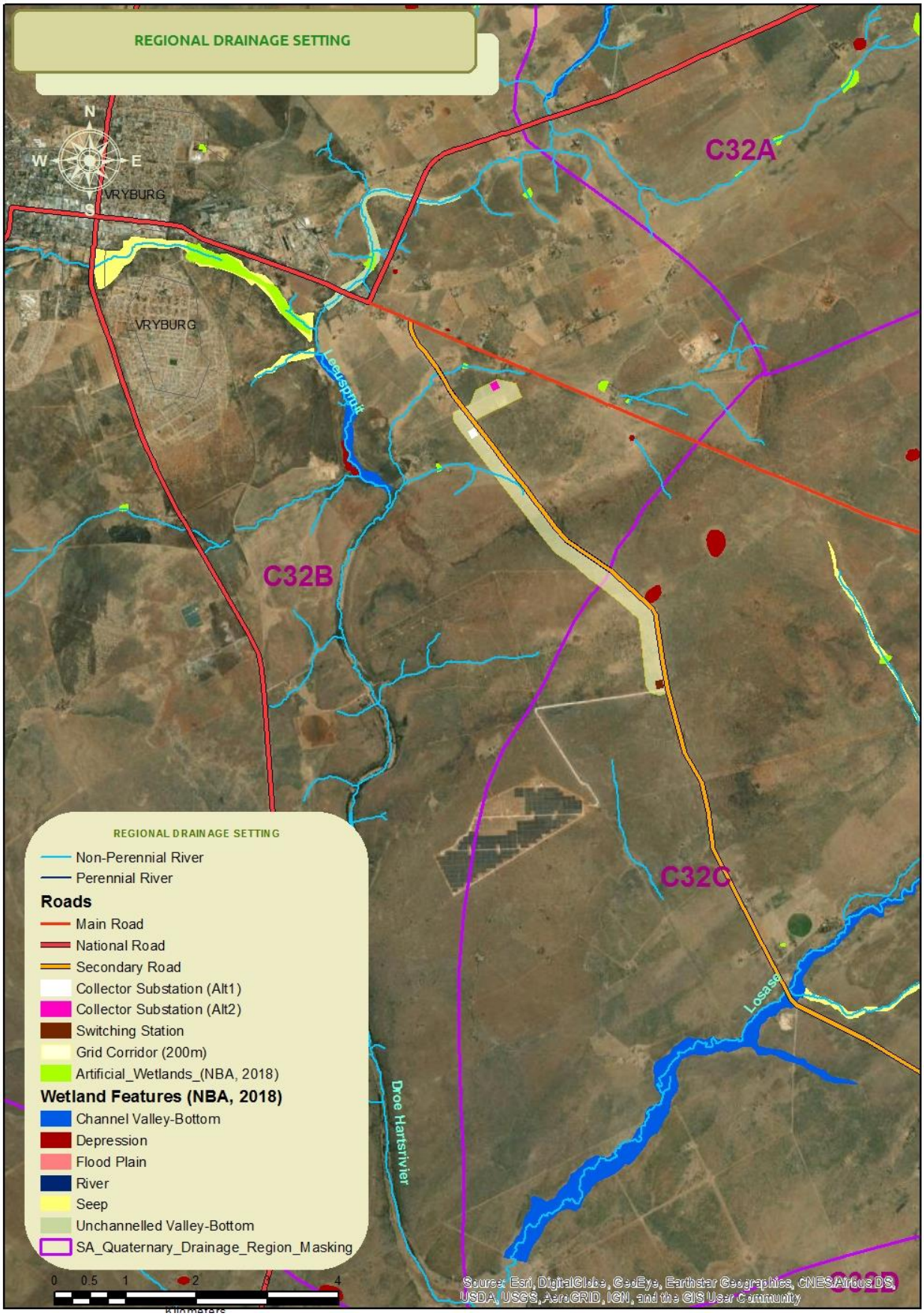

Figure 6: Regional drainage setting.

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	Project site is located approximately 25km south-east of the closest Focus Area (Molopo)	Not Classified
	Protected Areas and Conservation Areas (PACA) Database	South African Conservation Area (SACA)	Project site is located approximately 11km south-east of the closest SACA (Leon Taljaard Nature Reserve)	Not Classified
		South African Protected Area (SAPA)	Project site is located approximately 87km south-west of the closest SAPA (Baberspan Nature Reserve)	Not Classified
	Strategic Water Source Areas for groundwater (SWSA-gw)	Areas with high groundwater availability and of national importance	Project site is located approximately 42km south-east of the closest SWSA (Eastern Kalahari B SWSA_gw)	Not Classified
	Vegetation Types	Ghaap Plateau Vaalbosveld	Vegetation of Study Area	Least Threatened
	Threatened Ecosystems	Ghaap Plateau Vaalbosveld	Ecosystems of Study Area	Not listed
	National Freshwater Ecosystem Priority Area	River FEPA	Located outside of any River FEPAs	Not Classified
		Wetland FEPA	No Wetland FEPAs located within project site.	Not Classified
	Important Bird and Biodiversity Areas (IBAs)	IBAs	Project site is located approximately 87km south-west of the closest IBA (Baberspan and Leeupan)	Not Classified
PROVINCIAL AND REGIONAL LEVEL	NWBSP 2015	Ecological Support Areas (ESA1)	Corridors/linkages & Ridges Hills	ESA1

		Critical Biodiversity Areas (CBA2)	Important habitats for plants	CBA2

Strategic Water Source Areas (SWSAs)

Strategic Water Source Areas (SWSAs) are defined as areas of land that either:

» supply a disproportionate (i.e. relatively large) quantity of mean annual surface water runoff in relation to their size and so are considered nationally important;
» have high groundwater recharge and where the groundwater forms a nationally important resource;
» areas that meet both criteria mentioned above.

They include transboundary Water Source Areas that extend into Lesotho and Swaziland.

The project site is located outside of any SWSA for surface water as well as for ground water (Figure 8) with the closest SWSA being located approximately 42km to the north-west of the project site (Easter but is located within a SWSA for groundwater; namely the Eastern Kalahari B SWSA_gw.

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 well outside of any Focus Areas (Figure 7) with the nearest Focus Area being located approximately 25km to the north-west of the project site (Molopo Focus Area).

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- or Protected Areas are located in close proximity to the project site (Figure 7), with the closest Conservation Area located approximately 11km to the north-west (Leon Taljaard Nature Reserve), and the closest Protected Area located approximately 87km to the south-east (Baberspan 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, 2018	National Ecosystem List (NEM:BA)
Ghaap Plateau Vaalbosveld	16%	0	1%	Least Concerned	Not Listed

According to current layout the entire project site is located within the Least Concerned Ghaap Plateau Vaalbosveld (Figure 7).

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

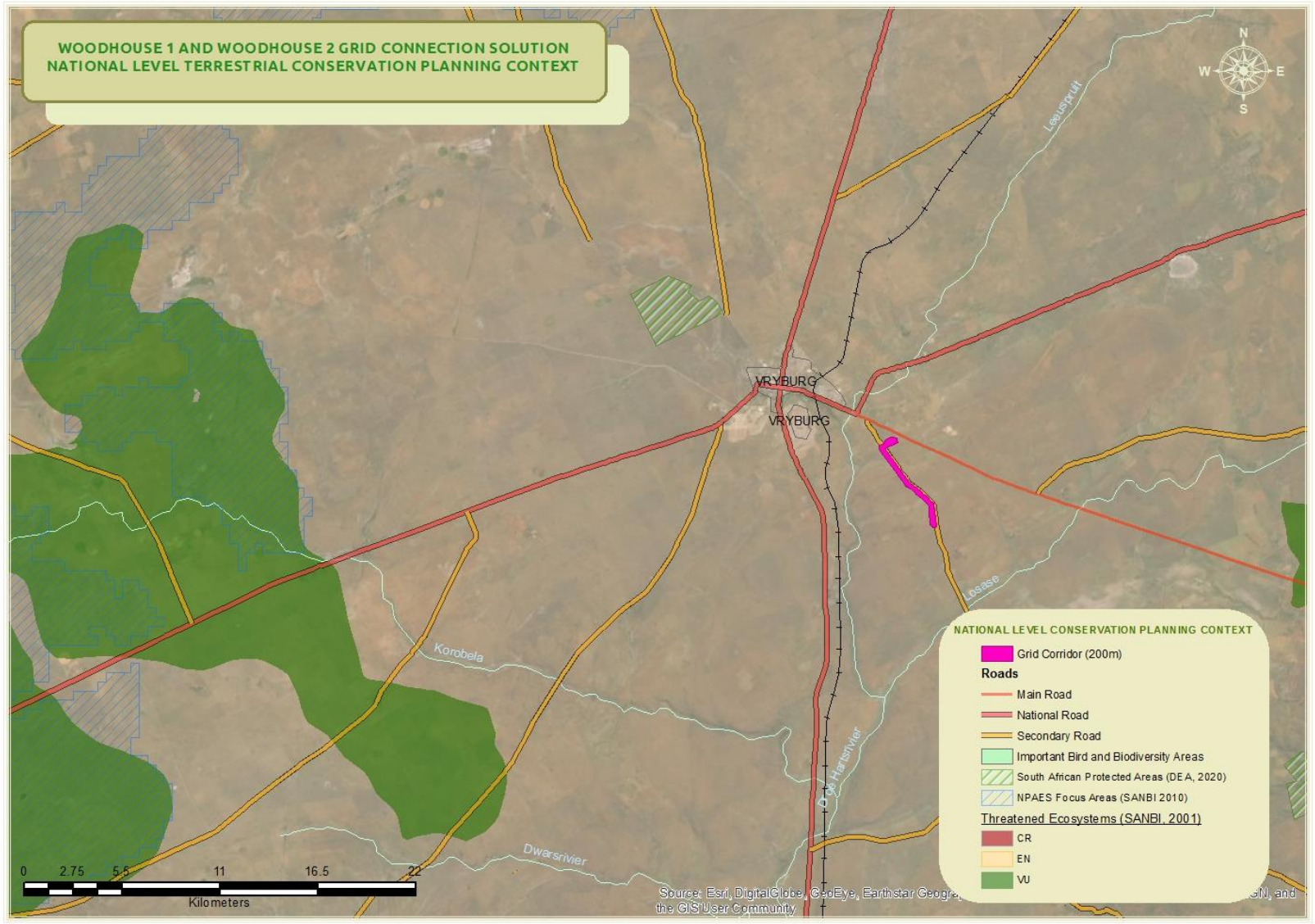

Figure 7: National Level Terrestrial Conservation Planning Context

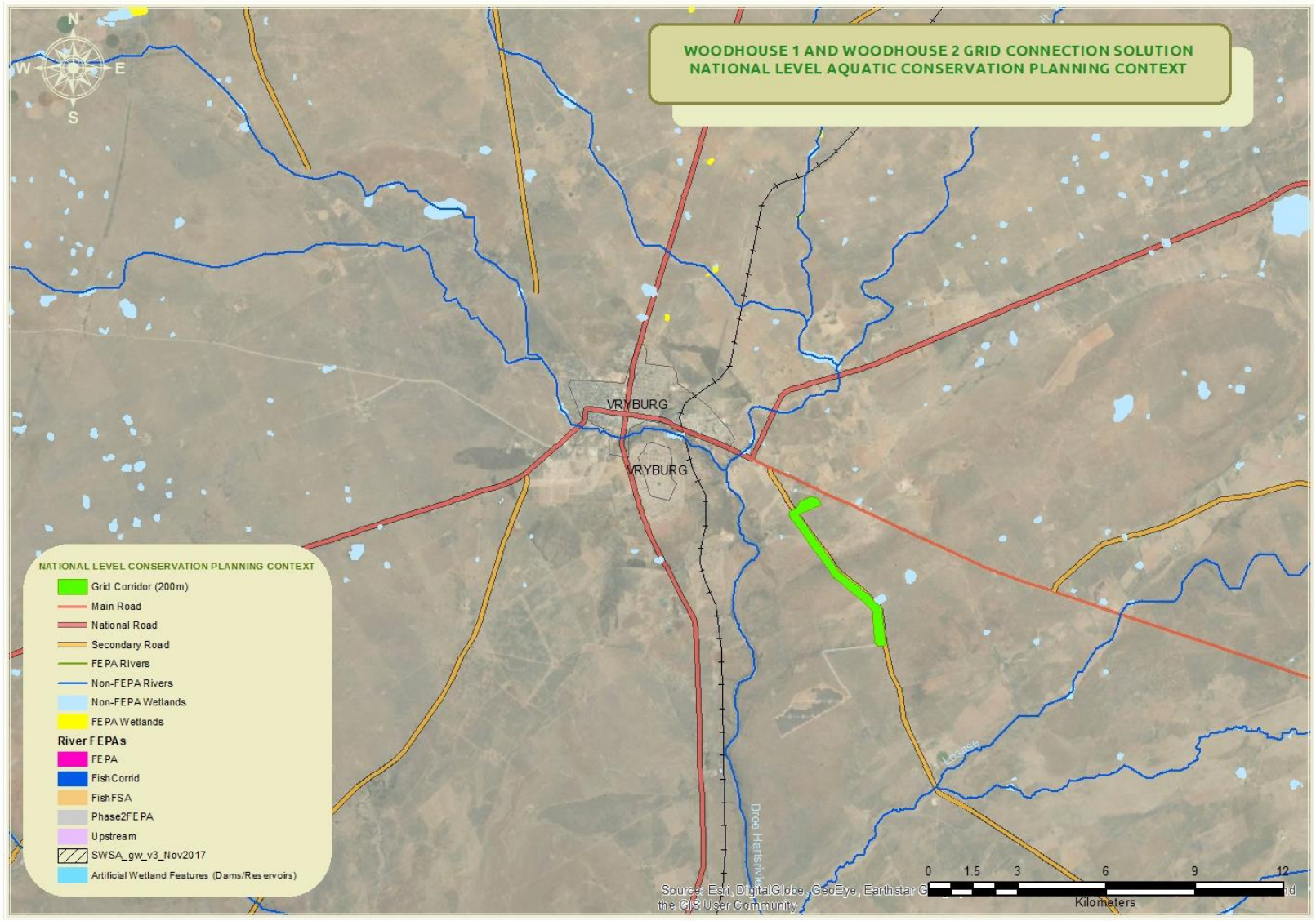

Figure 8: National Level Aquatic Conservation Planning Context

Important Bird and Biodiversity Areas (IBAs)

Important Bird and Biodiversity Areas (IBAs), as defined by BirdLife International, constitute a global network of over 13 500 sites, of which 112 sites are found in South Africa. IBAs are sites of global significance for bird conservation, identified nationally through multi-stakeholder processes using globally standardised, quantitative and scientifically agreed criteria. Essentially, these are the most important sites for conserving.

The IBA Programme speaks to all four focal areas – species, sites, habitats and people. The IBA Programme's vision is to see critical sites and habitats, and associated ecosystem services, better protected and sustainably managed for the benefit of birds, other biodiversity, and people. The Programme's mission is to identify, protect and manage a network of sites that are important for the persistence of birds, their habitats and other biodiversity.

The IBA Programme's 2018-2023 Strategy outlines the below objectives:

Strategic objective 1: Strategic, integrated landscape planning
The KBA Programme's approach is to develop and implement high quality and high impact projects, focusing on qualitative outcomes instead of perverse quantitative targets.

» Strategic objective 2: Safeguard the most important sites for birds
A comprehensive network of IBAs includes all sites important for birds. Priority sites are safeguarded, as protected areas or conservation areas, in order to mitigate severe impacts from climate change, to prevent unsustainable development and habitat loss, and by improving habitat management.

» Strategic objective 3: Improve habitat management in KBAs
Support habitat management through providing bird-friendly habitat management guidelines, developing innovative management planning, improving monitoring effectiveness, enhancing landowner awareness, providing advisory support, and implementing habitat rehabilitation interventions.

» Strategic objective 4: Manage data
The IBA and KBA networks are identified using global scientific criteria. To ensure that the networks are defensible and that accurate data can be provided to end users, the data need to be centrally collected, stored, vetted, analysed, and made available to inform academic research and conservation planning.

» Strategic objective 5: Mainstreaming
IBAs, Key Biodiversity Areas (KBAs) and bird species data are better represented in other spatial planning and assessment products, e.g. national biodiversity assessments,

conservation plans, spatial development frameworks and protected area expansion strategies.

» Strategic objective 6: Increase support
Increase awareness within the public, government and corporate sectors to gain support for IBA and KBA conservation and monitoring, and for specific projects. More specifically with landowners to create local custodians, with citizen scientists to increase data collection, with academics to fill information gaps, and with the general public to increase local support, awareness and sustainable use of IBAs and associated natural resources.

According to the IBA spatial data (BLSA, 2015), the project site is located well outside of any IBA (Figure 7) with the nearest IBA being located approximately 87km to the south-east (Baberspan and Leeupan IBA).

Critical Biodiversity Areas and Broad Scale Ecological Processes

The development footprint falls within the planning domain of the North West Province Biodiversity Conservation Assessment which maps Critical Biodiversity Areas and Ecological Support Areas within the North West Province. Approximately 30% of the development footprint falls within an ESA1 whilst approximately 20% falls within a CBA2 (Figure 9).

Critical Biodiversity Areas (CBAs) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services. These form the key output of a systematic conservation assessment and are the biodiversity sectors inputs into multi-sectoral planning and decision-making tools. The use of CBAs within the North West Province follows the definition laid out in the guideline for publishing bioregional plans (Anon, 2008).

According to the guidelines for bioregional plans, three basic CBA categories can be identified based on three high-level and management objectives (Table 8).

Table 8: Definitions and framework for linking CBAs to land-use planning and decision-making guidelines based on a set of high-level land biodiversity management objectives (Adapted from the guidelines for bioregional plans (Anon 2008).

CBA category	Land Management Objective
Critical Biodiversity Areas (CBAs) Definition: CBAs are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannon be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.	
Protected Areas (PA) & CBA 1	***Natural landscapes:*** » Ecosystems and species are fully intact and undisturbed.

	» These are areas with high irreplaceability or low flexibility in terms of meeting biodiversity pattern targets. If the biodiversity features targeted in these areas are lost then targets will not be met. » These are landscapes that are at or past their limits of acceptable change.
CBA 2	***Near-natural landscapes:*** » Ecosystems and species largely intact and undisturbed. » Areas with intermediate irreplaceability or some flexibility in terms of the area required to meet biodiversity targets. There are options for loss of some components of biodiversity in these landscapes without compromising the ability to achieve targets. » These are landscapes that are approaching but have not passed their limits of acceptable change.
Ecological Support Areas (ESAs) Definition: ESAs are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, food mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.	
ESA	***Functional landscapes:*** » Ecosystem moderately to significantly disturbed but still able to maintain basic functionality. » Individual species or other biodiversity indicators may be severely disturbed or reduced. » These are areas with low irreplaceability with respect to biodiversity pattern targets only.
ONA (Other Natural Areas) and Transformed	Production landscapes: Manage land to optimise sustainable utilisation of natural resources.

The high-level land management objectives (natural, near-natural and functional) can be further unpacked using the three ecosystem integrity indicators namely; ecosystem composition, structure and function. Composition relates to biodiversity pattern, whereas structure and function relate to ecological process and services (Table 9).

Table 9: A summary of the CBA map categories used in relation to the biodiversity-related land management objectives and potential landscape-level biodiversity indicators.

Land Management Objective:	**Land Management Objective Biodiversity Indicators**			
	Component of biodiversity:	Biodiversity Pattern	Ecological Processes and Services	
	Indicator category	Composition	Structure	Functioning
	Specific Indicators	» Habitat types, » Species; » Populations; » Met-populations; » Alien plants	» Transformation; » Fragmentation	» Fire; » Grazing regimes; » Biogeochemical processes; » Hydrological functioning; » Soil formation and erosion; » Biotic processes.
	CBA Category	*Limit of Acceptable Change (LAC): Permitted amount or degree of change in biodiversity indicator.*		
Natural	PA / CA	None	None	None

	CBA 1	None	None	None
Near-Natural	CBA 2	Some	Some	None
Functional	ESA 1	Significant	Some	None
	ESA 2	Significant	Some	Some
	ONA	Significant	Significant	Some
	Transformed	Significant	Significant	Significant

Description of Critical Biodiversity Areas within the project site.

Terrestrial 2 CBA

The area delineated as a CBA2 is associated with the east to west running ridge, and has been identified as such as this are is regarded as a unique plant habitat. However, during the site visit it was determined that this area was severely encroached with Senegalia mellifera, contained a very low diversity of plant species with no range restricted or conservation important plants. Thus, there is now justification for this portion of the ridge to be classified as a CBA2.

Terrestrial 1 ESA

These ESA 1 areas functions as linkages/corridors (comprising of natural vegetation) between the important biodiversity areas and major freshwater resource and their fringing terrestrial habitats. Due to the nature of the development, potential linkages and corridors will not be impacted/interrupted/fractured by the proposed development. Furthermore, current disturbance within the area have already somewhat impacted the connectivity of the landscape (larger provincial and national roads, game and farm fences etc.).

Aquatic 1 ESA

These are modelled freshwater resource features (watercourses and wetlands) based on the modelling technique developed by Nacelle Collins using SRMv3 90m DEM. According to this model a watercourse crosses the proposed project site, flowing predominantly in a east to west direction towards the Droë Harts River. Furthermore, a wetland depression is located in close proximity to the project site (southern portion of project site).

During the site visit, the modelled watercourse was determined to be a narrow, diffuse, ephemeral drainage line which feeds into a seepage wetland. Outside of the development area this seepage features drains into a small ephemeral watercourse that terminates into the Droë Harts River. The extent of these drainage features has been over-estimated/modelled and a more accurate delineation of the extent of these features within the development area have been provided. Due to the nature of this development, the integrity of this Aquatic 1 ESA will not be threatened and potential impacts can be significantly reduced through the implementation of mitigation measures.

The depression wetland classified as an ESA was confirmed. However, this wetland is located just outside of the development site, and due to the nature of this development it is unlikely that the wetland will be impacted.

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 study area revealed that no River FEPAs are located within the development area or the project site. Furthermore, the NFEPA coverage for the project site shows that now Wetland FEPAs are located within the development site (Figure 8).

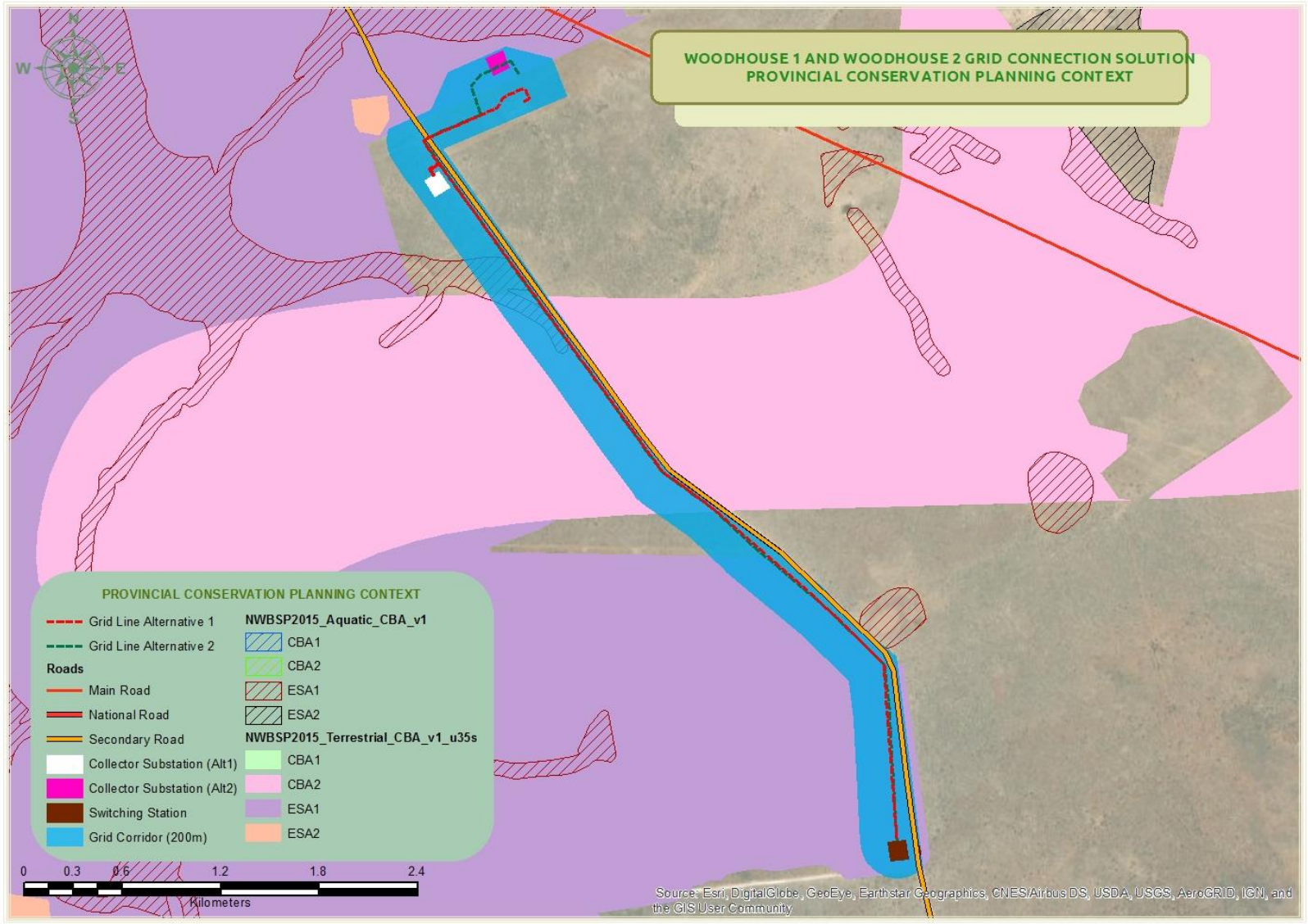

Figure 9: Provincial Level Conservation Planning Context – CBA Map.

6. FINDINGS OF THE FRESHWATER RESOURCE BASELINE ASSESSMENT

The baseline habitat assessment, informed by on-site data collection, focused primarily on wetland units rated as being at **Moderate to High risk** of being impacted by the proposed activities (as per section above). This section sets out the findings of the baseline assessment of those water resources units and includes:

» Delineation, Classification & Habitat Descriptions;
» Present Ecological State (PES) Assessment;
» Ecological Importance and Sensitivity (EIS) Assessment;

The on-site / in-field assessment of the wetlands indicators was conducted by Gerhard Botha from Nkurenkuru Biodiversity and Ecology on the 21st and 22nd of July 2021.

Within the project site, one wetland feature, namely a depression wetland, and one ephemeral, diffuse drainage line have been identified, whilst one wetland feature (seepage wetland) has been identified which is located in close proximity to the surveyed corridor area (Figure 10).

The identification and delineation of the wetland features were based on the following indicators:

» Geographical position and terrain unit features (e.g. valley-bottom settings and "key points");
» Hydromorphic features;
» Plant indicators; and
» Soil form and wetness indicators.

The wetlands were furthermore classified into appropriate hydro-geomorphic (HGM) units, according to the classification system of Kotze *et. al*. (2005).

The wetland extent and boundary delineation are based primarily on soil wetness indicators. The field-based soil survey and assessment was conducted by M. Pienaar of TerraAfrica Environmental Consultants in June 2018 and the results obtained was provided to Nkurenkuru Biodiversity and Ecology to incorporate in assessment of the surface hydrological and ecological assessment of the project site. For an area to be considered a wetland, redoximorphic features must be present within the top 50cm of the soil profile (Collins, 2005). Redoximorphic features are the result of the reduction, translocation and oxidation (precipitation) of Fe (iron) and Mn (manganese) oxides that occur when soils alternate between aerobic (oxygenated) and anaerobic (oxygen depleted) conditions. Only once soils within 50cm of the surface display these redoximorphic features, can the soils

be considered 'hydric soils'. Redoximorphic features typically occur in three types (Collins, 2005):

- A reduced matrix - i.e. an in situ low chroma (soil colour), resulting from the absence of Fe3+ ions which are characterised by "grey" colours of the soil matrix;
- Redox depletions - the "grey" (low chroma) bodies within the soil where Fe-Mn oxides have been stripped out, or where both Fe-Mn oxides and clay have been stripped. Iron depletions and clay depletions can occur;
- Redox concentrations - Accumulation of iron and manganese oxides (also called mottles).
- These can occur as:
  - Concretions - harder, regular shaped bodies;
  - Mottles - soft bodies of varying size, mostly within the matrix, with variable shape appearing as blotches or spots of high chroma colours;
  - Pore linings - zones of accumulation that may be either coatings on a pore surface, or impregnations of the matrix adjacent to the pore. They are recognized as high chroma colours that follow the route of plant roots and are also referred to as oxidised rhizospheres.

The description and classification of the freshwater resource features within the project site are provided in the following sections.

Classification, Delineation and Description of Surface Water Resource Features

The water body delineation and classification were conducted using the standards and guidelines produced by the DWS (DWAF, 2005 & 2007) and the South African National Biodiversity Institute (2009).

For the DWS definitions of different hydrological features refer to Appendix 1.

Soil and vegetation sampling in conjunction with the recording of topographical features enabled the delineation of five wetland units at risk of being impacted by the proposed development.

For reference the following definitions are as follows:

- Drainage line: A drainage line is a lower category or order of watercourse that does not have a clearly defined bed or bank. It carries water only during or immediately after periods of heavy rainfall i.e. non-perennial and riparian vegetation may not be present.
- Perennial and non-perennial: Perennial systems contain flow or standing water for all or a large proportion of any given year, while non-perennial systems are episodic or ephemeral and thus contain flows for short periods, such as a few hours or days in the case of drainage lines.

» Riparian: The area of land adjacent to a stream or river that is influenced by stream-induced or related processes. Riparian areas which are saturated or flooded for prolonged periods would be considered wetlands and could be described as riparian wetlands. However, some riparian areas are not wetlands (e.g. an area where alluvium is periodically deposited by a stream during floods but which is well drained).
» Wetland: Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil (Water Act 36 of 1998); land where an excess of water is the dominant factor determining the nature of the soil development and the types of plants and animals living at the soil surface (Cowardin et al., 1979).
» Water course: As per the National Water Act means –
(a) A river or spring;
(b) A natural channel in which water flows regularly or intermittently;
(c) A wetland, lake or dam into which, or from which, water flows; and
(d) Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

Surface Water Resource Classification

Depression Wetland (Pan)

Depression wetlands, also known as pans, form within shallowed-out basins within the flatter landscape areas and are generally closed systems that are inward draining (endorheic). This depression wetland is located outside of the proposed PV solar facility footprint, but a very small portion of this wetland's catchment will be impacted by the proposed development.

Such depression wetlands make up the majority of the lentic (non-flowing) systems of the greater landscape. This depression wetland is endorheic, i.e. isolated from other surface water ecosystems, usually with inflowing surface water but no outflow. There is generally little or no direct connection with groundwater, and this pan tends to be fed by unchanneled overland flow and interflow following rainfall events. Interflow is the lateral movement of water, usually derived from precipitation, that occurs in the upper part of the unsaturated zone between the ground surface and the water table. This water generally enters directly into a wetland or other aquatic ecosystem, without having occurred first as surface runoff, or it returns to the surface at some point down-slope from its point of infiltration. This depression wetland does however contain a small drainage line, which started as a small erosion feature.

Endorheic pans are the most common wetland type in arid and semi-arid environments (Allan *et al.*, 1995), and are generally thought to form as a result of the synergy of a number of factors and processes, including low rainfall, sparse vegetation, flat to gently sloping topography, disrupted drainage, geology (e.g. dolerite sills and dykes) grazing and deflation.

Inundation periods for this wetland is very short-lived (days to a few weeks) following sufficient precipitation. Similarly, the frequency is highly variable, from less than once a year to once every few decades. The flat, central portion of this pan is mostly devoid of vegetation, with a zonation of plants occurring around the margin.

Generally, the functions and services (value) of the pan wetland are quite similar but may vary slightly in extent according to the size of the pan, the level of disturbance to which the wetlands have been subjected and the period and size of inundation. The opportunity for attenuating floods is largely limited due to their positions within the landscape, which is generally isolated. However, these pans do capture runoff as a result of their inward draining nature, and thus they reduce the volume of surface water that would otherwise reach the stream system and contribute to storm flows. This inward draining nature, together with their generally impermeable underlying layer, also means, however, that they are highly unlikely to play a role in stream flow augmentation. Temporarily wet pans provide the opportunity for the precipitation of minerals including phosphate minerals because of the concentrating effects of evaporation. Nitrogen cycling is likely to be important with some losses due to de-nitrification, and volatilisation in the case of high pH. Water quality in pans is influenced by the pedology, geology, and local climate. These factors in turn, also influence the response of these systems to nutrient inputs. Probably the most significant functions these pan wetlands provide is the temporary collection and retention of runoff and associated resources after large rainfall events and seasonal preferential grazing for livestock and other smaller faunal species. Other important functions include the provision of niche habitat, in turn ensuring the persistence of smaller organisms and provides seasonal water and food to migrating fauna. Furthermore, some of the pan wetlands contain patches of larger trees and shrubs on their peripheries, which provide nesting space for birds and shelter/breeding areas for fauna.

This depression wetland covers an area of approximately 8.3ha with a small section encroaching into the proposed power line corridor area. This pan wetland contains no indications of channelled inflow and outflow and is subsequently regarded as an endorheic system. This wetland contains no clear inlet or outlet and can be classified as endorheic with no channelled outflow. The hydrodynamics of this wetland are primarily dominated by vertical water level fluctuations. Water inflow is furthermore fed primarily by surface interflow from the immediate catchment. It appears that this wetland contains a portion which is intermittently inundated with shallow surface water and can be relative clearly divided into hydrogeomorphic zones according to soil form and wetness.

This depression wetland has been somewhat disturbed by the crossing of the Amalia Road probably but can still be classified as only moderately modified to semi-natural. Other important disturbances within this wetland include; trampling and grazing (cattle).

Prominent ecosystem functions and services provided by this wetland includes:

» Collection and retention of runoff and associated resources after large rainfall events.
» Seasonal preferential grazing.
» Niche habitat ensures persistence of organisms and provides seasonal water and food to migrating fauna.
» Larger shrubs and small trees on the periphery provide nesting space for birds and shelter/breeding areas for fauna.

The Present Ecological State scores (PES) for this depression wetland was rated as C (Moderately Modified) with modifications due to the obstructions and roads traversing this depression wetland, most notably the Amalia Road.

Ecological Importance and Sensitivity of the depression wetlands can be summarised as follows:

Conservation status	» High » Niche habitats » Some species restricted to these areas
Ecosystem function	» Collection and retention of runoff and associated resources after large rainfall events. » Seasonal preferential grazing » Niche habitat ensures the persistence of organisms and provides seasonal water and food to migrating fauna. » Larger shrubs and small trees on the periphery provide nesting space for birds and shelter/breeding areas for fauna.
Stability	» High if habitat is kept intact, despite very variable seasonal herb cover » Loss of functionality will result from clearing this vegetation and altering the surface » Easily invaded by weeds and alien invasive species » Cover may vary significantly from one year to the next » Easily degraded by excessive trampling and overgrazing
Reversibility of degradation	» The rehabilitation of the herb layer will only be possible if the existing microtopography and topsoil characteristics of this and the immediately surrounding environment is maintained

Levels of acceptable Change	» No change in the morphology and vegetation structure of the depression and its associated vegetation, including the shrubby periphery of the wetland, should be allowed.
Rating	» ***High***

Seepage Wetlands

Soil and vegetation sampling in conjunction with the recording of topographical features enabled the delineation of one seepage wetland located just outside of the grid corridor. This seepage wetland is located on a gently sloping midslope side fed primarily by a short drainage line as well as lateral subsurface water inputs from shallow groundwater occurring over an impermeable substrate. Water movement is largely driven by colluvial unidirectional movement. Water movement and through flow is generally as interflow with diffuse overland flow (sheetwash) becoming more prominent during and after rainfall events. Outflow is predominantly contained within a channel.

This seepage wetland is regarded as largely natural with limited transformation. Disturbances within this depression include trampling and grazing (cattle) and dirt roads (twin track)

Prominent ecosystem functions and services provided by this wetland includes:
» Collection and retention of runoff and associated resources after large rainfall events.
» Seasonal preferential grazing
» Niche habitat ensures persistence of organisms and provides seasonal water and food to migrating fauna.

The Present Ecological State scores (PES) for these depression wetlands were rated as B (Largely Natural) with small modifications due to the obstructions and farm roads traversing the wetland

Ecological Importance and Sensitivity of the depression wetlands can be summarised as follows:

Conservation status	» Moderate » Niche habitats » Some species restricted to these areas
Ecosystem function	» Collection and retention of runoff and associated resources after large rainfall events. » Seasonal preferential grazing » Niche habitat ensures the persistence of organisms and provides seasonal water and food to migrating fauna.

Stability	» High if habitat is kept intact, despite very variable seasonal herb cover » Loss of functionality will result from clearing this vegetation and altering the surface » Easily invaded by weeds and alien invasive species » Cover may vary significantly from one year to the next » Easily degraded by excessive trampling and overgrazing
Reversibility of degradation	» The rehabilitation of the herb layer will only be possible if the existing microtopography and topsoil characteristics of this and the immediately surrounding environment is maintained
Levels of acceptable Change	» No change in the morphology and vegetation structure of the wetland and its associated vegetation, should be allowed.
Rating	» ***Moderate***

Small Ephemeral Channels/Drainage Lines:

Represents a linear and narrow watercourse in the form of headwater drainage lines (second order drainage line. This feature was captured as a lines during the delineation process and are expected to be consistent with the NWA watercourse definition of 'natural channels that flow regularly or intermittently'. Such a drainage line can be marginal in nature with discontinuous or poorly developed channels that represent swales due to poor channel development in arid areas with low rainfall, high evapotranspiration and high infiltration in areas with sandy soils. No hydromorphic (wetland soil) or hydrophyte (wetland plant) indicators were recorded in this watercourse.

Such drainage systems typically differ from downstream reaches due to a closer linkage with hillslope processes, higher temporal and spatial variation, and their need for different protection measures from land use activities (Gomi et al. 2002). Such drainage lines are never or very seldom in connection with the zone of saturation and they consequently never have base flow and are unlikely to support wetland conditions.

Such drainage lines can contain discontinuous channels due to lower annual rainfall, longer rainfall intervals, and low runoff versus infiltration ratio due to greater transmission losses (Lichvar et al., 2004). Discontinuous channels are more common on low gradient topographies (e.g. basins and plains) in arid and semi-arid environments, with deeper substrates that result in lower energy fluctuations and greater water recharge into the surrounding soils during flow events.

These systems form part of a continuum between hillslopes and stream channels, which can be generally classified into four topographic units (Gomi et al. 2002):

- *Hillslopes have divergent or straight contour lines with no channelised flow.*
- *Zero-order basins have convergent contour lines and form unchannelised hollows.*
- *Transitional channels (temporary or ephemeral channels) can have defined channel banks, as well as discontinuous channel segments along their length, and emerge out of zero-order basin. They form the headmost definable portion of the drainage line network (first-order channels) and can have either ephemeral or intermittent flow.*
- *Well defined first and second-order streams that are continuous with either intermittent or perennial flow*

The Present Ecological State scores (PES) for this depression wetland was rated as C (Moderately Modified) with modifications due to the obstructions and roads traversing this depression wetland, most notably the Amalia Road.

Ecological Importance and Sensitivity of the depression wetlands can be summarised as follows:

Conservation status	» Low in terms of species of conservation concern » Medium in terms of creation of microhabitats facilitating the persistence other plants as well as fauna
Ecosystem function	» Moderate: o Species diversity adds to resilience of system and supports pollinator populations during different seasons o Moderately important fauna refuge and feeding area, o Moderate seasonal agricultural potential (livestock) o Deeper unconsolidated soils facilitate rapid infiltration of runoff into sub-soil moisture reserves, protecting such moisture reserves from rapid evaporation and hence supporting vegetation during extended dry periods o Corridor and distribution of seed reserves » Collection of scarce organic material to replenish soil nutrients
Stability	» Moderate where the vegetation layer is moderate to dense, low if soils become bare » May also be negatively impacted if the immediate surroundings (with a radius of 50 to 100 m, depending on slopes) are significantly altered or disturbed » Grass, forb and low shrub layer will fluctuate significantly during seasons and from year to year » Low if soil surface if extensively disturbed or compacted
Reversibility of degradation	» The rehabilitation of the herb layer will only be possible if the existing microtopography and topsoil characteristics of

	this and the immediately surrounding environment is maintained
Levels of acceptable Change	» No change in the morphology and vegetation structure of the wetland and its associated vegetation, should be allowed. » Drainage line to be spanned with no placement of pylons within the feature itself. » Existing access routes to be used.
Rating	» ***Moderate***

Surface Water Resource Delineation

The soils in the study area provided a good indication, for all wetland, of the level of wetness of the soils and proved to be the most reliable indicator for most of the assessment (apart from areas where significant soil disturbance have occurred) used to delineate the outer wetland boundaries (i.e. boundary between temporary wetland and upland/terrestrial areas). While soil form and saturation periods varied across the study area, the overwhelming portion of the wetland comprised of temporary saturated soils, whilst the channel and immediate fringing terraces comprised of seasonal saturated soils. Permanent saturated soils were very scarce and is indicative of a predominantly seasonal system.

In terms of pan wetland geomorphology, the influx of silt and clay due to inward depositional processes results in the accumulation of sediment. This sediment forms a layer that is relatively impermeable and is found near the surface in the subsoil of a pan basin.

In contras the seepage wetland did not contain such a clear silt/clay layer and is likely due to the surrounding geology and soil types as well as the drainage nature of this wetland

In general, five types of soil forms were identified within the wetlands. The first type of soil within the pan wetland was predominantly found to contain clays up to the point that the soil type was almost vertic in characteristics. This soil type was darker in colour with a vertic structure deeper beneath the Orthic A horizon. Soil depth was however limited (up to 60cm) due to the presence of calcrete or bedrock. Small calcretions were evident in the soil samples drawn, before reaching calcrete. This soil type was mainly found within the seasonal and prolonged saturated zone, which experience intermittent but prolonged periods of inundation. The soil form that could be attributed to this zone is of the Arcadia. Mottling at the surface revealed hydric soils.

Following this soil form is a narrow section dominated by the Katspruit Soil Form (seasonal saturated zone), where gleying forms the major pedogenetic process and is driven by long periods of reduction (as a result of extended soil saturation).

Within this Pan Wetland the outer seasonal to temporary zones were either characterized by an Orthic A horizon overlying a Hard Plinthic B horizon, typically of the Dresden Soil Form, or a more loose and friable soil type characterized by an Orthic A horizon underlain by a grey matrix with a weakly developed structure, typically of the Fernwood Soil Form.

As for the seepage wetland, the Fernwood Soil Form was the dominant soil form recorded whilst Dresden was also present in some areas. The underlying grey matrix was also of a weakly developed structure which has undergone marked in situ net removal of colloidal matter (iron oxides, silicate clay, organic matter) as a result of reduction (extended periods of soil saturation) together with a lateral flow of water. Along with the removal of colouring materials such as oxides and organic matter, clay particles have also been largely removed resulting in a coarser texture. Rusty markings (flecks, streaks, mottles) are common and testify to the temporary saturated conditions within this area.

Vegetation of the Freshwater Resource Features

Refer to Section 7 (Habitat types and Fine Scale Vegetation Patterns)

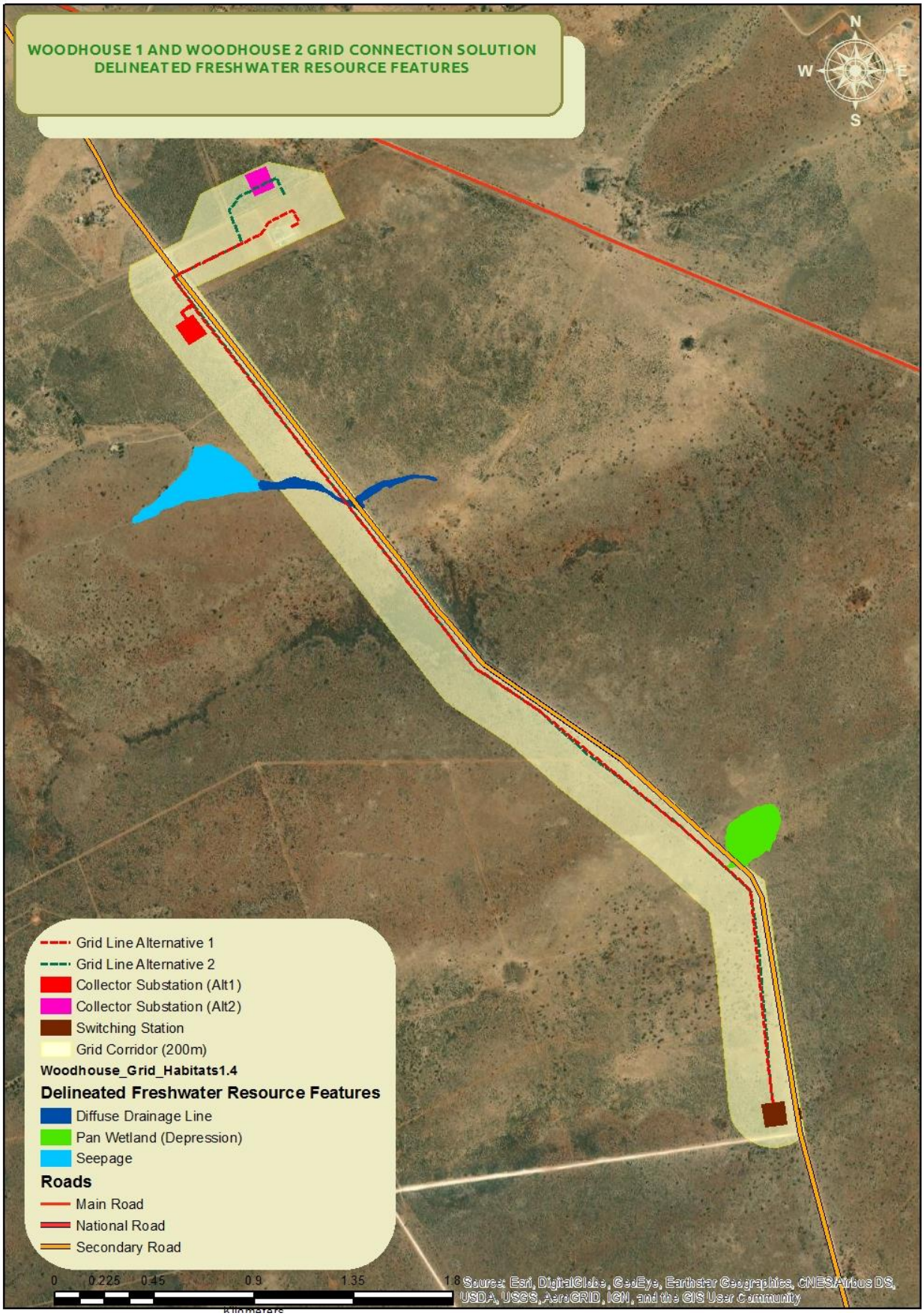

Figure 10: Delineated freshwater resource features within the 500m DWS regulated area.

7. FINDINGS OF THE TERRESTRIAL ECOLOGICAL BASELINE ASSESSMENT

Regional Terrestrial Ecological Overview

Vegetation Overview

Broad Vegetation Types

Broad vegetation types

The project site is situated in the Savanna biome and Eastern Kalahari Bushveld Bioregion. The vegetation in and surrounding the project site is Ghaap Plateau Vaalbosveld (SVk 7) (refer to Figure 11).

The distribution of the vegetation type is spread across the Northern Cape and North West Province, from about Campbell in the south east of Danielskuil through Reivilo to around Vryburg in the north. This vegetation type has been described by Mucina and Rutherford (2006) as a flat plateau with well-developed shrub layer with *Tarchonanthus camphoratus* and *Acacia karroo*. Open tree layer has *Olea europaea* subsp. *africana*, *A. tortilis*, *Ziziphus mucronata* and *Searsia lanceae*. *Olea* is more important in the southern parts of the unit, while *A. tortilis*, *A. hebeclada* and *A. mellifera* are more important in the north and part of the west of the unit. Much of the south-central part of this unit has remarkably low cover of Acacia species for an arid savanna and is dominated by the non-thorny *T. camphoratus, R. lanceae* and *O. europaea* subsp. *africana.*

Table 10: Key species associated with the Ghaap Plateau Vaalbosveld.

DOMINANT SPECIES	
Growth Form	**Key Species**
Low Shrubs	*Anthospermum rigidum subsp. pumilum, Indigofera comosa, Pygmaethamnus zeyheri var. rogersii, Searsia magaliesmontana, Tylosema esculentum, Ziziphus zeyheriana.*
Graminoids	*Aristida congesta, Brachiaria serrata, Cynodon dactylon, Digitaria tricholaenoides, Hiheteropogon ampletens, Eragrostis chloromelas, E. racemosa, Heteropogon contortus, Loudetia simplex, Schizachyrium sanguineum, Setaria sphacelata, Themeda triandra, Alloteropsis semilata subsp. eckloniana, Andropogon schirensis, Aristida canescens, A. diffusa, Bewsia bifola, Bulbostylis burchellii, Cymbopogon caesius, Elinonurus muticus, Eragrostis curvula, E. gummiflua, E. plantana, Eustachys paspaloides, Hyparrhenia hirta, Melinis nerviglumis, M. repens subsp. repens, Monocymbium ceresiiforme, Panicum coloratum, Pogonarthria squarrosa, Trichoneura grandiglumis, Triraphis andropogonoides, Tristachya leucothrix, T. rehmannii.*

Herbs	*Acalypha angustata, Chamaecrista mimosoides, Euphorbia inaequilatera, Crabbea angustifolia, Dianthus mooiensis, Dicoma anomala, Helichrysum caespititium, H. miconiifolium, H. nudifolium var. nudifolium, Ipomoea ommaneyi, Justicia anagalloides, Kohautia amatymbica, Kyphocarpa angustifolia, Ophrestia oblongifolia, Pollichia campestris, Senecio coronatus, Hillardia oligocephala.*
Geophytic Herbs	*Boophane disticha (Declining – Red List), Habenaria mossii.*
Geoxylic suffrutex	*Elephantorrhiza elephantina, Parinari capensis subsp. Capensis.*
ENDEMIC SPECIES	
Growth Form	**Key Species**
Succulent Shrub	*Delosperma davyi.*

A species list from POSA (http://posa.sanbi.org, Grid reference 2624 and 2724) containing the species that have been recorded to date in the Vryburg area was obtained. POSA generated species lists also contain updated Red Data species status according to the Red List of South African Plants published by SANBI in Strelitzia 25 (Raimondo *et al*. 2009, updated 2013). Only protected and red data species that may potentially occur in the project site have been listed under results. The actual field survey will confirm which of the species already recorded will actually occur in the project site, and may reveal the presence of additional species that may not have been recorded in official databases to date.

A total of 369 indigenous species have been recorded in the Vryburg region according to the SANBI database. It is highly unlikely that all of these species will occur within the project site. Alien invasive species (33) have also been recorded within the relevant quarter degree grids.

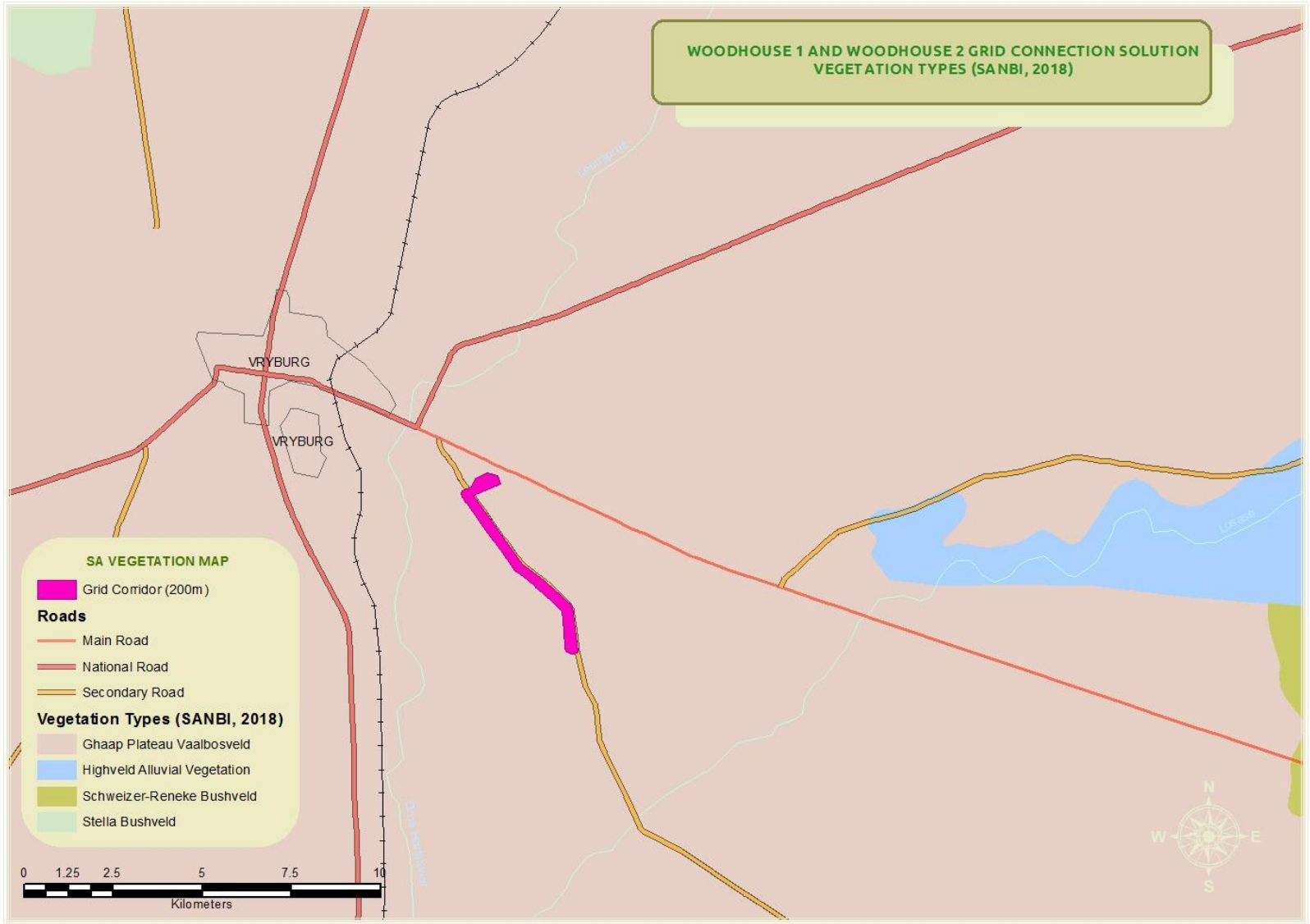

Figure 11: Vegetation Types (SANBI, 2018)

Plant Species of Conservation Concern Previously recorded within the Region

As previously mentioned, a species list was obtained from POSA for the relevant degree grids. The species on this list were evaluated to determine the likelihood of any of them occurring in the project site. Of the species that are considered to occur within the geographical area under consideration, there were three species which are regarded Species of Conservation Concern (Red List plant species). According to the South African Red List Categories, one is listed as Rare (*Gnaphalium nesonii*), one Vulnerable (*Rennera stellata*) and one Near Threatened (*Lithops lesliei*). *Boscia albitrunca* and *Vachellia erioloba* are the only tree species protected according to the National Forest Act (NFA) that may potentially occur within the project site. Sixteen species have been previously recorded which are protected within the Transvaal Nature Conservation Ordinance (TNCO) and Bophuthatswana Nature Conservation Act (BNCA).

Faunal Overview

Mammals

The potential diversity of mammals within the project site is high with as many as 98 terrestrial mammals potentially occurring within the area. Of the 98 mammals that have a distribution that include the project site, only 74 are known to occur in the 2724 Degree Grid with only 11 species from the 2724 QDSs (MammalMap, 2018).

Of the species that have a distribution that include the project site, 41 species are regarded as Conservation Important Species with 21 species either listed as Red Data species or as a Protected Species within the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) (refer to Table 11). Due to the relatively homogenous nature of the project site as well as the high level of disturbances associated with anthropogenic activities (agricultural activities and the major roads), the diversity within the project site itself are low to moderate. Even though suitable habitat is provided for approximately 41 species (Likelihood Rating of 2) and some 25-marginal species (Likelihood: 3), the actual on-site diversity is expected to be much lower.

A number of antelope species have been recorded by the ADU (Animal Demographic Unit) within the 2724 Degree Grid. Most of these antelope species are confined by fences and occur only where farmers have introduced them or allow them to persist and should be considered as part of the farming system rather than as wildlife per se. Some of these South African indigenous antelope species do not have a natural distribution within the specific region but as mentioned have been introduced by farmers. Such antelope species include; Black Wildebeest (*Connochaetes gnou*) Blesbuck (*Damaliscus dorcas* subsp. *phillipsi*), Red Hartebeest (*Alcelaphus buselaphus*), Roan Antelope (*Hippotragus equinus*), African Buffalo (*Sycerus caffer*), Springbok (*Antidorcas marsupialis*) etcetera. Both Duiker (*Sylvicapra grimmia*) and Steenbok (*Raphicerus campestris*) are adaptable species that are

able to tolerate high levels of human activity and are not likely to be highly sensitive to the disturbance associated with the development.

Table 11: Species listed as conservation worthy within the South African Red Data Base (Regional Red List Status, 2016), IUCN Red List (2015) and National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004); Threatened or Protected Species Regulations. Abbreviations: EN=Endangered, DD=Data Deficient, VU=Vulnerable, NT=Near Threatened, LC=Leas Concerned. Likelihood Rating: 1=Confirmed; 2=Likely; 3=Moderate; 4=Unlikely & 5= May occur as a managed population.

Scientific Name	Common Name	IUCN Status	Regional Status	TOPS (NEM:BA)	Likelihood
Rodentia (Rodents):					
Mystromys albicaudatus	White-tailed Mouse	EN	VU		2
Eulipotyphla (Shrews):					
Crocidura mariquensis	Swamp Musk Shrew	DD	NT		3
Erinaceomorpha (Hedgehog)					
Atelerix frontalis	South African Hedgehog	NT	NT	Protected	2
Philodota (Pangolins)					
Smutsia temminckii	Ground Pangolin	VU	VU	VU	3
Carnivora:					
Proteles cristatus	Aardwolf	LC	LC		2
Crocuta crocuta	Spotted Hyaena	NT	NT	Protected	4
Hyaena brunnea	Brown Hyena	NT	NT	Protected	4
Leptailurus serval	Serval	LC	NT	Protected	3
Felis nigripes	Black-footed cat	VU	VU	Protected	3
Panthera pardus	Leopard	VU	VU	Protected	4
Mellivora capensis	Honey Badger	NT	LC	Protected	3
Vulpes chama	Cape Fox	LC	LC	Protected	3
Aonyx capensis	Cape Clawless Otter	NT	NT	Protected	4
Lutra maculicolis	Spotted-necked Otter	NT	VU	Protected	4
Poecilogale albinucha	African Striped Weasel	DD	NT		3
Rumanantia & Perissodactyla (Ungulates):					
Connochaetes gnou	Black Wildebeest	LC	LC	Protected	5
Redunca fulvorufula	Mountain Reedbuck	LC	EN		5
Redunca arundinum	Southern Reedbuck	LC	LC	Protected	5
Pelea capreolus	Grey Rhebok	LC	NT		5
Chiroptera (Bats)					
Miniopterus natalensis	Natal long-fingered Bat	NT	NT		3
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	LC	NT		3
Rhinolophus darlingi	Darling's Horseshoe Bat	LC	NT		2

Reptiles and Amphibians

The potential diversity of reptilian species within the greater area is moderate with as many as 71 terrestrial reptilian species potentially occurring within the area. The potential diversity of Amphibian species is on the other hand regarded as low with 21 species having distribution that include the project site. As a result of the large absence of suitable habitat, the diversity within the project site itself is regarded as low.

Of the 71 reptilian species that have a distribution that include the project site, only 26 are known to occur in the 2724 Degree Grid with only 3 species within the 2724 QDS (ReptileMap, 2018). Of the species that have a distribution that include the project site, 1 species is regarded as Conservation Important (Southern African Python – *Python natalensis*) whilst 13 species are endemic/ near endemic to South Africa. Due to the relative homogenous nature of the project site, it is expected that the diversity within the project site itself will be moderate, with an expected 29 species likely to inhabit the project site and 22 with a moderate potential to occur within the project site.

Of the 21 amphibian species that have a distribution that include the project site, only 15 are known to occur in the 2724 Degree Gird with only 2 species recorded within the 2724BA QDS (FrogMap, 2018). Of the species that have a distribution that include the project site, 1 species is regarded as Conservation Important (Giant Bullfrog – *Pyxicephalus adspersus*). The Giant Bull Frog is classified as Near Threatened within the Atlas and Red Data book of the frogs of South Africa, Lesotho and Swaziland (2004). These species prefer and breed in the shallows of temporary rain filled depressions in grassland and dry savannah.

It is expected that the diversity within the project site itself will be low, with an expected 5 species likely (Likelihood: 2) to inhabit the project site and 9 with a moderate potential (Likelihood: 3) to occur within the project site. This is mostly due to on-site and surround disturbances and habitat transformation, which include a fractured landscape, surrounding agricultural practices, the presence of large roads and other anthropogenic activities. This was confirmed during the survey with very low diversity observed within the project site.

Table 12: Reptilian and Amphibian species listed as endemic or conservation important within the South African Red Data Base (Regional Red List Status for Reptiles, 2014 & Regional Red List Status for Amphibians, 2004), and National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004); Threatened or Protected Species Regulations (TOPS Species – Highlighted in Yellow). Abbreviations: EN=Endangered, DD=Data Deficient, VU=Vulnerable, NT=Near Threatened, LC=Leas Concerned; E=Endemic; N-E=Near Endemic. Likelihood Rating: 1=Confirmed; 2=Likely; 3=Moderate; 4=Unlikely & 5= May occur as a managed population.

Species	Common Name	Threat Status Regional	Endemism	Likelihood	ADU Database
Testudinidae					
Homopus femoralis	Greater Dwarf Tortoise	LC	E	4	
Amphisbaenidae					
Monopeltis capensis	Cape Worm Lizard	LC	N-E	3	
Cordylidae					
Karusasaurus polyzonus	Southern Karusa Lizard	LC	N-E	4	1
Scincidae					
Acontias gracilicauda	Thin-tailed Legless Skink	LC	E	2	
Agamidae					

Agama atra	Southern Rock Agama	LC	N-E	2	1
Typhlopidae					
Afrotyphlops bibronii	Bibron's Blind Snake	LC	N-E	3	
Pythonidae					
Python natalensis	Southern African Python	LC		4	
Lamprophiidae					
Lamprphis aurora	Aurora Snake	LC	E	3	
Elapidae					
Hemachatus haemachatus	Rinkhals	LC	N-E	4	
PYXICEPHALIDAE (CACOS, RIVER FROGS)					
Pyxicephalus adspersus	Giant Bullfrog	NT		2	3

Avifuana

A total of 221 species were recorded within the study area and broader impact zone of the development (SABAP1 & 2) with 17 species classified as Red Data species (Barnes 2014), 12 endemic species and 28 near-endemic species. Of these, 55 species were recorded during the site visit, most notable of which being sightings of Kori Bustard (Near Threatened) and Lanner Falcon (Vulnerable) (Table 13). Also, notable, despite being recorded outside of the project site (but included due to their transient nature which could bring them into contact with the development), being the sightings of White-backed Vulture (Critically Endangered) and Greater Flamingo (Near Threatened).

The birds of greatest potential relevance and importance in terms of the possible impacts of the Solar PV Project and its associated power infrastructure are likely to be local populations of threatened or endemic passerines (Ant-eating Chat *Myrmecocichla formicivora* and Cape Longclaw *Macronyx capensis*), shy ground-nesting species (Burchell's Courser *Cursorius rufus* and Double-banded Courser *Rhinoptilus africanus*), resident or visiting large terrestrial birds (Secretarybird *Sagittarius serpentarius*, Abdim's Stork *Ciconia abdimii*, Black Stork *Ciconia nigra* and Blue Crane *Anthropoides paradieus*), resident or passing raptors (Martial Eagle *Polemaetus bellicosus,* Tawny Eagle *Aquila rapax,* Lanner Falcon *Falco biarmicus* and Red-footed Falcon *Falco vespertinus* and White-back Vulture) and transient waterbirds (Greater Flamingo*,* Lesser Flamingo *Phoenicopterus minor,* South African Shelduck *Tadorna cana* and Yellow-billed Stork *Mycteria ibis*).

Southern Africa contains 13 avifaunal endemic regions, namely Western Arid, Woodland, Evergreen Forest, Grassland, Montane, Rocky slopes and cliffs, Fynbos, Marine and Inland Waters (MacLean 1999). Of these regions, Grassland, where the project site is located, contains the fourth highest number of endemics. Overall, the core study area and

immediate surroundings potentially contains a total of 40 endemics and near-endemics, which is 24% of the 167 southern African endemics and near-endemics (Hockey et al. 2005).

According to Appendix 5 (Bird Scoping Assessment Report and Development Protocols) of the Strategic Environmental Assessment for Wind and Solar Photovoltaic Energy in South Africa the following description has been provided for the Vryburg Focus Area (within which the project area is located):

"The Vryburg FA (9 204 km2) falls within the Savannah Biome and is dominated by the Eastern Kalahari Bushveld Bioregion (Mucina & Rutherford 2006). Open Savannah or bushveld vegetation covers the majority of the FA, which features very little topographic relief. The northwestern section includes a number of salt pans that form a unique feature in the open landscape. The FA is not located close to any registered national Important Bird Areas, but is located about 30 km north-east of Barberspan, an acknowledged and registered RAMSAR site since 1975, and one of the few wetlands in the area that contains water throughout the year, attracting large numbers of wetland and water-dependant bird species.

The FA supports up to 337 bird species, of which 23 are red-listed species, and two are red-listed endemics (Melodious Lark and Short-clawed Lark Certhilauda chuana).

The avifauna of this area is poorly known and virtually undocumented. Levels of rural and agricultural development appear to be high, but in areas where the open Savannah is at least partially intact, and especially where sizable trees still remain, large Savannah raptor species such as Tawny Eagle, Lappet-faced Vulture, White-backed Vulture, and even Bateleur Terathopius ecaudatus may still be present. Otherwise, the open plains are likely to hold numbers of threatened large terrestrial birds (e.g. Secretarybird, Blue Crane and Kori Bustard, the town of Stella is a summer roost site for >3000 Lesser Kestrels, and the wetlands areas are likely to attract both Greater and Lesser Flamingos and a variety of other waterbirds (particularly in wet years).

We identified a short-list of 18 threatened and/or impact susceptible priority species to inform the sensitivity mapping for this FA (Table 3). A suite of large Savannah raptors, Lesser Kestrel and Greater Flamingo were the most influential species in shaping the sensitivity maps for this area."

Table 13: Red listed species that may potentially occur within the project site and surroundings (surveyed area). Species that have been confirmed within the project site have been highlighted in **Green** font. (NT = Near Threatened; VU = Vulnerable; EN = Endangered; LC = Least Concern; CR = Critically Endangered)

Taxonomic name	Common Name	Red Data (Regional, Global)	Endemism	Habitat	Likelihood of occurrence	Susceptible to
Ciconia nigra	Stork, Black	VU, LC		Forages singly, occasionally in pairs/small groups in wetland habitats, dried up watercourses and small isolated pools. Roosts on cliff, tree or pylon.	Moderate	Collision / Electrocution
Ciconia abdimii	Stork, Abdim's	NT, LC		Gregarious and usually in flocks. Grassland, Savannah woodland, pan edges, pastures and cultivated areas. Regularly found foraging on irrigated lands, pastures and ploughed fields. Roost in large trees (incl. *Eucalyptus*), or cliffs.	Moderate	Habitat Loss / Disturbance / Collision / Electrocution
Mycteria ibis	Stork, Yellow-billed	EN, LC		Often in pairs or groups. Wide variety of wetland and aquatic habitats. Forages in shallow water free of emergent vegetation. Roosts communally on sandbanks, lake margins and large trees.	Moderate	Habitat loss / Disturbance
Phoenicopterus ruber	**Flamingo, Greater**	**NT, LC**		**Flocks greatly variable in size. Open water bodies (e.g. dams, sewage treatment works, ephemeral pans, river mouths and coastal mudflats). Breeds at recently flooded, large, eutrophic, shallow salt pans**	**Moderate**	**Collision**
Phoenicopterus minor	Flamingo, Lesser	NT, NT		Flocks greatly variable in size. Open, eutrophic, shallow wetlands. Small, ephemeral freshwater wetlands important for smaller flocks. Colonial nester. Breeds on saline lakes and saltpans	Moderate	Collision
Oxyura maccoa	Duck, Maccoa	NT, NT		Permanent wetlands in open grassland. Breeding habitat comprise of dense stands of emergent vegetation especially reeds, rushes and tall sedges.	Low	Habitat loss / Disturbance / Collision
Sagittarius serpentarius	Secretarybird	VU, VU		Pairs or sometimes solitary. Open grassland with scattered trees and shrubs. Roosts in crown of trees (mostly *Acacia* spp.).	High	Habitat loss / Disturbance / Collision
Gyps coprotheres	Vulture, Cape	EN, VU	E	Roosts mostly in mountainous area but may utilize large trees and pylons. Very wide and varying foraging range (up to 121,655 km^2). Colonial nester.	Low	Collision / Habitat loss / Disturbance / Electrocution
Gyps africanus	Vulture, White-backed	CR, CR		Savannah woodland and bushveld	Low	Habitat loss / disturbance / collisions / electrocutions
Polemaetus bellicosus	Eagle, Martial	EN, VU		Open woodland in fairly flat country, also open shrubland with drainage line woodland or high-tension pylons, and open farmland with clumps of trees.	Moderate	Collision / Electrocution
Coracias garrulus	Roller, European	NT, LC		Open woodlands	Moderate	Habitat loss / Disturbance

Aquila rapax	Eagle, Tawny	EN, LC		Open Savannah woodland	Moderate	Habitat loss / disturbance / Electrocution
Falco biarmicus	Falcon, Lanner	VU, LC		Singly or in pairs. Open grassland, open or cleared woodland, and agricultural areas. Nesting sites includes; cliffs (normally), large trees, electricity pylons and buildings). May utilize existing nests of other species, e.g. crows and other raptor species.	Confirmed	Collision/ Disturbance / Habitat loss / Electrocution
Falco vespertinus	Falcon, Red-footed	NT, NT		Gregarious. Open habitat with some trees, including semi-forested areas, forest fringes, croplands and wetlands. Mostly associated with open, grassy, arid woodland. Often utilizes dead trees, telephone poles and wire and fence lines as perches. Roosts in small tree clumps (often *Eucalyptus* stands). Non-breeding migrant.	High	Collision/ Disturbance / Habitat loss / Electrocution
Anthropoides paradiseus	Crane, Blue	NT, VU	E	Flocks of varying size. Open grassland but also wetlands, pastures and croplands. Frequently observed in cultivated fields. Roosts in shallow water bodies. Breeds in varies habitats including marshes, wet ground and grassland with a clear all-round visibility as the most important requirement.	Low	Collision
Ardeotis kori	Bustard, Kori	NT, NT		Dry open Savannah woodland, dwarf shrubland and occasionally grassland	Confirmed	Habitat loss / Disturbance / Collision
Cursorius rufus	Courser, Burchell's	VU, LC	NE	Sparsely vegetated arid regions	Moderate	Habitat loss / Disturbance

Habitat types and Fine Scale Vegetation Patterns

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

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

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

As these are field-based observations taken directly from the site, they are of greater reliability and pertinence than the results of the National Vegetation Map which is at a coarse scale and does not represent the detail of the site adequately. The habitat map derived for the study area (including the proposed development site) is provided in Figure 12.

At the time of the vegetation survey, the herbaceous as well as geophytic layer was well developed and as such the time of the survey is regarded acceptable. However, it is highly possible that a few additional species, can be expected to emerge outside of the period within which the survey was conducted.

The vegetation is consistent with the vegetation classification provided by Mucina & Rutherford (2006) (Ghaap Plateau Vaalbosveld). Small variations especially in terms of the dominant grass species occur throughout the site. Geology and soil features, appear to be the driving force between the variations found between the different units. Most of the area tends to have the same species composition with the differences being the dominant species, especially within the grasses (as mentioned). An exception to this is the siliciclastic rock outcropping which have a different species composition.

Five major habitat units have been identified namely:

1. *Vachellia tortilis* Woodland (Primary and Secondary Woodland);
2. *Tarchonanthus camphoratus* Shrubland *(*Dense and Open Shrubland*);*
3. *Pan Wetland*

4. Seepage and associated drainage line*;*
5. *Senegalia mellifera* Ridge

A. *Vachellia tortilis* Woodland (Primary and Secondary Woodland):

This habitat type is found and sandy and slightly gravelly substrate of various depths (normally of medium depth) mafic and ultramafic rocks from the Vryburg Formation. The vegetation can be described as an open grassland with scattered small to medium sized trees and shrubs. Areas severely overgrazed tend to be encroached by *Trachonanthus camphoratus* and to a lesser extent by *Acacia mellifera*. This vegetation unit has a relatively close resemblance to the *Tarchonanthus camphoratus* Shrubland in terms of species composition and diversity, with differences occurring in the form of the structure and relationship between the different plant strata. The tree savanna contains a denser (although still open) tree layer whilst the shrub layer is much more open. Dominant tree species include; *Vachellia tortilis, Vachellia erioloba* and *Ziziphus mucronata*. *T. camphoratus* and *G. flava*, even though still constant throughout the area, are much lower in density. Within this habitat type, two variations were identified namely; a denser tree and shrub variation occurring within the primary woodland and a sparse tree and shrub form located within an area that has been historically cultivated (very long time ago).

Important ecological factors influencing the vegetation composition of this unit are long term grazing with some overgrazing which is evident from the dominance of increasing II grass species, especially *Eragrostis lehmannia, E. trichophora* and *E. rigidior*. Within the secondary woodland *E. superba and Arista congesta* also becomes slightly more prominent.

The tree layer constitutes approximately 15% of the total vegetation cover and comprise of an almost equal mixture of broad leave and compound leave species. The shrub layer constitutes approximately 20% of the unit, predominantly *G. flava* and *Tarchonanthus camphoratus*. This habitat type comprises a moderate diversity of species (49 species) with all strata relatively well represented (15 grass species; 6 shrub species, 5 tree species and 18 forb species). Key species includes; *A. congesta, E. lehmanniana, E. superba, S. pappophoroides, E. echinochloidea, G. flava, T. camphoratus, S. lancea, A karroo, Z. mucronata, A. tortilis, Asparagus laricinus, Lantana rugosa, Pentzia incanum, Chascanum pinnatifidum, Nolletia ciliaris* and *Hertia pallens*.

No Red Data or Threatened species were recorded within this habitat. Protected species recorded includes provincially protected species such as *Babiana bainesii, Boophone disticha* and *Aloe greatheadii* plants as well the nationally protected tree *Vachellia erioloba*.

Species characterising this unit include:

» Medium sized trees: *Vachellia tortilis, Vachellia erioloba*
» Small trees/Shrubs: *Tragonanthus camphoratus, Grewia flava, Asparagus laricinus*

- Dwarf Shrubs: *Lantana rugosa, Pentzia incanum, Chascanum pinnatifidum, Nolletia ciliaris* and *Hertia pallens*
- Herbs: *Indigofera holubii, Indigofera melandenia, Convolvulus sagittatus, Commelina africana, Aerva leucura, Corchorus asplenifolius, Evolvulus alsinoides, Chaemaecrista spp.*
- *Geosuffrutex: Elephantorrhiza elephantina, Ziziphus zeyheriana*
- Grasses: *Cymbopogon pospischilii, Aristida diffusa, Hypharrhenia hirta, Digitaria eriantha, Aristida congesta, Anthephora pubescens, Aristida adscensionis, Schmidtia kalahariensis, Tragus berteronianus, Anthephora pubescens, Pennisetum spp., Centropodia glauca, Aristida adscensionis, Enneapogon cenchroides, Schmidtia pappophoroides, Eragrostis trichophora, Eragrostis rigidior, Eragrostis curvula, Urochloa mosambicensis, Eragrostis lehmannaina, Eragrostis trichopora, Eragrostis superba*

Ecological Function:

- Grazing and browsing,
- Occasional groves of taller trees and shrubs provide nesting areas for avifauna and occasional shelter for terrestrial fauna

B. Tarchonanthus camphoratus Shrubland (Dense and Open Shrubland):

This habitat unit covers the bulk of the gird corridor and also stretches well beyond the footprint area and forms the dominant unit within most of the farm portions as well as beyond the affected farm boundaries. This unit occur within relative deep red sand which have its origins mainly through weathering of siliciclastic rocks. Patches of calcrete outcroppings are also present within this area. This savannah type comprises of a dominant and dense shrub layer, primarily *T. camphoratus* and *G. flava*. The forb/ grass layer is also relatively well developed. Taller tree species are occasionally scattered within this shrub dominated area.

This unit is extensively used for grazing and subsequently has been steadily transformed over a very long period of time due to long term grazing (overgrazing). Although in a semi-natural state this unit still, provide valuable ecological functions. One of the effects of historical grazing pressure within this unit is the increase in the woody component (bush encroachment), especially *Tragonanthus camphoratus* and *Grewia flava*. Even with this increase in woody species this area still comprises a high coverage of grass. The grass mainly consists out of subclimax increaser 2 species which is indicative of overgrazed veld.

The tree layer comprises between 3% of the unit with *Vachellia tortillis* and *Searsia lancea* being the prominent tree species. The shrub layer comprising predominantly of T. *camphoratus* cover approximately 25 - 30% of the habitat. The grass layer is well developed and relative dense (coverage of approximately >50%) comprising of *Eragrostis lehmanniana, E. rigidior, E. superba, Schimtia pappophoroides, Anthephora pubenscens*

and *A. congesta*. Species diversity within this unit is fairly low comprising of 36 species; comprising of 16 graminoid species, 4 shrub species and 4 tree species.

Two variation of this habitat exist within the surveyed corridor, namely a denser, near-natural form located to the north and a form comprising of a low density of shrubs and trees due to the poisoning of these trees and shrubs in an attempt to improve the grazing of the area. It is currently unclear when the trees and shrubs has been poisoned and subsequently the exact impact on the tree and shrub layer and the extent of poisoning is unclear at this stage. However, it is expected that this reduction of the tree/shrub layer will have a noteworthy impact on faunal and avifaunal diversity.

No Red Data or Threatened species were recorded within this habitat. Protected species recorded includes provincially protected species such as *Babiana bainesii, Boophone disticha* and *Aloe greatheadii* plants as well the nationally protected tree *Vachellia erioloba* (seldomly observed within this habitat). Of the protected species, *Aloe grandidentata* (succulent) and *Babiana bainesii* (geophyte) were quite prominent within this unite and was regularly encountered. *Acacia erioloba* (tree) as well as *Boophone disticha* (geophyte) were sparsely distributed through this unit.

Ecological Function:

» Grazing and browsing,
» Occasional groves of taller trees and shrubs provide nesting areas for avifauna and occasional shelter for terrestrial fauna

C. Pan Wetland

This habitat type does not form part of the Savannah habitat types but rather moisture loving grassland fringed by a dense woody outer edge. This depression wetland experience various periods of soil saturation with some small areas which may experience short periods of inundation. This wetland is also characterized by soils with a higher clay content due to the accumulation of such textures in these low-lying areas. The depression wetland comprises of a low to tall moisture loving grassland which may be replaced by forbs when regularly trampled and grazed. The composition of dominant species typically varies along a moisture gradient.

The zones within these pans that are saturated seasonally to almost temporary are characterized by low growing graminoids such as *Panicum coloratum, Cynodon dactylon, Eragrostis cilianensis, Echinochloa holubii* and *Brachiaria marlothii* as well as *Eragrostis curvula*. Trampled areas may be dominated by *C. dactylon, Tragus berteronianus*, and *Schkuria pinnata*. Areas experiencing periods of inundation (typically temporarily for a few months after sufficient rainfall events) are characterised by *Persicaria serrulata* and *Echinochloa holubii*.

The seasonal to temporary saturated zone are usually characterized by a mixture of short and tall grasses with a stronger forb representation. Key species includes; *Brachiaria marlothii, Panicum coloratum, Cymbogon pospischilii, Cynodon dactylon, Salvia disermas, Gomphrena celosioides, Stachys natalensis* and *Heliotropium ciliatum.* Trampled areas are usually dominated by *Schkuria pinnata, Urochloa panicoides, Cynodon dactylon, Heliotropium ciliatum* and *Gomphrena celosioides*.

The outer edges of the temporary zones are very seldom saturated and comprise of a mixture of the surrounding dry terrestrial species and wetland species, predominantly tall grass species. Key species includes; *Digitaria eriantha, Enneapogon desvauxii, Eragrostis lehmanniana, Eragrostis rigidior, Cymbopogon pospischilii, Panicum coloratum, Sporobolus ioclados, Heliotropium ciliatum* and *Schkuria pinnata.* Very occasionally tall *Acacia erioloba* species may be located within these areas, which is regarded as a conservation important species. Woody patches are found as small, dense patches at the periphery of the pan wetland, where the soils are slightly clayey and relatively shallow with surface rock typically present. These patches comprise a combination of small to moderately sized trees and shrubs with a moderate ground cover, predominantly forbs and shade loving graminoids. Key species include *Searsia lancea, Ziziphus mucronata, Searsia pyroides, Diospyros lycioides, Grewia flava*, *Asparagus laricinus* and *A. suaveolens.*

No Red Data, threatened or protected species were recorded within this habitat.

Ecosystem Function:

» Below-ground water storage, supporting higher shrubs in close proximity to drainage lines
» Corridor for water, seed, nutrient flows and fauna
» Restricted island of fertility providing plant and seed resources to fauna even during periods of drought
» Softer and deeper substrates on banks provide burrowing sites for fauna
» Fringes of high shrubs provide bird-nesting sites and shelter to terrestrial fauna

D. Seepage Wetland and Associated Drainage Line

This vegetation coverage of the seepage wetland is very similar to that of the temporary and seasonal to temporary zone of the depression wetland and can also be described as a moisture loving grassland with the absence of the fringing woody patches. The seepage wetland comprises a low to tall moisture loving grassland which may be replaced by forbs when regularly trampled and grazed.

The seasonal to temporary saturated zones are usually characterized by a mixture of short and tall grasses with a stronger forb representation. Key species includes; *Eragrostis curvula, Aristida congesta, Eragrostis lappul*a, *Panicum coloratum, Cymbogon pospischilii,*

Cynodon dactylon, Salvia disermas, Gomphrena celosioides, Stachys natalensis and *Heliotropium ciliatum.* Trampled areas are usually dominated by *Schkuria pinnata, Urochloa panicoides, Cynodon dactylon, Heliotropium ciliatum* and *Gomphrena celosioides*.

The diffuse drainage line feeding into the seepage wetland comprise of a vegetation cover, very similar to that of the *Tarchonanthus camphoratus* shrubland, with the exception that shrubs and trees are much sparser along this drainage line.

Ecosystem Function:

» Corridor for water, seed, nutrient flows and fauna
» Restricted island of fertility providing plant and seed resources to fauna even during periods of drought

E. *Senegalia mellifera* Ridge:

This habitat occupies the siliciclastic rocky ridge that run in an east to west direction. Soil is sandy and generally shallow. This portion of the ridge (within the grid corridor) have been severely encroached by *S. mellifera*, forming a dense thicket, and has had a significant impact on local biodiversity (reduction).

Species characterising this unit include:

» Medium sized trees: *Acacia tortilis*
» Small trees / Shrubs: *Tragonanthus camphoratus, Grewia flava, Acacia mellifera, Ehretia rigida,*
» Dwarf Shrubs: *Asparagus nelsii,*
» Herbs: Limeum fenestratum, Hibiscus micranthus, Oxygonum alatum, Kohautia caespitose, Selago densiflora, Chascanum hederaceum, Rhynchosia totta, Sida dregei, *Monsonia burkeana, Senna italica, Barleria macrostegia, Commelina africana, Indigofera holubii, Indigofera daleoides, Corchorus asplenifolius, Gisekia africana, Sesamum triphyllum*
» Geophytes: *Albuca setosa, Ledebouria revoluta*
» Succulent herbs: *Aloe grandidentata*
» *Geosuffrutex: Elephantorrhiza elephantina, Ziziphus zeyheriana*
» Grasses: *Cymbopogon pospischilii, Tragus berteronianus, Anthephora pubescens, Aristida adscensionis, Aristida diffusa, Enneapogon cenchroides, Schmidtia pappophoroides, Eragrostis trichophora, Eragrostis rigidior, Eragrostis curvula, Digitaria eriantha, Urochloa mosambicensis, Eragrostis superba, Melenis nerviglumis, Eragrostis obtusa, Eragrostis biflora, Stipagrostis obtusa*

No Red Data or Threatened species were recorded within this habitat. Protected species recorded includes provincially protected species such as *Babiana bainesii,* and *Aloe greatheadii* plants.

Ecosystem function

» Niche habitats for fauna –Impacted by the encroachment of *S. mellifera*
» Niche habitats for specific flora species – Severely impacted by the encroachment of *S. mellifera*

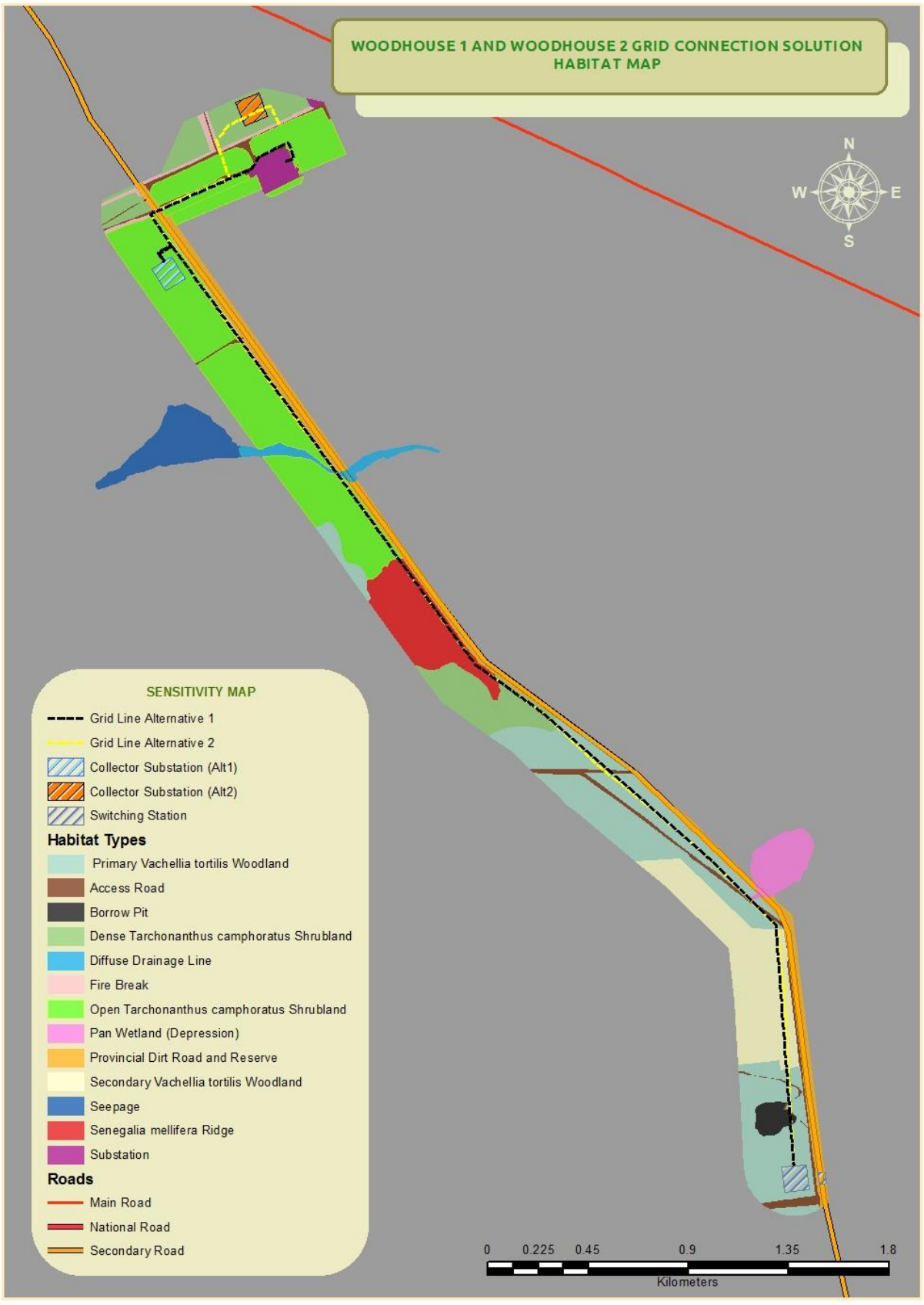

Figure 12: Delineated habitat units.

Plant Species of Conservation Concern (SCC)

During the survey no plant SCC was recorded. However, three provincially protected species were recorded, namely; *Boophone disticha, Babiana bainesii, Aloe grandidantata,* and one nationally protected tree species namely; *Vachellia erioloba*. Both *B. bainesii* and A. *grandidantata* were frequently observed within the terrestrial habitats, especially *Babiana bainesii. V. erioloba* trees are low in numbers and sparsely distributed throughout the grid corridor.

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 in order to gain permission for the removal, relocation, disturbance or destruction of these species

Alien Invasive Plants (AIPs)

Although a few AIPs and weeds were noted during the survey these species were sparsely distributed throughout the unit and never formed dominant stands. These species were mostly present were the soil have been disturbed (trampling by livestock) or along farm roads or were other forms of disturbances have occurred.

Alien Invasive Plants confirmed, includes:

» *Flaveria bidentis* (Category 1b),

» *Xanthium strumarium* (Category 1b),

» *Datura stramonium* (Category 1b),

» *Opuntia ficus-indica* (Category 1b)

Other weeds and exotics confirmed during the survey:

» *Chloris virgata, Tragus berteronianus, Tribulus terrestris, Conyza bonariensis, Schkuhria pinnata* and *Alternanthera pungens*

Mammals

This section represents the results from the field survey conducted from the 20th – 22nd of July 2021.

Overall, mammal diversity in the project area was moderate, with eighteen (18) mammal species being physically recorded based on direct observations, camera trap photographs, Sherman traps, and/or the presence of visual tracks & signs. Of these 18 species one

species are have been introduced into the area (highlighted in blue below). This data represents 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.

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
Rhabdomys pumilio	Four-Striped Grass Mouse	LC	LC
Mastomys coucha	Southern Multimammate Mouse	LC	LC
Saccostomus campestris	Pouched Mouse	LC	LC
Gerbillurus paeba	Pygmy Hairy-footed Gerbil	LC	LC
Gerbilliscus brantsii	Highveld Gerbil	LC	LC
Aethomys chrysophilus	Red Veld Rat	LC	LC
Xerus inauris	South African Ground Squirrel	LC	LC
Canis mesomelas	Black-back Jacal	LC	LC
Cynictis penicillata	Yellow Mongoose	LC	LC
Galerella sanguinea	Slender Mongoose	LC	LC
Sylvicapra grimmia	Common Duiker	LC	LC
Raphicerus campestris	Steenbok	LC	LC
Phacochoerus africanus	Warthog	LC	LC
Orycteropus afer	Aardvark	LC	LC
Tragelaphus strepsiceros	Greater Kudu	LC	LC

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), Brown Hyena – *Parahyanea brunnea* (Near Threatened), African Striped Weasel – *Poecilogale albinucha* (Near Threatened).

Mammal Habitat Analysis

A. *Vachellia tortilis* Woodland (Primary and Secondary Woodland).

These habitats provide relative good refugia and forage for small mammal species, which in turn form the basis for the trophic food chain. These savannas are also regarded as important breeding and foraging sites for mammal species. The grasses in this habitat is

moderately dense and of fair forage value. However, some encroaching of shrubs and small trees have had an impact on the total grass coverage. Positive effects are from moderate-high structural complexity and fairly strong foraging potential and overall, the species diversity for this area was moderate-low, with species from most trophic levels present. Overall diversity, connectivity and sensitivity of these areas can be regarded as Moderate.

Species recorded within this area includes:

- Large and Meso Carnivores: Black-back jackal
- Small Carnivores: Yellow mongoose, Slender Mongoose
- Ungulates: Steenbok, Warthog, Greater kudu, Common Duiker
- Fossorial Mammals: African mole-rat
- Small Mammals: Cape porcupine, Scrub hare, Four-striped grass mouse, Pygmy Hairy-footed Gerbil, Highveld Gerbil, South African Ground Squirrel and Red Veld Rat.
- Medium Sized Mammals: Aardvark

B. *Tarchonanthus camphoratus* Shrubland (Dense and Open Shrubland).

These habitats provide moderate to 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 this habitat is moderately dense and of fair forage value. However, some encroaching of shrubs has had an impact on the total grass coverage. Moderate-high structural complexity (habitat and niche diversity) and strong foraging potential allows for a moderate species diversity for these areas, with species from most trophic levels present. 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.

Species recorded within this area includes:

- Large and Meso Carnivores: Black-back jackal
- Small Carnivores: Yellow mongoose
- Ungulates: Steenbok, Greater kudu
- Fossorial Mammals: African mole-rat,
- Small Mammals: Scrub Hare, Cape Porcupine, Four Striped Grass Mouse, Southern Multimammate Mouse, Highveld Gerbil, Southern African Ground Squirrel.
- Medium Sized Mammals: Aardvark

C. *Senegalia mellifera* Ridge

These habitat shows excellent potential for mammal species (however currently greatly reduced due to severe encroachment of *Senegalia mellifera*). Such rocky ridges are mixed

with rocky refugia (which provide structural complexity) to provide a moderately sensitive habitat, especially for small mammals. Species diversity within the rocky grasslands of the project area where however very. The rock areas also provided excellent refugia for larger species (especially hyrax and porcupines and meso-predators such as black-backed jackal. The associated savanna and grasslands surrounding the rock refugia provided cover and foraging habitat for potential herbivores such as rabbits, steenbok and duikers. The overall diversity, sensitivity and connectivity to other habitats is considered to be Low due to the transformed state of this portion of the ridge, but has a potential to be moderate to moderate-high if rehabilitated to its original state.

Species recorded within this area includes:

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

D. Wetlands and Woody Fringes

Wetlands occur naturally or have been somewhat modified throughout the study area and support surrounding agricultural practices. Especially the depression wetland along with its vegetation is highly heterogenous and provides highly structural complexity and breeding/foraging habitats for various mammal species. The drainage line and seepage wetland are much more homogenous, providing significantly lower structural complexity and breeding/foraging habitats.

These wetland features furthermore contribute to habitat heterogeneity within the area and as such increase habitat and niche diversity within the larger area. Higher diversity of smaller mammals where recorded within the depression wetland whist very little diversity was recorded within the seepage and drainage systems.

These smaller mammal species, e.g. rodents, form the basis of the trophic food chain and sustain the local faunal meso-predators as well as raptors. The overall diversity, connectivity and sensitivity of these areas were Moderate to High

Species recorded within this area includes:

- Large and Meso Carnivores: Black-back jackal
- Small Carnivores: Yellow mongoose, Slender Mongoose
- Ungulates: Duiker, Warthog, Greater kudu
- Small Mammals: Cape porcupine, Four-striped grass mouse, Southern multimammate mouse, Pouched Mouse, Pygmy Hairy-footed Gerbil.

Herpetofauna

Herpetofauna diversity was considered to be low with three (8) 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)
Cape cobra	*Naja nivea*	LC	LC
Western Ground Agama	*Agama aculeata aculeata*	LC	LC
Speckled Rock Skink	*Trachylepis punctatissima*	LC	LC
Wahlberg's Snake-eyed Skink	*Afroablepharus wahlbergii*	LC	LC
Spotted Sandveld Lizard	*Nucras intertexta*	LC	LC
Holub's Sandveld Lizard	*Nucras holubi*	LC	LC
Savanna Lizard	*Meroles squamulosus*	LC	LC
Common Barking Gecko	*Ptenopus garrulus garrulus*	LC	LC
Guttural Toad	Sclerophrys gutturalis	LC	LC

Although the Giant Bull Frog - *Pyxicephalus adspersus (*Near Threatened*)* was not recorded within the project site, there is a likelihood for this species to inhabit the depression wetland as this wetland feature is regarded as a suitable habitat for this specie.

Avifauna

Avian micro-habitats

Most of the abundance and distribution of avian species can usually be attributed to the vegetation types and bioregions within an area. In determining the suitability of the project site for avian species, it is necessary to look at the habitats available to determine where the relevant species will most likely occur within the project site. These "micro habitats" do not always correspond to vegetation types and are determined by a combination of vegetation type, topography, land use, food sources and other various intrinsic factors.

During investigation of the project site (including the power line corridor), five important avian micro-habitats were identified. The project site was mostly consistent with the description of the Ghaap Plateau Vaalbosveld with some variations occurring between the grass and tree layer. This variation in vegetation structure species composition formed the basis identification of the different habitat types. Three of the habitat types are variations of the Savanah type whilst the fourth and fifth habitat types represent the moist grassland/wetland habitats.

The micro-habitats identified are as follows:

- *Vachellia tortilis* Woodland (Primary and Secondary Woodland)
- *Tarchonathus camphoratus* Shrubland (Dense and Open Shrubland)
- *Senegalia mellifera* Ridge;
- Depression Wetland and Woody Fringe;
- Seepage Wetland and associated Drainage Line:

A. *Vachellia tortilis* Woodland (Primary and Secondary Woodland).

This habitat type is found to the south of the grid corridor and is characterised by a mix of larger trees, shrubs and interspersed open plains. The higher biomass and structural and compositional variation in the vegetation supports a potentially high diversity and abundance of bird species

Avian diversity within this habitat where however found to be moderate with 35 species recorded. The larger tree clumps may provide roosting and nesting from many bird species (no important roosting or nesting sites were however recorded in the project site i.e. project site and 200m corridor). The denser woody areas provided niche and habitat for species such as Golden-breasted Bunting, Yellow Canary, Violet-eared Waxbill, Red-billed Firefinch, Ring-neck Dove, Cape penduline Tit, Black-chested Prinia, Yellow-bellied Eremomela, Kalahari Scrub Robin and Chestnut-vented Warbler. The open grassy areas represent foraging and/or hunting areas for many insectivorous and granivorous bird species, including species such as Helmeted Guineafowl, Common Quail, Northern Black Korhaan, Eastern Clapper Lark, Spike-heeled Lark, Sabota Lark, Desert Cisticola, Ant-eating Chat, Red-billed Quelea and African Pipit. Taller shrubs and tree species provide perching for especially insectivorous species such as; Southern Fiscal, Bokmakierie, Black-chested Prinia and Kalahari Scrub Robin. Avifaunal species typically recorded within and in close proximity to the tree clumps include; Ring-neck Dove, Cape penduline Tit, Black-chested Prinia, Yellow-bellied Eremomela, Kalahari Scrub Robin and Chestnut-vented Warbler.

One Red listed species were recorded within the project site namely; Lanner Falcon (Vulnerable).

B. *Tarchonanthus camphoratus* Shrubland (Dense and Open Shrubland).

This habitat type is fairly plant species poor. *T. camphoratus* and *G. flava* are the most dominant species within this unit. As already mentioned, two variation of this habitat types has been observed, namely a less transformed variation comprising of a denser coverage of *T. camphoratus.* The shrub layer, especially *T. camphoratus,* have densified over time as a result of long-term overgrazing. Within the second variation of this habitat type the tree/shrub layer has been anthropogenically modified through targeted poisoning in an attempt to reduce the tree/shrub layer and promote the grass layer for grazing purposes.

Avian abundance and diversity within this habitat are regarded as low with only 13 species recorded, with the second variation of this habitat type having far less avian activity than found within the "more natural" variation.

This low abundance and diversity are likely due to the largely modified and homogenous plant composition and structure. Prominent avifaunal species within this habitat includes; Southern Fiscal, Cape Penduline Tit, Black-chested Prinia, Chestnut-vented Warbler and Kalahari Scrub Robin.

No Conservation Important Avifaunal species were recorded within this habitat type.

C. *Senegalia mellifera* Ridge.

This portion of the ridge (within the grid corridor) have been severely encroached by *S. mellifera*, forming a dense, largely monotonous thicket, which has had a significant impact on local biodiversity (reduction).

Avian abundance and diversity within this habitat are regarded as very low with only 8 species recorded.

This low abundance and diversity are likely due to the largely modified and homogenous plant composition and structure. Prominent avifaunal species within this habitat includes; Black-chested Prinia and Chestnut-vented Warbler.

No Conservation Important Avifaunal species were recorded within this habitat type.

D. *Depression Wetland and Woody Fringe*.

This ephemeral depression/pan will only hold water after heavy rains being inundated for some time). This depression wetland is also usually characterized by soils with a higher clay content due to the accumulation of such textures in these low-lying areas. This depression wetland comprises a low to tall moisture loving grassland which may be replaced by forbs when regularly trampled and grazed. Key species include; *Panicum coloratum, Cynodon dactylon, Eragrostis cilianensis, Echinochloa holubii, Brachiaria marlothii, Schkuria pinnata* and *Persicaria serrulata*. Woody patches are found as small, dense patches at the peripheries of some of the pan wetlands, where the soils are slightly clayey and relatively shallow with surface rock typically present. These patches comprise a combination of small to moderately sized trees and shrubs with a moderate ground cover, predominantly forbs and shade loving graminoids. Key species include *Searsia lancea, Ziziphus mucronata, Searsia pyroides, Diospyros lycioides, Grewia flava*, *Asparagus laricinus* and *A. suaveolens.* This habitat unit is important for numerous species, as it is a reliable source of surface water in the area and because the vegetation potentially supports numerous wetland bird species especially during periods of inundation.

Avian diversity within this habitat is regarded as moderate with 26 species recorded. The larger tree clumps at the peripheries may provide roosting and nesting for many bird species (no important roosting or nesting sites where however recorded in the project site). The open grassy areas represent foraging and/or hunting areas for many insectivorous and granivorous bird species, including species such as Common Quail, Crowned Lapwing, Namaqua Sandgrouse, Spike-heeled Lark, Red-capped Lark, Lefaillant's Cisticola, Red-billed Quelea, Red-headed Finch, Grey-backed Sparrow Lark, Black-faced Waxbill, Yellow Canary and African Pipit. Taller shrubs and tree species provide perching for especially insectivorous species and smaller raptor species with the following recorded species; Greater Kestrel, Kite, Sabota Lark, Familiar Chat, Chat Flycatcher, Southern Fiscal, Black-chested Prinia and Kalahari Scrub Robin. Other avifaunal species typically recorded within and in close proximity to the tree clumps furthermore include; Red-eyed Dove, Ring-neck Dove, Cape penduline Tit, Yellow-bellied Eremomela, Violet-eared Waxbill and Chestnut-vented Warbler.

During periods of inundation waterfowl, herons and waders may frequent these pans and likely include Spur-winged Goose, Egyptian Goose, South African Shelduck, Yellow-billed duck, Hadada Ibis, Black-headed Heron, Pied Avocet, Three-banded Plover, Common Greenshank and sanpiper species etc.

No Conservation Important Avifaunal species were recorded within this habitat type.

E. *Seepage Wetland and Associated Drainage Line*.

This vegetation coverage of the seepage wetland is very similar to that of the temporary and seasonal to temporary zone of the depression wetland and can also be described as a moisture loving grassland with the absence of the fringing woody patches. The seepage wetland comprises a low to tall moisture loving grassland which may be replaced by forbs when regularly trampled and grazed. The diffuse drainage line feeding into the seepage wetland comprise of a vegetation cover, very similar to that of the *Tarchonanthus camphoratus* shrubland, with the exception that shrubs and trees are much sparser along this drainage line.

Avian abundance and diversity within this habitat are regarded as low with only 13 species recorded, with the second variation of this habitat type having far less avian activity than found within the "more natural" variation.

This low abundance and diversity are likely due to the slightly modified and homogenous plant composition and structure. Prominent avifaunal species within this habitat includes; Crowned Lapwing, Spike-heeled Lark and Red-billed Quelea.

Avian micro-habitats

At the time of the site visit bird species diversity and abundance were moderate to low across the entire project site and corridor with a total of 55 species recorded. The Savannah Grassland habitat unit supported the highest species diversity due to the structural variation provided by the composition of trees, shrubs and grass patches. Abundance of species recorded within this unit was much higher than within the Savannah Shrubland.

The most commonly recorded species within the project site were passerine of which Scaly-feathered Weaver, Bokmakierie, Southern Fiscal, Desert Cisticola, Eastern Clapper Lark, Red-billed Quelea, Black-chested Prinia, Cape Penduline Tit, Chestnut-vented Warbler, Kalahari Scrub Robin and Yellow Canary. Non-passerines commonly recorded included Ring-necked Dove, Namaqua Dove, Northern Black Korhaan and Crowned Lapwing. Raptor species were not common within the project site and were mostly associated with the taller *Acacia erioloba* species located within the woodland fringes of some of the pan wetlands. Raptor species that were recorded included, Black-winged Kite, Southern Pale Chanting Goshawk, Greater Kestrel and Lanner Falcon. Sixteen Endemic and Near-Endemic species were recorded during the site survey and includes; Southern Pale Chanting Goshawk, Northern Black Korhaan, Namaqua Sandgrouse, Acacia Pied Barbet, Bokmakierie, Sabota Lark, Spike-heeled Lark, Grey-backed Sparrow Lark, African Red-eyed Bulbul, Barred Wren-Warbler, Chestnut-vented Warbler, Kalahari Scrub Robin, Ant-eating Chat, Chat Flycatcher, Scaly-feathered Weaver and Yellow Canary. One Red listed species were recorded within the project site namely; Lanner Falcon (Vulnerable).

On the basis of the observations recorded during the field visit, and in combination with already documented information on the avifauna of the project site, 17 priority species are considered central in this avifaunal impact study (Table 6). These are mostly threatened species which are known to occur, or could occur, in relatively high numbers in the project site and the broader impact zone of the development and which are likely to be, or could be, negatively affected by the development.

Overall, the avifauna of the project site and the broader impact zone of the development footprint is not considered unique and is typical of what occurs across large areas of the Savannah Biome, which therefore suggests that the sensitivity of the site, from an avian perspective, will not be of any great significance.

8. COMBINED HABITAT SENSITIVITY

Depression wetland and woody periphery/fringe: High Sensitivity and No-Go Area

Avian Sensitivity	**High**
Faunal and Floral Sensitivity	**High**
Aquatic Sensitivity	**High**

Conservation status	**High**
	» Mostly natural moist grassland.
	» Niche habitats
	» Some species restricted to these areas
	» Provide valuable ecosystem functions and services.
	» Aquatic 1 Ecological Support Area
	» No Plant, Animal or Avian SCC
	  ○ However, habitat suitability exists for some SCC and the following SCC have a high likelihood of occurrence:
	  ▪ Giant Bullfrog (Pyxicephalus adspersus): Near Threatened
	  ▪ South African hedgehog (*Atelerix frontalis*): Near Threatened.

Ecosystem function	» Vegetation as grazing and stabilisation of soils, » Collection and retention of runoff and associated resources after large rainfall events, » Maximises infiltration of runoff into soils and filtering of runoff before it seeps further into lower-lying river systems, » Niche habitat ensures persistence of organisms and provides seasonal water and food to migrating fauna. » High importance in providing biodiversity maintenance » Corridor for water, seed, nutrient flows and fauna » Restricted island of fertility providing plant and seed resources to fauna even during periods of drought » Softer and deeper substrates on banks provide burrowing sites for fauna » Fringes of high shrubs provide bird-nesting sites and shelter to terrestrial fauna
Stability	» High if habitat is kept intact, despite very variable seasonal herb cover » Loss of functionality will result from clearing this vegetation and altering the surface » Easily invaded by weeds and alien invasive species » Cover may vary significantly from one year to the next » Easily degraded by excessive trampling and overgrazing

Reversibility of degradation	» Habitat will be difficult to recreate after significant modification, rehabilitation of vegetation and ecosystem functionality after disturbance will be problematic and slow
Rating	» ***High sensitivity (No-Go Area)***

General Development Recommendations:

» This wetland features should be regarded as No-Go area for all activities

Seepage Wetland: Medium/Moderate Sensitivity and No-Go Area

Avian Sensitivity	**Moderate**
Faunal and Floral Sensitivity	**Low**
Aquatic Sensitivity	**Moderate**
Conservation status	**Moderate** » Mostly natural moist grassland. » Niche habitats » Some species restricted to these areas » Provide some valuable ecosystem functions and services. » Aquatic 1 Ecological Support Area » No Plant, Animal or Avian SCC
Ecosystem function	» Collection and retention of runoff and associated resources after large rainfall events. » Seasonal preferential grazing » Niche habitat ensures the persistence of organisms and provides seasonal water and food to migrating fauna.
Stability	» High where the vegetation layer is dense, » Medium to low if soils become bare » Moderate to High sensitivity to external impacts.
Reversibility of degradation	» Habitat will be difficult to recreate after significant modification, rehabilitation of vegetation and ecosystem functionality after disturbance will be problematic and slow
Rating	» ***Medium sensitivity (No-Go Area)***

General Development Recommendations:

» This wetland features should be regarded as No-Go area for all activities

Ephemeral Drainage Line/Channel: Medium/Moderate Sensitivity

Avian Sensitivity	**Low**
Faunal and Floral Sensitivity	**Low**
Aquatic Sensitivity	**Moderate**
Conservation status	**Moderate** » Low in terms of species of conservation concern » Medium in terms of creation of microhabitats facilitating the persistence other plants as well as fauna » Aquatic 1 Ecological Support Area » No Plant, Animal or Avian SCC
Ecosystem function	» Moderate: o Species diversity adds to resilience of system and supports pollinator populations during different seasons o Moderately important fauna refuge and feeding area, o Moderate seasonal agricultural potential (livestock) o Deeper unconsolidated soils facilitate rapid infiltration of runoff into sub-soil moisture reserves, protecting such moisture reserves from rapid evaporation and hence supporting vegetation during extended dry periods o Corridor and distribution of seed reserves » Collection of scarce organic material to replenish soil nutrients
Stability	» Moderate where the vegetation layer is moderate to dense, low if soils become bare » May also be negatively impacted if the immediate surroundings (with a radius of 50 to 100 m, depending on slopes) are significantly altered or disturbed » Grass, forb and low shrub layer will fluctuate significantly during seasons and from year to year » Low if soil surface if extensively disturbed or compacted
Reversibility of degradation	» Habitat will be difficult to recreate after significant modification, rehabilitation of vegetation and ecosystem functionality after disturbance will be problematic and slow
Rating	» ***Medium sensitivity***

General Development Recommendations:

- The power line may span this drainage feature;
- Existing access roads, crossing this feature may be utilised.
- Monitoring of erosion and invasive alien plants should occur on a regular basis during the construction phase and should be carried out throughout the operational phase, where such features are observed swift actions should be taken in order to remediate these impacts in order to avoid the potential spread of erosion into the wetland areas as well as the establishment of invasive alien plants.

Senegalia mellifera Ridge: Medium/Moderate Sensitivity

Avian Sensitivity	**Low**
Faunal and Floral Sensitivity	**Low**
Terrestrial Ecological Sensitivity	**Moderate**

Conservation status	**Low** (can potentially be moderate to High if rehabilitated to natural state)
	- Highly transformed (through encroachment of *S. mellifera*)
	- Classified as a CBA2 but due to transformed state this are does not fulfil the criteria that warrant such a classification.
	- Due to its current state/condition this habitat fulfils its ecosystem functions and services to a limited extent.
	- Potentially unique and isolated habitat:
	  - Provide structural complexity (rocky refugia)
	- May potentially contribute to habitat and niche diversity at a local scale
	  - No Plant, Animal or Avian SCC
	- Provincially protected flora:
	  - *Babiana bainesii*
	  - *Aloe grandidentata*

Ecosystem function	- Contribute to habitat and niche diversity (local scale) and the maintenance thereof
	- Rocky refugia for habitat sensitive fauna:
	- Stable Vegetation cover for:
	  - Soil conservation and stabilisation,
	  - Accumulation and slowing down of runoff;
	  - Maximising of infiltration of runoff into soils
	- High sensitivity to external impacts.

Stability	- Moderate if habitat is kept intact
	  - Clearing and monitoring of weeds and invasive species.
	  - Erosion control

Reversibility of degradation	» Limited possibility, will require intervention, clearing of invasives needed to improve ecosystem functionality » Much of the original species diversity may be lost if original vegetation is significantly impacted
Rating	» ***Moderate/Medium Sensitivity***

General Development Recommendations:

- » Development within this habitat is 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. 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.
- » 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.

Vachellia tortilis Woodland (Primary and Secondary Woodland): Medium/Moderate Senitivity

Avian Sensitivity	**Moderate**
Faunal and Floral Sensitivity	**Moderate**
Terrestrial Ecological Sensitivity	**Moderate**
Conservation status	**Medium/Moderate** » Semi-natural to moderately transformed tree savanna » Low invasion of AIPs, most notable: o *Opuntia ficus-indica* » However still capable of providing ecosystem functions and services. » Terrestrial 1 Ecological Support Area » No Plant or Animal SCC o However, habitat suitability exists for some SCC » One recorded Avian SCC: o Lanner falcon (*Falco biarmicus*) o However, habitat suitability exists for other Avian SCC » Provincially protected flora:

	○ *Boophone disticha* ○ *Babiana bainesii;* ○ *Aloe grandidentata,* » National Protected Tree: ○ *Acacia erioloba*
Ecosystem function	» Stable Vegetation cover for: ○ Grazing; ○ Maintenance of pollinator populations, ○ Soil conservation and stabilisation, ○ Accumulation and slowing down of runoff; ○ Maximising of infiltration of runoff into soils ○ Filtering of runoff; ○ Buffering for lower lying wetlands against potential disturbances and thus vital for the protection of these sensitive habitats against deterioration. » Moderate sensitivity to external impacts.
Stability	» Medium to high if habitat is kept intact ○ Clearing and monitoring of weeds and invasive species will be necessary. ○ Monitoring and partial clearing of encroaching indigenous woody plants.
Reversibility of degradation	» Habitat will be difficult to recreate after significant modification, » Rehabilitation of vegetation and ecosystem functionality after disturbance will be problematic and slow ○ Clearing of invasives is needed to improve ecosystem functionality » Management and partial clearing of encroaching indigenous woody plants
Rating	» ***Medium Sensitivity***

General Development Recommendations:

- » Development within this habitat is acceptable.
- » 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.

Dense *Tarchonanthus camphoratus* Shrubland

Avian Sensitivity	**Low**

Faunal and Floral Sensitivity	**Low**
Terrestrial Ecological Sensitivity	**Moderate**
Conservation status	**Moderate to Low** » Semi-natural to moderately transformed shrub savanna » Low invasion of AIPs, most notable: o *Opuntia ficus-indica* » However still capable of providing ecosystem functions and services. » Terrestrial 1 Ecological Support Area » No Plant, Animal or Avian SCC o However, habitat suitability exists for some SCC » Provincially protected flora: o *Boophone disticha* o *Babiana bainesii;* o *Aloe grandidentata* » National Protected Tree: o *Acacia erioloba*
Ecosystem function	» Stable Vegetation cover for: o Grazing; o Maintenance of pollinator populations, o Soil conservation and stabilisation, o Accumulation and slowing down of runoff; o Maximising of infiltration of runoff into soils o Filtering of runoff; o Buffering for lower lying valley-bottom wetlands against potential disturbances and thus vital for the protection of these sensitive habitats against deterioration. » Moderate sensitivity to external impacts.
Stability	» Medium if habitat is kept intact o Clearing and monitoring of weeds and invasive species will be necessary. o Erosion control will be important
Reversibility of degradation	» Possible, will require intervention such as erosion control and over sowing, » Clearing of invasives is needed to improve ecosystem functionality
Rating	» ***Medium Sensitivity***

General Development Recommendations:

» Development within this habitat is acceptable.
» 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.

Open *Tarchonanthus camphoratus* Shrubland

Avian Sensitivity	**Low**
Faunal and Floral Sensitivity	**Low**
Terrestrial Ecological Sensitivity	**Low**
Conservation status	**Low** » Moderately transformed shrub savanna » Ecosystem functions and services has been modified to some extent. » No Plant, Animal or Avian SCC » Provincially protected flora: o *Boophone disticha* o *Babiana bainesii;* o *Aloe grandidentata*
Ecosystem function	» Grazing; » Soil conservation and stabilisation, » Accumulation and slowing down of runoff; » Maximising of infiltration of runoff into soils
Stability	» Medium if habitat is kept intact o Clearing and monitoring of weeds and invasive species will be necessary. o Erosion control will be important
Reversibility of degradation	» Possible, will require intervention such as erosion control and over sowing, » Clearing of invasives is needed to improve ecosystem functionality
Rating	» ***Low Sensitivity***

General Development Recommendations:

» Development within this habitat is acceptable.
» 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.

Severely Degraded and Transformed Grassland

Conservation status	**LOW** » Severely degraded and transformed areas associated with access roads, fire breaks and trampled areas. » Low diversity of fauna and flora. » No Plant and Animal SCC recorded. » No Provincially Protected Fauna and Flora recorded. » No Endemic Fauna and Flora recorded. » These areas are characterized with numerous weeds and some invasive alien plants.
Ecosystem function	» Permanent vegetation cover for stabilising, maintaining and nourishing soil as well as for slowing down runoff to increase infiltration into the soil.
Stability	» Medium to high if habitat is kept intact o Clearing and monitoring of weeds and invasive species will be necessary. o Erosion control will be important
Reversibility of degradation	» Possible, will require intervention such as erosion control and over sowing, » Clearing of invasives is needed to improve ecosystem functionality
Rating	» ***Low Sensitivity***

General Development Recommendations:

» Development within this area is acceptable
» Existing access roads and tracks to be used as far as possible.
» Alien species must be removed entirely from site and not used as mulch to prevent the spread of regenerative material.

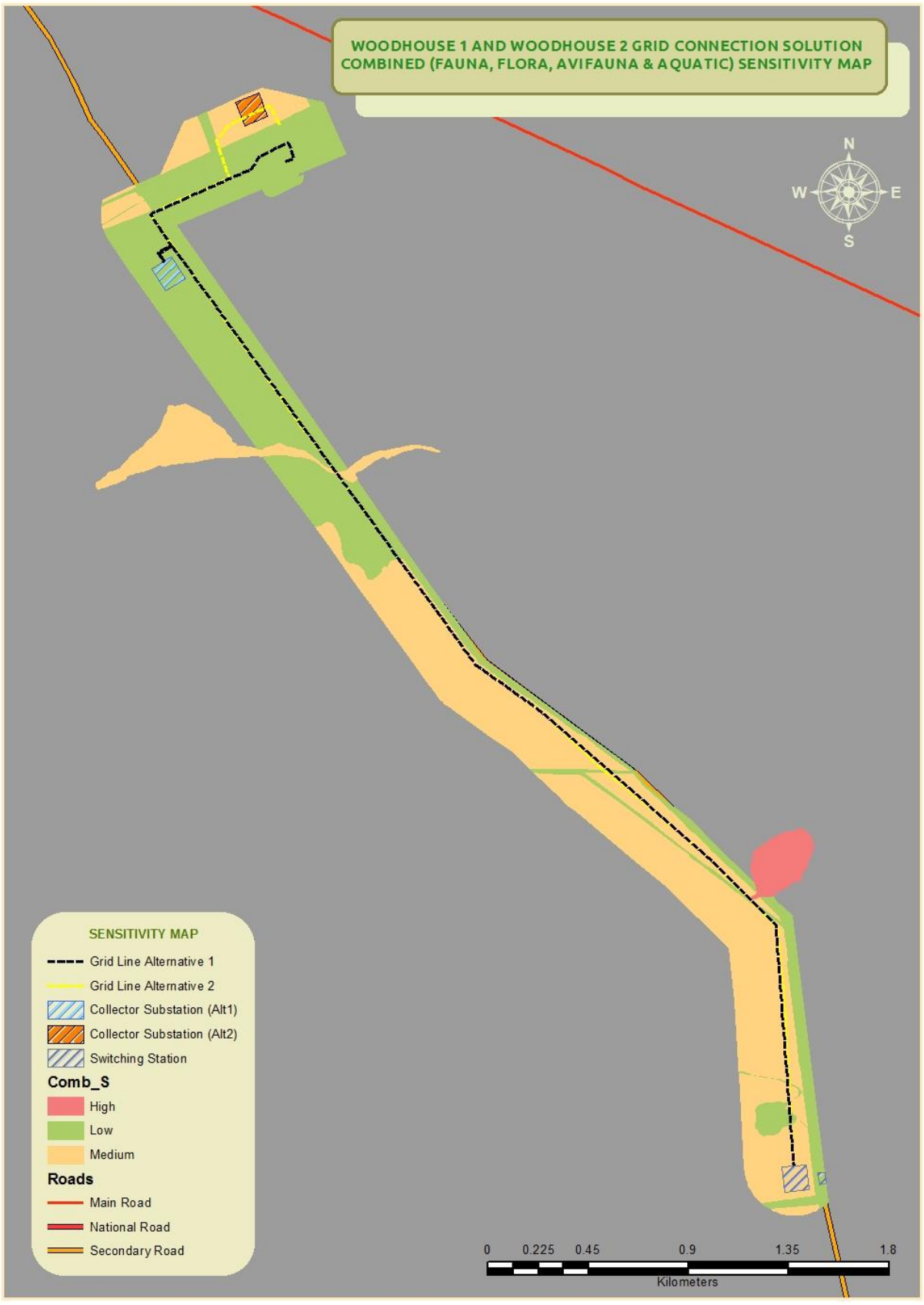

Figure 13: Terrestrial Ecological Importance and Sensitivity Map

9. ASSESSMENT OF PROPOSED IMPACTS

Impact Statement and Assumptions

The following is assumed and/or known:

- The site establishment itself will be associated with clearing of vegetation within the footprint of the grid infrastructure only.
- Vegetation within a 31m wide servitude, extending the length of the power line, will be altered to some extent, although still deemed largely suitable to various faunal and avifaunal species.
- During the construction phase of the grid infrastructure, disturbance levels will be significantly higher in the immediate vicinity than previously. This disturbance will result from machinery and vehicle disturbance as well as other construction activities.
- During the operational phase, there will be some vehicle activity during maintenance of the power line.
- Throughout the duration of the project life cycle the footprint will be routinely cleared of all alien invasive plants if detected.
- The power line will potentially pose a collision risk to avifauna, particularly heavier birds with low manoeuvrability (specifically the resident Bustard species).
- The power line towers and the substation infrastructure provide perching and nesting structures for various avifauna, particularly larger raptors.
- There is a possibility that species such as crows/owls could be electrocuted on the substation infrastructure.
- After the decommissioning of the power line, a continuous vegetation layer will be 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.

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 rare species, 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 development be kept as close together as possible.

For the proposed on-site substation location, due to its extent/size, proposed location within a historically cultivated area (secondary grassland), away from any freshwater resource features, the construction and operation of the on-site substation is expected to have a **very limited contribution** to the cumulative impacts of the area and will **not:**

» compromise the ecological functioning of the larger "natural" environment; and
» disrupt the connectivity of the landscape for fauna and flora and impair their ability to respond to environmental fluctuations.

In terms of the power line route options, both options, due to their extent and the nature of such linear developments, is also expected to have a **limited contribution** to the cumulative impacts of the area. Grid Alternative 2 will however traverse historically cultivated (secondary grassland) lands and it is thus expected that this power line route option will contribute the least to potential cumulative impacts within the area.

Excessive clearing of vegetation can and will influence runoff and stormwater flow patterns and dynamics, which could cause excessive accelerated erosion of plains and intermittent drainage lines, and this could also have detrimental effects on the lower-lying areas.

- Rehabilitation and revegetation of all surfaces disturbed or altered during the operational phase are desirable.

Disturbance of indigenous vegetation creates a major opportunity for the establishment of invasive species and the uncontrolled spread of alien invasives into adjacent rangelands.

» A regular monitoring and eradication protocol must be part of all the developments' long-term management plans.

After decommissioning, a continuous vegetation layer will be 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, lacks the binding and absorption capacity that creates the buffering functionality of vegetation to prevent or lessen erosion as a result of floods.

Identification of Potential Terrestrial (Fauna and Flora) and Fresh Water Resource Ecological Impacts and Associated Activities

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

Construction and Operation 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 purposes.
- Site clearing for site establishment of the construction camp and for the construction of the foundations for the pylons required for the power line.
- Vegetation clearing could impact locally listed plant species. Vegetation clearing would also lead to the loss of vegetation communities and habitats for fauna and potentially the loss of faunal species, habitats, and ecosystems. On a larger and cumulative scale (if numerous and uncontrolled power line 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 responsibilities (functions).
- 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 and aquatic habitats. These potential impacts may result in a reduction in the buffering capacities of the landscape during extreme weather events.
- 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. Also, 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.
- The power line 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.

Cumulative Impacts

- The loss of unprotected vegetation types on a cumulative basis from the broad area may impact the country's ability to meet its conservation targets.
- Transformation of intact habitat would contribute to the fragmentation of the landscape and would potentially disrupt the connectivity of the landscape for

fauna, avifauna, and flora and impair their ability to respond to environmental fluctuations.

Identification of Potential Avifaunal Impacts and Associated Activities

Potential bird impacts regarding transmission lines comprise of electrocution, collision and disturbances caused during the construction and maintenance of transmission lines. It is however a common rule that large and heavy-bodied terrestrial bird species are more at risk of being affected in a negative way when interacting with power lines.

These include the following.

Electrocution

Power Line Infrastructure: Electrocution happens when a bird bridges the gap between the live components or a combination of a live and earth component of a power line, thereby creating a short circuit. This happens when a bird, mainly a species with a fairly large wingspan attempts to perch on a pylon or attempts to fly-off a pylon. These larger species will attempt to roost and even breed on the pylon structures if available nesting platforms are a scarce commodity.

Other types of electrocutions happen by means of so-called "birdstreamers". This happens when a bird, especially when taking off, excretes and thereby causing a short-circuit through the fluidity excreta (Van Rooyen & Taylor, 1999). This method of electrocution is however an extremely rare phenomenon.

Large transmission lines (from 220kV to 765kV) are seldom a risk of electrocution, although smaller distribution lines (88 – 132kV) pose a higher risk.

Substation Infrastructure: Since there is live hardware in the switching and collector station yards, the potential exists for birds to bridge the gap between a phase and earth resulting in electrocution. However, very few electrocutions have been recorded on switching stations. Species likely to be affected are crows, ravens and other species that are tolerant of disturbance. Small raptors such as Lanner Falcons, Amur Falcons and Lesser Kestrel are sometimes attracted into switching station yards in pursuit of species nesting there such as sparrows and canaries and may be susceptible to electrocutions.

The impact of electrocution from switching/collector station infrastructure are considered to be much lower of significance once mitigation in the form of bird friendly structures and bird deterrent measures have been put in place. Species likely to be affected are crows and other non-threatened species with the majority of threatened species avoiding the switching station yard as they are sensitive to disturbances.

Collision

Power Line Infrastructure: Collisions with earth wires have probably accounted for most bird-transmission line interactions in South Africa. In general, the earth wires are much thinner in diameter when compared to the live components, and therefore less visible to approaching birds. Many of the species likely to be affected include heavy, large-bodied terrestrial species such as cranes, storks, flamingos, bustards, korhaans, Secretarybirds and a variety of waterbirds that are not very agile or manoeuvrable once airborne. These species, especially those with the habit of flying with outstretched necks (e.g. most species of storks and flamingos) find it difficult to make a sudden change in direction while flying – resulting in the bird flying into the earth wires.

Habitat destruction and physical disturbance during construction and maintenance

Power Line as well as Switching and Collector Stations: Access roads and laydown areas will need to be constructed, including the clearing of vegetation as part of the power line servitude. Subsequently, clearing and removal of vegetation is likely to take place underneath the power line. The placement of access roads and laydown areas (for the poles and stringing material) next to habitat features with a high probability of sustaining congregations of bird species (e.g. pans) or along drainage lines and rivers is likely to disrupt the natural movement of bird species or it could result in the abandoning of these areas. Therefore, special care should be taken near drainage lines, rivers, pans and dams as not to disturb the bird community or the vegetation structure.

Habitat destruction is not considered to be a major impact since many of the bird species will temporarily vacate the area during the construction phase. It is inevitable that most bird species (including the smaller passerine) will be affected by road construction, the construction of pylons and stringing operations. However, the impact is considered to be more severe within or in close proximity to pans, watercourses and drainage lines, and could displace large-bodied bird species (especially if these are breeding in the proximal vicinity within 100m). Typical species include foraging and breeding large-bodied terrestrial bird taxa.

Disturbances during construction and maintenance is unavoidable. These will especially be significant near or in close proximity to dams. Although it is not anticipated to pose a significant impact on bird species, special care should be exercised during the crossing of wetland and watercourse systems to prevent unnecessary disturbances caused to potential breeding and roosting species.

Assessment of Impacts

Collector Substation (CS) and Switching Station (SS) Options

» Terrestrial Ecology:
Two collector substation alternative locations are currently investigated and assessed below. As mentioned, CS Alternative 1 is located in a slightly less sensitive and transformed habitat, however the potential significance of impacts on terrestrial habitats and biodiversity will be very similar for both alternative options as well as for the SS option. As such the two CS options as well as the SS option will not be assessed separately but a single impact assessment will be done which will be applicable to both CS options as well as to the SS option.

» Freshwater/Aquatic Ecology:
Both CS alternative options as well as the SS option are located well away from any freshwater/aquatic resource features and will subsequently not have an impact on such resource features.

» Avifauna:
Both CS alternative options are located in low sensitive avifaunal habitats, whilst the SS is proposed within a slightly more sensitive habitat, however, it is envisaged that the potential impacts on avifauna will be very similar for both CS options as well as the SS options and as such these options will not be assessed separately but within a single impact assessment that will be applicable to both CS options as well as to the SS option.

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

Impact Nature: Vegetation clearing will lead to the loss of current habitat and is an inevitable consequence of this type of activity. The extent of the proposed footprint, is however, small and located within a least concerned ecosystem type. Furthermore, no species of conservation concern were recorded within the proposed footprints.

The loss of local vegetation within the footprint is expected to be of relatively minor significance when considered on a broad scale.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (3)	Small (1)
Probability	Highly Probable (4)	Improbable (2)
Significance	**Medium (32)**	**Low (12)**
Status	Negative	Negative
Reversibility	Low	Low

Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Pre-construction environmental induction for all construction staff on-site to ensure that basic environmental principles are adhered to. This includes awareness as to no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, 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 fires should be allowed on-site.	
Residual Impacts	Some residual vegetation loss will result from the development, equivalent to the operational footprint.	

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

Impact Nature: Disturbance, transformation, and loss of habitat will have a negative effect on resident fauna during construction.

There are fauna residents within the site, and these will be impacted during the construction of the on-site substation. However, faunal diversity and density within the site were very low, and post-mitigation impacts are likely to be Low and of Local significance only.

Increased levels of noise, pollution, disturbance, and human presence during the construction and decommissioning phases may affect the local fauna. Sensitive and shy fauna would move away from the area during these phases and may only move back and inhabit the area post-decommission. Some slow-moving species would not be able to avoid the activities and might be killed.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (3)	Small (1)
Probability	Probable (3)	Improbable (2)
Significance	**Low (24)**	**Low (12)**
Status	Negative	Negative
Reversibility	Low	Low

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	Due to the nature of this development, there will be a permanent loss of habitat and forage for fauna. However, due to the relatively small footprint of the development and the fact that this area contain a low faunal diversity this potential residual impact can be regarded as low.	

Impact 3 (Terrestrial Ecology): *Potential increased erosion risk during construction 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 to neighbouring areas (2)	Local (1)
Duration	Medium-term (3)	Short-term (1)
Magnitude	Moderate (6)	Small (1)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (44)**	**Low (9)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	

Mitigation	» Any erosion problems observed to be associated with the project infrastructure should be rectified as soon as possible 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. » An erosion control management plan should be utilised to prevent erosion » There should be reduced activity at the site after large rainfall events when the soils are wet. No driving off of hardened roads should occur immediately following large rainfall events until soils have dried out and the risk of bogging down has decreased. » Any storm-water within the site must be handled in a suitable manner, i.e. trap sediments, and reduce flow velocities » Stormwater from the substations and other hard stand areas, must be managed using appropriate channels and swales when located within steep areas. » Storm water run-off infrastructure must be maintained to mitigate both the flow and water quality impacts of any storm water leaving the substation sites. » Construction of gabions and other stabilisation features to prevent erosion, if deemed necessary. » 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.
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 (Terrestrial Ecology): *Altered runoff patterns due to rainfall interception by infrastructure and compacted areas resulting in high levels of erosion (Operational Phase)*

Impact Nature: 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 (1)	Local (1)
Duration	Permanent (5)	Short-term (1)
Magnitude	Minor (2)	Small (1)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (32)**	**Low (9)**
Status	Negative	Negative
Reversibility	Low	High

Irreplaceable loss of resources	No	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. » 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. » 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, the development area should be adequately landscaped and rehabilitated to contain expected accelerated erosion. » Runoff may have to be specifically channelled 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 5 (Terrestrial Ecology): *Potential increased alien plant invasion during the construction, operational and decommissioning phase.*

Impact Nature: 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 (1)	Local (1)
Duration	Permanent (5)	Short-term (1)
Magnitude	Minor (2)	Small (1)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (32)**	**Low (9)**
Status	Negative	Negative
Reversibility	Low	High

Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	
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. » 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.	
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 6 (Avifauna): Loss/Destruction of Avifaunal Habitat (initiated during the construction phase and carried throughout the operational phase)

Impact Nature: Some habitat destruction and alteration are inevitable, although this is will be limited. The construction and operation of the collector substation and switching station will have a very slight impact on foraging, breeding and roosting ecology of avian species within the area through modification of the local habitat.

No Red Data species were recorded within the immediate area of the proposed CS and SS locations, as well as within the surrounding area. Furthermore, the limited displacement that may occur, will only be from a very restricted area. The impact on smaller, non-Red Data species that are potentially breeding in the area will be local and very restricted in extent, and will not have a significant effect on regional or national populations.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (3)	Small (1)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (32)**	**Low (18)**
Status	Negative	Negative
Reversibility	Moderate	Moderate
Irreplaceable loss of resources	Only very slight loss of resources	Only very slight loss of resources
Can impacts be mitigated?	Yes, to a large extent.	
Mitigation	» The temporal and spatial footprint of the development should be kept to a minimum. » The boundaries of the development footprint are to be clearly demarcated and it must be ensured that all activities remain within the demarcated footprint area.	

	» Open fires are strictly prohibited and only allowed at designated areas. » Provide adequate briefing for site personnel on the possible important (Red Data) species occurring and/or nesting in the area and the procedures to be followed in this regard (for example notification of ECO and avoidance of area until appropriate recommendations have been provided by a specialist). » The above measures must be covered in a site specific EMPr and monitored by an ECO.
Residual Impacts	Some residual habitat loss will result from the development, equivalent to the operational footprint of the power line.

Impact 7 (Avifauna): *Disturbance of avifauna during the construction, operational (maintenance activities) and decommissioning phase.*

Impact Nature: Disturbance, transformation, and loss of habitat will have a negative effect on resident avifauna during construction.

Species sensitive to disturbance include ground-nesting species potentially resident within the development footprint. Disturbance can also influence the community structure of avifauna within close proximity to the development as certain species will be displaced and forced to find alternative territories. Disturbance could have a negative impact on the breeding activities of various species, particularly if this occurs during a sensitive period in the breeding cycle.

Increased levels of noise, pollution, disturbance, and human presence during the construction phase and periods of maintenance (operational phase) may affect the local avifauna. Sensitive and shy avifauna would move away from the area during these periods and may move back into the area upon completion of the construction phase and after maintenance activities.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Moderate (5)	Minor (3)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (32)**	**Low (18)**
Status	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources	Only very slight loss of resources	Only very slight loss of resources
Can impacts be mitigated?	Yes, to a large extent.	
Mitigation	» Strict control must be maintained over all activities during construction and maintenance, in line with an approved EMPr. » During construction, if any of the Red Data species identified in this report are observed to be roosting and/or breeding in the vicinity, the ECO must be notified and were deemed necessary an appropriate buffer should be placed around the nests and/or roosting areas. If uncertain on the size of such buffer the Environmental Officer (EO) may contact an avifaunal specialist for advice. » The construction equipment camps must be as close to the site as possible and within disturbed areas as far as possible.	

	» Contractors and working staff must remain within the development footprint and movement outside these areas especially into avian micro-habitats must be restricted. » Driving must take place on existing roads and a speed limit of 30km/h must be implemented on all roads associated with the project during the construction phase.
Residual Impacts	There will be minimal residual impact as the facility will have low operational impacts on avifauna, after the construction phase.

Impact 8 (Avifauna): *Electrocution of birds on substation infrastructure*

Impact Nature: Since there is live hardware in the CS and SS yards, the potential exists for birds to bridge the gap between a phase and earth resulting in electrocution. However, very few electrocutions have been recorded on CS and SS. Species likely to be affected are crows, ravens and other species that are tolerant of disturbance. Small raptors such as Lanner Falcons, Amur Falcons and Lesser Kestrel are sometimes attracted into switching station yards in pursuit of species nesting there such as sparrows and canaries and may be susceptible to electrocutions.

The impact of electrocution from the infrastructure are considered to be much lower of significance once mitigation in the form of bird friendly structures and bird deterrent measures have been put in place. Species likely to be affected are crows and other non-threatened species with the majority of threatened species avoiding these areas as they are sensitive to disturbances.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (4)	Small (1)
Probability	Probable (3)	Improbable (2)
Significance	**Low (27)**	**Low (12)**
Status	Negative	Negative
Reversibility	Low (birds will be injured or killed)	Low (birds will be injured or killed)
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes,	
Mitigation	» All relevant perching surfaces should be fitted with bird guards and perch guards as deterrents (Hunting, 2002). » Installation of artificial bird space perches and nesting platforms, at a safe distance from energised components (Goudie, 2006; Prinsen et al., 2012).	
Residual Impacts	The CS and SS and associated infrastructure will be within the area over a long period of time, if not permanently. However, if the facilities and infrastructure are removed the impacts associated (avian injuries and mortalities) will cease	

Woodhouse 1 and 2 Grid Power Line

» Both power line options are very similar in terms of their potential impacts on terrestrial as well as freshwater/aquatic ecosystems and biodiversity.
» As such the impact assessment conducted below, is applicable to both gridline alternatives.

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

Impact Nature: Vegetation clearing will lead to the loss of current habitat within the grid connection corridor and is an inevitable consequence of this type of activity. The extent of this grid connection corridor, is however, relatively small and the vegetation types within the affected area have a relatively wide distribution and are regarded as Least Concern.

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 (e.g. *Vachellia erioloba, Boophone disticha*, *Babiana hypogea*).

The development footprints for both options are largely 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. The loss of local vegetation within the footprint is expected to be of relatively minor significance when considered on a broad scale.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (4)	Minor (3)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (36)**	**Low (24)**
Status	Negative	Negative
Reversibility	Low	Moderate
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Pre-construction walk-through of the power line route/corridor to locate protected and species of conservation concern that can be translocated or avoided. » Vegetation clearing to commence only after walkthrough has been conducted and necessary permits obtained. » Pre-construction environmental induction for all construction staff on-site to ensure that basic environmental principles are adhered to. This includes awareness as to no littering, appropriate handling of pollution	

	and chemical spills, avoiding fire hazards, 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. » Vegetation clearing to be kept to a minimum. No unnecessary vegetation to be cleared. » 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. » Existing tracks should be used for access wherever possible. » The morphology and hydrology of the wetland features not be altered by unnecessary excavations, dumping of soil or other waste. » No fires should be allowed on-site.
Residual Impacts	Some residual vegetation loss will result from the development, equivalent to the operational footprint of the power line.

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

Impact Nature: Disturbance, transformation, and loss of habitat will have a negative effect on resident fauna during construction.

There are fauna residents within the site, and these will be impacted during the construction of the power line. However, faunal diversity and density within the site are low, and post-mitigation impacts are likely to be Low and of Local significance only.

Increased levels of noise, pollution, disturbance, and human presence during the construction phase may affect the local fauna. Sensitive and shy fauna would move away from the area during the construction phase and may move back into the area upon completion of the construction phase. Some slow-moving species (i.e. tortoise & snakes) would not be able to avoid the activities and might be killed.

Faunal diversity and density within the site are low and post-mitigation impacts are likely to be Low and of Local significance only.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Minor (4)	Small (2)
Probability	Highly Probable (4)	Probable (3)
Significance	**Low (28)**	**Low (15)**
Status	Negative	Negative
Reversibility	Moderate	Moderate to High

Irreplaceable loss of resources	Unlikely	Unlikely
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	» All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises which are often persecuted out of superstition. » 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	There will be minimal residual impact as the facility will have low operational impacts on fauna, after the construction phase.	

Impact 3 (Terrestrial Ecology): *Potential increased erosion risk during construction 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. It is critically important 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	Medium-term (3)	Short-term (1)
Magnitude	Moderate (5)	Small (2)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (40)**	**Low (12)**
Status	Negative	Negative
Reversibility	Low	Moderate to High
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	

Mitigation	» Any erosion problems observed to be associated with the access road and/or hardened/engineered surfaces should be rectified as soon as possible 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. » An erosion control management plan should be utilised to prevent erosion » There should be reduced activity at the site after large rainfall events when the soils are wet. No driving off of hardened roads should occur immediately following large rainfall events until soils have dried out and the risk of bogging down has decreased. » Construction of gabions and other stabilisation features to prevent erosion, if deemed necessary. » 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.
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 (Terrestrial Ecology): *Potential increased alien plant invasion during the construction, operational and decommissioning phase.*

Impact Nature: 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 (2)	Local (1)
Duration	Permanent (5)	Short-term (1)
Magnitude	Minor (4)	Small (1)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (44)**	**Low (9)**
Status	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes, to a large extent	
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. » 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.
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 (Freshwater/Aquatic Ecology): *Loss and/or disturbance of wetland and drainage systems during the construction, operation and decommissioning phase*

Impact Nature: The physical removal/disturbance of the narrow strips of wetland/drainage zones by pylon construction and road crossings, being replaced by hard engineered surfaces during construction. This biological impact would however be localised, as a large portion of the remaining catchment would remain intact.

These disturbances will be the greatest during the construction and again in the decommissioning phases as the related disturbances could result in loss and/or damaged vegetation.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (4)	Small (2)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (36)**	**Low (21)**
Status	Negative	Negative
Reversibility	Low – Destruction of wetland/drainage systems and associated vegetation will not be remedied easily.	Low – Destruction of wetland/drainage systems and associated vegetation will not be remedied easily.
Irreplaceable loss of resources	Local and potential loss of downstream resources	Unlikely
Can impacts be mitigated?	Yes, to a large degree	
Mitigation	» No pylons may be placed within the delineated wetland/drainage habitats; however, the power line may span these features. » Use as far as possible the existing roads. » No activities or movement shall be allowed outside of the approved development footprint. » It is recommended that the power line should be placed as close as possible to the provincial gravel road and should rather span the small drainage system than the seepage feature. » The depression wetland is regarded as a No-Go area and no activities may be allowed within this wetland feature.	

	» No new access roads may be constructed within the seepage wetland. » Crossing of the drainage line is regarded as acceptable and where possible, existing access routes should be utilized and may be upgraded where deemed necessary. » No vehicles may refuel within wetland/drainage features. » With micro adjustments of the pylon positions, it is possible to place pylons outside of any wetland habitats.
Residual Impacts	Possible impact on the remaining catchment due to changes in run-off characteristics in the development site. However, due to the extent of this development this potential residual impact is regarded as low.

Impact 6 (Freshwater/Aquatic Ecology): *Impact on localized surface water quality during the construction, operation and decommissioning phase*

Impact Nature: During pre-construction, construction, decommissioning and to a **limited degree** the operational phase (during maintenance), chemical pollutants (hydrocarbons from equipment and vehicles, cleaning fluids, cement powder, wet concrete, shutter-oil, etc.) associated with site-clearing machinery and construction activities could be washed downslope via the ephemeral systems.

	Without Mitigation	**With Mitigation**
Extent	Local (2)	Local (1)
Duration	Long-term (2)	Short-term (2)
Magnitude	Minor (4)	Small (2)
Probability	Probable (3)	Improbable (2)
Significance	**Low (24)**	**Low (10)**
Status	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources	Local and potential loss of downstream resources	Unlikely
Can impacts be mitigated?	Yes, to a large degree	
Mitigation	» Implement appropriate measures to ensure strict use and management of all hazardous materials used on site. » Implement appropriate measures to ensure strict management of potential sources of pollutants (e.g. litter hydrocarbons from vehicles and machinery, cement during construction and maintenance, etc.) » Implement appropriate measures to ensure the containment of all contaminated water through careful run-off management on the development site. » Implement appropriate measures to ensure strict control over the behaviour of construction workers. » Working protocols incorporating pollution control measures (including approved method statements by the Contractor) should be clearly set out in the Construction Environmental Management Plan (CEMP) for the project and strictly enforced. » Place spill kits on site which are operated by trained staff members for the adhoc remediation of minor chemical and hydrocarbon spillages. » Due to the low gradient of most of the development footprint any accidental spill or leakage of hazardous or harmful substances can be effectively contained around the source of the spillage. In the case of	

	such an accidental spillage, prompt and effective action is required in order to prevent the spillage form spreading and to successfully rehabilitate the contaminated area. » Waste should be stored on site in clearly marked containers in a demarcated area. » All waste material should be removed at the end of every working day to designated waste facilities at the main construction camp/suitable waste disposal facility. » All waste must be disposed of offsite. » Appropriate ablution facilities should be provided for construction workers, well outside of the boundaries of the wetland/drainage features.
Residual Impacts	Residual impacts will be negligible after appropriate mitigation.

Impact 7 (Freshwater/Aquatic Ecology): *Increase in sedimentation and erosion during the construction, operational and decommissioning phase*

Impact Nature: For the construction and decommissioning phases this refers to the alteration in the physical characteristics of freshwater resource features as a result of increased turbidity and sediment deposition, caused by soil erosion and earthworks that are associated with construction activities. Possible ecological consequences associated with this impact may include:

» Deterioration in freshwater ecosystem integrity; and
» Reduction/loss of habitat for aquatic dependent flora & fauna.

This may furthermore, influence water quality downstream.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Very Short (1)
Magnitude	Minor (3)	Small (1)
Probability	Highly Probable (4)	Improbable (2)
Significance	**Medium (32)**	**Low (6)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources	Very limited loss of local resources	No irreplaceable loss of local resources
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Use as far as possible the existing roads. » No activities or movement shall be allowed outside of the approved development footprint. » It is recommended that the power line should be placed as close as possible to the provincial gravel road and should rather span the small drainage system than the seepage feature. » The depression wetland is regarded as a No-Go area and no activities may be allowed within this wetland feature. » No new access roads may be constructed within the seepage wetland. » Crossing of the drainage line is regarded as acceptable and where possible, existing access routes should be utilized and may be upgraded where deemed necessary.	

	» Any erosion observed to be associated with the project infrastructure should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur. » All bare areas, as a result of the development, should be revegetated with locally occurring species, to bind the soil and limit erosion potential. » Silt traps should be used where there is a danger of topsoil or material stockpiles eroding and entering streams and other sensitive areas. » Topsoil should be removed and stored separately and should be re-applied where appropriate as soon as possible, to encourage and facilitate the rapid regeneration of the natural vegetation on cleared areas. » Where practical, phased development and vegetation clearing should be applied so that cleared areas are not left un-vegetated and vulnerable to erosion for extended periods. » Construction of gabions and other stabilisation features to prevent erosion if deemed necessary. » There should be reduced activity at the site after large rainfall events when the soils are wet. No driving off of hardened roads should occur immediately following large rainfall events until soils have dried out and the risk of bogging down has decreased.
Residual Impacts	Due to the extent and nature of the development, residual impacts are unlikely to occur if the recommended mitigation measures are implemented.

Impact 8 (Freshwater/Aquatic Ecology): *Impact on freshwater resource systems through the increase in surface runoff on form and function during the operational phase*

Impact Nature: The addition of hardened and compacted areas around the pylons. Service roads have the potential to further increase areas of hardening. The aforementioned will increase the runoff generated on site due to the addition of areas of hard surfaces and could lead to increased erosion risk, potentially reducing or disturbing important/sensitive downstream riparian habitats.		
	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (4)	Small (1)
Probability	Probable (3)	Improbable (2)
Significance	**Low (27)**	**Low (12)**
Status	Negative	Negative
Reversibility	Low – Destruction of drainage systems and associated vegetation will not be remedied easily.	Low – Destruction of drainage systems and associated vegetation will not be remedied easily.
Irreplaceable loss of resources	Local loss of resources	Very limited loss of local resources
Can impacts be mitigated?	Yes, to a large extent	
Mitigation	» Any erosion observed to be associated with the project infrastructure should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur.	

	» Construction of gabions and other stabilisation features to prevent erosion if deemed necessary.
Residual Impacts	Altered morphology. Due to the extent and nature of the development this residual impact is unlikely to occur.

Impact 9 (Avifauna): Loss/Destruction of Avifaunal Habitat (initiated during the construction phase and carried throughout the operational phase)

Impact Nature:

During the **construction** of the power line, some habitat destruction and alteration will occur, although this is will be limited. These activities may have a very slight impact on foraging, breeding and roosting ecology of avian species within the area through modification of habitat.

No Red Data species were recorded within the immediate, as well as within the surrounding area. Furthermore, the limited displacement that may occur, will only be from a very restricted area. The impact on smaller, non-Red Data species that are potentially breeding in the area will be local and very restricted in extent, and will not have a significant effect on regional or national populations.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Minor (3)	Small (2)
Probability	Definite (5)	Probable (3)
Significance	**Medium (40)**	**Low (21)**
Status	Negative	Negative
Reversibility	Moderate	High
Irreplaceable loss of resources	Only very slight loss of resources	Only very slight loss of resources
Can impacts be mitigated?	Yes, impacts mostly limited to construction phase:	
Mitigation	» The temporal and spatial footprint of the development should be kept to a minimum. » The boundaries of the development footprint are to be clearly demarcated and it must be ensured that all activities remain within the demarcated footprint area. » Open fires are strictly prohibited and only allowed at designated areas. » Provide adequate briefing for site personnel on the possible important (Red Data) species occurring and/or nesting in the area and the procedures to be followed in this regard (for example notification of ECO and avoidance of area until appropriate recommendations have been provided by a specialist). » The above measures must be covered in a site specific EMPr and monitored by an ECO.	
Residual Impacts	Some residual habitat loss will result from the development, equivalent to the operational footprint of the power line.	

Impact 10 (Avifauna): *Disturbance of avifauna during the construction, operational (maintenance activities) and decommissioning phase*

Impact Nature:

Disturbance, transformation, and loss of habitat will have a negative effect on resident avifauna during construction.

Species sensitive to disturbance include ground-nesting species resident within the development footprint. Disturbance can also influence the community structure of avifauna within close proximity to the development as certain species will be displaced and forced to find alternative territories.

Disturbance could have a negative impact on the breeding activities of various species, particularly if this occurs during a sensitive period in the breeding cycle.

Increased levels of noise, pollution, disturbance, and human presence during the construction phase may affect the local avifauna. Sensitive and shy avifauna would move away from the area during the construction phase and may move back into the area upon completion of the construction phase.

	Without Mitigation	**With Mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Moderate (5)	Minor (4)
Probability	Highly Probable (4)	Probable (3)
Significance	**Medium (32)**	**Low (21)**
Status	Negative	Negative
Reversibility	High	Medium
Irreplaceable loss of resources	Only very slight loss of resources	Only very slight loss of resources
Can impacts be mitigated?	Impacts can be mitigated to a large extent. Noise and disturbance at the site during construction and maintenance are largely unavoidable.	
Mitigation	» Strict control must be maintained over all activities during construction, in line with an approved construction EMPr. » During construction, if any of the Red Data species identified in this report are observed to be roosting and/or breeding in the vicinity, the ECO must be notified and were deemed necessary an appropriate buffer should be placed around the nests and/or roosting areas. If uncertain on the size of such buffer the Environmental Officer (EO) may contact an avifaunal specialist for advice. » The construction equipment camps must be as close to the site as possible and within disturbed areas as far as possible. » Contractors and working staff must remain within the development footprint and movement outside these areas especially into avian micro-habitats must be restricted. » Driving must take place on existing roads and a speed limit of 30km/h must be implemented on all roads associated with the project during the construction phase. » Breeding, egg laying and incubation occur typically between October and February for most of the sensitive ground nesting avifaunal species.	

	During these months' disturbances within natural and near-natural habitats should be limited as far as possible.
Residual Impacts	There will be minimal residual impact as the facility will have low operational impacts on avifauna, after the construction phase.

Impact 11 (Avifauna): *Electrocution of birds due to overhead power lines*

Impact Nature:

Electrocution of birds on associated overhead power lines is an important cause of mortality for a variety of large bird species particularly storks, cranes and raptors in South Africa (Van Rooyen & Ledger, 1999). Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004; Lehman *et al*., 2007).

The impact assessment found the impact of electrocution to be of moderate significance before mitigation, and low significance after the mitigation in the form of bird friendly structures.

	Without Mitigation	**With Mitigation**
Extent	Larger Surroundings (3)	Local (2)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**Medium (39)**	**Low (16)**
Status	Negative	Negative
Reversibility	Low	Medium
Irreplaceable loss of resources	Yes, owing to the potential loss of critically endangered or endangered bird species	Low potential for irreplaceable loss of resources
Can impacts be mitigated?	Mitigation is very difficult to prescribe at this stage. It is suggested that the impact be monitored by the operations environmental manager and should it be found to be a significant impact a suitably qualified avifaunal specialist be consulted to recommend suitable mitigation.	
Mitigation	» Position electrical infrastructure in close proximity to existing infrastructure (e.g. existing roads and power lines). » A "Bird Friendly" structure, with a bird perch (as per standard Eskom guidelines) must be used for the tower structures. » All relevant perching surfaces should be fitted with bird guards and perch guards as deterrents (Hunting, 2002). » Installation of artificial bird space perches and nesting platforms should be installed, at a safe distance from energised components (Goudie, 2006; Prinsen *et al*., 2012). » Line inspections should be ongoing for the operational life of the line.	
Residual Impacts	Direct mortality is possible and may still happen irrespective of applied mitigation measures. The residual impacts should subsequently be regarded as medium.	

Impact 5 (Avifauna): *Collisions of birds with overhead power line*

Impact Nature:

Collisions are the biggest single threat posed by transmission power lines to birds in Southern Africa (van Rooyen, 2004). Avian species most susceptible and impacted upon are bustards, storks and cranes (especially bustards which have been confirmed are at risk within the project site). These species are heavy-bodied birds with limited manoeuvrability (as a result of high wing loading), which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (Van Rooyen 2004, Anderson 2001). Many of the collision sensitive species are considered threatened in Southern Africa.

The Red Data species that are vulnerable to power line collisions are generally long living, slow reproducing species. Furthermore, various species require specific conditions for breeding, resulting in very few successful breeding attempts and breeding might be restricted to very small areas. Consistent high adult mortality over an extensive period could have a serious long-term effect on the population.

	Without Mitigation	**With Mitigation**
Extent	Larger Surroundings (3)	Local (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Moderate (6)	Low (4)
Probability	Highly Probable (4)	Probable (3)
Significance	**Moderate (52)**	**Low (27)**
Status	Negative	Negative
Reversibility	Low (birds will be injured or killed)	Low (birds will be injured or killed)
Irreplaceable loss of resources	Medium	Low
Can impacts be mitigated?	Yes, to a large extent.	
Mitigation	» Construction of the power line in close proximity to the provincial dirt road and existing lines will reduce the cumulative impacts and collision risk. » All relevant perching surfaces must be fitted with bird guards and perch guards as deterrents (Hunting, 2002). » Mark sections of line in high sensitivity areas with anti-collision marking devices (diurnal and nocturnal diverters) to increase the visibility of the power line and reduce likelihood of collisions. Marking devices should be spaced 10m apart. » These line marking devices include spiral vibration dampers, strips, Bird Flight Diverters, bird flappers, aerial marker spheres, ribbons, tapes, flags and aviation balls (Prinsen *et al.,* 2012). » It is proposed that sections of the line in close proximity to important wetlands and drainage systems be fitted with "Double Loop Bird Flight Diverters" (BFDs). » The risk of collision is particularly high where the proposed servitude traverse across corridors for avifaunal movement between important wetlands and other water bodies that are generally within 300m of the power line and anti-collision marking devices should be installed along the line sections that falls within such potential flight corridors. » The power line should, as far as possible, be placed parallel to existing power lines or other linear infrastructure such as roads, as this will also greatly increase the visibility of the overhead cables	

Residual Impacts	Low. The power line will be within the area over a long period of time if not permanent. However, if the power line is removed the impacts associated (avian mortalities) will cease.

Cumulative Impacts (Collector Substation, Switching Station & Gridline)

Cumulative Impact 1 (Terrestrial Ecology): *Reduced ability to meet conservation obligations and targets*

Impact Nature: The loss of unprotected vegetation types on a cumulative basis from the broader area impacts the Province's 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 (4)
Duration	Long Term (4)	Long-Term (4)
Magnitude	Small (1)	Small (2)
Probability	Very Improbable (1)	Highly Improbable (2)
Significance	**Low (6)**	**Low (20)**
Status	Slightly Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Highly unlikely	Unlikely
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. » Reduce the footprint of the facility within sensitive habitat types as much as possible. » Mitigation measures of the current site should align with neighbouring sites and other developments in the area.	

Cumulative Impact 2 (Terrestrial Ecology): *Impacts on Broad-Scale Ecological Processes*

Impact Nature: Transformation of intact habitat could potentially compromise ecological processes of the Critical Biodiversity- and Ecological Support Areas as well as ecological functioning of important terrestrial 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)	Neighbouring Areas (3)
Duration	Long Term (4)	Long-Term (4)
Magnitude	Small (1)	Minor (3)

Probability	Very Improbable (6)	Improbable (2)
Significance	**Low (6)**	**Low (20)**
Status	Neutral	Slightly Negative
Reversibility	Low	Low
Irreplaceable loss of resources	Highly unlikely	Unlikely
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. » Position electrical infrastructure in close proximity to existing infrastructure (e.g. existing roads and power lines). » Mitigation measures of the current site should align with neighbouring sites and other developments in the area.	

Cumulative Impact 3 (Terrestrial Ecology): *Compromise ecological processes as well as ecological functioning of important terrestrial habitats.*

Impact Nature: Transformation of intact terrestrial habitats could potentially compromise ecological processes as well as ecological functioning of important habitats and would contribute to habitat fragmentation and potential disruption of habitat connectivity and impair their ability to respond to environmental fluctuations. This in turn may lead to;

- » A change in the status of impacted vegetation type, 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 and 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)	Neighbouring Areas (3)
Duration	Long Term (4)	Long Term (4)
Magnitude	Small (1)	Minor (3)
Probability	Very Improbable (1)	Improbable (2)
Significance	**Low (6)**	**Low (20)**
Status	Negative	Negative
Reversibility	High	Moderate

Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes	
Mitigation	» The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas. » Position electrical infrastructure in close proximity to existing infrastructure (e.g. existing roads and power lines).	

Cumulative Impact 4 (Freshwater/Aquatic Ecology): *Compromise ecological processes as well as ecological functioning of important freshwater/aquatic habitats.*

Impact Nature: Transformation of intact freshwater resource habitats could potentially compromise ecological processes as well as ecological functioning of important habitats and would contribute to habitat fragmentation and potentially disruption of habitat connectivity and furthermore impair their ability to respond to environmental fluctuations. This is especially of relevance for larger watercourses and wetlands serving as important groundwater recharge and floodwater attenuation zones, important microhabitats for various organisms and important corridor zones for faunal movement		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Local (1)	Local (1)
Duration	Long Term (4)	Long Term (4)
Magnitude	Small (1)	Moderate (6)
Probability	Highly Improbable (1)	Highly Improbable (1)
Significance	**Low (7)**	**Low (11)**
Status	Negative	Negative
Reversibility	Moderate	Low
Irreplaceable loss of resources	No	No
Can impacts be mitigated?	Yes	
Mitigation	» The development footprint should be kept to a minimum and natural vegetation should be encouraged to return to disturbed areas. » No pylons may be placed within the delineated wetland/drainage habitats; however, the power line may span these features. » Use as far as possible the existing roads. » It is recommended that the power line should be placed as close as possible to the provincial gravel road and should rather span the small drainage system than the seepage feature. » The depression wetland is regarded as a No-Go area and no activities may be allowed within this wetland feature.	

Cumulative Impact 5 (Avifuana): Regional losses of natural habitat

Impact Nature: Regional losses of natural habitat and subsequently displacement of birds

	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Regional (4)	Regional (4)
Duration	Long-term (4)	Long-Term (4)
Magnitude	Small (1)	Moderate (5)
Probability	Very Improbable (1)	Improbable (2)
Significance	**Low (9)**	**Low (26)**
Status	Negative	Negative
Reversibility	Moderate	Low
Irreplaceable loss of resources	Only very slight loss of resources	Yes
Can impacts be mitigated?	Yes, to a large extent.	
Mitigation	» Consolidate infrastructure to areas where existing impacts occur (e.g. placing the proposed power line alongside existing power lines and roads). » The development footprint of the various individual facilities must be kept as small as possible and sensitive habitats must be avoided.	

Cumulative Impact 2: Collisions of birds with overhead power line

Impact Nature: Avian collision impacts related to the overhead power lines during operation		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Regional (4)	Regional (4)
Duration	Long-term (4)	Long-Term (4)
Magnitude	Minor (3)	Moderate (6)
Probability	Improbable (2)	Probable (3)
Significance	**Low (22)**	**Medium (42)**
Status	Negative	Negative
Reversibility	Low (birds will be injured or killed)	Low (birds will be injured or killed)
Irreplaceable loss of resources	Low	Yes, owing to the potential loss of critically endangered or endangered avifaunal species.
Can impacts be mitigated?	Yes, to some extent	
Mitigation	» Apply bird deterrent devices to the power line and make use of "bird-friendly" pylon structures. » Consolidate infrastructure to areas where existing impacts occur (e.g. placing the proposed power line alongside existing power lines and roads).	

	» The development footprint of the various individual facilities must be kept as small as possible and sensitive habitats must be avoided.

Cumulative Impact 3: Electrocution of birds due to overhead power lines

Impact Nature: Avian electrocution related to the power lines during operation.		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects within the area**
Extent	Regional (4)	Regional (4)
Duration	Long-term (4)	Long-Term (4)
Magnitude	Minor (3)	Moderate (6)
Probability	Improbable (2)	Probable (3)
Significance	**Low (22)**	**Medium (42)**
Status	Negative	Negative
Reversibility	Low (birds will be injured or killed)	Low (birds will be injured or killed)
Irreplaceable loss of resources	Low potential for irreplaceable loss of resources	Yes, owing to the potential loss of critically endangered or endangered avifaunal species.
Can impacts be mitigated?	Yes, to some extent	
Mitigation	» Apply bird deterrent devices to the power line and make use of "bird-friendly" pylon structures. » Consolidate infrastructure to areas where existing impacts occur (e.g. placing the proposed power line alongside existing power lines and roads).	

Summary and Comparison of the Impact Assessments done for the substation options.

A summary of the assessment of impacts done for the Woodhouse 1 and 2 collector substation options/alternatives are detailed below and include the identification of the preferred alternative, in terms of its potentials impacts on terrestrial (Fauna, Flora and Avifauna) as well as freshwater resource features. The overall impact significance provided in the table below are essentially a combination of the aspects assessed above and their impact significance ratings, with the implementation of mitigation measures.

Take note that "not-preferred" does not necessarily mean that such an option contains a fatal flaw and may not be considered at all (unless specified as such). If not specified otherwise, it merely means that in terms of the available options this is not the most preferable and may need some layout adjustments/amendments in order to avoid any sensitive features.

<table>
<tr><th>PV Solar Project</th><th>Collector Substation Option 1</th><th>Collector Substation Option 2</th><th>Reasons (incl. potential issues)</th></tr>
<tr><td rowspan="7">Woodhouse 1 and Woodhouse 2 PV Solar Facilities</td><td colspan="2">Overall Impact Significance in terms Freshwater/Aquatic Resource Features</td><td rowspan="7">» Both substation options are located outside of the boundaries of delineated freshwater resource features.
» Both CS options are located outside of any high/very highly sensitive areas.
» CS Alternative 1 is located in a slightly less sensitive and transformed habitat.
» Furthermore, both substation options are located outside of any conservation important areas (Threatened Ecosystems, and Critical Biodiversity Areas).
» CS Alternative 2 is however located within an Ecological Support Area (Corridor).
» No Plant or Animal Species of Conservation Concern were recorded within the proposed footprint areas of the substation options.
» Due to the above provided reasons, both options are regarded as favorable, with CS Alternative 1 being the most preferred options from an ecological perspective.</td></tr>
<tr><td colspan="2">Both CS alternative options are located well away from any freshwater/aquatic resource features and will subsequently not have an impact on such resource features.</td></tr>
<tr><td colspan="2">Overall Impact Significance in terms Terrestrial (Fauna, Flora and Avifauna) Ecological Features</td></tr>
<tr><td colspan="2">Both options are very similar in terms of their potential impacts on terrestrial features.

Mainly Low to Medium prior to Mitigation and Low with Mitigation considered</td></tr>
<tr><td colspan="2">Preference</td></tr>
<tr><td>Most Favorable/Preferred</td><td>Favorable</td></tr>
</table>

10. CONCLUSION AND RECOMMENDATIONS

The study area falls within the Ghaap Plateau Vaalbosveld. This savanna type is not listed as a threatened ecosystem (classified as Least Concern).

Nkurenkuru Ecology and Biodiversity undertook a terrestrial ecological (fauna, flora and avifauna) and aquatic/freshwater resource study for an environmental impact assessment of the target areas (corridor) of the electrical grid infrastructure, connecting the Woodhouse 1 Solar PV Facility with the Woodhouse 2 Solar PV Facility, and provide a professional opinion on terrestrial and aquatic ecological issues pertaining to the target area to aid in future decisions regarding the proposed project.

This study has been commissioned to meet the requirements of the EIA process in the form of an Environmental Impact Assessment as set out by the National Environmental Management Act (1998) and a Water Use Licence Application as set out by the National Water Act (Act 36 of 1998). Furthermore, this study should and has been done in accordance with the "newly" Gazetted Protocols 3(a),(c) and (d) in terms of Section 24(5)(a) and 24(5)(h) of NEMA (Published on the 20th of March 2020); and meet the requirements as set out within the Aquatic Biodiversity Protocol published in GN NO. 1105 of 30 October 2020.

Furthermore, according to the guidelines specified within GN509 of 2016 all wetlands within a radius of 500m of the facility footprint were identified and those with a high and moderate risk of being impacted was delineated, mapped and classified

A site visit was conducted on the 9th and the 20th to the 22nd of July 2021. On-site conditions were regarded acceptable for such a survey and as such the data collected can be regarded reliable and satisfactory.

In terms of the Collector Substation Options and the Switching Station Option:

» Terrestrial Ecology:

Two collector substation (CS) alternative locations are currently investigated. CS Alternative 1 is located in a slightly less sensitive and transformed habitat, however the potential significance of impacts on terrestrial habitats and biodiversity will be very similar for both alternative options as well as for the Switching Station (SS) option. Furthermore, CS Alternative 2 is located within an Ecological Support Area (Corridor). Subsequently, both CS options as well as the SS options is regarded as acceptable. However, in terms of the two CS options, Option 1 is regarded as the most preferred CS options. Furthermore, both CS options as well as the SS option is located in close proximity to existing access routs including the Amalia Road, which can be used as far

as possible in order to further reduce the potential impact on the terrestrial environment.

» Freshwater/Aquatic Ecology:
Both CS alternative options as well as the SS option are located well away from any freshwater/aquatic resource features and will subsequently not have an impact on such resource features.

» Avifauna:
Both CS alternative options are located in low sensitive avifaunal habitats, whilst the SS is proposed within a slightly more sensitive habitat, however, it is envisaged that the potential impacts on avifauna will be very similar for both CS options as well as the SS options. Subsequently, both CS options as well as the SS options is regarded as acceptable.

In terms of the preferred grid route option:

» Both power line options are very similar in terms of their potential impacts on terrestrial as well as freshwater/aquatic ecosystems and biodiversity.
» The potential impact on the terrestrial environment, including avifauna can be significantly reduced, through the placement of the power line as close as possible to existing infrastructure (e.g. existing roads and power lines), and the use of existing access roads, including the Amalia road.
» In terms of the freshwater resource features identified within the grid corridor, the grid line may span the drainage line (no pylons may be placed within this feature) and should avoid any form of disturbance within the depression as well as seepage wetlands. Furthermore, existing access roads should be used when crossing the drainage line.

A combined terrestrial (fauna, flora and avifauna) and aquatic ecological sensitivity map of the site has been compiled based on the findings of this study (refer to Figures 13).

The sensitive areas identified, are as follow:

High Sensitivity and No-Go Area:

» Depression Wetland and Woody Fringe: This freshwater resource features and its associated vegetation provide 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. This wetland area, even though small, must therefore be treated as a No-Go zone.

The findings of the baseline wetland assessment suggest the following Present Ecological Status' for the delineated wetland feature:

- Depression Wetland: C (Moderately Modified)

» Following the Ecological Importance and Sensitivity (EIS) assessment, it was found that both depression wetland was determined to be of high importance and sensitivity (Class B: High EI&S).

Moderate Sensitivity and No-Go Area:

» Seepage Wetland: This freshwater resource features and its associated vegetation provide unique habitats and niches, and fulfil vital ecological functions and services including flood attenuation, stream flow augmentation, erosion control, trapping of nitrates and toxicants. As such this wetland should be treated as a No-Go zone.

The findings of the baseline wetland assessment suggest the following Present Ecological Status' for the delineated wetland feature:

- Seepage Wetland: B (Largely Natural)

» Following the Ecological Importance and Sensitivity (EIS) assessment, it was found that the seepage wetland was determined to be of moderate importance and sensitivity (Class C: Moderate EI&S).

Medium/Moderate Sensitivity:

» Drainage line feeding into the seepage wetland: This freshwater resource features is of relative low species conservation concern and of medium importance in terms of the creation of unique micro-habitats and niches. The importance of the ecosystem functions provided by this feature is also of moderate importance and includes;

- Species diversity adds to resilience of system and supports pollinator populations during different seasons
- Moderately important fauna refuge and feeding area,
- Moderate seasonal agricultural potential (livestock)
- Deeper unconsolidated soils facilitate rapid infiltration of runoff into sub-soil moisture reserves, protecting such moisture reserves from rapid evaporation and hence supporting vegetation during extended dry periods
- Corridor and distribution of seed reserves

The power line may span this drainage feature and existing access roads, crossing this feature may be utilised. Apart from these activities, no other activities may be allowed within this habitat.

The findings of the baseline freshwater resource assessment suggest the following Present Ecological Status' for the delineated drainage feature:

- Drainage Line: C (Moderately Modified)

Following the Ecological Importance and Sensitivity (EIS) assessment, it was found that the drainage line was determined to be of moderate importance and sensitivity (Class C: Moderate EI&S).

» Senegalia mellifera Ridge: This portion of the ridge (within the grid corridor) have been severely encroached by S. mellifera, forming a dense thicket, and has had a significant impact on local biodiversity (reduction). However, the rocky ridge potentially provides a fairly unique habitat for fauna within the area (rocky refugia).

Development of the grid line within this habitat is however, still acceptable.

» Dense *Tarchonanthus camphoratus* Shrubland: This unit is extensively used for grazing and subsequently has been steadily transformed over a very long period of time due to long term grazing (overgrazing). Although in a semi-natural state this unit still, provide valuable ecological functions, including:

- Grazing;
- Maintenance of pollinator populations,
- Soil conservation and stabilisation,
- Accumulation and slowing down of runoff;
- Maximising of infiltration of runoff into soils
- Filtering of runoff;
- Buffering for lower lying wetlands against potential disturbances and thus vital for the protection of these sensitive habitats against deterioration.

Development of the grid line within this habitat is acceptable.

» *Vachelia tortilis* Woodland (Primary and Secondary Woodland: This unit is extensively used for grazing and subsequently has been steadily transformed over a very long period of time due to long term grazing (overgrazing). Although in a semi-natural state this unit still, provide valuable ecological functions including:

- Grazing;
- Maintenance of pollinator populations,
- Soil conservation and stabilisation,
- Accumulation and slowing down of runoff;
- Maximising of infiltration of runoff into soils
- Filtering of runoff;
- Buffering for lower lying wetlands against potential disturbances and thus vital for the protection of these sensitive habitats against deterioration.

Development of the grid line within this habitat is acceptable

Low Sensitivity

» Open *Tarchonanthus camphoratus* Shrubland: This variation of *the Tarchonanthus camphoratus*, owes its reduction of the woody component (tree and shrub layer) to recent poisoning of this layer in an attempt to improve the grazing of the area. It is currently unclear when the trees and shrubs has been poisoned and subsequently the exact impact on the tree and shrub layer and the extent of poisoning is unclear at this stage. However, it is expected that this reduction of the tree/shrub layer will have a noteworthy impact on faunal and avifaunal diversity.

Development of the grid line within this habitat is acceptable

» Highly Transformed and Disturbed Areas: This includes access roads and disturbed road shoulders, farm roads, fire breaks and trampled areas. Development within these areas are acceptable.

Overall, no significant terrestrial (fauna, flora and avifauna) and freshwater/aquatic ecological flaws that could pose a problem to the proposed development were identified during the 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 grid infrastructure:

» 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 within the development footprint is kept to a minimum. No unnecessary vegetation to be cleared.
- » 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.
- » The depression and seepage wetland areas, must be treated as No-Go zones.
- » In terms of the drainage line:
  - The power line may span this drainage feature and existing access roads crossing this feature may be utilised. Apart from these activities, no other activities may be allowed within this habitat.
- » Stormwater from hard stand areas, buildings and substation must be managed using appropriate channels and swales when located within steeper areas.
- » The runoff should be dissipated over a broad area covered by natural vegetation or managed using appropriate channels and swales.
- » During the construction and operational /decommissioning phase, monitor the development footprint and wetland areas to see if erosion issues arise and if any erosion control is required.
  - Any erosion problems observed to be associated with the project infrastructure should be rectified as soon as possible and monitored thereafter to ensure that they do not re-occur.
  - All bare areas, as a result of the development, should be revegetated with locally occurring species, to bind the soil and limit erosion potential.
  - Site rehabilitation should aim to restore surface drainage patterns, natural soil and vegetation as far as is feasible.
  - An erosion control management plan should be utilised to prevent erosion
  - Any storm-water within the site must be handled in a suitable manner
  - All alien plant re-growth must be monitored and should it occur these plants should be eradicated.
  - Mitigation and follow up monitoring of residual impacts (alien vegetation growth and erosion) may be required.
- » Store hydrocarbons off site where possible, or otherwise implement hydrocarbon storage using impermeable floors with appropriate bunding, sumps and roofing.
- » Handle hydrocarbons carefully to limit spillage.
- » Ensure vehicles are regularly serviced so that hydrocarbon leaks are limited.
- » Designate a single location for refuelling and maintenance, outside of any freshwater resource features.
- » Keep a spill kit on site to deal with any hydrocarbon leaks.
- » Remove soil from the site which has been contaminated by hydrocarbon spillage.

In addition, 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. With these recommendations and mitigation measures in place, impacts on terrestrial and surface water resource integrity and functioning can be reduced to a sufficiently low level This would be best achieved by incorporating the recommended management & mitigation measures into an Environmental Management Programme (EMPr) for the site, together with appropriate rehabilitation guidelines and ecological monitoring recommendations.

Based on the outcomes of this study it is my considered opinion that the proposed Woodhouse 1 and 2 Grid Infrastructure project detailed in this report could be authorised from an ecological perspective.

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12. APPENDICES

Appendix 1: Methodology - Ecology (Biodiversity)

Methods to be followed during Field Sampling and Assessment

As part of the BA process, a detailed field survey of the vegetation of the development footprint was undertaken (from the 4th to 7th of March 2020) with the main purpose of:

» Inspecting the various habitat, vegetation, and landscape units that are present the mining site and to correlate such observations with the results of the desktop study.
» Identifying all observed species that were recorded within the development footprint.
» Providing a list of protected and red list species.
» Noting the presence of sensitive habitats such quartz patches, drainage lines, and unique edaphic environments,

These features were mapped onto satellite imagery of the site.

Aspects of biodiversity that were used to guide the interpretation and assessment of the study area are summarized below (Table 14).

Table 14: Summary of the different aspects of biodiversity considered in the assessment of the study site.

Intrinsic / Ecological Values
Species-level aspects of biodiversity
» Protected species of flora; » Threatened Species (Red Data List); » Keystone species performing a key ecological role; » Large or congregatory species population; » Endemic species or species with restricted ranges; » Previously unknown species.
Community & ecosystem-level aspects of biodiversity
» Distinct or diverse communities or ecosystems; » Unique ecosystems; » Locally adapted communities or assemblages; » Species-rich or diverse ecosystems; » Communities with a high proportion of endemic species or species with restricted ranges; » Communities with a high proportion of threatened and/or declining species; » The main uses and users of the area and its ecosystem goods and services: important ecosystem services, valued ecosystem goods, valued cultural areas.
Community & ecosystem-level aspects of biodiversity
» Key ecological processes (e.g. seed dispersal, pollination, primary production, carbon sequestration); » Areas with large congregations or species and/or breeding grounds; » Migration routes/corridors; » Importance as a link or corridor to other fragments of the same habitat, to protected or threatened or valued biodiversity areas;

» Importance and role in the landscape with regard to a range of 'spatial components of ecological processes', comprising processes tied to fixed physical features (e.g. soil or vegetation interfaces, river or sand movement corridors, upland-lowland interfaces) and flexible processes (e.g. upland-lowland gradients and macro-climatic gradients), as well as important movement or migration corridor for species.

The following methods were used to assess mapped terrestrial habitat:

Vegetation Species Composition:

The vegetation species composition was documented during field surveys to estimate the relative abundance of indigenous species vs alien/exotic species. The level of naturalness was subjectively rated per habitat unit assessed using the table below:

% Indigenous Cover	Level of Naturalness	Score
> 90	Natural	5
75 – 90	High	4
31 – 74	Moderate	3
6 – 30	Low	2
1 – 5	Very Low	1
0	Non (transformed)	0

Grass composition:

The ecological status of grasses refers to the grouping of grasses based on their reaction to different levels of grazing and disturbance (Van Oudtshoorn, 2006). It can either become more dominant (increaser type) or less dominant (decreaser type). The status of species indicates the ecological or veld condition, as per the table below which was used to guide the condition rating of grasslands:

Abundant Grass Status	Description
Decreaser	Abundant in good veld, palatable climax species, that decrease when veld is overgrazed
Increaser I	Grasses that are abundant in the underutilised veld, unpalatable, and robust climax species.
Increaser II	Abundant in overgrazed veld, mostly pioneer and subclimax species that quickly establish on new ground.
Increaser III	Commonly found in overgrazed veld, usually unpalatable, dense climax grasses that are strong competitors
Invaders	Invader species

Structural intactness of habitat:

The structural intactness of habitat is rated based on visual assessments in the field and rated according to the matrix below which compares the present structure of habitat with the estimated reference structure (natural state):

Structural Intactness Matrix	Present State				
Reference State	Continuous	Clumped	Scattered	Sparse	Very Sparse
Continuous	5	4	3	2	1
Clumped	4	5	4	3	2
Scattered	3	4	5	4	3
Sparse	2	3	4	5	4
Very Sparse	1	2	3	4	5

The existing level of disturbance:

The existing level of disturbance was documented based on the presence of on-site and adjacent anthropogenic impacts such litter/pollution, soil erosion, vegetation removal/clearing, grazing/harvesting, cultivation, housing development, etc. which were documented in the field and used to provide a qualitative rating of the level of habitat disturbance according to the ratings in the table below:

Level of disturbance	Score
None	5
Low	4
Medium	3
High	2
Very High	1
Extreme (no natural vegetation remains)	0

Present Ecological Status:

The scores assigned to each habitat unit based on the rating tables (shown above) were then used to provide an overall PES (Present Ecological State) rating that describes the condition or integrity for each habitat unit based on the following calculation:

» **PES = (Level of disturbance + Structural Intactness + % indigenous) / 3**

<u>Assessing species of conservation concern:</u>

Species of conservation concern are species that have high conservation importance in terms of preserving South Africa's biodiversity. A description of the different SANBI categories of species of conservation concern is provided in Table 16, below.

Table 15: South African Red List Categories for species of conservation significance (adapted from SANBI, on-line at http://redlist.sanbi.org/redcat.php).

Present State			
Species of Conservation Concern		Extinct (EX)	A species is Extinct when there is no reasonable doubt that the last individual has died. Species should be classified as Extinct only once exhaustive surveys throughout the species' known range have failed to record an individual.
		Extinct in the Wild (EW)	A species is Extinct in the Wild when it is known to survive only in cultivation or as a naturalized population (or populations) well outside the past range.
		Regionally Extinct (RE)	A species is Regionally Extinct when it is extinct within the region assessed (in this case South Africa), but wild populations can still be found in areas outside the region.
	Threatened Species	Critically Endangered, Possibly Extinct (CR PE)	Possibly Extinct is a special tag associated with the category Critically Endangered, indicating species that are highly likely to be extinct, but the exhaustive surveys required for classifying the species as Extinct has not yet been completed. A small chance remains that such species may still be rediscovered.
		Critically Endangered (CR)	A species is Critically Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Critically Endangered, indicating that the species is facing an extremely high risk of extinction.
		Endangered (EN)	A species is Endangered when the best available evidence indicates that it meets at least one of the five IUCN criteria for Endangered, indicating that the species is facing a very high risk of extinction.
		Vulnerable (VU)	A species is Vulnerable when the best available evidence indicates that it meets at least one of the five IUCN criteria for Vulnerable, indicating that the species is facing a high risk of extinction.
		Near Threatened (NT)	A species is Near Threatened when available evidence indicates that it nearly meets any of the IUCN criteria for Vulnerable, and is, therefore, likely to become at risk of extinction in the near future.
		Critically Rare	A species is Critically Rare when it is known to occur at a single site, but is not exposed to any direct or plausible potential threat and does not otherwise qualify for a category of threat according to one of the five IUCN criteria.
		Rare	A species is Rare when it meets at least one of four South African criteria for rarity, but is not exposed to any direct or plausible potential threat and does not qualify for a category of threat according to one of the five IUCN criteria.
		Declining	A species is Declining when it does not meet or nearly meet any of the five IUCN criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened, but there are threatening processes causing a continuing decline of the species.
		Data Deficient – Insufficient Information (DDD)	A species is DDD when there is inadequate information to make an assessment of its risk of extinction, but the species is well defined. Listing of species in this category indicates that more information is required and that future research could show that threatened classification is appropriate.
Other		Data Deficient – Taxonomically Problematic (DDT)	A species is DDT when taxonomic problems hinder the distribution range and habitat from being well defined so that an assessment of the risk of extinction is not possible.
		Least Concern (LC)	A species is Least Concern when it has been evaluated against the IUCN criteria and does not qualify for any of the above categories. Species classified as Least Concern are considered at low risk of extinction. Widespread and abundant species are typically classified in this category.
		Not Evaluated (NE)	species is Not Evaluated when it has not been evaluated against the criteria. The national Red List of South African plants is a comprehensive assessment of all South African indigenous plants, and therefore all species are assessed and given

			a national Red List status. However, some species included in Plants of southern Africa: an online checklist are species that do not qualify for national listing because they are naturalized exotics, hybrids (natural or cultivated), or synonyms. These species are given the status Not Evaluated and the reasons why they have not been assessed are included in the assessment justification.

As mentioned, flora of conservation significance (including threatened, protected and rare species) likely to occur in the various habitats of the study area were assessed at a desktop level using the outputs of SANBI's PRECIS (National Herbarium Pretoria Computerized Information System) electronic database. This information was used to identify potential habitat in the project area that could support these species based on information on each species' particular habitat preferences which were obtained from SANBI online species database. Special attention was given to the identification of any of these Red Data species as well as the identification of suitable habitat for Red Data species observed during field investigations.

Ecological Mapping

Mapping has been done by comparing georeferenced ground survey data to the visual inspection of available Google-Earth Imagery (which is a generalised colour composite image without any actual reflectance data attached to it) and in that way extrapolating survey reference points to the entire study area. Delineations are therefore approximate, and due to the intricate mosaics and often gradual mergers of vegetation units, generalisations had to be made. Mapped units will thus show where a certain vegetation unit is predominant, but smaller inclusions of another vegetation type in this area do exist but have not been mapped separately. The latter would require a supervised classification of georeferenced raw SPOT or similar satellite imagery (with all reflectance data), which has not been available to this project due to the high cost of such imagery.

Sensitivity Analysis and Criteria

The determination of specific ecosystem services and the sensitivity of ecosystem components, both biotic and abiotic, is rather complex and no single overarching criterion will apply to all habitats studied. The main aspects of an ecosystem that need to be incorporated in a sensitivity analysis, however, include the following:

» Describing the nature and number of species present, taking into consideration their conservation value as well as the probability of such species to survive or re-establish itself following disturbances, and alterations to their specific habitats, of various magnitudes
» Identifying the species or habitat features that are 'key ecosystem providers' and characterising their functional relationships (Kremen 2005)

» Determining the aspects of community structure that influence function, especially aspects influencing stability or rapid decline of communities (Kremen 2005)
» Assessing key environmental factors that influence the provision of services (Kremen 2005)
» Gaining knowledge about the spatial-temporal scales over which these aspects operate (Kremen 2005).

This implies that in the sensitivity analysis not only aspects that currently prevail on the area should be taken into consideration, but also if there is a possibility of a full restoration of the original environment and its biota, or at least the rehabilitation of ecosystem services resembling the original state after an area has been significantly disturbed.
According to the above, sensitivity classes have been summarised as follows:

» **Vert High Sensitivity:** Areas that contain critical and/or unique habitats have a very high sensitivity; such areas usually serve as habitats for rare/endangered species or perform critical and irreplaceable ecological roles. Very high sensitivity areas are no-go areas and developments in such areas should be avoided at all costs.
» **High Sensitivity:** High sensitivity areas are those that usually have a high biodiversity value or important ecological roles, and it is expected that impacts on such areas will likely be high; these areas include natural or transformed land. It might be difficult to mitigate all impacts appropriately in high sensitivity areas, and thus development within these areas is undesirable and should proceed with caution.
» **Medium Sensitivity:** The impacts on medium sensitivity areas are likely to be mostly local with the risk of secondary impacts (such as erosion) being low; these areas include natural or previously transformed land. On the condition that appropriate mitigation measures are implemented, development within medium sensitivity areas will have a relatively little ecological impact.
» **Low Sensitivity:** The impact on ecological processes and plant diversity in a low sensitivity area is likely to be negligible. Areas of low sensitivity are those areas where natural vegetation has already been transformed, for example as a result of intensive agricultural practices such as crop production. The majority of developments would have a little ecological impact in low sensitivity areas. The majority of the site is a Low Sensitivity area since it has already been heavily transformed due to past mining activities.

Appendix 2: Methodology – Freshwater Resource

The assessment was initiated with a survey of the pertinent literature, past reports and the various conservation plans that exist for the study region. Maps and Geographical Information Systems (GIS) were then employed to ascertain, which portions of the proposed development, could have the greatest impact on the wetlands and associated habitats.

A three-day site visit was then conducted to ground-truth the above findings, thus allowing critical comment of the development when assessing the possible impacts and delineating the wetland areas.

» The following equipment were utilized during field work.
  - Canon EOS 450D Camera
  - Garmin Etrex Legend GPS Receiver
  - Bucket Soil Auger
  - Munsell Soil Colour Chart (2000)
  - Braun-Blanquet Data Form (for vegetation recording and general environmental recordings).

Wetland and riparian areas were then assessed on the following basis:

» Identification and delineation of wetlands and riparian areas according to the the procedures specified by DWAF (2005a).
» Vegetation type – verification of type and its state or condition based, supported by species identification using Germishuizen and Meyer (2003), Vegmap (Mucina and Rutherford, 2006 as amended) and the South African Biodiversity Information Facility (SABIF) database.
» Plant species were further categorised as follows:
  - Terrestrial: species are not directly related to any surface or groundwater base-flows and persist solely on rainfall.
  - Facultative: species usually found in wetlands (inclusive of riparian systems) (67 – 99% of occurrences), but occasionally found in terrestrial systems (non-wetland) (DWAF, 2005)
  - Obligate: species that are only found within wetlands (>99% of occurrences) (DWAF, 2005).
» Assessment of the wetland type based on the NWCS method discussed below and the required buffers.
» Mitigation or recommendations required.

Data sources consulted

The following date sources and GIS spatial information provided in the table below was consulted to inform the assessment. The data type, relevance to the project and source of the information has been provided.

Table 16: Information and data coverages used to inform the wetland assessment

Data/Coverage Type	Relevence	Source
Colour Aerial Photography (2009)	Mapping of wetlands and other features	National Geo-Spatial Information
Latest Google Earth™ imagery	To supplement available aerial photography	Google Earth™ On-line
Proposed power line routes and substation locations.	Shows location to the porposed powerline routes and impacted zone	Client
NFEPA wetland Coverage	Shows location fo FEPA river and wetland sites.	CSIR (2011)
National Land-Cover	Shows the land-use and disturbances/transformations within and around the impacted zone.	DEA (2015)
SA National Land-Cover	Shows the expected land caracteristics including land form & shape, geology, soil types and slope gradients.	AGIS (2014)
Quaternary Drainage Regions	Indicates the drainage region and major tributaries and water sources.	DWS (2009)
Present Ecological State of watercourses	Shows the present ecological state of the affected non-perennial watercourses	Kleynhans (1999)

National Wetland Classification System (NWCS 2010)

Since the late 1960's, wetland classification systems have undergone a series of international and national revisions. These revisions allowed for the inclusion of additional wetland types, ecological and conservation rating metrics, together with a need for a system that would allude to the functional requirements of any given wetland (Ewart-Smith et al., 2006). Wetland function is a consequence of biotic and abiotic factors, and wetland classification should strive to capture these aspects.

The South African National Biodiversity Institute (SANBI) in collaboration with a number of specialists and stakeholders developed the newly revised and now accepted National Wetland Classification Systems (NWCS 2010). This system comprises a hierarchical

classification process of defining a wetland based on the principles of the Hydrogeomorphic (HGM) approach at higher levels, with including structural features at the finer or lower levels of classification (SANBI 2009).

Wetlands develop in a response to elevated water tables, linked either to rivers, groundwater flows or seepage from aquifers (Parsons, 2004). These water levels or flows then interact with localised geology and soil forms, which then determines the form and function of the respective wetlands. Water is thus the common driving force, in the formation of wetlands (DWAF, 2005). It is significant that the HGM approach has now been included in wetland classification as the HGM approach has been adopted throughout the water resources management realm with regard the determination of the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) and WET-Health assessments for aquatic environments. All of these systems are then easily integrated using the HGM approach in line with the Eco-classification process of river and wetland reserve determinations used by the Department of Water Affairs.

The NWCS process is provided in more detail in the methods section of the report, but some of the terms and definitions used in this document are present below:

Definition Box Present

Ecological State is a term for the current ecological condition of the resource. This is assessed relative to the deviation from the Reference State. Reference State/Condition is the natural or pre-impacted condition of the system. The reference state is not a static condition, but refers to the natural dynamics (range and rates of change or flux) prior to development. The PES is determined per component - for rivers and wetlands this would be for the drivers: flow, water quality and geomorphology; and the biotic response indicators: fish, macroinvertebrates, riparian vegetation and diatoms. PES categories for every component would be integrated into an overall PES for the river reach or wetland being investigated. This integrated PES is called the EcoStatus of the reach or wetland.

EcoStatus is the overall PES or current state of the resource. It represents the totality of the features and characteristics of a river and its riparian areas or wetland that bear upon its ability to support an appropriate natural flora and fauna and its capacity to provide a variety of goods and services. The EcoStatus value is an integrated ecological state made up of a combination of various PES findings from component EcoStatus assessments (such as for invertebrates, fish, riparian vegetation, geomorphology, hydrology and water quality).

Reserve: The quantity and quality of water needed to sustain basic human needs and ecosystems (e.g. estuaries, rivers, lakes, groundwater and wetlands) to ensure ecologically sustainable development and utilisation of a water resource. The Ecological Reserve pertains specifically to aquatic ecosystems.

Reserve requirements: The quality, quantity and reliability of water needed to satisfy the requirements of basic human needs and the Ecological Reserve (inclusive of instream requirements).
Ecological Reserve determination study: The study undertaken to determine Ecological Reserve requirements.
Licensing applications: Water users are required (by legislation) to apply for licenses prior to extracting water resources from a water catchment.
Ecological Water Requirements: This is the quality and quantity of water flowing through a natural stream course that is needed to sustain instream functions and ecosystem integrity at an acceptable level as determined during an EWR study. These then form part of the conditions for managing achievable water quantity and quality conditions as stipulated in the Reserve Template.
Water allocation process (compulsory licensing): This is a process where all existing and new water users are requested to reapply for their licenses, particularly in stressed catchments where there is an over-allocation of water or an inequitable distribution of entitlements.
Ecoregions are geographic regions that have been delineated in a top-down manner on the basis of physical/abiotic factors. • NOTE: For purposes of the classification system, the 'Level I Ecoregions' for South Africa, Lesotho and Swaziland (Kleynhans et al. 2005), which have been specifically developed by the Department of Water Affairs & Forestry (DWAF) for rivers but are used for the management of inland aquatic ecosystems more generally, are applied at Level 2A of the classification system. These Ecoregions are based on physiography, climate, geology, soils and potential natural vegetation.

Wetland definition

Although the National Wetland Classification System (SANBI, 2009) is used to classify wetland types it is still necessary to understand the definition of a wetland. Wetland definitions as with classification systems have changed over the years. Terminology currently strives to characterise a wetland not only on its structure (visible form), but also to relate this to the function and value of any given wetland.

The Ramsar Convention definition of a wetland is widely accepted as "**areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres**" (Davis 1994). South Africa is a signatory to the Ramsar Convention and therefore its extremely broad definition of wetlands has been adopted for the proposed NWCS, with a few modifications.

Whereas the Ramsar Convention included marine water to a depth of six metres, the definition used for the NWCS extends to a depth of ten metres at low tide, as this is

recognised seaward boundary of the shallow photic zone (Lombard et al., 2005). An additional minor adaptation of the definition is the removal of the term 'fen' as fens are considered a type of peatland. The adapted definition for the NWCS is, therefore, as follows (SANBI, 2009):

WETLAND: an area of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed ten metres.

This definition encompasses all ecosystems characterised by the permanent or periodic presence of water other than marine waters deeper than ten metres. The only legislated definition of wetlands in South Africa, however, is contained within the National Water Act (Act No. 36 of 1998) (NWA), where wetlands are defined as "land which is transitional between terrestrial and aquatic systems, where the water table is usually at, or near the surface, or the land is periodically covered with shallow water and which land in normal circumstances supports, or would support, vegetation adapted to life in saturated soil." This definition is consistent with more precise working definitions of wetlands and therefore includes only a subset of ecosystems encapsulated in the Ramsar definition. It should be noted that the NWA definition is not concerned with marine systems and clearly distinguishes wetlands from estuaries, classifying the later as a watercourse (SANBI, 2009). The DWA is however reconsidering this position with regard the management of estuaries due to the ecological needs of these systems with regard to water allocation. Table 12 provides a comparison of the various wetlands included within the main sources of wetland definition used in South Africa.

Although a subset of Ramsar-defined wetlands was used as a starting point for the compilation of the first version of the National Wetland Inventory (i.e. "wetlands", as defined by the National Water Act, together with open waterbodies), it is understood that subsequent versions of the Inventory include the full suite of Ramsar-defined wetlands in order to ensure that South Africa meets its wetland inventory obligations as a signatory to the Convention (SANBI, 2009).

Wetlands must therefore have one or more of the following attributes to meet the above definition (DWAF, 2005):

- A high-water table that results in the saturation at or near the surface, leading to anaerobic conditions developing in the top 50cm of the soil.
- Wetland or hydromorphic soils that display characteristics resulting from prolonged saturation, i.e. mottling or grey soils
- The presence of, at least occasionally, hydrophilic plants, i.e. hydrophytes (water loving plants).

It should be noted that riparian systems that are not permanently or periodically inundated are not considered true wetlands, i.e. those associated with the drainage lines.

Table 17: Comparison of ecosystems considered to be 'wetlands' as defined by the proposed NWCS, the National Water Act (Act No. 36 of 1998), and ecosystems are included in DWAF's (2005) delineation manual.

Ecosystem	NWCS "wetland"	National Water Act wetland	DWAF (2005) delineation manual
Marine	YES	NO	NO
Estuarine	YES	NO	NO
Waterbodies deeper than 2 m (i.e. limnetic habitats often describe as lakes or dams)	YES	NO	NO
Rivers, channels and canals	YES	NO[2]	NO
Inland aquatic ecosystems that are not river channels and are less than 2 m deep	YES	YES	YES
Riparian[3] areas that are permanently / periodically inundated or saturated with water within 50 cm of the surface	YES	YES	YES3
Riparian areas that are not permanently / periodically inundated or saturated with water within 50 cm of the surface	NO	NO	YES[4]

Wetland importance and function

South Africa is a Contracting Party to the Ramsar Convention on Wetlands, signed in Ramsar, Iran, in 1971, and has thus committed itself to this intergovernmental treaty, which provides the framework for the national protection of wetlands and the resources they could provide. Wetland conservation is now driven by the South African National Biodiversity Institute, a requirement under the National Environmental Management: Biodiversity Act (No 10 of 2004).

Wetlands are among the most valuable and productive ecosystems on earth, providing important opportunities for sustainable development (Davies and Day, 1998). However,

[2] Although river channels and canals would generally not be regarded as wetlands in terms of the National Water Act, they are included as a 'watercourse' in terms of the Act.

[3] According to the National Water Act and Ramsar, riparian areas are those areas that are saturated or flooded for prolonged periods would be considered riparian wetlands, opposed to non –wetland riparian areas that are only periodically inundated and the riparian vegetation persists due to having deep root systems drawing on water many meters below the surface.

[4] The delineation of 'riparian areas' (including both wetland and non-wetland components) is treated separately to the delineation of wetlands in DWAF's (2005) delineation manual.

wetlands in South Africa are still rapidly being lost or degraded through direct human induced pressures (Nel et al., 2004).

The most common attributes or goods and services provided by wetlands include:

» Improve water quality;
» Impede flow and reduce the occurrence of floods;
» Reeds and sedges used in construction and traditional crafts;
» Bulbs and tubers, a source of food and natural medicine;
» Store water and maintain base flow of rivers;
» Trap sediments; and
» Reduce the number of water borne diseases.

In the past wetland conservation, has focused on biodiversity as a means of substantiating the protection of wetland habitat. However not all wetlands provide such motivation for their protection, thus wetland managers and conservationists began assessing the importance of wetland function within an ecosystem.

Table 18 summarises the importance of wetland function when related to ecosystem services or ecoservices (Kotze et al., 2008). One such example is emergent reed bed wetlands that function as transformers converting inorganic nutrients into organic compounds (Mitsch and Gosselink, 2000).

Table 18: Summary of direct and indirect ecoservices provided by wetlands from Kotze et al., 2008.

Wetland benefits (goods and services)	**Indirect benefits**	Hydrological benefits	Water purification
			Sustained stream flow
			Flood reduction
			Ground water recharge/discharge
			Erosion control
		Biodiversity conservation – integrity & irreplaceability	
		Chemical cycling	
	Direct benefits	Water supply	
		Provision of harvestable resources	
		Socio-cultural significance	
		Tourism and recreation	
		Education and research	

Relevant wetland legislation and policy

Locally the South African Constitution, seven (7) Acts and two (2) international treaties allow for the protection of wetlands and rivers. These systems are protected from the destruction or pollution by the following:

» Section 24 of The Constitution of the Republic of South Africa;

- Agenda 21 – Action plan for sustainable development of the Department of Environmental Affairs and Tourism (DEAT) 1998;
- The Ramsar Convention, 1971 including the Wetland Conservation Programme (DEAT) and the National Wetland Rehabilitation Initiative (DEAT, 2000);
- National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) inclusive of all amendments, as well as the NEM: Biodiversity Act;
- National Water Act, 1998 (Act No. 36 of 1998);
- Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983); and
- Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002).
- Nature and Environmental Conservation Ordinance (No. 19 of 1974)
- National Forest Act (No. 84 of 1998)
- National Heritage Resources Act (No. 25 of 1999)

Apart from NEMA, the Conservation of Agricultural Resources Act (CARA), 1983 (Act No. 43 of 1983) will also apply to this project. The CARA has categorised a large number of invasive plants together with associated obligations of the land owner. A number of Category 1 & 2 plants were found at all of the sites investigated; thus, the contractors must take extreme care further spread of these plants doesn't occur. This should be done through proper stockpile management (topsoil) and suitable rehabilitation of disturbed areas after construction.

An amendment of the National Environmental Management was promulgated late December 2011, namely the Biodiversity Act or NEM:BA (Act No 10 of 2004), which lists 225 threatened ecosystems based on vegetation type (Vegmap, 2006 as amended). Should a vegetation type or ecosystem be listed, actions in terms of NEM:BA are triggered.

Other policies that are relevant include:

- Provincial Nature Conservation Ordinance (PNCO) – Protected Flora. Any plants found within the sites are described in the ecological assessment.
- National Freshwater Ecosystems Priority Areas – CSIR 2011 draft. This mapping product highlights potential rivers and wetlands that should be earmarked for conservation on a national basis.

National Wetland Classification System method

During this study, due to the nature of the wetlands and watercourses observed, it was decided that the newly accepted National Wetlands Classification System (NWCS) be adopted. This classification approach has integrated aspects of the HGM approached used in the WET-Health system as well as the widely accepted eco-classification approach used for rivers.

The NWCS (SANBI, 2009) as stated previously, uses hydrological and geomorphological traits to distinguish the primary wetland units, i.e. direct factors that influence wetland

function. Other wetland assessment techniques, such as the DWAF (2005) delineation method, only infer wetland function based on abiotic and biotic descriptors (size, soils & vegetation) stemming from the Cowardin approach (SANBI, 2009).

The classification system used in this study is thus based on SANBI (2009) and is summarised below:
The NWCS has a six-tiered hierarchical structure, with four spatially nested primary levels of classification (Figure 15). The hierarchical system firstly distinguishes between Marine, Estuarine and Inland ecosystems (**Level 1**), based on the degree of connectivity the particular systems has with the open ocean (greater than 10 m in depth). **Level 2** then categorises the regional wetland setting using a combination of biophysical attributes at the landscape level, which operate at a broad bioregional scale. This is opposed to specific attributes such as soils and vegetation. **Level 2** has adopted the following systems:

» Inshore bioregions (marine)
» Biogeographic zones (estuaries)
» Ecoregions (Inland)

Level 3 of the NWCS assess the topographical position of inland wetlands as this factor broadly defines certain hydrological characteristics of the inland systems. Four landscape units based on topographical position are used in distinguishing between Inland systems at this level. No subsystems are recognised for Marine systems, but estuaries are grouped according to their periodicity of connection with the marine environment, as this would affect the biotic characteristics of the estuary.

Level 4 classifies the hydrogeomorphic (HGM) units discussed earlier. The HGM units are defined as follows:

(i) Landform – shape and localised setting of wetland
(ii) Hydrological characteristics – nature of water movement into, through and out of the wetland
(iii) Hydrodynamics – the direction and strength of flow through the wetland.

These factors characterise the geomorphological processes within the wetland, such as erosion and depositing, as well as the biogeochemical processes.

Level 5 of the assessment pertains to the classification of the tidal regime within the marine and estuarine environments, while the hydrological and inundation depth classes are determined for the inland wetlands. Classes are based on frequency and depth of inundation, which are used to determine the functional unit of the wetlands and are considered secondary discriminators within the NWCS.

Level 6 uses of six descriptors to characterise the wetland types on the basis of biophysical features. As with Level 5, these are non-hierarchal in relation to each other and are applied in any order, dependent on the availability of information.

The descriptors include:
(i) Geology;
(ii) Natural vs. Artificial;
(iii) Vegetation cover type;
(iv) Substratum;
(v) Salinity; and
(vi) Acidity or Alkalinity.
It should be noted that where sub-categories exist within the above descriptors, hierarchical systems are employed, thus are nested in relation to each other.

The HGM unit (Level 4) is the **focal point of the NWCS**, with the upper levels (Figure 14 – Inland systems only) providing means to classify the broad bio-geographical context for grouping functional wetland units at the HGM level, while the lower levels provide more descriptive detail on the particular wetland type characteristics of a particular HGM unit. Therefore Level 1 – 5 deals with functional aspects, while Level 6 classifies wetlands on structural aspects.

In the past wetland conservation, has focused on biodiversity as a means of substantiating the protection of wetland habitat. However not all wetlands provide such motivation for their protection, thus wetland managers and conservationists began assessing the importance of wetland function within an ecosystem.

The HGM unit (Level 4) is the **focal point of the NWCS**, with the upper levels (Figure 15 – Inland systems only) providing means to classify the broad bio-geographical context for grouping functional wetland units at the HGM level, while the lower levels provide more descriptive detail on the particular wetland type characteristics of a particular HGM unit. Therefore Level 1 – 5 deals with functional aspects, while Level 6 classifies wetlands on structural aspects.
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Level 1:
System » Connectivity to open ocean

WETLAND/AQUATIC ECOSYSTEM CONTEXT	
LEVEL 2: REGIONAL SETTING	LEVEL 3: LANDSCAPE UNIT
DWA Level 1 Ecoregions or NFEPA WetVeg Groups or Other spatial frameworks	Valley floor
	Slope
	Plain
	Bench (Hilltop/Saddle/Shelf)

FUNCTIONAL UNIT	
LEVEL 4: HYDROGEOMORPHIC (HGM) UNIT	LEVEL 5: HYDROLOGICAL REGIME
River	Perenniality
Floodplain wetland	Period and depth of inundation and Period of saturation
Channelled valley-bottom wetland	
Unchannelled valley-bottom wetland	
Depression	
Seep	
Wetland flat	

WETLAND/AQUATIC ECOSYSTEM CHARACTERISTICS
LEVEL 6: DESCRIPTORS
Natural vs. Artificial Salinity pH Substratum type Vegetation type Geology

Figure 14: Basic structure of the National Wetland Classification System, showing how 'primary discriminators' are applied up to Level 4 to classify Hydrogeomorphic (HGM) Units, with 'secondary discriminators' applied at Level 5 to classify the hydrological regime, and 'descriptors' applied at Level 6 to categorise the characteristics of wetlands classified up to Level 5 (From SANBI, 2009).

Wetland condition and conservation importance assessment

Wetland functional assessment

» ***WET-Health Assessment (Wetland integrity/Present Ecological State)***

The Wet-Health tool (Macfarlane *et al.* 2008) was used to assess the Present Ecological State (PES) of wetlands by highlighting specific impacts within wetlands and within wetland catchment areas. For the purposes of this study, a Level 1 assessment was undertaken. While this is a rapid assessment, it is regarded as adequate to inform an assessment of existing impacts on wetland condition.

The WET-Health tool provides an appropriate framework for undertaking an assessment to indicate the functional importance of the wetland system that could be impacted by the proposed development. The assessment also helps to identify specific impacts thereby highlighting issues that should be addressed through mitigation and rehabilitation activities. The Level 1 assessment, approach relies on a combination of desktop and on-site indicators to assess various aspects of wetland condition, including:
Hydrology: defined as the distribution and movement of water through a wetland and its soils.
Geomorphology: defined as the distribution and retention patterns of sediment within the wetland.
Vegetation: defined as the vegetation structural and compositional state.

Each of these modules follows a broadly similar approach and is used to evaluate the extent to which anthropogenic changes have impacted upon wetland functioning or condition. While the impacts considered vary considerably across each module, a standardized scoring system is applied to facilitate the interpretation of results (Table 19). Scores range from 0 indicating no impact to a maximum of 10 which would imply that impacts had totally destroyed the functioning of a particular component.

Table 19: Guideline for interpreting the magnitude of impacts on wetland integrity (after Macfarlane *et al*. 2008)

IMPACT CATEGORY	DESCRIPTION	SCORE
None	No discernible modification or the modification is such that it has no impact on this component of wetland integrity.	0 – 0.9
Small	Although identifiable, the impact of this modification on this component of wetland integrity is small.	1 – 1.9
Moderate	The impact of this modification on this component of wetland integrity is clearly identifiable, but limited	2 – 3.9
Large	The modification has a clearly detrimental impact on this component of wetland integrity. Approximately 50% of wetland integrity has been lost.	4 – 5.9
Serious	The modification has a highly detrimental effect on this component of wetland integrity. Much of the wetland integrity has been lost but remaining integrity is still clearly identifiable.	6 – 7.9

Critical	The modification is so great that the ecosystem processes of this component of wetland integrity are almost totally destroyed, and 80% or more of the integrity has been lost.	8 - 10

Impact scores obtained for each of the modules reflect the degree of change from natural reference conditions. Resultant health scores fall into one of six health categories (A-F) on a gradient from "unmodified/natural" (Category A) to "severe/complete" deviation from natural" (Condition F) as depicted in Table 20, below. This classification is consistent with DWAF categories used to evaluate the present ecological state of aquatic ecosystems.

Table 20: Guideline for interpreting the magnitude of impacts on wetland integrity (after Macfarlane *et al*. 2008)

PES CATEGORY	DESCRIPTION	RANGE
A	Unmodified, natural.	0 – 0.9
B	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitat and biota may have taken place.	1 – 1.9
C	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2 – 3.9
D	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota and has occurred.	4 – 5.9
E	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable	6 – 7.9
F	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota	8 - 10

An overall wetland health score is calculated by weighting the scores obtained for each module and combining them to give an overall combined score using the following formula:

» **Overall health rating**
= [(Hydrology*3)+(Geomorphology*2)+(Vegetation*2)]/7

This overall score assists in providing an overall indication of wetland health/functionality which can in turn be used for recommending appropriate management measures.

Appendix 3: Listed Plant Species

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

Colours Relate as follow:
Threatened Status: Critically (CR), Endangered (EN), Vulnerable (VU), Near Threatened (NT), Critically Rare, Rare, Declining and Data Deficient (DDD), Not Evaluated (NE)

» Protected according to National Forest Act 1998 / NFA (No 84 of 1998).

» Protected according to The Transvaal Nature Conservation Ordinance (No. 12 of 1983), and

» Protected according to The Bophuthatswana Nature Conservation Act (Act 3 of 1973).

» Invasive Alien Plant

Family	Species	Threat status
ACANTHACEAE	Barleria irritans	LC
ACANTHACEAE	Barleria macrostegia	LC
ACANTHACEAE	Barleria rigida	LC
ACANTHACEAE	Blepharis integrifolia var. integrifolia	LC
ACANTHACEAE	Crabbea angustifolia	LC
ACANTHACEAE	Dyschoriste pseuderecta	LC
ACANTHACEAE	Dyschoriste transvaalensis	LC
ACANTHACEAE	Monechma divaricatum	LC
ACANTHACEAE	Ruellia patula	LC
ACANTHACEAE	Ruelliopsis setosa	LC
AIZOACEAE	Galenia affinis	LC
AIZOACEAE	Galenia portulacacea	LC
AIZOACEAE	Galenia pubescens	LC
AIZOACEAE	Galenia secunda	LC
AIZOACEAE	Plinthus sericeus	LC
AIZOACEAE	Tetragonia spicata	LC
AIZOACEAE	Trianthema salsoloides var. transvaalensis	LC
AIZOACEAE	Zaleya pentandra	LC
ALLIACEAE	Tulbaghia leucantha	LC
AMARANTHACEAE	Achyranthes aspera var. aspera	NE
AMARANTHACEAE	Aerva leucura	LC
AMARANTHACEAE	Alternanthera nodiflora	NE
AMARANTHACEAE	Alternanthera pungens	NE
AMARANTHACEAE	Amaranthus thunbergii	LC
AMARANTHACEAE	Cyathula lanceolata	LC
AMARANTHACEAE	Gomphrena celosioides	NE
AMARANTHACEAE	Hermbstaedtia fleckii	LC
AMARANTHACEAE	Hermbstaedtia odorata var. albi-rosea	LC
AMARANTHACEAE	Hermbstaedtia odorata var. aurantiaca	LC
AMARANTHACEAE	Hermbstaedtia odorata var. odorata	LC

AMARANTHACEAE	Kyphocarpa angustifolia	LC
AMARANTHACEAE	Pupalia lappacea var. lappacea	LC
AMARANTHACEAE	Sericocoma avolans	LC
AMARANTHACEAE	Sericorema sericea	LC
AMARYLLIDACEAE	**Ammocharis coranica**	LC
AMARYLLIDACEAE	**Brunsvigia radulosa**	LC
AMARYLLIDACEAE	**Crinum crassicaule**	LC
AMARYLLIDACEAE	**Nerine frithii**	LC
AMARYLLIDACEAE	**Nerine hesseoides**	LC
AMARYLLIDACEAE	**Nerine laticoma**	LC
ANACARDIACEAE	Ozoroa paniculosa var. paniculosa	LC
ANACARDIACEAE	Searsia burchellii	LC
ANACARDIACEAE	Searsia lancea	LC
ANACARDIACEAE	Searsia leptodictya	NE
ANACARDIACEAE	Searsia magalismontana subsp. magalismontana	LC
ANACARDIACEAE	Searsia pyroides var. pyroides	LC
ANACARDIACEAE	Searsia tenuinervis	LC
ANACARDIACEAE	Searsia tridactyla	LC
ANTHERICACEAE	Chlorophytum angulicaule	LC
ANTHERICACEAE	Chlorophytum fasciculatum	LC
ANTHERICACEAE	Chlorophytum krauseanum	LC
ANTHERICACEAE	Chlorophytum recurvifolium	LC
APIACEAE	Apium graveolens	NE
APIACEAE	Berula thunbergii	LC
APIACEAE	Centella asiatica	LC
APIACEAE	Cyclospermum leptophyllum	NE
APIACEAE	Deverra burchellii	LC
APOCYNACEAE	Asclepias eminens	LC
APOCYNACEAE	**Brachystelma dimorphum subsp. dimorphum**	LC
APOCYNACEAE	**Brachystelma foetidum**	LC
APOCYNACEAE	**Ceropegia crassifolia var. crassifolia**	LC
APOCYNACEAE	Fockea angustifolia	LC
APOCYNACEAE	Gomphocarpus fruticosus subsp. fruticosus	LC
APOCYNACEAE	Gomphocarpus tomentosus Burch. subsp. tomentosus	LC
APOCYNACEAE	Gomphocarpus tomentosus subsp. tomentosus	LC
APOCYNACEAE	**Hoodia pilifera subsp. annulata**	LC
APOCYNACEAE	Pentarrhinum insipidum	LC
APOCYNACEAE	Pentarrhinum insipidum E.Mey.	LC
APOCYNACEAE	Pergularia daemia subsp. daemia	LC
APOCYNACEAE	Raphionacme hirsuta	LC
APOCYNACEAE	Raphionacme velutina	LC
APOCYNACEAE	**Stapelia grandiflora var. grandiflora**	LC
APOCYNACEAE	Stenostelma capense	LC
APOCYNACEAE	Xysmalobium gomphocarpoides var. gomphocarpoides	LC
APONOGETONACEAE	Aponogeton rehmannii	LC
ASPARAGACEAE	Asparagus bechuanicus	LC
ASPARAGACEAE	Asparagus cooperi	LC
ASPARAGACEAE	Asparagus laricinus	LC
ASPARAGACEAE	Asparagus nodulosus	LC
ASPARAGACEAE	Asparagus retrofractus	LC
ASPARAGACEAE	Asparagus setaceus	LC
ASPARAGACEAE	Asparagus suaveolens	LC

ASPHODELACEAE	**Aloe grandidentata**	LC
ASPHODELACEAE	**Aloe zebrina**	LC
ASPHODELACEAE	Bulbine abyssinica	LC
ASPHODELACEAE	Bulbine narcissifolia	LC
ASPHODELACEAE	**Chortolirion angolense**	LC
ASPHODELACEAE	Haworthia venosa subsp. tessellata	LC
ASPHODELACEAE	Trachyandra burkei	LC
ASPHODELACEAE	Trachyandra laxa var. rigida	LC
ASPHODELACEAE	Trachyandra saltii var. oatesii	LC
ASPHODELACEAE	Trachyandra saltii var. saltii	LC
ASPLENIACEAE	Asplenium phillipsianum	LC
ASTERACEAE	Acanthospermum glabratum	NE
ASTERACEAE	Amphiglossa triflora	LC
ASTERACEAE	Arctotheca calendula	LC
ASTERACEAE	Arctotis arctotoides	LC
ASTERACEAE	Arctotis microcephala	LC
ASTERACEAE	Arctotis venusta	LC
ASTERACEAE	Artemisia afra var. afra	LC
ASTERACEAE	Aster squamatus	NE
ASTERACEAE	Berkheya carlinopsis subsp. magalismontana	LC
ASTERACEAE	Berkheya discolor	LC
ASTERACEAE	Berkheya onopordifolia var. onopordifolia	LC
ASTERACEAE	Berkheya pinnatifida subsp. pinnatifida	LC
ASTERACEAE	Berkheya radula	LC
ASTERACEAE	Bidens bipinnata	NE
ASTERACEAE	Bidens pilosa	NE
ASTERACEAE	Blumea dregeanoides	LC
ASTERACEAE	Chrysocoma ciliata	LC
ASTERACEAE	Chrysocoma obtusata	LC
ASTERACEAE	Cichorium intybus subsp. intybus	NE
ASTERACEAE	Cineraria vallis-pacis	LC
ASTERACEAE	Cirsium vulgare	NE
ASTERACEAE	Conyza bonariensis	NE
ASTERACEAE	Cotula anthemoides	LC
ASTERACEAE	Cotula burchellii	NE
ASTERACEAE	Denekia capensis	LC
ASTERACEAE	Dicoma anomala subsp. anomala	LC
ASTERACEAE	Dicoma anomala subsp. gerrardii	LC
ASTERACEAE	Dicoma capensis	LC
ASTERACEAE	Dicoma macrocephala	LC
ASTERACEAE	Dicoma schinzii	LC
ASTERACEAE	Dimorphotheca cuneata	LC
ASTERACEAE	Dimorphotheca zeyheri	LC
ASTERACEAE	Erlangea misera	LC
ASTERACEAE	Felicia clavipilosa subsp. clavipilosa	LC
ASTERACEAE	Felicia filifolia subsp. filifolia	LC
ASTERACEAE	Felicia hirsuta	LC
ASTERACEAE	Felicia muricata subsp. cinerascens	LC
ASTERACEAE	Felicia muricata subsp. muricata	LC
ASTERACEAE	Flaveria bidentis	NE
ASTERACEAE	Galinsoga parviflora	NE
ASTERACEAE	Gazania krebsiana subsp. serrulata	LC

ASTERACEAE	Geigeria aspera var. aspera	LC
ASTERACEAE	Geigeria brevifolia	LC
ASTERACEAE	Geigeria burkei subsp. burkei var. burkei	LC
ASTERACEAE	Geigeria burkei subsp. burkei var. zeyheri	LC
ASTERACEAE	Geigeria burkei subsp. diffusa	LC
ASTERACEAE	Geigeria burkei subsp. fruticulosa	LC
ASTERACEAE	Geigeria filifolia	LC
ASTERACEAE	Geigeria obtusifolia	LC
ASTERACEAE	Geigeria ornativa subsp. ornativa	LC
ASTERACEAE	Gnaphalium filagopsis	LC
ASTERACEAE	Gnaphalium nelsonii	Rare
ASTERACEAE	Helianthus debilis subsp. cucumerifolius	NE
ASTERACEAE	Helichrysum argyrosphaerum	LC
ASTERACEAE	Helichrysum caespititium	LC
ASTERACEAE	Helichrysum cerastioides var. cerastioides	LC
ASTERACEAE	Helichrysum dregeanum	LC
ASTERACEAE	Helichrysum lineare	LC
ASTERACEAE	Helichrysum nudifolium var. nudifolium	LC
ASTERACEAE	Helichrysum obtusum	LC
ASTERACEAE	Helichrysum paronychioides	LC
ASTERACEAE	Helichrysum tomentosulum subsp. aromaticum	LC
ASTERACEAE	Helichrysum zeyheri	LC
ASTERACEAE	Hertia pallens	LC
ASTERACEAE	Hirpicium bechuanense	LC
ASTERACEAE	Ifloga glomerata	LC
ASTERACEAE	Lactuca inermis	LC
ASTERACEAE	Laggera decurrens	LC
ASTERACEAE	Lasiopogon muscoides	LC
ASTERACEAE	Launaea rarifolia var. rarifolia	LC
ASTERACEAE	Litogyne gariepina	LC
ASTERACEAE	Mikaniopsis cissampelina	LC
ASTERACEAE	Nidorella hottentotica	LC
ASTERACEAE	Nidorella resedifolia subsp. resedifolia	LC
ASTERACEAE	Nolletia ciliaris	LC
ASTERACEAE	Osteospermum muricatum ex subsp. muricatum	LC
ASTERACEAE	Pegolettia retrofracta	LC
ASTERACEAE	Pentzia calcarea	LC
ASTERACEAE	Pentzia calcarea Kies	LC
ASTERACEAE	Pentzia globosa	LC
ASTERACEAE	Pentzia incana	LC
ASTERACEAE	Pentzia lanata	LC
ASTERACEAE	Pentzia quinquefida	LC
ASTERACEAE	Pseudognaphalium luteo-album	
ASTERACEAE	Pseudognaphalium oligandrum	LC
ASTERACEAE	Rennera stellata	VU
ASTERACEAE	Schkuhria pinnata	NE
ASTERACEAE	Senecio arenarius	LC
ASTERACEAE	Senecio burchellii	LC
ASTERACEAE	Senecio inaequidens	LC
ASTERACEAE	Senecio reptans	LC
ASTERACEAE	Sonchus oleraceus	NE
ASTERACEAE	Tagetes minuta	NE

ASTERACEAE	Tarchonanthus camphoratus	LC
ASTERACEAE	Tarchonanthus obovatus	LC
ASTERACEAE	Tripteris aghillana var. aghillana	LC
ASTERACEAE	Ursinia nana subsp. leptophylla	LC
ASTERACEAE	Verbesina encelioides var. encelioides	NE
ASTERACEAE	Vernonia galpinii	LC
ASTERACEAE	Xanthium spinosum	NE
ASTERACEAE	Zinnia peruviana	NE
BIGNONIACEAE	Rhigozum brevispinosum	LC
BORAGINACEAE	Anchusa riparia	LC
BORAGINACEAE	Cynoglossum lanceolatum	LC
BORAGINACEAE	Ehretia alba	LC
BORAGINACEAE	Heliotropium ciliatum	LC
BORAGINACEAE	Heliotropium nelsonii	LC
BORAGINACEAE	Heliotropium ovalifolium	LC
BORAGINACEAE	Heliotropium strigosum	LC
BORAGINACEAE	Heliotropium zeylanicum	LC
BORAGINACEAE	Lithospermum cinereum	LC
BORAGINACEAE	Lithospermum scabrum	LC
BORAGINACEAE	Trichodesma angustifolium subsp. angustifolium	LC
BRASSICACEAE	Capsella bursa-pastoris	NE
BRASSICACEAE	Coronopus integrifolius	NE
BRASSICACEAE	Erucastrum strigosum	LC
BRASSICACEAE	Rorippa fluviatilis var. caledonica	LC
BRASSICACEAE	Sisymbrium capense	LC
BRASSICACEAE	Sisymbrium turczaninowii	LC
BUDDLEJACEAE	Buddleja saligna	LC
BUDDLEJACEAE	Gomphostigma virgatum	LC
BUDDLEJACEAE	Nuxia gracilis	LC
BURSERACEAE	Commiphora glandulosa	LC
BURSERACEAE	Commiphora pyracanthoides	LC
BURSERACEAE	Commiphora pyracanthoides Engl.	LC
CAMPANULACEAE	Wahlenbergia androsacea	LC
CAMPANULACEAE	Wahlenbergia denticulata var. denticulata	LC
CAMPANULACEAE	Wahlenbergia denticulata var. transvaalensis	LC
CAMPANULACEAE	Wahlenbergia paniculata	LC
CAMPANULACEAE	Wahlenbergia undulata	LC
CAPPARACEAE	**Boscia albitrunca**	LC
CAPPARACEAE	Boscia foetida subsp. minima	LC
CAPPARACEAE	Cadaba aphylla	LC
CAPPARACEAE	Cleome angustifolia subsp. diandra	LC
CAPPARACEAE	Cleome angustifolia subsp. petersiana	LC
CAPPARACEAE	Cleome gynandra	LC
CAPPARACEAE	Cleome maculata	LC
CAPPARACEAE	Cleome monophylla	LC
CAPPARACEAE	Cleome rubella	LC
CARYOPHYLLACEAE	Dianthus micropetalus	LC
CARYOPHYLLACEAE	Pollichia campestris	LC
CARYOPHYLLACEAE	Pollichia campestris Aiton	LC
CARYOPHYLLACEAE	Silene undulata	LC
CELASTRACEAE	Gymnosporia buxifolia	LC
CELASTRACEAE	Maytenus acuminata var. acuminata	LC

CELTIDACEAE	Celtis africana	LC
CHENOPODIACEAE	Atriplex semibaccata var. appendiculata	LC
CHENOPODIACEAE	Chenopodium ambrosioides	NE
CHENOPODIACEAE	Chenopodium carinatum	NE
CHENOPODIACEAE	Chenopodium phillipsianum	NE
CHENOPODIACEAE	Salsola atrata	LC
CHENOPODIACEAE	Salsola glabrescens	LC
COLCHICACEAE	Colchicum melanthoides subsp. melanthoides	LC
COLCHICACEAE	Ornithoglossum dinteri	LC
COLCHICACEAE	Ornithoglossum vulgare	LC
COMBRETACEAE	Terminalia sericea	LC
COMMELINACEAE	Commelina africana var. africana	LC
COMMELINACEAE	Commelina africana var. barberae	LC
COMMELINACEAE	Commelina africana var. krebsiana	LC
COMMELINACEAE	Commelina africana var. lancispatha	LC
COMMELINACEAE	Commelina benghalensis	LC
COMMELINACEAE	Commelina livingstonii	LC
COMMELINACEAE	Cyanotis speciosa	LC
CONVOLVULACEAE	Convolvulus multifidus	LC
CONVOLVULACEAE	Convolvulus ocellatus var. ocellatus	LC
CONVOLVULACEAE	Convolvulus sagittatus	LC
CONVOLVULACEAE	Evolvulus alsinoides	LC
CONVOLVULACEAE	Falkia oblonga	LC
CONVOLVULACEAE	Ipomoea bolusiana	LC
CONVOLVULACEAE	Ipomoea obscura var. obscura	LC
CONVOLVULACEAE	Ipomoea oenotheroides	LC
CONVOLVULACEAE	Ipomoea sinensis subsp. blepharosepala	LC
CONVOLVULACEAE	Merremia verecunda	LC
CONVOLVULACEAE	Seddera capensis	LC
CONVOLVULACEAE	Seddera suffruticosa	LC
CONVOLVULACEAE	Xenostegia tridentata subsp. angustifolia	LC
CRASSULACEAE	Crassula lanceolata subsp. transvaalensis	LC
CRASSULACEAE	Kalanchoe paniculata	LC
CUCURBITACEAE	Acanthosicyos naudinianus	LC
CUCURBITACEAE	Coccinia sessilifolia	LC
CUCURBITACEAE	Cucumis africanus	LC
CUCURBITACEAE	Cucumis myriocarpus subsp. myriocarpus	LC
CUCURBITACEAE	Cucumis zeyheri	LC
CUCURBITACEAE	Kedrostis crassirostrata	LC
CUCURBITACEAE	Momordica balsamina	LC
CYPERACEAE	Bulbostylis burchellii	LC
CYPERACEAE	Bulbostylis hispidula subsp. pyriformis	LC
CYPERACEAE	Bulbostylis pusilla	LC
CYPERACEAE	Cyperus atriceps	LC
CYPERACEAE	Cyperus austro-africanus	LC
CYPERACEAE	Cyperus bellus	LC
CYPERACEAE	Cyperus decurvatus	LC
CYPERACEAE	Cyperus difformis	LC
CYPERACEAE	Cyperus esculentus var. esculentus	LC
CYPERACEAE	Cyperus fastigiatus	LC
CYPERACEAE	Cyperus indecorus var. namaquensis	LC
CYPERACEAE	Cyperus longus var. tenuiflorus	LC

CYPERACEAE	Cyperus margaritaceus var. margaritaceus	LC
CYPERACEAE	Cyperus marginatus	LC
CYPERACEAE	Cyperus marlothii	LC
CYPERACEAE	Cyperus obtusiflorus var. obtusiflorus	LC
CYPERACEAE	Cyperus palmatus	LC
CYPERACEAE	Cyperus rubicundus	LC
CYPERACEAE	Cyperus sexangularis	LC
CYPERACEAE	Cyperus sphaerospermus	LC
CYPERACEAE	Cyperus squarrosus	LC
CYPERACEAE	Cyperus usitatus	LC
CYPERACEAE	Kyllinga alba	LC
CYPERACEAE	Kyllinga erecta var. erecta	LC
EUPHORBIACEAE	Acalypha segetalis	LC
EUPHORBIACEAE	Acalypha segetalis Müll.Arg.	LC
EUPHORBIACEAE	Euphorbia inaequilatera var. inaequilatera	LC
FABACEAE	Acacia robusta subsp. robusta	LC
FABACEAE	Gleditsia triacanthos	NE
FABACEAE	Indigastrum costatum subsp. macrum	LC
FABACEAE	Indigofera cryptantha var. cryptantha	LC
FABACEAE	Indigofera heterotricha	LC
FABACEAE	Indigofera sessilifolia	LC
FABACEAE	Otoptera burchellii	LC
FABACEAE	Rhynchosia totta var. totta	LC
FABACEAE	Zornia milneana	LC
HYACINTHACEAE	Dipcadi viride	LC
IRIDACEAE	**Babiana bainesii**	LC
IRIDACEAE	Moraea polystachya	LC
LAMIACEAE	Salvia disermas	LC
LAMIACEAE	Teucrium trifidum	LC
MALVACEAE	Hermannia quartiniana	LC
MALVACEAE	Hibiscus pusillus	LC
MALVACEAE	Hibiscus trionum	
MALVACEAE	Melhania prostrata	LC
MALVACEAE	Sida chrysantha	LC
MESEMBRYANTHEMACEAE	Lithops lesliei subsp. lesliei	NT
MOLLUGINACEAE	Hypertelis salsoloides var. salsoloides	LC
MOLLUGINACEAE	Limeum viscosum subsp. transvaalense	LC
MOLLUGINACEAE	Limeum viscosum subsp. viscosum var. viscosum	LC
NYCTAGINACEAE	Commicarpus pentandrus	LC
PASSIFLORACEAE	Adenia repanda	LC
PHYLLANTHACEAE	Phyllanthus incurvus	LC
PLUMBAGINACEAE	Plumbago zeylanica	NE
POACEAE	Andropogon schirensis	LC
POACEAE	Anthephora pubescens	LC
POACEAE	Aristida bipartita	LC
POACEAE	Aristida canescens subsp. canescens	LC
POACEAE	Aristida congesta subsp. barbicollis	LC
POACEAE	Aristida congesta subsp. congesta	LC
POACEAE	Aristida meridionalis	LC
POACEAE	Aristida spectabilis	LC
POACEAE	Aristida stipitata subsp. graciliflora	LC
POACEAE	Aristida stipitata subsp. spicata	LC

POACEAE	Aristida vestita	LC
POACEAE	Brachiaria brizantha	LC
POACEAE	Brachiaria deflexa	LC
POACEAE	Brachiaria nigropedata	LC
POACEAE	Cymbopogon pospischilii	NE
POACEAE	Diandrochloa pusilla	LC
POACEAE	Digitaria brazzae	LC
POACEAE	Digitaria eriantha	LC
POACEAE	Digitaria sanguinalis	NE
POACEAE	Diheteropogon amplectens var. amplectens	LC
POACEAE	Elionurus muticus	LC
POACEAE	Enneapogon scoparius	LC
POACEAE	Eragrostis barrelieri	NE
POACEAE	Eragrostis bicolor	LC
POACEAE	Eragrostis chloromelas	LC
POACEAE	Eragrostis curvula	LC
POACEAE	Eragrostis echinochloidea	LC
POACEAE	Eragrostis gummiflua	LC
POACEAE	Eragrostis homomalla	LC
POACEAE	Eragrostis lehmanniana var. lehmanniana	LC
POACEAE	Eragrostis nindensis	LC
POACEAE	Eragrostis pallens	LC
POACEAE	Eragrostis rigidior	LC
POACEAE	Eragrostis superba	LC
POACEAE	Eragrostis viscosa	LC
POACEAE	Eragrostis x pseud-obtusa	NE
POACEAE	Fingerhuthia africana	LC
POACEAE	Heteropogon contortus	LC
POACEAE	Hyparrhenia hirta	LC
POACEAE	Leptochloa fusca	LC
POACEAE	Melinis repens subsp. repens	LC
POACEAE	Panicum coloratum var. coloratum	LC
POACEAE	Panicum kalaharense	LC
POACEAE	Panicum maximum	LC
POACEAE	Panicum stapfianum	LC
POACEAE	Pogonarthria squarrosa	LC
POACEAE	Schizachyrium sanguineum	LC
POACEAE	Schmidtia pappophoroides	LC
POACEAE	Sporobolus fimbriatus	LC
POACEAE	Stipagrostis uniplumis var. neesii	LC
POACEAE	Themeda triandra	LC
POACEAE	Tricholaena monachne	LC
POACEAE	Trichoneura grandiglumis	LC
POACEAE	Triraphis andropogonoides	LC
POACEAE	Urochloa panicoides	
POLYGONACEAE	Oxygonum alatum var. alatum	LC
POTTIACEAE	Pseudocrossidium porphyreoneurum	
PTERIDACEAE	Actiniopteris radiata	LC
RICCIACEAE	Riccia albolimbata	
RUBIACEAE	Anthospermum rigidum subsp. rigidum	LC
RUBIACEAE	Kohautia cynanchica	LC
SCROPHULARIACEAE	Aptosimum albomarginatum	LC

SCROPHULARIACEAE	Aptosimum elongatum	LC
SCROPHULARIACEAE	Peliostomum leucorrhizum	LC
SCROPHULARIACEAE	Selago mixta	LC
SCROPHULARIACEAE	Selago mixta Hilliard	LC
SINOPTERIDACEAE	Cheilanthes dolomiticola	LC
SINOPTERIDACEAE	Cheilanthes hirta var. brevipilosa	
SINOPTERIDACEAE	Pellaea calomelanos var. calomelanos	LC
SOLANACEAE	Solanum catombelense	LC
VERBENACEAE	Lantana mearnsii var. latibracteolata	LC
VERBENACEAE	Lantana rugosa	LC
VERBENACEAE	Lippia scaberrima	LC
VERBENACEAE	Verbena officinalis	NE

Appendix 4: Listed of Mammals

List of Mammals which may potentially occur within the surrounding area. Taxonomy notes are derived from Skinner & Chimimba (2005), while conservation status is according to the IUCN 2010.

Colours Relate as follow:

» Protected according to The Transvaal Nature Conservation Ordinance (No. 12 of 1983); Schedule 2 – Protected Game (Section 15(1)(a)) and Schedule 4 – Protected Wild Animals (Section 15(1)(c)), and

» Protected according to The Bophuthatswana Nature Conservation Act (Act 3 of 1973); Schedule 1 – Protected Game.

» Protected according to The Bophuthatswana Nature Conservation Act (Act 3 of 1973); Schedule 2 – Ordinary Game.

» National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004); Threatened or Protected Species Regulations

- Endangered Species
- Vulnerable Species
- Protected Species

Likelihood Rating: 1=Confirmed; 2=Likely; 3=Moderate; 4=Unlikely & 5= May occur as a managed population

Scientific Name	Common Name	IUCN Status	Regional Status	Likelihood	ADU Database
MACROSCLEDIDEA (ELEPHANT SHREWS): SPECIES: 2 CONSERVATION IMPORTANT SPECIES: 0					
Elephantulus myurus	Eastern Rock Sengi	LC	LC	3	X
Elephantulus brachyrhynchus	Short-snouted Sengi	LC	LC	2	
TUBULENTATA: SPECIES: 1 CONSERVATION IMPORTANT SPECIES: 1					
Orycteropus afer	Aardvark	LC	LC	3	X
HYRACOIDEA (HYRAXES) SPECIES: 1 CONSERVATION IMPORTANT SPECIES: 0					
Procavia capensis	Rock Hyrax	LC	LC	4	
LAGOMORPHA (HARES AND RABBITS): SPECIES: 3 CONSERVATION IMPORTANT SPECIES: 2					
Pronolagus randensis	Jameson's Red Rock Rabbit	LC	LC	4	
Lepus capensis	Cape Hare	LC	LC	3	X
Lepus victoriae	Savanna Hare	LC	LC	2	X
RODENTIA (RODENTS): SPECIES: 29 CONSERVATION IMPORTANT SPECIES: 1					
Cryptomys hottentotus	African Mole Rat	LC	LC	2	X
Hystrix africaeaustralis	Cape Porcupine	LC	LC	2	X
Pedetes capensis	Springhare	LC	LC	2	X
Xerus inauris	South African Ground Squirrel	LC	LC	2	X
Paraxerus cepapi	Tree Squirrel	LC	LC	4	
Graphiurus microtis	Small-eared Dormouse		LC	3	
Graphiurus platyops	Rock Dormouse	DD	LC	2	
Graphiurus murinus	Woodland Dormouse	LC	LC	2	
Thryonomys swinderianus	Greater Cane-rat	LC	LC	4	
Rhabdomys pumilio	Four-striped Grass Mouse	LC	LC	2	X
Rhabdomys dilectus	Mesic Four-striped Grass Mouse	LC	LC	2	X
Lemniscomys rosalia	Single-striped Grass Mouse	DD	LC	2	X
Mus minutoides	Pygmy Mouse	LC	LC	2	

Mus indutus	Desert Pygmy Mouse	LC	LC	3	
Mastomys coucha	Southern Multimammate Mouse	LC	LC	2	X
Mastomys natalensis	Natal Multimammate Mouse	LC	LC	3	
Aethomys ineptus	Tete Veld Rat	LC	LC	2	X
Aethomys chrysophilus	Red Veld Rat	LC	LC	2	
Micaelamys namaquensis	Namaqua Rock Mouse	LC	LC	2	X
Desmodillus auricularis	Cape Short-tailed Gerbil	LC	LC	2	
Gerbilliscus leucogaster	Bushveld Gerbil	DD	LC	2	X
Gerbilliscus brantsii	Highveld Gerbil	LC	LC	3	X
Mystromys albicaudatus	White-tailed Mouse	EN	VU	2	
Saccostamus campestris	Pouched Mouse	LC	LC	2	
Thallomys paedulcus	Acacia Tree Rat	LC	LC	3	x
Malacothrix typica	Large-eared Mouse	LC	LC	2	
Otomys angoniensis	Angoni Vlei Rat	LC	LC	4	
Dendromus melanotis	Grey Climbing Mouse	LC	LC	2	X
Steatomys krebsii	Krebs's Fat Mouse	LC	LC	4	
PRIMATES SPECIES: 3 CONSERVATION IMPORTANT SPECIES: 1					
Papio ursinus	Chacma Baboon	LC	LC	3	
Cercopithecus aethiops	Vervet Monkey	LC	LC	3	X
Galago moholi	Southern Lesser Galago	LC	LC	3	
EULIPOTYPHLA (SHREWS): SPECIES: 5 CONSERVATION IMPORTANT SPECIES: 1					
Myosorex varius	Forest Shrew	DD	LC	3	
Crocidura cyanea	Reddish-Grey Musk Shrew	DD	LC	2	
Crocidura hirta	Lesser Red Musk Shrew	DD	LC	2	
Suncus varilla	Lesser Dwarf Shrew	DD	LC	3	
Crocidura mariquensis	Swamp Musk Shrew	DD	NT	4	X
ERINACEOMORPHA (HEDGEHOG) SPECIES: 1 CONSERVATION IMPORTANT SPECIES: 1					
Atelerix frontalis	South African Hedgehog	NT	NT	2	
PHILODOTA (PANGOLINS) SPECIES: 1 CONSERVATION IMPORTANT SPECIES: 1					

Smutsia temminckii	Ground Pangolin	VU	VU	3	
CARNIVORA: SPECIES: 24 CONSERVATION IMPORTANT SPECIES: 11					
Proteles cristatus	Aardwolf	LC	LC	2	
Crocuta crocuta	Spotted Hyaena	NT	NT	4	
Hyaena brunnea	Brown Hyena	NT	NT	4	
Caracal caracal	Caracal	LC	LC	3	
Leptailurus serval	Serval	LC	NT	3	X
Felis silvestris	African Wild Cat	LC	LC	2	
Felis nigripes	Black-footed cat	VU	VU	3	
Genetta genetta	Small-spotted genet	LC	LC	3	
Genetta maculata	Rusty-spotted genet	LC	LC	4	
Panthera pardus	Leopard	VU	VU	4	
Suricata suricatta	Meerkat	LC	LC	2	X
Mellivora capensis	Honey Badger	NT	LC	3	
Atilax paludinosus	Marsh Mongoose	LC	LC	4	X
Cynictis penicillata	Yellow Mongoose	LC	LC	2	X
Galerella sanguinea	Slender Mongoose	LC	LC	2	X
Ichneumia albicauda	White-tailed Mongoose	LC	LC	4	
Vulpes chama	Cape Fox	LC	LC	3	
Canis mesomelas	Black-backed Jackal	LC	LC	2	X
Otocyon megalotis	Bat-eared Fox	LC	LC	2	
Aonyx capensis	Cape Clawless Otter	NT	NT	4	
Lutra maculicolis	Spotted-necked Otter	NT	VU	4	
Poecilogale albinucha	African Striped Weasel	DD	NT	3	
Ictonyx striatus	Striped Polecat	LC	LC	2	
Mungos mungo	Banded Mongoose	LC	LC	4	
RUMANANTIA & PERISSODACTYLA (UNGULATES): SPECIES: 18 CONSERVATION IMPORTANT SPECIES: 17					
Connochaetes gnou	Black Wildebeest	LC	LC	5	X
Connochaetes taurinus	Blue Wildebeest	LC	LC	5	
Alcelaphus caama	Red Hartebeest	LC	LC	5	
Aepyceros melampus	Impala	LC	LC	5	X

Damaliscus pygargus phillipsi	Blesbok	LC	LC	5	X
Equus quagga	Plains Zebra	LC	LC	5	X
Syncerus caffer	African Savanna Buffalo	LC	LC	5	X
Tragelaphus strepsiceros	Greater Kudu	LC	LC	3	X
Tragelaphus sylvaticus	Bushbuck	LC	LC	5	X
Oryx gazelle	Gemsbok	LC	LC	5	X
Redunca fulvorufula	Mountain Reedbuck	LC	EN	5	X
Redunca arundinum	Southern Reedbuck	LC	LC	5	X
Tragelaphus oryx	Eland	LC	LC	5	X
Pelea capreolus	Grey Rhebok	LC	NT	5	X
Sylvicapra grimmia	Common Duiker	LC	LC	2	X
Antidorcas marsupialis	Springbok	LC	LC	5	X
Raphicerus campestris	Steenbok	LC	LC	2	X
**Elephurus davidianus*	Pere David's Deer	CE	LC	5	X
PIGS & HOGS (SUIDAE) SPECIES: 2 CONSERVATION IMPORTANT SPECIES: 1					
Phacochoerus africanus	Common Warthog	LC	LC	5	X
CHIROPTERA (BATS) SPECIES: 8 CONSERVATION IMPORTANT SPECIES: 3					
Neoromicia capensis	Cape Serotine Bat	LC	LC	2	
Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC	LC	2	
Nycteris thebaica	Egyptian Slit-faced Bat	LC	LC	2	
Miniopterus natalensis	Natal long-fingered Bat	NT	NT	3	
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	LC	NT	3	
Rhinolophus darlingi	Darling's Horseshoe Bat	LC	NT	2	
Pipistrellus rusticus	Rusty Pipestrelle	LC	LC	2	
Scotophilus dinganii	Yellow-bellied House Bat	LC	LC	2	

Appendix 5: Listed of Reptiles

List of Reptiles which may potentially occur within the greater area. Taxonomy notes are derived from Branch (1998) and Bates *et al*. (2014), while conservation status is according

to Bates *et al*. (2014). List of reptiles which are known from the 2626AA and 2526CC Quarter Degree Squares, according to the SARCA database are also provided.

Colours Relate as follow:

» National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004); Threatened or Protected Species Regulations

- Endangered Species
- Vulnerable Species
- Protected Species

Likelihood Rating: 1=Confirmed; 2=Likely; 3=Moderate; 4=Unlikely & 5= May occur as a managed population

Species	Common Name	Threat Status Regional	Endemism	Likelihood	ADU Database
Pelomedusidae Species:1 Conservation Important Species:0 Endemic & Near Endemic Species:0					
Pelomedusa subrufa	Marsh Terrapin	LC		3	
Testudinidae Species:3 Conservation Important Species:0 Endemic & Near Endemic Species:1					
Homopus femoralis	Greater Dwarf Tortoise	LC	E	4	
Psammobates oculifer	Serrated Tent Tortoise	LC		3	
Stigmochelys pardalis	Leopard Tortoise	LC		2	1
Gekkonidae Species:4 Conservation Important Species:0 Endemic & Near Endemic Species:0					
Hemidactylus mabouia	Common Tropical House Gecko	LC		3	
Lygodactylus capensis capensis	Common Dwarf Gecko	LC		3	1
Pachydactylus capensis	Cape Thick-toed Gecko	LC		2	
Ptenopus garrulus garrulus	Common Barking Gecko	LC		2	
Amphisbaenidae Species:3 Conservation Important Species:0 Endemic & Near Endemic Species:1					
Monopeltis capensis	Cape Worm Lizard	LC	N-E	3	
Monopeltis infuscata	Dusky Spade-snouted Worm Lizard	LC		4	
Zygaspis quadrifrons	Kalahari Dwarf Worm Lizard	LC		3	
Lacertidae Species:6					

Conservation Important Species:0 Endemic & Near Endemic Species:0					
Meroles squamulosus	Savanna Lizard	LC		2	
Heliobolus lugubris	Bushveld Lizard	LC		2	
Nucras holubi	Holub's Sandveld Lizard	LC		2	
Nucras intertexta	Spotted Sandveld Lizard	LC		3	
Pedioplanis lineoocellata lineoocellata	Spotted Sand Lizard	LC		2	
Pedioplanis namaquensis	Namaqua Sand Lizard	LC		4	
Cordylidae Species:1 Conservation Important Species:0 Endemic & Near Endemic Species:1					
Karusasaurus polyzonus	Southern Karusa Lizard	LC	N-E	4	1
Gerrhosauridae Species:1 Conservation Important Species:0 Endemic & Near Endemic Species:0					
Gerrhosaurus flavigularis	Yellow-throated Plated Lizard	LC		2	1
Scincidae Species:11 Conservation Important Species:0 Endemic & Near Endemic Species:1					
Acontias gracilicauda	Thin-tailed Legless Skink	LC	E	2	
Acontias kgalagadi kgalagadi	Kgalagadi Legless Skink	LC		4	
Acontias occidentalis	Savanna Legless Skink	LC		3	
Afroablepharus wahlbergii	Wahlberg's Snake-eyed Skink	LC		2	
Mochlus sundevallii sundevallii	Sundevall's Writhing Skink	LC		4	
Trachylepis capensis	Cape Skink	LC		2	1
Trachylepis punctatissima	Speckled Rock Skink	LC		1	1
Trachylepis punctulata	Speckled Sand Skink	LC		4	
Trachylepis spilogaster	Kalahari Tree Skink	LC		3	
Trachylepis varia	Variable Skink	LC		2	1
Trachylepis variegata	Variegated Skink	LC		3	
Varanidae Species:1 Conservation Important Species:0 Endemic & Near Endemic Species:0					
Varanus albigularis albigularis	Southern Rock Monitor	LC		2	
Chamaeleonidae Species:2 Conservation Important Species:0 Endemic & Near Endemic Species:0					
Chamaeleo dilepis dilepis	Common Flap-neck Chameleon	LC		3	
Chamaeleo namaquensis	Namaqua Chameleon	LC		4	
Agamidae Species:2 Conservation Important Species:0 Endemic & Near Endemic Species:1					

Agama aculeata aculeata	Western Ground Agama	LC		2	
Agama atra	Southern Rock Agama	LC	N-E	2	1
Typhlopidae Species:2 Conservation Important Species:0 Endemic & Near Endemic Species:1					
Afrotyphlops bibronii	Bibron's Blind Snake	LC	N-E	3	
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake	LC		3	
Leptotyphlopidae Species:1 Conservation Important Species:0 Endemic & Near Endemic Species:0					
Leptotyphlops scutifrons	Peter's Thread Snake	LC		2	
Pythonidae Species:1 Conservation Important Species:0 Endemic & Near Endemic Species:0					
Python natalensis	Southern African Python	LC		4	
Viperidae Species:1 Conservation Important Species:0 Endemic & Near Endemic Species:0					
Bitis arietans arietans	Puff Adder	LC		2	
Lamprophiidae Species:12 Conservation Important Species:0 Endemic & Near Endemic Species:2					
Aparallactus capensis	Black-headed Centipede-eater	LC		2	
Atractaspis bibronii	Bibron's Stiletto Snake	LC		3	
Xenocalamus bicolor bicolor	Bicoloured Quill-snouted Snake	LC		3	
Boaedon capensis	Common House Snake	LC		2	1
Lamprphis aurora	Aurora Snake	LC	E	3	
Lycodonomorphus rufulus	Brown Water Snake	LC		4	
Lycophidion capense capense	Cape Wolf Snake	LC		3	
Dipsina multimaculata	Dwarf Beaked Snake	LC		3	
Psammophis brevirostris	Short-snouted Grass Snake	LC		2	1
Psammophis trinasalis	Fork-marked Sand Snake	LC		2	
Psammophylax tritaeniatus	Striped Grass Snake	LC		2	
Pseudaspis cana	Mole Snake	LC		2	
Elapidae Species:4 Conservation Important Species:0 Endemic & Near Endemic Species:1					
Aspidelaps scutatus scutatus	Common Shield Cobra	LC		4	
Hemachatus haemachatus	Rinkhals	LC	N-E	4	
Naja annulifera	Snouted Cobra	LC		2	
Naja nivea	Cape Cobra	LC		2	X
Colubridae Species:5					

Conservation Important Species:0 Endemic & Near Endemic Species:0					
Crotaphopeltis hotamboeia	Red-lipped Snake	LC		3	
Dasypeltis scabra	Rhombic Egg-eater	LC		2	X
Dispholidus typus	Boomslang	LC		2	
Philthamnus semivariegatus	Spotted Bush Snake	LC		3	
Telescopus semiannulatus semiannulatus	Eastern Tiger Snake	LC		3	

Appendix 6: Listed of Amphibians

List of Amphibians which may potentially occur within the greater area. Taxonomy notes are derived from Du Preez & Carruthers (2009) and Minter *et al*. (2004), while conservation status is according to Minter *et al*. (2004). List of reptiles which are known from the 2626AA and 2526CC Quarter Degree Squares, according to the SARCA database are also provided.

Colours Relate as follow:

» National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004); Threatened or Protected Species Regulations

- Endangered Species
- Vulnerable Species
- Protected Species

Likelihood Rating: 1=Confirmed; 2=Likely; 3=Moderate; 4=Unlikely & 5= May occur as a managed population

Species	Common Name	Threat Status Regional	Likelihood	ADU Database
BREVICIPITIDAE (RAIN FROGS) Species:1 Conservation Important Species:0				
Breviceps adspersus adspersus	Bushveld Rain Frog	LC	3	X
BUFONIDAE (TYPICAL TOADS, PYGMY TOADS & RED TOADS) Species:6 Conservation Important Species:0				
Amietophrynus gutturalis	Guttural Toad	LC	4	
Amietophrynus poweri	Western Olive Toad	LC	2	X
Amietophrynus rangeri	Raucous Toad	LC	4	
Schismaderma carens	Red Toad	LC	3	X
HYPEROLIIDAE (KASSINAS) Species:1 Conservation Important Species:0				
Kassina senegalensis	Bubbling Kassina	LC	2	X

MYCROHYLIDAE (RUBBER FROGS) Species:1 Conservation Important Species:0				
Phrynomantis bifasciatus	Banded Rubber Frog	LC	3	
PHRYNOBATRACHIDAE (PUDDLE FROGS) Species:1 Conservation Important Species:0				
Phrynobatrachus natalensis	Snoring Puddle Frog	LC	4	
PIPIDAE (PLATANNAS) Species:1 Conservation Important Species:0				
Xenopus laevis	Common Platanna	LC	4	
PYXICEPHALIDAE (CACOS, RIVER FROGS) Species:9 Conservation Important Species:1				
Cacosternum boettgeri	Boettger's Caco	LC	2	X
Amietia quecketti	Common River Frog	LC	4	
Amietia fuscigula	Cape River Frog	LC	4	
Pyxicephalus adspersus	Giant Bullfrog	NT	2	X
Tomopterna cryptotis	Tremolo Sand Frog	LC	2	X
Tomopterna krugerensis	Knocking Sand Frog	LC	3	
Tomopterna tandyi	Tandy's Sand Frog	LC	2	

Appendix 7: Avifaunal Species List obtained from SABAP (South African Bird Atlass Project) – Birds recorded within the greater Quarter Degree Grid (SABAP 1 & 2) as well as within the affected Pentad (SABAP 2).

Common name	Scientific name	Conservation status	Regional endemism	Susceptibility to		
				Collision	Electrocution	Disturbance / habitat loss
Avocet, Pied	*Recurvirostra avosetta*	-	-	-	-	-
Barbet, Acacia Pied	*Tricholaema leucomela*	-	Near-endemic	-	-	Moderate
Barbet, Crested	*Trachyphonus vaillantii*	-	-	-	-	Moderate
Batis, Pririt	*Batis pririt*	-	Near-endemic	-	-	Moderate
Bee-eater, European	*Merops apiaster*	-	-	-	-	-
Bee-eater, Little	*Merops pusillus*	-	-	-	-	Moderate
Bee-eater, Little	*Merops pusillus*	-	-	-	-	Moderate
Bee-eater, Swallow-tailed	*Merops hirundineus*	-	-	-	-	-
Bishop, Southern Red	*Euplectes orix*	-	-	-	-	-
Bishop, Yellow-crowned	*Euplectes afer*	-	-	-	-	Moderate
Bokmakierie	*Telophorus zeylonus*	-	Near-endemic	-	-	Moderate
Bulbul, African Red-eyed	*Pycnonotus capensis*	-	Near-endemic	-	-	Moderate
Bunting, Cinnamon-breasted	*Emberiza tahapisi*	-	-	-	-	Moderate
Bunting, Golden-breasted	*Emberiza flaviventris*	-	-	-	-	Moderate
Bustard, Kori	*Ardeotis kori*	Near-threatened	-	High	-	Moderate
Buzzard, Common	*Buteo buteo*	-	-	Moderate	Moderate	-
Canary, Black-throated	*Crithagra atrogularis*	-	-	-	-	Moderate
Canary, Yellow	*Crithagra flaviventris*	-	Near-endemic	-	-	Moderate
Chat, Ant-eating	*Myrmecocichla formicivora*	-	Endemic	-	-	Moderate
Chat, Familiar	*Cercomela familiaris*	-	-	-	-	-

Cisticola, Desert	*Cisticola aridulus*	-	-	-	-	Moderate
Cisticola, Levaillant's	*Cisticola tinniens*	-	-	-	-	-
Cisticola, Rattling	*Cisticola chiniana*	-	-	-	-	-
Cisticola, Zitting	*Cisticola juncidis*	-	-	-	-	Moderate
Cliff-Swallow, South African	*Petrochelidon spilodera*	-	Endemic	-	-	Moderate
Coot, Red-knobbed	*Fulica cristata*	-	-	-	-	-
Cormorant, Reed	*Microcarbo africanus*	-	-	Moderate	-	-
Cormorant, White-breasted	*Phalacrocorax lucidus*	-	-	Moderate	-	-
Courser, Burchell's	*Cursorius rufus*	Vulnerable	Near-endemic	-	-	Moderate
Courser, Temminck's	*Cursorius temminckii*	-	-	-	-	Moderate
Crane, Blue	*Anthropoides paradieus*	Near-threatened	Endemic	High	-	-
Crombec, Long-billed	*Sylvietta rufescens*	-	-	-	-	Moderate
Crow, Pied	*Corvus ablus*	-	-	Moderate	Moderate	-
Cuckoo, Diederick	*Chrysococcyx caprius*	-	-	-	-	Moderate
Cuckoo, Jacobin	*Clamator jacobinus*	-	-	-	-	Moderate
Darter, African	*Anhinga rufa*	-	-	Moderate	-	-
Dove, Cape Turtle	*Streptopelia capicola*	-	-	-	-	-
Dove, Laughing	*Spilopelia senegalensis*	-	-	-	-	-
Dove, Namaqua	*Oena capensis*	-	-	-	-	Moderate
Dove, Red-eyed	*Streptopelia semitorquata*	-	-	-	-	Moderate
Dove, Rock	*Columba livia*	-	-	-	-	-
Drongo, Fork-tailed	*Dicrurus adsimilis*	-	-	-	-	-
Duck, Maccoa	*Oxyura maccoa*	Near-threatened	-	Moderate	-	-
Duck, White-faced	*Dendrocygna viduata*	-	-	Moderate	-	-
Duck, Yellow-billed	*Anas undulata*	-	-	Moderate	-	-
Eagle, African Fish	*Haliaeetus vocifer*	-	-	Moderate	Moderate	-
Eagle, Martial	*Polemaetus bellicosus*	Endangered	-	High	High	Moderate
Eagle, Tawny	*Aquila rapax*	Endangered	-	High	Moderate	Moderate
Eagle-Owl, Spotted	*Bubo africanus*	-	-	-	High	Moderate

Egret, Great	*Ardea alba*	-	-	Moderate	-	-
Egret, Little	*Egretta garzetta*	-	-	-	-	-
Egret, Western Cattle	*Bubulcus ibis*	-	-	-	-	-
Egret, Yellow-billed	*Egretta intermedia*	-	-	Moderate	-	-
Falcon, Amur	*Falco amurensis*	-	-	-	-	Moderate
Falcon, Lanner	*Falco biarmicus*	Vulnerable	-	High	Moderate	-
Falcon, Red-footed	*Falco vespertinus*	Near-threatened	-	-	-	Moderate
Finch, Red-headed	*Amadina erythrocephala*	-	Near-endemic	-	-	Moderate
Finch, Scaly-feathered	*Sporopipes squamifrons*	-	Near-endemic	-	-	Moderate
Firefinch, Red-billed	*Lagonosticta senegala*	-	-	-	-	Moderate
Fiscal, Common	*Lanius collaris*	-	-	-	-	-
Flamingo, Greater	*Phoenicopterus ruber*	Near-threatened	-	High	-	-
Flamingo, Lesser	*Phoenicopterus minor*	Near-threatened	-	High	-	-
Flycatcher, Fairy	*Stenostira scita*	-	Endemic	-	-	Moderate
Flycatcher, Fairy	*Stenostira scita*	-	Endemic	-	-	Moderate
Flycatcher, Fiscal	*Sigelus silens*	-	Endemic	-	-	Moderate
Flycatcher, Marico	*Bradornis mariquensis*	-	Near-endemic	-	-	Moderate
Francolin, Orange River	*Scleroptila levaillantoides*	-	Near-endemic	-	-	Moderate
Goose, Egyptian	*Alopochen aegyptiaca*	-	-	High	High	-
Goose, Spur-winged	*Plectropterus gambensis*	-	-	Moderate	-	-
Goshawk, Southern Pale Chanting	*Melierax canorus*	-	Near-endemic	-	Moderate	Moderate
Grebe, Little	*Tachybaptus ruficollis*	-	-	-	-	-
Guineafowl, Helmeted	*Numida meleagris*	-	-	Moderate	-	-
Hamerkop	*Scopus umbretta*	-	-	Moderate	Moderate	-
Heron, Black-headed	*Ardea melanocephala*	-	-	Moderate	Moderate	-
Heron, Green-backed	*Butorides striata*	-	-	-	-	-
Heron, Grey	*Ardea cinerea*	-	-	High	High	-
Hoopoe, African	*Upupa africana*	-	-	-	-	-

Hornbill, African Grey	*Tockus nasutus*	-	-	-	-	-
Ibis, African Sacred	*Threskiornis aethiopicus*	-	-	Moderate	-	-
Ibis, Glossy	*Plegadis falcinellus*	-	-	Moderate	-	-
Ibis, Hadeda	*Bostrychia hagedash*	-	-	Moderate	Moderate	-
Kestrel, Greater	*Falco rupicoloides*	-	-	-	Moderate	Moderate
Kestrel, Lesser	*Falco naumanni*	-	-	High	-	Moderate
Kingfisher, Brown-hooded	*Halycon albiventris*	-	-	-	-	Moderate
Kingfisher, Pied	*Ceryle rudis*	-	-	-	-	-
Kite, Black-shouldered	*Elanus caeruleus*	-	-	-	-	Moderate
Korhaan, Northern Black	*Afrotis afraoides*	-	Endemic	High	-	Moderate
Korhaan, Red-crested	*Lophotis ruficrista*	-	Near-endemic	Moderate		Moderate
Lapwing, Blacksmith	*Vanellus armatus*	-	-	-	-	-
Lapwing, Crowned	*Vanellus coronatus*	-	-	-	-	-
Lark, Eastern Clapper	*Mirafra fasciolata*	-	Near-endemic	-	-	Moderate
Lark, Fawn-coloured	*Calendulauda semitorquata*	-	Near-endemic	-	-	Moderate
Lark, Rufous-naped	*Mirafra africana*	-	-	-	-	Moderate
Lark, Sabota	*Calendulauda sabota*	-	Near-endemic	-	-	Moderate
Lark, Spike-heeled	*Chersomanes albofasciata*	-	Near-endemic	-	-	High
Longclaw, Cape	*Macronyx capensis*	-	Endemic	-	-	Moderate
Martin, Brown-throated	*Riparia paludicola*	-	-	-	-	Moderate
Masked-Weaver, Southern	*Ploceus velatus*	-	-	-	-	Moderate
Moorhen, Common	*Gallinula chloropus*	-	-	-	-	-
Mousebird, Red-faced	*Urocolius indicus*	-	-	-	-	Moderate
Mousebird, White-backed	*Colius colius*	-	Endemic	-	-	Moderate
Neddicky	*Cisticola fulvicapilla*	-	-	-	-	Moderate
Night-Heron, Black-crowned	*Nycticorax nycticorax*	-	-	-	-	-
Ostrich, Common	*Struthio camelus*	-	-	-	-	-
Owl, Marsh	*Asio capensis*	-	-	Moderate	-	Moderate

Pigeon, Speckled	*Columba guinea*	-	-	-	-	-
Pipit, African	*Anthus cinnamomeus*	-	-	-	-	Moderate
Plover, Kittlitz's	*Charadrius pecuarius*	-	-	-	-	-
Plover, Three-banded	*Charadrius tricollaris*	-	-	-	-	-
Pochard, Southern	*Netta erythrophthalma*	-	-	Moderate	-	-
Prinia, Black-chested	*Prinia flavicans*	-	Near-endemic	-	-	Moderate
Pytilia, Green-winged	*Pytilia melba*	-	-	-	-	Moderate
Quailfinch, African	*Ortygospiza fuscocrissa*	-	-	-	-	Moderate
Quelea, Red-billed	*Quelea quelea*	-	-	-	-	-
Robin-chat, Cape	*Cossypha caffra*	-	-	-	-	-
Roller, European	*Coracias garrulus*	Near-threatened	-	-	-	Moderate
Roller, Lilac-breasted	*Coracias caudatus*	-	-	-	-	-
Ruff	*Philomachus pugnax*	-	-	-	-	-
Sandgrouse, Namaqua	*Pterocles namaqua*	-	Near-endemic	-	-	Moderate
Sandpiper, Common	*Actitis hypoleucos*	-	-	-	-	-
Sandpiper, Curlew	*Calidris ferruginea*	-	-	-	-	-
Sandpiper, Marsh	*Tringa stagnatilis*	-	-	-	-	-
Sandpiper, Wood	*Tringa glareola*	-	-	-	-	-
Scimitarbill, Common	*Rhinopomastus cyanomelas*	-	-	-	-	Moderate
Scrub-Robin, Kalahari	*Erythropygia paena*	-	Near-endemic	-	-	Moderate
Secretarybird	*Sagittarius serpentarius*	Vulnerable	-	High	-	Moderate
Shelduck, South African	*Tadorna cana*	-	Endemic	Moderate	-	-
Shoveler, Cape	*Anas smithii*	-	Near-endemic	Moderate	-	-
Shrike, Crimson-breasted	*Laniarius atrococcineus*	-	Near-endemic	-	-	Moderate
Shrike, Lesser Grey	*Lanius minor*	-	-	-	-	-
Shrike, Red-backed	*Lanius collurio*	-	-	-	-	-
Snake-Eagle, Black-chested	*Circaetus pectoralis*	-	-	Moderate	-	-
Snake-Eagle, Brown	*Circaetus cinereus*	-	-	-	Moderate	Moderate
Sparrow, Cape	*Passer melanurus*	-	Near-endemic	-	-	-
Sparrow, House	*Passer domesticus*	-	-	-	-	-
Sparrow, Southern Grey-headed	*Passer diffusus*	-	-	-	-	-

Sparrowlark, Chestnut-backed	*Eremopterix leucotis*	-	-	-	-	Moderate
Sparrow-Weaver, White-browed	*Plocepasser mahali*	-	-	-	-	Moderate
Spoonbill, African	*Platalea alba*	-	-	Moderate	-	-
Spurfowl, Swainson's	*Pternistis swainsonii*	-	-	Moderate	-	-
Starling, Cape Glossy	*Lamprotornis nitens*	-	-	-	-	-
Stilt, Black-winged	*Himantopus himantopus*	-	-	-	-	-
Stint, Little	*Calidris minuta*	-	-	-	-	-
Stork, Abdim's	*Ciconia abdimii*	Near-threatened	-	-	Moderate	Moderate
Stork, Black	*Ciconia nigra*	Vulnerable	-	High	Moderate	-
Stork, Yellow-billed	*Mycteria ibis*	Endangered	-	Moderate	-	Moderate
Sunbird, Dusky	*Cinnyris fuscus*	-	Near-endemic	-	-	Moderate
Swallow, Barn	*Hirundo rustica*	-	-	-	-	Moderate
Swallow, Greater-striped	*Cecropis cucullata*	-	-	-	-	Moderate
Swallow, Red-breasted	*Cecropis semirufa*	-	-	-	-	-
Swallow, White-throated	*Hirundo albigularis*	-	-	-	-	Moderate
Swift, African Black	*Apus barbatus*	-	-	-	-	-
Swift, Little	*Apus affinis*	-	-	-	-	-
Swift, White-rumped	*Apus caffer*	-	-	-	-	-
Tchagra, Brown-crowned	*Tchagra australis*	-	-	-	-	Moderate
Teal, Cape	*Anas capensis*	-	-	Moderate	-	-
Teal, Red-billed	*Anas erythrorhyncha*	-	-	Moderate	-	-
Tern, Whiskered	*Chlidonias hybrida*	-	-	-	-	-
Tern, White-winged	*Chlidonias leucopterus*	-	-	-	-	-
Thrush, Karoo	*Turdus smithii*	-	Endemic	-	-	Moderate
Tit, Cape Penduline-	*Anthoscopus minutus*	-	Near-endemic	-	-	Moderate

Tit-Babbler, Chestnut-vented	*Sylvia subcaerulea*	-	Near-endemic	-	-	Moderate
Vulture, Cape	*Gyps coprotheres*	Endangered	Near-endemic	High	High	-
Vulture, White-backed	*Gyps africanus*	Critically Endangered	-	High	High	-
Wagtail, Cape	*Motacilla capensis*	-	-	-	-	-
Warbler, Lesser Swamp	*Acrocephalus gracilirostris*	-	-	-	-	-
Waxbill, Black-faced	*Estrilda erythronotos*	-	-	-	-	Moderate
Waxbill, Common	*Estrilda astrild*	-	-	-	-	Moderate
Waxbill, Violet-eared	*Uraeginthus granatinus*	-	-	-	-	Moderate
Weaver, Sociable	*Philetairus socius*	-	Endemic	-	-	Moderate
Wheatear, Capped	*Oenanthe pileata*	-	-	-	-	Moderate
Whydah, Long-tailed Paradise	*Vidua paradisaea*	-	-	-	-	Moderate
Whydah, Pin-tailed	*Vidua macroura*	-	-	-	-	Moderate
Whydah, Shaft-tailed	*Euplectes progne*	-	Near-endemic	-	-	Moderate
Widowbird, Long-tailed	*Euplectes progne*	-	-	-	-	Moderate
Woodpecker, Golden-tailed	*Campethera abingoni*	-	-	-	-	Moderate
Wren-Warbler, Barred	*Calamonastes fasciolatus*	-	Near-endemic	-	-	Moderate

Appendix 8: Avifaunal Species List (Identified within the surveyed area).

Common Name	Scientific Name	Status
Helmeted Guineafowl	*Numiba meleagris*	
Common Quail	*Coturnix coturnix*	
Western Cattle Egret	*Bubulcus ibis*	
Black-winged Kite	*Elanus caeruleus*	
Southern Pale Chanting Goshawk	*Melierax canorus*	Near-Endemic
Greater Kestrel	*Falco rupicoloides*	
Lanner Falcon	*Falco biarmicus*	Vulnerable
Kori Bustard	*Ardeotis kori*	Near Threatened
Northern Black Korhaan	*Afrotis afraoides*	Near-Endemic
Crowned Lapwing	*Vanellus coronatus*	
Namaqua Sandgrouse	*Pterocles namaqua*	Near-Endemic
Ring-necked Dove	*Streptopelia capicola*	
Laughing Dove	*Spilopelia senegalensis*	
Namaqua Dove	*Oena capensis*	
Red-eyed Dove	*Streptopelia semitorquata*	
Red-faced Mousebird	*Urocolius indicus*	
African Hoopoe	*Upupa africana*	
Acacia Pied Barbet	*Tricholaema leucomelas*	Near-Endemic
Bokmakierie	*Telophorus zeylonus*	Near-Endemic
Southern Fiscal	*Lanius collaris*	
Fork-tailed Drongo	*Dicrurus adsimilis*	
Pied Crow	*Corvus albus*	
Cape Penduline Tit	*Anthoscopus minutus*	
Eastern Clapper Lark	*Mirafra fasciolata*	
Sabota Lark	*Calendulauda sabota*	Near-Endemic
Spike-heeled Lark	*Chersomanes albofasciata*	Near-Endemic
Red-capped Lark	*Calandrella cinerea*	
Grey-backed Sparrow-Lark	*Eremopterix verticalis*	Near-Endemic
African Red-eyed Bulbul	*Pycnonotus nigricans*	Near-Endemic
Rock Martin	*Ptyonoprogne fuligula*	
Greater Striped Swallow	*Cecropis cucullata*	
Desert Cisticola	*Cisticola aridulus*	
Rufous-naped Lark	*Mirafra africana*	
Lefaillant's Cisticola	*Cisticola natalensis*	
Black-chested Prinia	*Prinia flavicans*	
Barred Wren-Warbler	*Calamonastes fascilatus*	Near-Endemic
Yellow-bellied Eremomela	*Eremomela icteropygialis*	
Chestnut-vented Warbler	*Sylvia subcaerulea*	Endemic
Cape Starling	*Lamprotornis nitens*	
Kalahari Scrub Robin	*Cercotrichas paena*	Near-Endemic
Familiar Chat	*Emarginata familiaris*	
Ant-eating Chat	*Myrmecocichla formicivora*	Endemic
Chat Flycatcher	*Melaenornis infuscatus*	Near-Endemic
White-bellied Sunbird	*Cinnyris talatala*	
Southern Grey-headed Sparrow	*Passer diffusus*	
Scaly-feathered Weaver	*Sporopipes squamifrons*	Near-Endemic
Red-billed Quelea	*Quelea quelea*	
Red-headed Finch	*Amadina erythrocephala*	
Red-billed Firefinch	*Lagonosticta senegala*	
Violet-eared Waxbill	*Granatina granatina*	
Black-faced Waxbill	*Estrilda erythronotos*	
African Pipit	*Anthus cinnamomeus*	
Black-throated Canary	*Crithagra atrogularis*	
Yellow Canary	*Crithagra mozambica*	Near-Endemic
Golden-breasted Bunting	*Emberiza flaviventris*	

Appendix 9. 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 10. Specialist's Work Experience and References

WORK EXPERIENCES

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References

Gerhard Botha

ECOLOGICAL RELATED STUDIES AND SURVEYS

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

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

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

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

WETLAND DELINEATION AND HYDROLOGICAL ASSESSMENTS

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

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

AVIFAUNAL ASSESSMENTS

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

ENVIRONMENTAL IMPACT ASSESSMENT

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

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

ENVIRONMENTAL COMPLIANCE AUDITING AND ECO

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

OTHER PROJECTS:

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