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Terrestrial Flora, Fauna & Avifaunal Scoping Assessment of the proposed Mutsho Power Project, Limpopo Province©

produced by

B E C

Bathusi Environmental Consulting

Biodiversity Assessments

in collaboration with:

Ecocheck Environmental Services & Pachnoda Consulting cc

This report was produced for

savannah environmental

I PROJECT DETAILS

Table 1: Relevant Project Details	
Client:	Savannah Environmental (PTY) Limited, on behalf of Mutsho Power Company (Pty) Ltd
Report Name:	Terrestrial Flora, Fauna & Avifaunal Scoping Assessment of the proposed Mutsho Power Project, Limpopo Province©
Report Type:	Biodiversity Scoping Report
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Report Version:	2017.08.18.3
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Date of Release:	18th August 2017
Report Author:	Riaan A. J. Robbeson (Pr.Sci.Nat.) (Bathusi Environmental Consulting cc)

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III CONTRIBUTING SPECIALISTS

The Natural Scientific Professions Act of 2003 aims to '*provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP), and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith'.*

Quoting the Natural Scientific Professions Act of 2003: '*Only a registered person may practice in a consulting capacity*' (20(1) – pg 14).

Table 3: Biodiversity specialists for this project	
Botanical Specialist:	**Riaan Robbeson (Pr.Sci.Nat.)**
Qualification:	M.Sc. (Botany), UP
Affiliation:	South African Council for Natural Scientific Professions
Fields of Expertise:	Botanical Scientist & Ecological Scientist
Registration Number:	*400005/03*
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Qualification:	M.Sc. (Conservation Biology), UP
Affiliation:	South African Council for Natural Scientific Professions
Fields of expertise:	Ecological Scientist & Zoological Scientist
Registration number:	*400204/05*
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Qualification:	M.Sc. (Restoration Ecology), UP
Affiliation:	South African Council for Natural Scientific Professions
Fields of expertise:	Ecological Scientist & Zoological Scientist
Registration number:	*400095/06*

IV REPORT CITATION

When used as a reference, or included as an addendum, this report should be cited as:

Bathusi Environmental Consulting cc (2017). Terrestrial Flora, Fauna & Avifaunal Scoping Assessment of the proposed Mutsho Power Project, Limpopo Province. Reference Number SVE – MPS – 2017/15, Version 2017.08.18.3

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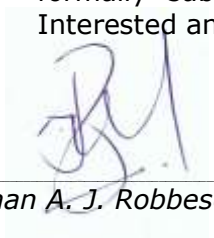
VI DECLARATION OF INDEPENDENCE

All specialist investigators, project investigators and members of companies employed for conducting this biodiversity investigation declare that:

- We act as independent specialist consultants conducting the assessment and compiling the report;
- We consider ourselves bound to the rules and ethics of the South African council for natural scientific professions;
- Bathusi Environmental Consulting cc is not a subsidiary, legally or financially, of either the Client or Savannah Environmental (Pty) Ltd;
- At the time of completing this report, we did not have any interest, hidden or otherwise, in the proposed development or activity as outlined in this document, other than fair financial compensation for work performed in a professional capacity;
- We will not be affected in any manner by the outcome of the environmental process of which this assessment forms part of, other than being part of the general public;
- We do not necessarily object to or endorse the proposed development, but aim to present facts and recommendations based on scientific data and relevant professional experience;
- We do not have any influence over decisions made by the governing authorities;
- We undertake to disclose, to the competent authority, any material information that have 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 Environmental Impact Assessment Regulations, 2005;
- We undertake to provide the competent authority with access to all information at our disposal regarding the application, whether such information is favourable to the applicant or not;
- Should we consider ourselves in conflict with any of the above declarations, we shall formally submit a Notice of Withdrawal to all relevant parties and register as an Interested and Affected Party.



Riaan A. J. Robbeson (Pr.Sci.Nat.)

On behalf of **Bathusi Environmental Consulting cc (CK1999/052182/23)**

18th August 2017

VII ACRONYMS & ABBREVIATIONS

BEC	Bathusi Environmental Consulting cc
CBA	Critical Biodiversity Areas
CBD	Convention on Biological Diversity
CITES	Convention of International Trade in Endangered Species
CR	Critically Endangered
DAFF	Department of Fisheries and Forestry
DD	Data Deficient
EAP	Environmental Assessment Practitioner
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EN	Endangered
End	Endemic Species
ESA	Ecological Support Areas
IBA	Important Bird Area
IPP	Independent Power Producer
IUCN	International Union for Conservation of Nature
LC	Least Concern
LCP	Limpopo Conservation Plan (Version 2)
LEDET	Limpopo Department of Economic Development, Environment and Tourism
LEMA	Limpopo Environmental Management Act
LM	Lephalale Municipality
NEMBA	National Environmental Management Biodiversity Act
NEnd	Near Endemic Species
NFA	National Forest Act
NT	Near Threatened
PAN	Protected Area Network
POSA	Plants of Southern Africa
Pr.Sci.Nat.	Professional Natural Scientist (registered at SACNASP)
SABAP	South African Bird Atlas Project
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SEIA	Social and Environmental Impact Assessment
SSC	Species of Special Concern
TOPS	Threatened or Protected Species
TWINSPAN	Two Way INdicator Species Analysis
VU	Vulnerable

VIII REPORT NAVIGATION

IX LIST OF FIGURES

X LIST OF TABLES

1 EXECUTIVE SUMMARY

Mutsho Power (Pty) Ltd (The Client) are investigating the feasibility of developing a new coal-fired power station and associated infrastructure. Results of a high-level identification process have indicated the following properties in the Limpopo Province (Musina Municipality) for consideration, including:

- Farm Du Toit 563; and
- Farm Vrienden 589.

An Ecological Screening Assessment (BEC 2017) was compiled to establish the level of existing knowledge and to evaluate the inherent biological sensitivity of the receiving environment. An appraisal of available data and a brief site investigation revealed various inherent ecological sensitivities, although no Red Flag issues were identified during the process. It was therefore recommended that these two farms be investigated in more detail during the subsequent scoping and EIA phases of the project to confirm the initial assumptions and to highlight the biological attributes of the receiving environment. An important aspect of the scoping assessment will be to highlight existing information gaps to guide the EIA phase of the project.

This Scoping Assessment report will therefore aim to establish the sensitivity of the receiving environment on a regional scale, the focus of which will be directed at identifying and describing the ecological assets of the target area. Specifically, attributes that are recognized to be of global significance need to be identified at an early stage of the process, ultimately being expressed as a prediction of the consequences of a proposal that will manifest as irreversible/irreparable impacts on these assets.

The following project alternatives were presented for the project and brief comments with regards to the preference of the project alternatives will be provided:

1. The project will be developed entirely on Farm Vrienden;
2. The project will be developed entirely on Farm Du Toit; or
3. Portions of the project will be developed on Farm Vrienden and portions on Farm Du Toit.

1.1 Biophysical Environment

Available satellite imagery and brief site observations indicate that the general region is notably rural, with extremely little anthropogenic developments and transformed environments. It is therefore a natural assumption that the development of a coal-fired power station and the appurtenant infrastructure within a definitively rural region will inevitably result in a significant increase in human movement, influx and transformative activities. A preliminary estimation of the expected cumulative impacts on a local and regional scale would suggest that the effects would be significant and high, representing a significant consideration, albeit not a fatal flaw.

No declared conservation areas or protected areas occur within the immediate surrounds of the study sites; the closest being Baobab Tree Reserve (32 km north-east) and Honnet Nature Reserve (35 km east).

No major rivers are present in the immediate surrounds; the Sand River is situated approximately 8.5 km to the north of the Farm Du Toit and the Mutamba River 12.3 km south of the Farm Vrienden. The BGIS (2015) database indicate no RAMSAR sites being present in the Musina Municipality. However, the general region exhibits attributes of periodic flooding with both ill-defined and well-defined floodplains and drainage lines. The north-western part of Farm Du Toit comprises a significant floodplain with a drainage line in which an artificial impoundment has been constructed. This drainage line flows northwards towards the Sand River and, likely, will comprise of atypical vegetation attributes. Similarly, ill-defined flood zones are noted on Farm Vrienden, which will contribute towards habitat diversity on a local scale.

The Limpopo Conservation Plan (LCP), which provides a broad indication of the conservation importance of the province, indicates the presence of Ecological Support Areas within both farms Du Toit and Vrienden. ESA's cover approximately 22 % of the Limpopo province, of which 16 % are intact natural areas (ESA 1) and 7 % are degraded or areas with no natural remaining, which are nevertheless required as they potentially retain some value for supporting ecological processes (ESA 2).

The geographical placement of the study sites within a definitively rural environment represents a Red Flag that will undoubtedly result in significant cumulative impacts, specifically on temporal and spatial scales.

1.2 Vegetatal Assessment

The study area corresponds to the Savanna Biome and more particularly to the Central Bushveld Bioregion as defined by Mucina & Rutherford (2006), comprising an ecological type known as the Musina Mopane Bushveld (Least Threatened). The following key findings are noted for the flora of study areas:

- The SANBI database indicates the presence of 59 plant species within the ¼-degree grid (2229DB), reflecting a poor knowledge of the floristic diversity of the area in general.
- The SANBI database for ¼-degree grid 2229DB indicates the known presence of four species of conservation concern within the immediate region. Taking cognisance of the status and availability of habitat within the site and surrounds, the possibility that other plant species of conservation importance would persist within the region cannot be discounted at this stage of the process.
- Four protected tree species have been recorded within the study sites (NFA, 1998). Specific reference is made of extremely large *Adansonia digitata* individuals on both site alternatives, but specifically on Farm Vrienden.
- The LEMA (Schedules 11 - Specially protected plants and Schedule 12 - Protected plants) indicate the presence of 3 protected plant species. The presence of *Hoodia* has been confirmed on Farm Vrienden, in addition to numerous *Adansonia digitata* trees across both sites.
- From a floristic perspective, four broad macro-habitat types are prominent in the area, the most significant (in extent), the Undifferentiated arid broad-leaved woodland on sandy soils and (sensitivity) the Seasonal drainage lines

- The proposed activity implies the loss of natural habitat and no impacts of a beneficial nature on the floristic environment are likely to result. Based on a generic list of impacts associated with this type of development, three categories of impacts are likely to result, namely, direct impacts, indirect impacts and impacts of a cumulative nature.
- A brief comparative assessment of the proposed project alternatives was undertaken, primarily based on:
  - » Floristic habitat diversity;
  - » Inherent floristic sensitivity of the receiving environment (abundance/ presence of sensitive habitat types, riparian habitat, impoundments, outcrops, etc.;
  - » Approximate densities of protected tree species, with specific reference to *Adansonia digitata*;
  - » Known locations of important/ protected trees/ plants; and
  - » Suitable habitat, or known locations of conservation important plant taxa.
- Results of the comparative assessment indicate a slight preference for Farm Vrienden. The difference between the 2 areas are however not of such a nature to be determining at this stage and EIA related studies will further inform the suitability of either of the options, or indeed, an amalgamation of respective portions of both farms that will ultimately render the impact on the biological environment lower than the use of only one option.
- Key differences between the farms include a slightly higher habitat diversity on Farm Du Toit as a result of the presence of defined seasonal drainage lines; habitat on Farm Vrienden appears more homogenous.

The following impacts on the floristic environment are expected:

a) loss of plant taxa (individuals, stands, populations) of conservation importance (threatened taxa);
b) loss of plant taxa of conservation concern (declining status, provincially protected taxa);
c) loss of natural vegetation (physical modifications, removal, damage);
d) local depletion of plant taxa and reduction of phytodiversity; and
e) loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance.
f) decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.;
g) reduced ecological functionality (including fire, erosion);
h) decreased aesthetic appeal of the landscape; and
i) the introduction of invasive, exotic and encroacher plant species.
j) increased exploitation of natural resources due to increased human presence and resource requirements;
k) exacerbation of existing levels of habitat fragmentation and isolation; and
l) cumulative impacts on local/ regional and national conservation targets and obligations.

The expected and likely impacts on the floristic environment is likely to result in severe and irreversible impacts on the footprint areas. These impacts will generally result in the local destruction of plants, with specific reference to protected and Red Data species; preliminary assessments did reveal the presence of numerous protected trees within the proposed sites.

The nature of the development will however determine that these direct impacts are generally a 'once-off' event and are unlikely to result in similar impacts on the neighbouring habitat. However, secondary or indirect impacts, such as deterioration of habitat, peripheral impacts, degradation and deterioration of surrounding areas, will likely constitute longer term impacts, but generally to a lower significance level. These impacts can generally be mitigated/ prevented to some extent, or to a more acceptable level, but will generally occur inevitably. Impacts on the floristic environment that spread beyond the controllable boundaries of the proposed development (cumulative impacts) generally comprise of the effects of the significant increase of human presence and human-related activities and developments required and flowing from the proposed project. Since the proposed sites are situated within a largely rural area with low existing anthropogenic activity levels, the effects of these cumulative impacts are regarded significant, long-term and irreversible. Evidence from similar developments have indicated a significant deterioration of the natural environment on a local/ regional scale subsequent to the commencement of development activities.

The receiving environment is generally homogenous, but does exhibit typical variations in terms of the presence of drainage lines and localised topographical variability. These areas generally represent sensitive habitat and should ideally be avoided. The EIA phase will allow for the collation of adequate data to inform the project in terms of a suitable footprint site that will render the best possible solution to impact management and control.

1.3 Faunal Assessment

The following key findings are presented:

- Thirty-nine invertebrates are listed for the ¼-degree grid 2229DB (vmus.adu.org.za); none of the invertebrate species listed for 2229DB are considered sensitive or threatened (Red Data listed)
- Twenty-seven herpetofaunal species are listed for the ¼-degree grid 2229DB (vmus.adu.org.za), two of the reptile species listed for 2229DB are listed Red Data species.
- Seventeen mammals are listed for the ¼-degree grid 2229DB (vmus.adu.org.za), three of the mammal species listed for the ¼-degree grid 2229DB are listed Red Data species.
- A total of five Red Data animals have previously been recorded in the region, namely:
  - » Muller's Velvet Gecko, *Homopholis mulleri* Visser, 1987 (Vulnerable): medium-high PoC;
  - » Nile Crocodile, *Crocodylus niloticus* Laurenti, 1768 (Vulnerable): low PoC;
  - » Leopard, *Panthera pardus* (Linnaeus, 1758) (Vulnerable): high PoC;
  - » Brown Hyaena, *Parahyaena brunnea* (Thunberg, 1820) (Near Threatened): high PoC; and
  - » African Clawless Otter, *Aonyx capensis* (Schinz, 1821) (Near Threatened): low PoC.
- Given the size of the study area, the habitat diversity, quality and unfragmented nature of the faunal habitats available in the study area and surrounds, all five species are considered potential inhabitants of the region, but not necessarily for the study sites.
- The following general faunal habitats are expected to be found within the study site alternatives (based on brief site observations):

  - » Transformed/ Deteriorated Woodland Habitat;
  - » Untransformed Terrestrial Woodland Habitat; and
  - » Faunal Wetland Habitat.
- A comparative evaluation of the proposed development options is largely based on the potential prevalence of Red Data animals. This assessment does consider the status and ecological functionality of habitat of each development portion.
- Results of a brief comparative assessment indicated Farm Vrienden as the most preferred option, with selected portions of lower sensitivity habitat of neighbouring farms as the 2nd preferred option.
- Farm Du Toit was indicated as the least preferred option in terms of perceived faunal sensitivities.

The following impacts on the faunal environment are expected:

a) Impacts on/ losses of fauna taxa of conservation importance and habitat associated with CI species;
b) Loss of natural habitat, including essential habitat refugia; and
c) Depletion of faunal diversity, human/ animal conflict situations.
d) Degradation of untransformed habitat in areas surrounding the project area;
e) Indirect impacts on movement/ migration patterns of animals, ecological interaction and processes, including the introduction of invasive and non-endemic species; and
f) An increase in edge effects in the project areas.
g) Cumulative losses and degradation of natural faunal habitat; and
h) Cumulative depletion of faunal taxa, assemblages and communities on a regional scale, with specific reference to the conservation status of certain fauna taxa.

Expected and likely impacts on the faunal environment are largely two-fold:

- Direct, severe, permanent and irreversibly impacts are expected to occur within the development footprint with significant impacts on the faunal attributes, specifically those animals that are not able to vacate unfavourable areas; and
- Indirect impacts that will render surrounding areas less suitable for a high diversity of animal species that typically inhabit the region. Specific reference is made of appurtenant infrastructure that will result in deterioration of existing habitat and the human-animal conflict situations that are created through the significant increase of human numbers in a natural environment.

Due to the vague nature of cumulative impacts, speculation dictate that the larger region will likely be affected adversely through the loss of natural habitat and severe deterioration of the PES of the area, as evidence from similar developments have suggested.

It is important to note that mitigation of most of these impacts are possible to some extent, but aspects such as habitat loss and deterioration are uncontrollable and beyond the scope of the project to manage, short of preventing the project altogether. However, no faunal attribute currently known of the project area would represent a 'Red flag' to the development and it is anticipated that significant and detailed management measures included in the EMP would ameliorate impacts to an acceptable level.

1.4 Avifaunal Assessment

Based on the results, the avifaunal community on the study area is summarised in terms of the following key features:

- The study area supports a high diversity of bird species representing approximately 31% of the regional richness (irrespective of the SABAP2 statistic);
- In general, habitat diversity and heterogeneity were relatively low, and the woodland structure was monotonous across the area;
- The avifaunal community on the study area is not regionally unique (on a national level) and poorly represented by South African endemics and near-endemics. The dominant composition is widespread in the region;
- Several threatened and near threatened species (mainly scavenging bird of prey species and Kori Bustard - *Ardeotis kori*) is expected to be present. The majority of these species requires large home range sizes, with many species occupy low densities;
- Part of the woodland habitat consists of an open canopy structure which is expected to provide optimal foraging habitat for terrestrial large-bodied bird species (e.g. the near-threatened Kori Bustard - *Ardeotis kori* and vulnerable Secretarybird *Sagittarius serpentarius*);
- The depressions, pans and impoundment features on some of the farms (especially Farm Du Toit) have benefitted the colonisation of "specialised" bird taxa (mainly wader and wading bird species) that are of local importance and contribute towards the regional avifaunal diversity. It also provides ephemeral foraging habitat for threatened and near threatened stork taxa.

Farm Vrienden appears to be "more preferable" for the proposed development when compared to Farm Du Toit. Although Farm Vrienden is slightly larger than Farm Du Toit, it appears to be more uniform in habitat structure with fewer land cover categories. In addition, Farm Du Toit is the "less preferable" since it contains both distinct seasonal drainage lines holding surface water for extended periods of times, manmade dams and several depressions. It also provides optimal foraging habitat for the near threatened Kori Bustard (*Ardeotis kori*) and threatened and near threatened stork taxa.

The spatial arrangement of lower sensitivity areas across the available properties should dictate the placement of infrastructure and not necessarily property boundaries. It is strongly suggested that the most optimal footprint be located through a synthesis of available habitat and such a footprint could potentially extend across the boundaries of the properties and not be restricted within a single property. The spatial proximity to sensitive habitat, in terms of ecological attributes will dictate the recommendation of a suitable footprint location.

Based on this assessment, the following impacts are expected on the avifaunal community of the area:

a) Loss and transformation of habitat resulting in displacement of bird species, especially large-bodied birds of prey and large terrestrial bird species requiring large home ranges (so-called K-selected species);

b) Loss of sensitive habitat (e.g. trees used as breeding platforms, pans and depressions) and subsequent loss of threatened and near-threatened species and habitat containing high avifaunal diversity and unique species compositions;
c) Changes in bird community structures due to habitat fragmentation (e.g. roads, loss of continuous woodland patches) and habitat loss;
d) Bird collisions and electrocution with fence structures and proposed overhead power lines (anticipated); and
e) Loss of migration/foraging corridors.
f) Loss of dispersal corridors owing to habitat alteration;
g) Subsequent habitat changes and changes to the local avifaunal community structure and composition (colonisation by generalists and secondary species); and
h) Urban sprawl based on "job-seeking" opportunities leading to the localised depletion of natural resources and direct persecution of bird taxa.
i) Cumulative impacts are often related to the "after-effect" when the project is decommissioned. It mainly pertains to rehabilitation effort, and how this relates to the residing avifaunal communities. Therefore, it is often witnessed that early successional habitat contributes to the establishment of a transient avifaunal community.

Expected and likely impacts on the receiving environment are expected to result in severe, irreversible and significant effects on the avifaunal guilds of the area; direct results will generally be restricted to the site and immediate surrounds while indirect and cumulative effects will disperse across a wider geographical area surrounding the development footprint. It is emphasised that, due to the existing natural status of the site and surrounds, these impacts are regarded significant and will likely constitute permanent and irreversible impacts that are typically problematic (impossible) to control and mitigated.

The respective sites exhibit aspects of important avifaunal habitat, with reference to localised and restricted habitat types and unique habitat features. The loss of these areas and habitat are regarded significant on a local scale; the occurrence of similar habitat in the general surrounds is unclear at this stage. A high diversity of birds is known to occur in the region and the effect of the proposed development will undoubtedly have an adverse effect on abundance and diversity of birds in the region, also taking cognisance of cumulative impacts associated with the project. It is also evident that the habitat comprised in the study area exhibit typical habitat characteristics and avifaunal compositional attributes that is prevalent on a scale wider than the study area. No impacts of an unacceptable nature on habitat or singular species were recorded for the study area at this stage of the project, but collated data will inform subsequent statements to this effect. The application of generic and site-specific mitigation measures is expected to ameliorate impacts to an acceptable significance on a larger scale.

2 ENVIRONMENTAL SCOPING PROCESS

This specific phase of the project aims to provide a high-level investigation for the proposed development of the coal-fired power station. Bathusi Environmental Consulting (BEC) has been requested to assist with the process by providing specialist consulting services for the project, specifically the terrestrial ecology (inclusive of the vegetatal, faunal and avifaunal disciplines).

The content of this specialist report will be compliant to applicable guidelines relating to undertaking screening and specialist studies, including Integrated Environmental Management (IEM) Information Series guidelines on Scoping (Series 2) and Specialist Studies (Series 4) (DEAT 2002).

The scope of an environmental assessment is defined by the range of issues and alternatives it considers, and the approach towards the assessment that will follow it (DEA 1992b). Scoping is a critical stage in the integrated environmental management (IEM) procedure, since it is an important tool for involving the public in the environmental assessment process, and for structuring assessment studies. IEM is an approach that integrates environmental considerations into all stages of the planning and development process. Through scoping, the priorities of the environmental assessment are set. As an open and iterative process, it may continue throughout planning and assessment, depending on whether additional issues or alternatives are introduced or eliminated because of new information.

Scoping is typically divided into three phases:
- planning the scoping procedure;
- a process of stakeholder engagement to identify the key issues; and
- reporting on the terms of reference for the next phase of the assessment.

Though scoping is described as a discrete step in the environmental assessment procedure, in practice the process of identifying the significant issues usually continues throughout the assessment process, as well as decision-making, detailed design, implementation and monitoring.

Characteristics of a scoping exercise are as follows:
- It is an open process that involves the authorities, proponent and stakeholders.
- Feasible alternatives are identified and selected for further assessment.
- Important characteristics of the affected environment are identified.
- Significant issues to be examined in the assessment procedure are identified.
- It provides the basis for determining terms of reference for the assessment procedure.

3 PROJECT SYNOPSIS

Mutsho Power (Pty) Ltd (The Client) are investigating the feasibility of developing a new coal-fired power station and associated infrastructure. Savannah Environmental (Pty) Ltd has been appointed as the Environmental Assessment Practitioner (EAP) to undertake the Environmental Impact Assessment (EIA) for the Mutsho Power Project, proposed near the Makhado Mine in Limpopo Province. To date, ILEnergy, the technical consultants appointed by the project developers, have undertaken a high-level identification process and have identified two properties for investigation, namely:

- Farm Du Toit 563; and
- Farm Vrienden 589.

An Environmental Screening Assessment (BEC 2017) was compiled to establish the level of existing knowledge and to evaluate the inherent environmental sensitivity of these properties (BEC 2017). An appraisal of available data and a brief site investigation revealed various inherent ecological sensitivities, although no Red Flag issues were identified during the process. It was therefore recommended that these two farms be investigated in more detail during the subsequent scoping and EIA phases of the project to confirm the initial assumptions and to highlight the biological attributes of the receiving environment. These farms will therefore be investigated in more detail during this scoping and subsequent EIA phases of the project to confirm the initial assumptions and estimations and also to highlight the biological attributes of the receiving environment

The following project alternatives were presented for the project:

1. The project will be developed entirely on Farm Vrienden;
2. The project will be developed entirely on Farm Du Toit; or
3. Portions of the project will be developed on Farm Vrienden and portions on Farm Du Toit.

Preliminary sensitivity maps for the respective sites are presented in **Figures 1** & **2.**

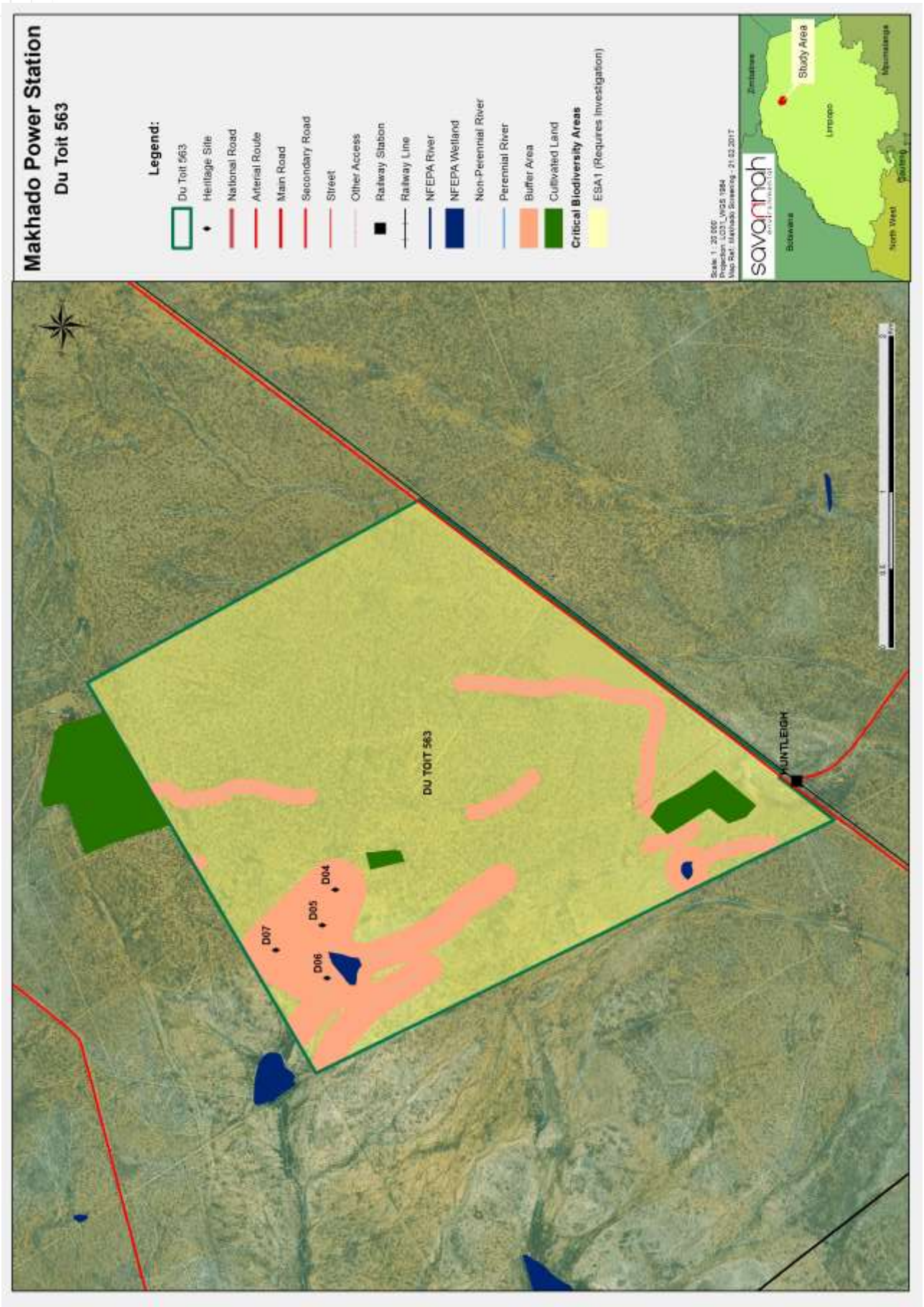


Figure 1: Preliminary sensitivity of Farm Du Toit 563
(image courtesy of Savannah Environmental)

Figure 2: Preliminary sensitivity of Farm Vrienden 589
(image courtesy of Savannah Environmental)

4 GEOGRAPHIC LOCATION & PROJECT LAYOUT

Results of the high-level identification process have indicated the following two properties for further consideration in the process, including:

- Farm Du Toit 563; and
- Farm Vrienden 589.

The regional location of the site alternatives is illustrated in **Figure 3**. A Google Earth image of the general region is presented in **Figure 4**, also illustrating the geographic location of project alternatives. The farms are situated within the Musina Municipality in the Limpopo Province, located approximately 35.5 km north of Makhado (Louis Trichardt) and 39 km southwest of Musina.

5 ANNOTATIONS ON BIOPHYSICAL ATTRIBUTES OF IMPORTANCE

5.1 Land Cover & Land Use of the Region

Land use often determines land cover; it is an important factor contributing to the condition of the land. Different uses have varying effects on the integrity of the land. For this assessment, land cover is loosely categorized into classes that represent natural habitat and land cover categories that originated from habitat degradation and transformation on a local or regional scale. Areas that are characterized by high levels of transformation and habitat degradation are generally more suitable for development purposes as it is unlikely that biodiversity attributes of conservation importance will be present or affected by development. Conversely, areas that are characterized by extensive untransformed and pristine habitat are generally not regarded suitable options for development purposes.

The Musina Municipality comprises approximately 758 000 ha, of which 717 000 ha (94.59 %) remains untransformed (BGIS, 2015), reflecting the observations made in the immediate region of the study sites.

Available satellite imagery and brief site observations indicate that the general region is definitively rural, with extremely little anthropogenic developments and transformed environments. It is therefore a natural assumption that the development of a coal-fired power station and the appurtenant infrastructure will inevitably result in significant increases in human movement, influx and transformative activities within a, largely, natural and untransformed environment, affecting the receiving environment adversely. A preliminary estimation of the expected cumulative impacts on a local and regional scale would suggest that the effects would be significant and high, specifically on a spatial and temporal scale. Despite this being regarded a significant and adverse impact, it is not regarded a fatal flaw for the development. The consideration of site locations closer to areas of existing transformation will decidedly lower this particular impact. Cattle and game farming constitute the major land use activity within the proposed farms and in the surrounds, implying that the area is decidedly untransformed with natural woodland habitat.

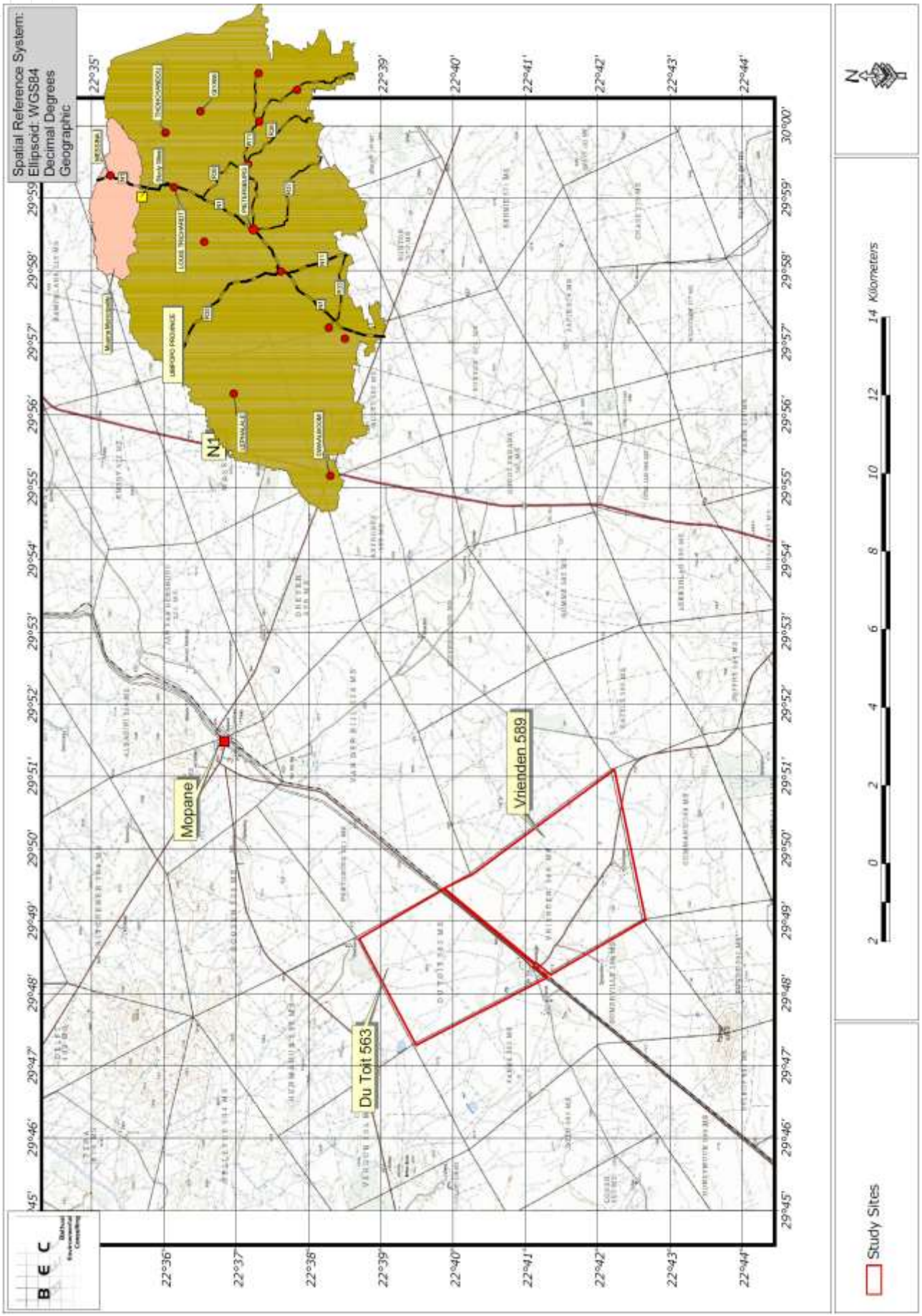


Figure 3: Geographic location of the proposed study sites

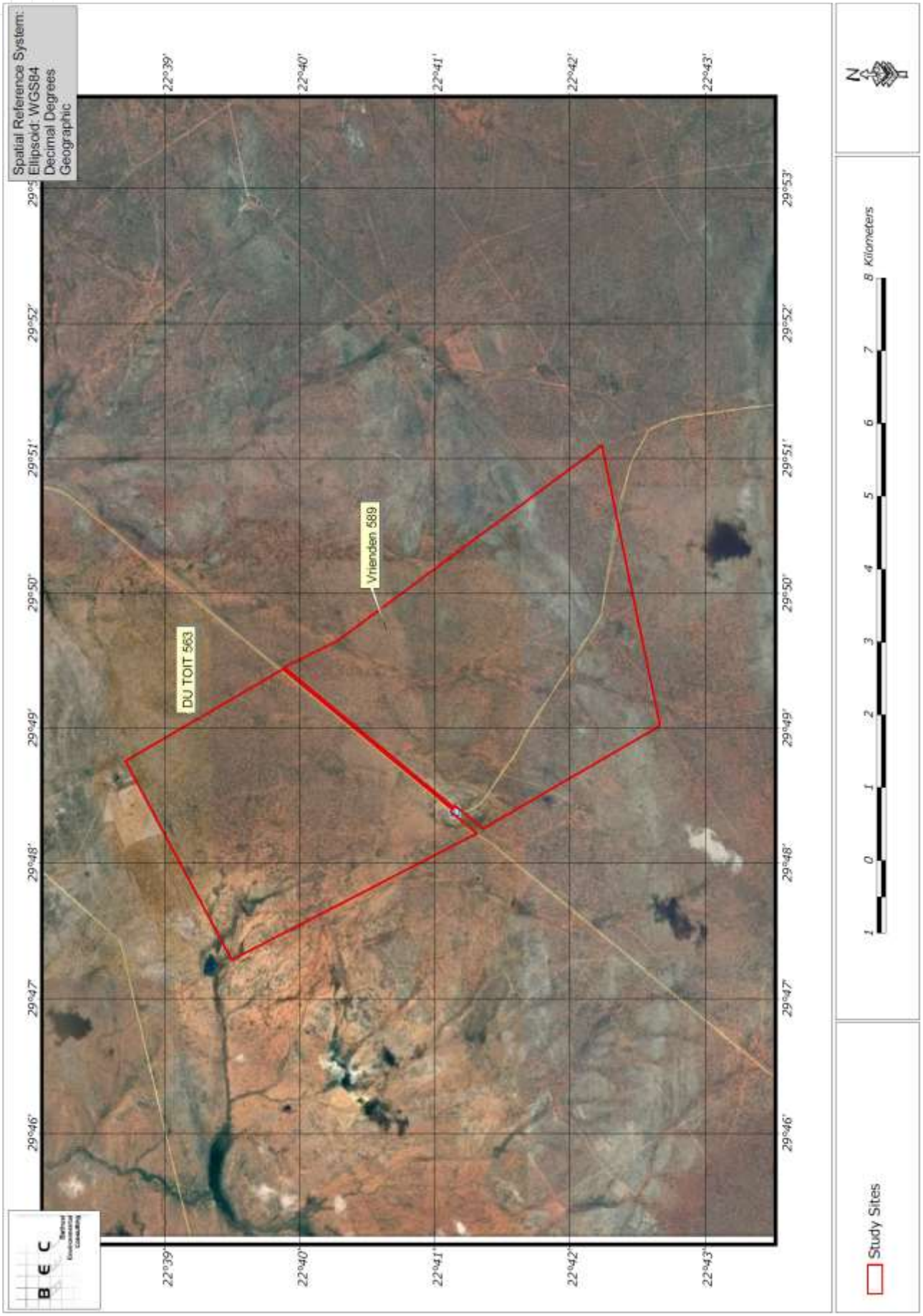


Figure 4: Aerial imagery of the immediate area
Imagery courtesy of www.googleearth.com

5.2 Protected Areas

Currently, there are four declared land-based protected areas in the Musina Municipality, comprising approximately 5.26 % of municipality. These include:

• Baobab Tree Reserve	Conservation Area	1 2281 ha	1,62 %
• Honnet Nature Reserve	Nature Reserve	1 992 ha	0,26 %
• Mapungubwe National Park	National Park	19 929 ha	2,63 %
• Nwanedi Nature Reserve	Nature Reserve	5 660 ha	0,75 %

There are no protected areas within the immediate surrounds of the study sites; the closest being Baobab Tree Reserve (32 km northeast) and Honnet Nature Reserve (35 km east).

5.3 Surface Water[1]

The study sites are situated within the Limpopo Catchment area, specifically in the A71K Quaternary Catchment Area. While no major rivers are present in the immediate surrounds, the Sand River is situated approximately 8.5 km to the north of the Farm Du Toit and the Mutamba River 12.3 km south of the Farm Vrienden. The BGIS (2015) database indicate no RAMSAR sites being present in the Musina Municipality.

The study sites exhibit attributes of periodic flooding with ill- and well-defined drainage lines and floodplains. The northwestern part of Farm Du Toit comprises a significant floodplain with a defined drainage line in which an artificial impoundment has been constructed. This drainage line flows northwards towards the Sand River, exhibiting atypical vegetation attributes. Similarly, ill-defined flood zones are noted on Farm Vrienden, which will contribute towards habitat diversity on a local scale. The presence and ecological contribution of these attributes, increases the habitat diversity of the farms and, ultimately, the perceived sensitivity. However, none of these attributes could be construed as a fatal flaw to the project.

5.4 Topography, Relief & Slopes

Topographical heterogeneity is recognized as a powerful influence contributing to the high biodiversity of southern Africa. Landscapes composed of spatially heterogeneous abiotic conditions provide a greater diversity of potential niches for plants and animals than do homogeneous landscapes. The species richness and biodiversity has been found to be significantly higher in areas of geomorphological heterogeneity.

In general, the area is described as 'Extremely Irregular Plains' (ENPAT, 2002). No significant topographical features have been observed on either of the sites. The topography of both sites is mostly flat, with minor undulations and localised topographical variances.

[1] Please note that it is not the intention of this report to present a detailed account of the wetland and aquatic habitat types of the area; this is addressed in a separate specialist report. However, certain aspects do relate to the biodiversity of the study area and general comments pertaining to this attribute are therefore included in this report.

5.5 Regional Conservation Planning

The purpose of the Limpopo Conservation Plan version 2 (LCP) (Desmet 2013) is to develop the spatial component of a bioregional plan (*i.e.* map of Critical Biodiversity Areas (CBA) and associated land-use guidelines). Incomplete biodiversity datasets and generally coarse mapping of biodiversity features impose limitations on this plan, which although they do not restrict the application of the plan, need to be recognized and appropriately accommodated when it is used:

1. The conservation plan does not replace the need for site assessments, particularly for Environmental Impact Assessments. Although it is based on a systematic conservation plan using best available data, this does not remove the need for on -site verification of the identified CBAs. Further, due to incomplete knowledge of the distribution of biodiversity features, it is likely that additional or alternative areas will need to be identified in the future as we gain a better understanding of rare, threatened, cryptic and understudied species;
2. This LCP is designed to be used at a scale of approximately 1:50 000. Although it can be used at a finer scale, this requires specialist interpretation of the specific biodiversity features identified in the systematic biodiversity plan; and
3. Ongoing changes in land-use, especially loss of natural habitat, as well as changes in the distribution of biodiversity (*e.g.* in response to climate change), will impact on the identified network of Critical Biodiversity Areas. It is likely that in future additional areas would need to be designated as CBAs to meet biodiversity targets in future iterations of the plan.

Categories employed in the LCP (which are also spatially represented in the general project area), include the following:

» Critical Biodiversity Areas - Based on the LCP, 40 % of the province is designated as Critical Biodiversity Area. These CBAs have been split into CBA 1 and CBA 2, based on selection frequency and the underlying characteristics of the biodiversity features that are being protected (*i.e.* location fixed features such as sites for CR species and flexible ones such as Least Cost Corridors). The majority of the CBAs in the province are CBA 1 (22 %), which can be considered "irreplaceable" in that there is little choice in terms of areas available to meet targets. If CBA 1 areas are not maintained in a natural state then targets cannot be achieved. CBA 2's are considered "optimal" as there is significant design involved in their identification. CBA 2's make up 18% of the province, and represent areas where there are spatial options for achieving targets and the selected sites are the ones that best achieve targets within the landscape design objectives of the plan; and

» Ecological Support Areas, spatially represented in Farms Du Toit and Vrienden, cover a further 22 % of the province, of which 16 % are intact natural areas (ESA 1) and 7 % are degraded or areas with no natural remaining, which are nevertheless required as they potentially retain some value for supporting ecological processes (ESA 2).

Figure 5 illustrates the spatial representation of CBAs and ESAs within the project area and surrounds.

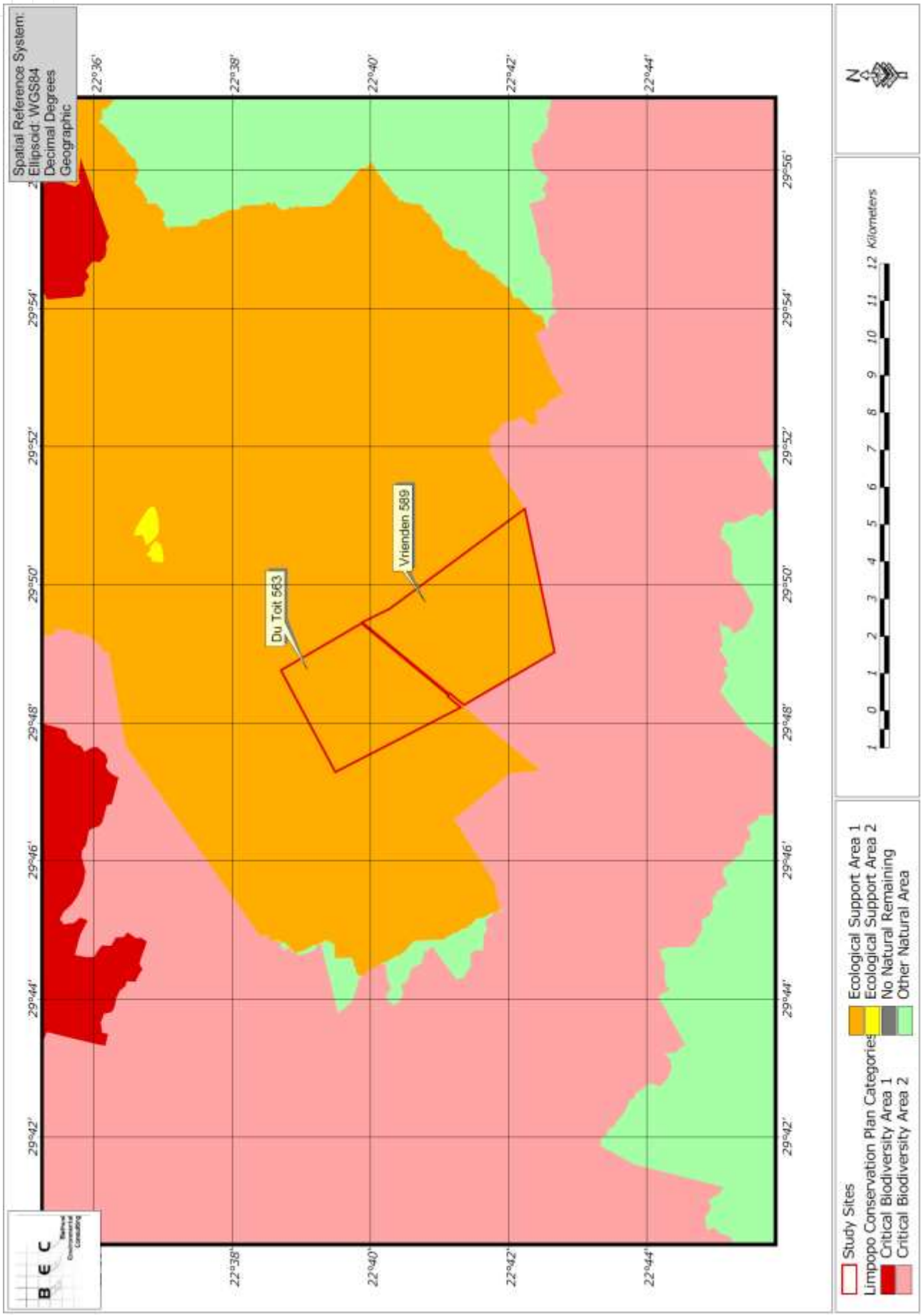


Figure 5: Illustration of regional conservation plan categories on a local scale

6 BACKGROUND TO THE SAVANNA ECOLOGY

The Savanna Biome is the largest biome in southern Africa, covering about 46 % of its area. The term savanna is widely accepted as describing a vegetation type with a well-developed grassy layer and an upper layer of woody plants. Many environmental factors correlate with the distribution of different savanna vegetation types, including landform, climate, soil types, fire and a very specific fauna. South African savannas of nutrient-poor substrates are characteristically broad-leaved and without thorns, while those of nutrient-rich substrates are fine-leaved and thorny. Nutrient-rich savannas have high grass layer productivity and the grasses are acceptable to grazers, resulting in a high grazing capacity (Knobel, 1999).

The diversity of African savanna is exceptional, comprising more than 13,000 plant species, of which 8,000 are savanna endemics. Specifically, dry savannas have more than 3,000 plant species. This diversity equals that of the South African grasslands and is exceeded only by the Fynbos Biome (Knobel 1999). Similarly, in respect of animal diversity, savannas are without peer, including approximately 167 mammals (15 % endemism), 532 birds (15 % endemism), 161 reptiles (40 % endemism), 57 amphibians (18 % endemism) and an unknown number of invertebrates (Knobel, 1999). Flagship species include the Starburst Horned Baboon Spider (Ceratogyrus bechuanicus), ground Hornbill (*Bucorvus leadbeateri*), Cape Griffon (*Gyps coprotheres*), Wild dog (*Lycaon pictus*), Short-Eared Trident Bat (*Cloeotis percivali*) and the White Rhino (*Ceratotherium simum*) (EWT, 2002).

Conservation within and of the savanna biome is good in principle, mainly due to the presence of a number of wildlife reserves. Urbanization is not a threat, perhaps because the hot, dry climate and diseases prominent in the savanna areas have hindered urban development. Much of the area is used for game farming and the importance of tourism and big-game hunting in the conservation areas must not be underestimated. Savannas are the basis of the African wildlife and ecotourism industry and play a major role in the meat industry.

Surprisingly little is known about the vegetation as most studies have been done in nature reserves and game farms, but five major regions are present, three of which are represented in the immediate region. Sweet Bushveld occurs on fertile soils in the dry and hot valleys of the Limpopo River and the thorny, small-leaved vegetation is dominated by Acacia species that increase to dense, impenetrable thickets at the expense of the grass layer when overutilised. Mixed Bushveld varies from short, dense bushveld to a rather open tree savanna. On shallow, infertile soils the broad-leaved Red Bushwillow (*Combretum apiculatum*) dominates, whereas on deeper, leached soils the Silver Clusterleaf (*Terminalia sericea*) becomes dominant. The Waterberg moist mountain bushveld is a typical example of moist, infertile savanna. Due to the high proportion of unpalatable grasses, the area has become known as 'sour bushveld'. An interesting phenomenon is the presence of many plant species showing affinities with the flora of the Drakensberg, which indicates an ancient link with this range (Knobel, 1999).

The vegetation that characterizes this area has developed many survival strategies, including the ability to produce tannins that are triggered when the leaves are browsed, the production of toxic sap, the development of thorns or their adaptation to sourveld areas that are not

generally favoured by grazers. The interaction of vegetation, fire and animals play important roles in maintaining savanna ecosystems (Knobel, 1999).

Over thousands of years, the savanna system and the antelope that inhabit them have developed side by side. Grasses, for example, have become well adapted to defoliation, as much a defensive response to constant pressure by grazers as to the regular veld fires that rage through the savanna in the dry seasons. The success of grasses has been a constantly renewed vast reservoir of food upon which large herds of grazers flourish. The woody component is also constantly exploited by many browsers, and with so many herbivores present, the carnivore component of the complex ecological system has also flourished (Knobel, 1999).

The savanna biome is populated by a greater diversity of bird species than any other biome in South Africa. The presence of both woody plants and a well-developed herbaceous layer provides diverse sources of food and shelter for specialist and generalist bird species, including seedeaters, insectivores and diurnal and nocturnal birds of prey abound.

The Musina region receives summer rainfall with an average annual of 350 to 400 mm. During summer time, average sunshine duration is approximately 65 %, and the temperature varies around 32°C, within moderate summer evening temperatures. The sunshine duration throughout the winter months is as high as 80 % while the temperature varies around 21°C.

Much of the area is used for game farming and big game hunting, illustrating that utilization and conservation of an area are not mutually exclusive. The savanna biome is the core of the wildlife, ecotourism and meat-production industries. Threats include rapidly expanding development of settlements for impoverished human populations and the associated need for firewood and building materials, diminishing water supply, agriculture and over-grazing (Knobel, 1999).

7 VEGETATION ATTRIBUTES

7.1 Regional Floristic Traits

The study area corresponds to the Savanna Biome and more particularly to the Central Bushveld Bioregion as defined by Mucina & Rutherford (2006), comprising an ecological type known as the Musina Mopane Bushveld (refer **Figure 6**). This unit is geographically situated in the Limpopo Province on undulating plains from around Baines Drift and Alldays in the west, remaining north of the Soutpansberg and south of the Limpopo River (but also occurring to the north in Zimbabwe), through Musina and Tshipise to Malongavlakte, Masisi and Banyini Pan in the east. Altitude ranges between 300 m (in the eastern Limpopo Valley) to 800 m.

Vegetation & Landscape Features comprises undulating to very irregular plains, with some hills. In the western section, open woodland to moderately closed shrubveld dominated by *Colophospermum*[2] *mopane* on clayey bottomlands and *Combretum apiculatum* on hills. In the eastern section on basalt, moderately closed to open shrubveld is dominated by *Colophospermum mopane* and *Terminalia prunioides*. On areas with deep sandy soils, moderately open savanna dominated by *Colophospermum mopane*, *T. sericea*, *Grewia flava* and *Combretum apiculatum*. Field layer well developed (especially on the basalt), open during the dry season; the herbaceous layer is poorly developed in areas with dense cover of *Colophospermum mopane* shrubs, for example, north of Alldays bordering the Limpopo floodplain.

The conservation status is set at Least Threatened; only 2 % is statutorily conserved mainly in the Mapungubwe National Park as well as in Nwanedi and Honnet Nature Reserves. Additionally, about 1 % is conserved in the Baobab Tree Reserve. Roughly, 3 % is transformed, mainly by cultivation. This unit is the most diverse mopaneveld type in South Africa. The Musina region has the highest species richness—also relative to *Colophospermum mopane*-dominated areas in Namibia and the Save River Valley in Zimbabwe (F. Siebert et al. 2003). The relationship of this unit with the adjacent and often fragmented parts of Limpopo Ridge Bushveld is spatially complex. It is very dependent on scale and has not been fully captured on the map.

7.2 Regional Phytodiversity

The SANBI database was consulted to provide a brief account of the known regional phytodiversity; the presence of 59 plant species within the ¼-degree grid (2229DB) has been recorded, reflecting a poor knowledge of the floristic diversity of the area in general. Detailed assessments during the EIA phase of the project will afford the opportunity to contribute to the floristic knowledge of the region by submission of sampling records to SANBI.

[2] Possible name change to *Hardwickia*, to be confirmed

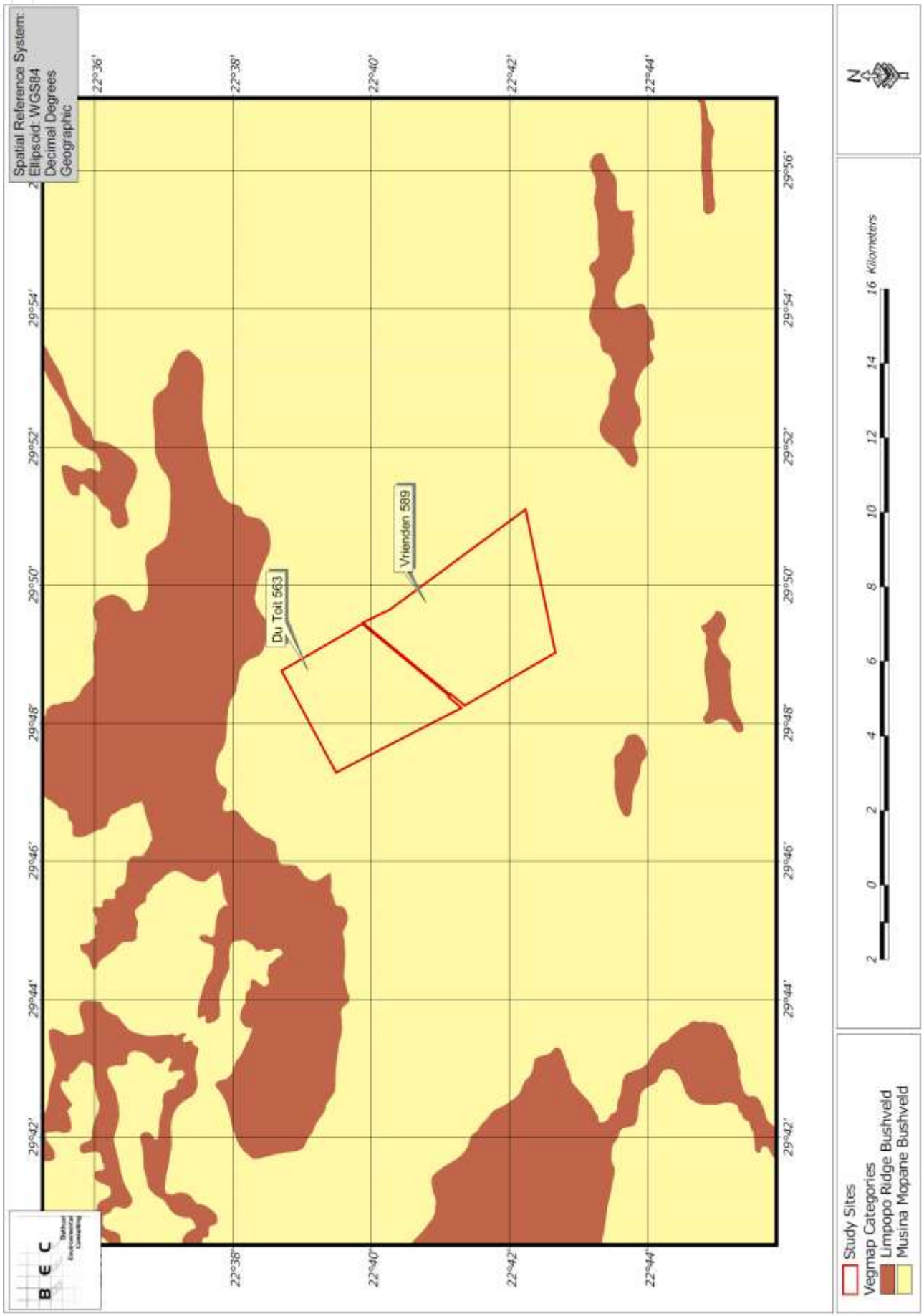


Figure 6: Vegmap categories of the surrounding region

7.3 Plants of Conservation Importance

The assessment of plants of conservation concern and importance is based on the following legislative sets:

- Union for Conservation of Nature (IUCN);
- National Forest Act of 1998; and
- Limpopo Environmental Management Act (Act No. 7 of 2003).

7.3.1 Union for Conservation of Nature (IUCN)

South Africa's Red List system is based on the IUCN Red List Categories and Criteria Version 3.1 (finalized in 2001), amended to include additional categories to indicate species that are of local conservation concern (refer **Figure 7**). The IUCN Red List system is designed to detect risk of extinction. Species that are at risk of extinction, also known as threatened or endangered species are those that are classified in the categories Critically Endangered (CR), Endangered (EN) and Vulnerable (VU). The SANBI database for ¼-degree grid 2229DB indicate the known presence of four species of conservation concern within the immediate region (refer **Table 5**).

The **absence** of conservation important taxa from the regional sampling records reflects on the paucity of accurate floristic knowledge for the region. Taking cognisance of the status and availability of habitat within the site and surrounds, the possibility that plant species of conservation importance would persist within the region cannot be discounted at this stage of the process.

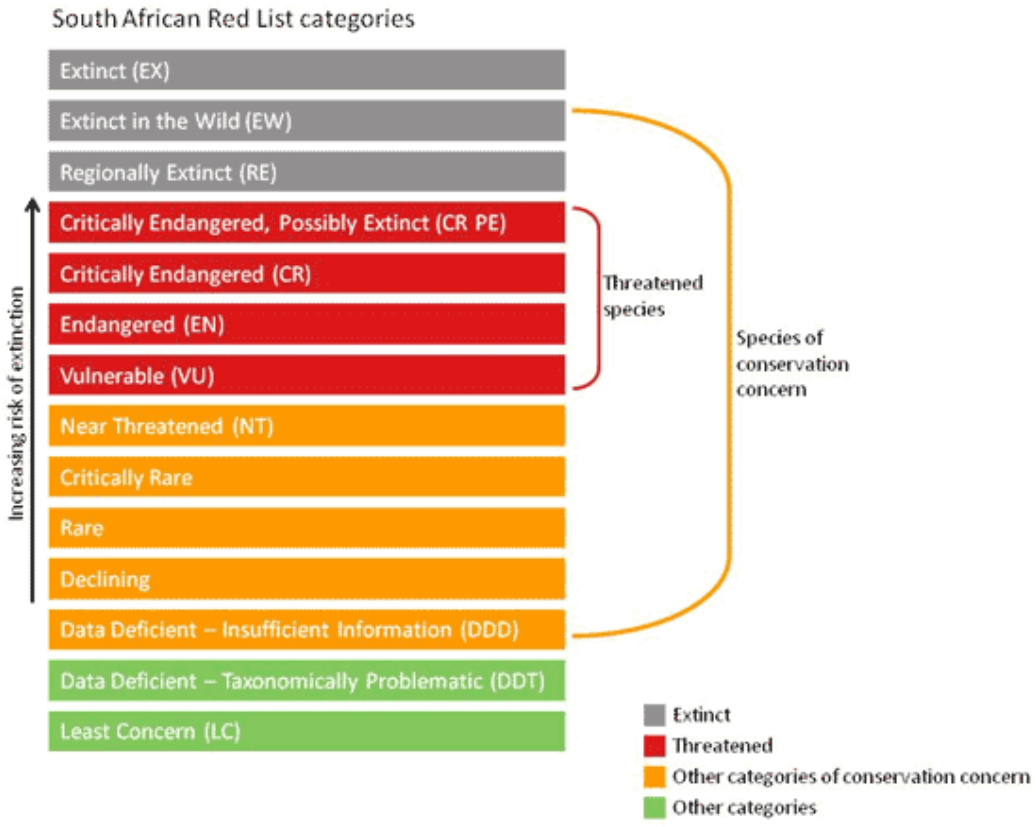


Figure 7: South African Red List Categories (courtesy of SANBI)

7.3.2 National Forests Act of 1998

In terms of the National Forests Act of 1998, certain tree species can be identified and declared as protected. All trees occurring in natural forests are also protected in terms of the Act. Protective actions take place within the framework of the Act as well as national policy and guidelines. Trees are protected for a variety of reasons, and some species require strict protection while others require control over harvesting and utilization. In terms of the National Forests Act of 1998, protected tree species may not be "cut, disturbed, damaged, destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold, except under license granted by the Department of Water Affairs and Forestry (or a delegated authority)". It is therefore necessary to conduct a survey that will determine the number and relevant details pertaining to protected tree species on the property for the submission of relevant permits to authorities prior to the disturbance of these individuals. **Table 4** presents a list of protected trees that have been recorded in the study sites during the brief observation period.

Table 4: Historic sampling records of protected trees in the region

Taxon	*Family*	*Status*
Adansonia digitata	Malvaceae	Protected tree (NFA, 1998)
Boscia albitrunca	Capparaceae	Protected tree (NFA, 1998)
Combretum imberbe	Combretaceae	Protected tree (NFA, 1998)
Sclerocarya birrea subsp. *caffra*	Anacardiaceae	Protected tree, (NFA, 1998), Declining (IUCN)

Local umbrella species[3] will also be considered during the EIA stage of the process in order to identify areas of concern that should be targeted for protection during subsequent processes and developments.

7.3.3 Limpopo Environmental Management Act (Act No 7 of 2003)

The LEMA provides for the consolidation and amendment of the environmental management legislation of, or assigned to the Province and to provide for matters incidental thereto. Specifically, Schedules 11 (Specially protected plants) and Schedule 12 (Protected plants) have relevance to this section. **Table 5** provides a list of protected plant taxa that are known to occur in the immediate region of the study sites.

Table 5: Regional sampling records of protected species in the region (POSA, LEMA)

Taxon	*Family*	*Status*
Adansonia digitata	Malvaceae	LEMA, Protected, Schedule 12
Hibiscus sabiensis	Malvaceae	Data Deficient - Taxonomically Problematic, LEMA, Protected, Schedule 12
Hoodia species	Apocynaceae	LEMA, Protected, Schedule 12

[3] Species that are selected for making conservation related decisions, typically because protecting these species indirectly protects the many other species that make up the ecological community of its habitat.

7.4 Local Floristic Context

From a floristic perspective[4], four broad habitat types are prominent in the area, as discussed below.

7.4.1 Undifferentiated arid broad-leaved woodland on sandy soils

The majority of the study area comprise open, arid woodland located on sandy soils, notably a well-developed woody layer consisting of *Colophospermum (=Hardwickia) mopane, Terminalia prunioides*, *Vachellia tortilis, Kirkia acuminata, Grewia bicolor, Boscia albitrunca, Lannea schweinfurthii* and various species of *Commiphora*. Typical canopy constituents include *Xanthocercis zambesiaca, Senegalia nigrescens* and *Adansonia digitata*. The graminoid layer includes dominant taxa such as *Panicum maximum, Schmidtia pappophoroides* and *Stipagrostis uniplumis*. Open structure and sparse graminoid layer (presumably due to grazing pressure and climatic factors such as unpredictable precipitation and frequent aridity) was noted. Some sections of this woodland type comprise dense *Grewia flavescens* and *Dichrostachys cinerea* shrubs. This natural woodland community includes the Large *Adansonia digitata* (Baobab) canopy constituents that is encountered as scattered individuals across the region. Although described in the avifaunal report as a separate entity, in a floristic context, it is not regarded separate to the natural woodland.

7.4.2 Seasonal drainage lines

This habitat type represents the linear riparian zones along drainage lines, which were most prominent on the Farm Du Toit, but also occurs on the Farm Vrienden. The riparian vegetation consists of a dense canopy of *Schotia brachypetala, Xanthocercis zambesiaca,* and *Peltophorum africanum*. The understory is well defined and thicket-like, consisting of *Grewia flava, G. hexamita* and *Ziziphus mucronata*. *Panicum maximum* dominates the graminoid layer. A high vertical heterogeneity and leaf litter deposition associated with the alluvial vegetation allow for, specifically, avifaunal compositions that are not typically associated with adjacent dryland habitat types - thereby enhancing local biodiversity.

7.4.3 Impoundments and natural depressions (pans)

These respectively represent manmade water bodies and shallow depressions, mostly situated within the riparian floodplains and linear drainage lines. Vegetation associated with these features are frequently degraded because of high grazing pressure, and often conforms to a piosphere type of nodal vegetatal development pattern.

7.4.4 Secondary woodland and deteriorated vegetation

These represent areas of secondary woodland previously used for agricultural purposes and exhibit few attributes of the surrounding natural woodland vegetation patterns. The prominence of fine-leaved *Acacia* (*Senegalia/ Vachellia*) species predominate in these parts.

[4] Taken from L. Niemand, Avifaunal Screening Assessment, Makhado Power Station, 2017

7.5 Potential and Likely Impacts on The Floristic Environment

The proposed activity implies the loss of natural habitat and no impacts of a beneficial nature on the floristic environment are likely to result. Based on a generic list of impacts associated with this type of development, three categories of impacts are likely to result, namely, direct impacts, indirect impacts and impacts of a cumulative nature.

7.5.1 Nature of Potential and Likely Impacts

The largest extent of impacts within the floristic environment is likely to result due to direct (physical) effects of land clearing activities and vegetation loss. Direct impacts include any effect on the vegetation, including locally endemic species, populations or individual species of conservation importance, as well as on overall species richness, diversity and abundance. These effects include impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of conservation consideration. Impacts on sensitive, restricted or protected habitat types are included in this category, but only on a local scale. These impacts are mostly measurable and easy to assess, as the effects thereof are immediately visible and can be determined to an acceptable level of certainty. Impacts of a direct nature include the following:

a. loss of Red Data and protected plant taxa (individuals, stands, populations) of conservation importance (threatened taxa), including protected trees (declining status, provincially protected taxa, DAFF protected status, etc.);
b. loss of natural vegetation (physical modifications, removal, damage) including the loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance; and
c. local depletion of plant taxa and reduction of phytodiversity.

In contrast, indirect impacts are not always immediately evident and can consequently not be measured at a specific moment in time; the extent of the effect is frequently at a scale that is larger than the actual site of impact, but usually restricted to a local scale (and not regional). A measure of estimation, extrapolation, or interpretation is therefore required to evaluate the importance of these impacts and is usually a factor of the sensitivity of the receiving surrounding environment. This type of impact typically results in adverse effects or deterioration of surrounding areas due to uncontrolled, development related activities. In addition, the ecological functionality of the immediate and surrounding area could be adversely affected by development, with specific reference to the ecological interaction between plants and animals. The aesthetic appeal of the region, although a personal and highly debatable attribute, is regarded a potential receiver of landscape changes through the addition of industrial plants, ashing facilities, linear infrastructures, etc. Lastly, one of the most important impacts of indirect measures is represented by the alteration of floristic characteristics of the surrounding areas through the introduction and proliferation of plants with an exotic nature or encroachment characteristics. Impacts of an indirect nature include the following:

d. decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.;
e. reduced ecological functionality (including fire, erosion);

f. decreased aesthetic appeal of the landscape; and
g. the introduction of invasive, exotic and encroacher plant species.

Lastly, impacts of a cumulative nature places direct and indirect impacts of this projects into a regional and national context, particularly in view of similar or resultant developments and activities in the region. Impacts of a cumulative nature typically adversely affect the local and regional conservation status of plant taxa and protected habitat types as well as local and regional fragmentation levels, but also issues such as increased exploitation due to the exacerbation of anthropogenic activities on a local scale. These impacts are notoriously problematic to control or prevent and frequently require huge financial commitments to mitigate. Impacts of a cumulative nature typically include the following:

h. increased exploitation of natural resources due to increased human presence and resource requirements;
i. exacerbation of existing levels of habitat fragmentation and isolation; and
j. cumulative impacts on local/ regional and national conservation targets and obligations.

7.5.2 Mitigation

The objective of mitigation is to firstly avoid and minimise impacts where possible and where these cannot be completely avoided, to compensate for the negative impacts of the development on the vegetation and habitat and to maximise re-vegetation and rehabilitation of degraded areas.

For each impact identified as being of significance, appropriate mitigation measures to reduce or otherwise avoid the potential impacts should be suggested. As part of the EIA process, all impacts should be assessed without mitigation measures and with mitigation measures as suggested and appropriately implemented. In selected cases, where impacts of extreme significance can be demonstrated, and where no appropriate mitigation or avoidance measures are deemed appropriate, a process of consideration of biodiversity offsets, or 'offsite mitigation measures', should be compiled and implemented. This process of:

1. impact identification;
2. impact evaluation (nature and extent);
3. mitigation/ avoidance recommendations; and
4. offset considerations,

will form part of the EIA and EMP phase of the project.

7.6 Preliminary assessment of impacts on the floristic environment

Table 6: Preliminary assessment of impacts on the floristic environment

Impact

a. Loss of Red Data and protected trees and protected plant species (IUCN, LEMA, NFA). As these species occur across the site in moderate densities (protected trees), all areas where land clearance will take place are likely to be affected.

Desktop Sensitivity Analysis of the Site:

Moderate to high densities of protected trees were identified, with specific reference to large Baobab individuals. The sensitivity of the site, in terms of this aspect is therefore regarded moderately to highly sensitive

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Loss of Red Data plants and protected trees with high intrinsic ecological value, also with reference to habitat associated with these species	Localised depletion of numbers of Red Data plants and protected species is expected. The densities and presence of similar habitat and plants/ protected trees in the surrounding region is not known at this stage and the likelihood of significant effects on population numbers cannot be discounted at this stage.	Local/ Regional	Whilst no specific 'No-Go' areas were identified, areas of high ecological sensitivity, including riparian/ wetland habitat as well as topographically heterogeneous habitat should be avoided.

Description of expected significance of impact

Due to the nature of the development, land clearance will result in the complete removal of all vegetation within the footprint area, unavoidable impacts are therefore likely to occur in habitat where protected/ RD plants could potentially occur. Losses of protected and Red Data plants are regarded a significant impact on the floristic attributes and should ideally be avoided at all costs, particularly since these impacts are of a permanent nature and cannot be reversed. However, careful planning, the use of low sensitivity areas, and removal and/ or relocation of specific target species might mitigate the significance of this impact to acceptable levels.

Description of expected significance of impact

Distributional patterns of protected trees and the presence/ location of Red Data plants are not known at this stage and will be investigated in more detail during the specialist surveys during the EIA phase of the project. Collated data will inform the identification of sensitivity and recommendation of suitable development areas.

Impact

b. Loss of natural vegetation located in the eventual footprint that will be subjected to land clearance for construction purposes. This impact also includes areas of higher sensitivity that are unavoidably included in the footprint area, as well as habitat that does not occur abundantly across the landscape and region

Desktop Sensitivity Analysis of the Site:

A moderate sensitivity is generally ascribed to the proposed sites because of the existing natural status of the receiving environment, no areas of deterioration and/ or transformation was identified and the receiving environment therefore comprises of a vegetation type that is representative of the regional ecological type, albeit included in the Least Threatened conservation category (Vegmap 2016)

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Loss of natural vegetation, natural habitat and habitat that might not necessarily be abundantly present on a local and/ or regional scale	Unaccounted losses of natural vegetation and sensitive habitat types could potentially result in significant impacts beyond the boundaries of the development footprint, also resulting in impacts on local and/ or regional conservation efforts	Local/ Regional	Whilst no specific 'No-Go' areas were identified, areas of high ecological sensitivity, including riparian/ wetland habitat as well as topographically heterogeneous habitat should be avoided.

Description of expected significance of impact

Losses of natural vegetation, also with specific reference to habitat types of high sensitivity, is likely to result in impacts beyond the boundaries of the site. It is also mentioned that sensitive habitat types are known to be associated with plant taxa of conservation importance/ concern and could therefore cumulatively contribute to impacts on these taxa, as well as ecological functionality of the surrounding region

Gaps in knowledge & recommendations for further study

Preliminary results obtained during the screening and scoping phases indicated the presence of extensive areas of natural habitat that is representative of the regional ecological types as well as the presence of habitat types of higher sensitivity. The identification, description and delineation of these habitat types will inform the identification of sensitivity and recommendation of suitable development areas.

Impact

c. Depletion of plant species on a local scale and the reduction of phytodiversity of the immediate surrounds

Desktop Sensitivity Analysis of the Site:

Whilst a Least Concern conservation level is ascribed to the regional ecological type, the loss of natural habitat within the eventual footprint is an unavoidable impact, albeit likely to occur only on a local scale

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Loss of natural vegetation and associated plant species and decreased diversity of plant taxa that do not necessarily occur at high densities across the landscape	Unaccounted losses of plant species and the decrease in phytodiversity across the development footprint and immediate surrounds, also include unavoidable changes to compositional and structural aspects of the vegetation	Local, not likely to affect areas significantly beyond the development footprint	Whilst no specific 'No-Go' areas were identified, areas of high ecological sensitivity, including riparian/ wetland habitat as well as topographically heterogeneous habitat should be avoided. Recommendations pertaining to the development footprint should take cognisance of floristic diversity patterns on a local scale.

Description of expected significance of impact

Due to the nature of the development, land clearance is an unavoidable impact and therefore constitutes a realistic and definite impact. Results of the impact is also irreversible and will ultimately result in the creation of sterile areas on a local scale. Whilst this impact cannot be prevented, mitigation and guidance during the planning phases of the project will likely curtail the effects to an acceptable level. The identification and use of target areas/ low sensitivity areas is strongly recommended to prevent the uncontrolled losses of floristic diversity beyond the development footprint. Considering the existing Least Threatened conservation status of the vegetation, it is potentially likely that surrounding areas could harbour similar vegetation and/ or species, ultimately providing some mitigation for losses to the vegetation.

Gaps in knowledge & recommendations for further study

Identified habitat types will be subjected to phyto diversity assessments, providing insight into the floristic species richness patterns across the proposed sites. The recommendation of suitable areas for development purposes will form part of the EIA phase.

Impact

d. Deterioration of adjacent natural habitat, changes to local ecological functionality and quality

Desktop Sensitivity Analysis of the Site:

Whilst a Least Concern conservation level is ascribed to the regional ecological type, the loss of natural habitat within the eventual footprint is an unavoidable impact, albeit likely to occur only on a local scale, with specific reference to linear infrastructure and perimeter areas

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Changes to and deterioration of remaining natural vegetation situated in proximity to development footprints, with specific reference to potentially sensitive habitat types	Deterioration of surrounding vegetation, with reference to structural and/ or species changes	Local/ regional	Whilst no specific 'No-Go' areas were identified, areas of high ecological sensitivity, including riparian/ wetland habitat as well as topographically heterogeneous habitat should be avoided. Recommendations pertaining to the development footprint should take cognisance of floristic diversity patterns on a local scale and adequate buffer zones should be instituted

Description of expected significance of impact

Anthropogenic developments are unavoidably associated with habitat deterioration of peripheral areas. Littering, surface disturbances, erosion, etc. generally occur along the perimeter and linear infrastructure that is required for the development. The deterioration of habitat could potentially affect sensitive habitat that are situated in proximity to the footprints as well as adversely impact on remaining ecological processes and functionality. While mitigation is possible, the success of mitigative actions is not high and careful planning, monitoring and strict EMP guidance is generally required.

Gaps in knowledge & recommendations for further study

The EIA phase will inform the exact nature of risks to the surrounding environment and EMP guidelines will be adapted to allow for the correct identification and mitigation of issues.

Impact

e. Reduced ecological functionality (including fire, erosion)

Desktop Sensitivity Analysis of the Site:

Significant changes to the natural environment, i.e. the creation of an industrial development and the significant increase in human activities and associated impacts, will result in unavoidable changes to the ecological functionality of the natural environment. Increased or decreased fire intensities and frequency, increased erosion patterns, disruption and/ or floristic development patterns represent some of these unavoidable impacts

Issue	Nature of Impact	Extent of Impact	No-Go Areas
The creation and operation of an industrial footprint and appurtenant infrastructure, also with reference to linear infrastructure, will result in the losses of, and changes to, natural ecological processes and functionality on a local and regional scale	Disruption and/ or changes to ecological patterns associated with these developments are generally regarded permanent and contribute cumulatively to deterioration of the receiving environment.	Local/ regional	Whilst no specific 'No-Go' areas were identified, areas of high ecological sensitivity, including riparian/ wetland habitat as well as topographically heterogeneous habitat should be avoided. Recommendations pertaining to the development footprint will take cognisance of floristic patterns on a larger scale and provide insight into sensitivity beyond the site boundaries

Description of expected significance of impact

Anthropogenic developments are unavoidably associated with habitat deterioration of peripheral areas. Littering, surface disturbances, erosion, etc. generally occur along the perimeter and linear infrastructure that is required for the development. The deterioration of habitat could potentially affect sensitive habitat that are situated in proximity to the footprints as well as adversely impact on remaining ecological processes and functionality. While mitigation is possible, the success of mitigative actions is not always high and careful planning, monitoring and strict EMP guidance is generally required.

Gaps in knowledge & recommendations for further study

The EIA phase will inform the exact nature of risks to the surrounding environment and EMP guidelines will be adapted to allow for the correct identification and mitigation of issues.

Impact

f. Decreased aesthetic appeal of the landscape

Desktop Sensitivity Analysis of the Site:

Significant changes to the natural environment, i.e. the creation of an industrial development and the significant increase in human activities and associated impacts, will result in unavoidable changes to the visual appearance of the landscape and natural environment, also with reference to required linear infrastructures and topographically dominating structures (ashing facilities, towers, structures, etc)

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Visual deterioration in the aesthetic appeal of an untransformed landscape and uninterrupted natural environment	Changes to the visual appearance of the natural environment will result from the addition of industrial structures and a fragmented landscape, ultimately resulting in decreased appeal of the natural	Local/ regional	No specific 'No-Go' areas were identified, visually appealing areas, with reference to topographically heterogeneous habitat should be avoided.

	environment		Recommendations pertaining to the development footprint will take cognisance of floristic patterns on a larger scale and provide insight into sensitivity beyond the site boundaries

Description of expected significance of impact

An industrial development of this nature results in unavoidable and irreversible physical changes to the natural environment and complete mitigation is not possible. However, recommendations pertaining to landscaping, screening of structures, etc. could potentially contribute to limited mitigation of the visual effects of the impact.

Gaps in knowledge & recommendations for further study

The EIA phase will inform the exact nature of risks to the surrounding environment and EMP guidelines will be adapted to allow for the correct identification and mitigation of issues.

Impact

g. Introduction of invasive, exotic and / or encroacher plants

Desktop Sensitivity Analysis of the Site:

Increased human movement, associated with the creation of sterile environments and significant land clearance activities, are generally associated with the introduction and proliferation of weeds and invasive (exotic and indigenous) species. These impacts are generally regarded significant as it results in deterioration and significant economic impact on surrounding natural habitat.

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Introduction of weeds and declared invasive plants in surrounding natural environment and the proliferation/ increase in locally indigenous encroacher species	Changes to remaining natural habitat	Local/ regional	No specific 'No-Go' areas were identified, specific reference is however made of riparian zones that could contribute to increased distribution of certain species

Description of expected significance of impact

This impact is of significance as it could potentially result in significant changes to surrounding natural vegetation, causing widespread impacts beyond the boundary of the site. However, prevention is generally effective in limiting the occurrence and severity of the impact, but cause is advised that an effective management and monitoring plan should be developed prior to occurrence of the impact.

Gaps in knowledge & recommendations for further study

The EIA phase will inform the exact nature of risks to the surrounding environment and EMP guidelines will be adapted to allow for the correct identification and mitigation of issues. Specific risk species will be identified and included as recommended target species.

Impact

h. The cumulative and increased exploitation of natural resources due to increase human presence and resource requirements

Desktop Sensitivity Analysis of the Site:

Increased human presence and the demand for natural resources will likely result in adverse impacts on certain target species (muthi and medicinal plants, firewood, etc.). This impact is also likely to cause adverse impacts due to the introduction of popular species that do not occur naturally in the region, with specific reference to accommodation areas, etc.

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Depletion of popular muthi species, plants used for tradition and/ or medicinal uses, etc.	Changes to local floristic abundance of certain taxa, depletion of local plant species	Local/ regional	No specific 'No Go' areas were identified as part of this process

Description of expected significance of impact

Effects associated with this impact are regarded moderately significant. Based on existing evidence, it is highly likely to occur, causing moderately severe losses of natural resources (depending on the target species, but will likely be contained with a relative small geographic area surrounding the development and associated infrastructure where human activities are high. Mitigation is generally possible, but with a limited level of success.

Gaps in knowledge & recommendations for further study
The EIA phase will inform the exact nature of risks to the surrounding environment and EMP guidelines will be adapted to allow for the correct identification and mitigation of issues. Specific risk species will be identified and included as recommended target species.
Impact
i. Cumulative exacerbation of existing levels of habitat fragmentation and isolation
Desktop Sensitivity Analysis of the Site:
A low level of habitat fragmentation and isolation of the environment is currently evident. The receiving environment is therefore regarded extremely sensitive towards this impact

Issue	**Nature of Impact**	**Extent of Impact**	**No-Go Areas**
Construction and operation of an industrial development in a largely untransformed natural environment will undoubtedly result in severe increases in habitat fragmentation levels, also taking cognisance of associated developments	Loss and degradation of the natural receiving environment	Regional	No specific 'No Go' areas were identified as part of this process

Description of expected significance of impact
Within a largely untransformed natural environment, the effects of this impact are generally accepted to be severe, unavoidable and impossible to mitigate against. While every effort could be made to limit the spread of developments and associated infrastructure across an untransformed landscape, the increase in anthropogenic developments, movement, transportation, effluents, discards, etc., will ultimately over the long-term result in a fragmented landscape on a local and regional scale.
Gaps in knowledge & recommendations for further study
The EIA phase will inform the exact nature of risks to the surrounding environment and EMP guidelines will be adapted to allow for the correct identification and mitigation of issues
Impact
j. Cumulative impacts on local/ regional and national conservation targets and obligations
Desktop Sensitivity Analysis of the Site:
Despite a Least Concern conservation status of the local ecological type, cumulative losses of natural vegetation due to associated developments and infrastructure could potentially result in these losses contributing to an increased sensitivity and conservation status

Issue	**Nature of Impact**	**Extent of Impact**	**No-Go Areas**
Continued, unaccounted and uncontrolled loss of natural habitat due to associated developments and transformative activities	Loss and degradation of the natural receiving environment	Regional	No specific 'No Go' areas were identified as part of this process

Description of expected significance of impact
An increase in the local development patterns and activities that will undoubtedly result from this development will cause definitive and irreversible changes/ losses to the remaining natural environment. Mitigation is generally not possible as most of these activities will not be under the control of this project.
Gaps in knowledge & recommendations for further study
The EIA phase will inform the exact nature of risks to the surrounding environment and EMP guidelines will be adapted to allow for the correct identification and mitigation of issues

The expected and likely impacts on the floristic environment is likely to result in severe and irreversible impacts on the footprint areas. These impacts will generally result in the local destruction of plants, with specific reference to protected and Red Data species; preliminary assessments did reveal the presence of numerous protected trees within the proposed sites. The nature of the development will however determine that these direct impacts are generally a 'once-off' event and are unlikely to result in similar impacts on the neighbouring habitat. However, secondary or indirect impacts, such as deterioration of habitat, peripheral impacts, degradation and deterioration of surrounding areas, will likely constitute longer term impacts,

but generally to a lower significance level. These impacts can generally be mitigated/ prevented to some extent, or to a more acceptable level, but will generally occur inevitably. Impacts on the floristic environment that spread beyond the controllable boundaries of the proposed development (cumulative impacts) generally comprise of the effects of the significant increase of human presence and human-related activities and developments required and flowing from the proposed project. Since the proposed sites are situated within a largely rural area with low existing anthropogenic activity levels, the effects of these cumulative impacts are regarded significant, long-term and irreversible. Evidence from similar developments have indicated a significant deterioration of the natural environment on a local/ regional scale subsequent to the commencement of development activities.

The receiving environment is generally homogenous, but does exhibit typical variations in terms of the presence of drainage lines and localised topographical variability. These areas generally represent sensitive habitat and should ideally be avoided. The EIA phase will allow for the collation of adequate data to inform the project in terms of a suitable footprint site that will render the best possible solution to impact management and control.

7.7 Perceived Floristic Sensitivity/ Suitability of Project Alternatives

Biophysical and botanical attributes of the respective site alternatives were taken into consideration in evaluating the perceived floristic sensitivity of the sites. Based on this perceived floristic sensitivity, and with cognisance of potential and likely impacts that are likely to result from the proposed construction and operation of a coal-fired power station, site alternatives were evaluated for suitability. While no comparative assessment is presented, the proposed site alternatives will ultimately be subjectively ranked in order of preference. These results will form part of the range of recommendations presented by the panel of environmental specialists, results of which will ultimately be taken forward for consideration in the EIA phase of the project.

Aspects that are taken into consideration for the project alternatives include the extent of the development footprint, including the power plant, ashing facilities, offices complex, etc. Availability of suitable habitat and proximity to sensitive habitat will play a determining role in a suggested development footprint. Ideally, it is suggested that the entire development footprint be placed on a single property, however, should insufficient area be available, nearby suitable habitat from the adjacent property should be used. Floristic attributes that are regarded important in terms of proposing potential footprints, will include:

- Floristic habitat diversity;
- Inherent floristic sensitivity of the receiving environment (abundance/ presence of sensitive habitat types, riparian habitat, impoundments, outcrops, etc.;
- Approximate densities of protected tree species, with specific reference to *Adansonia digitata*;
- Known locations of important/ protected trees/ plants; and
- Suitable habitat, or known locations of conservation important plant taxa.

A crucial consideration would be to reduce the development footprint as far as possible within the natural environment. Uncontrolled spread of the infrastructure across a wide terrain will undoubtedly lead to exacerbation of expected and likely impacts on the biological environment. Clarity on the exact nature of the floristic sensitivity of the units and respective farms will be sought during the EIA phase of the project.

Table 7: Comparative analysis based on vegetatal attributes		
Vegetatal Attribute	*Farm Option*	
	Du Toit	**Vrienden**
Habitat diversity (estimated)	Moderate	Moderate-high
Approximate densities of protected trees	Moderate - High	Moderate
Important habitat for CI plants	Moderate	Moderate
Occurrence of azonal habitat (pans and dams)	High	Moderate
Estimate of seasonal drainage lines (sensitive habitat types)	5	5
Estimate number of dams/impoundments (sensitive habitat types)	2	0
Suitability outcome:	**Less preferable**	**More preferable**

7.7.2 Option 1 – Farm Vrienden

While little or no transformed habitat is prevalent on Farm Vrienden, the availability of large tracts of homogenous vegetation is expected to suffice in the selection of a footprint that will not cause destruction of several habitat types, concentrating impacts within one, or a few habitat types. An appraisal of the initial sensitivity images revealed that it would be possible to place the footprint outside riparian drainage lines. However, from visual observations, it is apparent that densities of protected tree species, specifically large *Adansonia digitata*, are slightly higher on this farm. It is regarded possible to arrange the development footprint to impact as few of these individuals as possible. This option would therefore be regarded as the most preferred option.

7.7.3 Option 2 – Farm Du Toit

Habitat diversity appears to be slightly higher on Farm Du Toit, with specific reference to riparian drainage lines. Several protected tree species have also been recorded on this farm, including several large *Adansonia digitata* individuals, albeit at slightly lower abundance levels compared to Farm Vrienden. Expected and likely impacts within this farm will be strongly dependent on the exact placement of the footprint, but considering the extent of impacts on a more diverse habitat range, it is currently regarded as the least preferable development option.

7.7.4 Option 3 – Portions of Farms Du Toit and Vrienden

Should insufficient suitable habitat be available on either farm option, the possibility exists that portions of both farms be utilised for development purposes. It is emphasised that the proximal placement of these development portions is crucial as the uncontrolled spread of facilities across large expanses of natural habitat will undoubtedly result in exacerbation of the expected and likely impacts on the biological environment. Only if these requirements for the concentration of development can be met, will this option be regarded as the 2nd preferred

alternative. Should the development footprint result in uncontrolled and expansive development areas, this option will be regarded as the least preferred option.

7.8 Botanical EIA: Recommended Plan of Study

7.8.1 Sampling Approach

The number of sample plots to be distributed in a given area depends on various factors, such as the scale of the classification, environmental heterogeneity and the accuracy required for the classification (Bredenkamp 1982). Stratification of sample plots will be based on visual observations made during the initial site investigation as well as aerial imagery. The Zurich-Montpellier approach of phytosociology (Braun-Blanquet 1964) will be followed; this is a standardised and widely used sampling technique for general vegetation surveying in South Africa. During the surveys, all plant species in the sample plots and the cover and/or abundance of each species will be estimated according to the following Braun-Blanquet cover abundance scale:

+ infrequent, with less than one percent cover of total sample plot area
1 frequent, with low cover/ infrequent but with higher cover, 1-5 % cover of the total sample plot area
2 abundant, with 5-25 % cover of total sample plot area
2A >5-12 %
2B >12-25 %
3 >25-50 % cover of the total sample plot area, irrespective of the number of individuals
4 >50- 75 % cover of the total sample plot area, irrespective of the number of individuals
5 >75 % cover of the total sample plot area, irrespective of the number of individuals.

In addition, a relevant selection of the following biophysical attributes will be recorded within each relevè:

- Altitude- and longitude positions for each relevè - obtained from a GPS;
- Soil characteristics, including colour, clay content, etc;
- Topography (crests, scarps, midslopes, footslopes, valley bottoms, floodplains or drainage lines);
- Altitude, slope and aspect;
- Rockiness, estimated as a percentage;
- Rock size; and
- General observations (including the extent of erosion, utilisation, disturbances of the vegetation management practices, etc.).

In addition to species captured within the sample plots, general observations will be made to compile a comprehensive species list that will include taxa that, because of low abundance levels, are unlikely to be captured within the sample areas. Specific attention will be afforded to identify Red Data plants, which normally do not occur at great densities.

7.8.2 Phytodiversity Measurements

Phytodiversity is a measure of the number and variety of plants within a given area. Three main indices are used to indicate floristic species richness and diversity in the sampled areas, namely:

- Species richness (Alpha diversity) refers to the number of species represented in a set or collection of individuals in each of the releveès. It represents a simple count of species, and does not consider abundance of species or relative abundance distributions;
- EstimateS analyses are implemented to present an estimation of the expected species richness of the areas, based on collated data from the surveys;
- The Shannon-Weiner diversity index presents an opinion on how species are distributed in an ecosystem or a community, taking cognisance of the species richness and relative abundance of each species in a community. Making use of the Shannon-Weiner values, the Evenness Index compares releveès by controlling for the number of species found within the communities; and
- The Simpsons Diversity Index quantifies the biodiversity of a habitat or relevè. It considers the number of species present (species richness), as well as the abundance of each species (Evenness).

7.8.3 Data Processing

The combined data sets will be subjected to the Two-Way Indicator Species Analysis technique (TWINSPAN) (Hill 1979) and subsequently refined by Braun-Blanquet procedures. TWINSPAN will be applied to derive a first approximation of the vegetation units. These classifications will be further refined by the application of Braun-Blanquet procedures to determine the plant communities. A phytosociological table showing the vegetation lines will be used to compile a synoptic table of the datasets. A synoptic table summarizes and confirms the vegetation types/ habitat types and variations. Relevant descriptions will follow from the data analysis, based on the presence/ absence and abundance of taxa.

8 FAUNAL ATTRIBUTES

The study sites are is geographically situated within the 2229DB ¼-degree grid (refer **Figures 3 & 4**). The Animal Demography Unit (ADU) of the University of Cape Town (UCT) provides Q-degree level distribution data on various plant and animal groups in their Virtual Museum (vmus.adu.org.za). Distribution data on the following animal groups is currently available and will be utilised as a basis for this report and the subsequent EIA assessment:

1. Scorpions (Arachnida: Scorpiones);
2. Spiders (Arachnida: Araneae);
3. Dung Beetles (Coleoptera: Scarabaeinae);
4. Dragonflies and Damselflies (Insecta: Odonata);
5. Lacewings (Insecta: Neuroptera and Megaloptera);
6. Butterflies and Moths (Insecta: Lepidoptera);
7. Frogs (Amphibia: Anura);
8. Reptiles (Reptilia: Testudines and Squamata); and
9. Mammals (Mammalia).

8.1 Invertebrates

Thirty-nine invertebrates are listed for the ¼-degree grid 2229DB (vmus.adu.org.za), including:

- three scorpion species;
- one spider species;
- four dragonfly species;
- one antlion species;
- one dung beetle species;
- twenty-six butterfly species; and
- three moth species.

None of the invertebrate species listed for 2229DB are considered sensitive or threatened (Red Data listed); however, one alien/ invasive species, the Cucumber Moth, *Diaphania indica* (Saunders, 1851), is listed (refer **Table 8**, **blue**).

8.2 Herpetofauna

Twenty-seven herpetofaunal species are listed for the ¼-degree grid 2229DB (vmus.adu.org.za), including:

- four frog species;
- one tortoise species; and
- twenty-two reptile species.

Two of the reptile species listed for 2229DB are listed Red Data species (refer **Table 9**, **red**).

Table 8: Invertebrates of the Q-degree grid 2229DB

Order	*Family*	*Genus species*	*English Name*	*Regional Status*	*Global Status*
Scorpiones	Buthidae	*Afroisometrus minshullae* (Fitzpatrick, 1994)	Pygmy Thicktail	NL	NL
		Hottentota trilineatus (Peters, 1861)	Eastern Thicktail	NL	NL
	Hormuridae	*Hadogenes troglodytes* (Peters, 1861)	Giant Rock Scorpion	NL	NL
Araneae	Nephilidae	*Nephila senegalensis* (Walckenaer, 1841)	Banded-legged Nephila	NL	NL
Odonata	Libellulidae	*Crocothemis erythraea* Brullé, 1832	Broad Scarlet	NL	LC
		Orthetrum chrysostigma Burmeister, 1839	Epaulet Skimmer	NL	LC
		Trithemis arteriosa Burmeister, 1839	Red-veined Dropwing	NL	LC
		Trithemis kirbyi Selys, 1891	Kirby's Dropwing	NL	LC
Neuroptera	Myrmeleontidae	*Lachlathetes moestus* (Hagen, 1853)	Antlion	NL	NL
Coleoptera	Scarabaeidae	*Chalconotus convexus* Boheman, 1857	Dung Beetle	NL	NL
Lepidoptera	Hesperiidae	*Gomalia elma elma* (Trimen, 1862a)	Green-marbled Skipper	LC	NL
	Pieridae	*Belenois aurota* (Fabricius, 1793)	Brown-veined White	LC	NL
		Belenois creona severina (Stoll, [1781])	African Common White	LC	NL
		Colotis evagore antigone (Boisduval, 1836)	Small Orange Tip	LC	NL
		Colotis evenina evenina (Wallengren, 1857)	Orange Tip	LC	NL
		Colotis ione (Godart, [1819])	Bushveld Purple Tip	LC	LC
		Colotis regina (Trimen, 1863)	Queen Purple Tip	LC	NL
		Colotis vesta argillaceus (Butler, 1877)	Veined Arab	LC	NL
		Eurema brigitta brigitta (Stoll, [1780])	Broad-bordered Grass Yellow	LC	LC
		Pinacopteryx eriphia eriphia (Godart, [1819])	Zebra White	LC	NL
		Teracolus eris eris (Klug, 1829)	Banded Gold Tip	LC	NL
		Teracolus subfasciatus (Swainson, [1833])	Lemon Traveller	LC	NL
	Nymphalidae	*Acraea oncaea* Hopffer, 1855	Rooibok Acraea	LC	NL
		Byblia ilithyia (Drury, [1773])	Spotted Joker	LC	NL
		Charaxes jasius saturnus Butler, 1866	Foxy Charaxes	LC	NL
		Coenyropsis natalii natalii (Boisduval, 1847)	Natal Brown	LC	NL
		Danaus chryssipus orientis (Aurivillius, 1909)	African Monarch	LC	LC
		Junonia hierta cebrene Trimen, 1870	Yellow Pansy	LC	LC
		Junonia oenone oenone (Linnaeus, 1758)	Blue Pansy	LC	LC
		Telchinia serena (Fabricius, 1775)	Dancing Acraea	LC	NL
		Vanessa cardui (Linnaeus, 1758)	Painted Lady	LC	LC
	Lycaenidae	*Aloeides damarensis mashona* Tite & Dickson, 1973	Damara Copper	LC	NL
		Chilades trochylus (Freyer, [1843])	Grass Jewel Blue	LC	NL
		Lampides boeticus (Linnaeus, 1767)	Pea Blue	LC	LC
		Leptotes pirithous pirithous (Linnaeus, 1767)	Common Zebra Blue	LC	NL

Table 8: Invertebrates of the Q-degree grid 2229DB					
Order	*Family*	*Genus species*	*English Name*	*Regional Status*	*Global Status*
		Virachola antalus (Hopffer, 1855)	Brown Playboy	LC	NL
	Crambidae	*Diaphania indica* (Saunders, 1851)	Cucumber Moth	NL	NL
	Noctuidae	*Cyligramma latona* Cramer, 1779	Cream-striped Owl Moth	NL	NL
	Sphingidae	*Batocnema africanus* Distant, 1899	Harlequin Hawkmoth	NL	NL

Table 9: Herpetofauna of the Q-degree grid 2229DB					
Order	*Family*	*Genus species*	*English Name*	*Regional Status*	*Global Status*
Anura	Bufonidae	*Sclerophrys garmani* (Meek, 1897)	Eastern Olive Toad	LC	LC
	Rhacophoridae	*Chiromantis xerampelina* Peters, 1854	Southern Foam Nest Frog	LC	LC
	Phrynobatrachidae	*Phrynobatrachus natalensis* Smith, 1849	Snoring Puddle Frog	LC	LC
	Breviceptidae	*Breviceps adspersus* Peters, 1882	Bushveld Rain Frog	LC	LC
Testudines	Testudinidae	*Stigmochelys pardalis* Valverde, 2005	Leopard Tortoise	LC	LC
Squamata	Pythonidae	*Python natalensis* Smith, 1840	Southern African Python	LC	NL
	Lamprophiidae	*Hemirhagerrhis nototaenia* (Günther, 1864)	Eastern Bark Snake	LC	NL
		Psammophis angolensis (Bocage, 1872)	Dwarf Sand Snake	LC	NL
		Psammophis subtaeniatus Peters, 1882	Western Yellow-bellied Sand Snake	LC	LC
		Rhamphiophis rostratus Peters, 1854	Rufous Beaked Snake	LC	NL
	Elapidae	*Aspidelaps scutatus scutatus* (Smith, 1849)	Speckled Shield Cobra	LC	NL
	Scincidae	*Panaspis maculicollis*	Spotted-neck Snake-eyed Skink	LC	NL
		Panaspis wahlbergi (Smith, 1849)	Wahlberg's Snake-eyed Skink	LC	NL
		Trachylepis margaritifer Branch et al, 2005	Rainbow Skink	LC	LC
		Trachylepis varia (Peters, 1867)	Variable Skink	LC	NL
	Gerrhosauridae	*Gerrhosaurus flavigularis* Wiegmann, 1828	Yellow-throated Plated Lizard	LC	NL
	Varanidae	*Varanus albigularis albigularis* Daudin, 1802	Rock Monitor	LC	NL
	Agamidae	*Agama armata* Peters, 1855	Peters' Ground Agama	LC	NL
	Gekkonidae	*Afroedura transvaalica* (Hewitt, 1925)	Zimbabwe Flat Gecko	LC	NL
		Chondrodactylus turneri (Gray, 1864)	Turner's Gecko	LC	NL
		Hemidactylus mabouia (Moreau De Jonnès, 1818)	Common Tropical House Gecko	LC	NL
		Homopholis mulleri Visser, 1987	Muller's Velvet Gecko	VU	VU
		Lygodactylus capensis capensis (Smith, 1849)	Common Dwarf Gecko	LC	NL
		Pachydactylus punctatus Peters, 1854	Speckled Gecko	LC	NL
		Pachydactylus wahlbergii wahlbergii	Kalahari Ground Gecko	LC	NL
		Ptenopus garrulus garrulus (A. Smith, 1849)	Common Barking Gecko	LC	NL
	Crocodylidae	*Crocodylus niloticus* Laurenti, 1768	Nile Crocodile	VU	LC

Table 10: Mammals of the Q-degree grid 2229DB					
Order	*Family*	*Genus species*	*English Name*	*Regional Status*	*Global Status*
Primates	Cercopithecidae	*Chlorocebus pygerythrus* (F. Cuvier, 1821)	Vervet Monkey	LC	LC
Rodentia	Sciuridae	*Paraxerus cepapi* (A. Smith, 1836)	Tree Squirrel	LC	LC
Carnivora	Felidae	*Panthera pardus* (Linnaeus, 1758)	Leopard	VU	VU
	Viverridae	*Civettictis civetta* (Schreber, 1776)	African Civet	LC	LC
	Hyaenidae	*Parahyaena brunnea* (Thunberg, 1820)	Brown Hyaena	NT	NT
		Proteles cristatus (Sparrman, 1783)	Aardwolf	LC	LC
	Canidae	*Canis mesomelas* Schreber, 1775	Black-backed Jackal	LC	LC
		Otocyon megalotis (Desmarest, 1822)	Bat-eared Fox	LC	LC
	Mustelidae	*Aonyx capensis* (Schinz, 1821)	African Clawless Otter	NT	NT
Artiodactyla	Suidae	*Phacochoerus africanus* (Gmelin, 1788)	Common Warthog	LC	LC
	Bovidae	*Aepyceros melampus* (Lichtenstein, 1812)	Impala	LC	LC
		Nyala angasii (Angas, 1849)	Nyala	LC	LC
		Raphicerus campestris (Thunberg, 1811)	Steenbok	LC	LC
		Tragelaphus strepsiceros (Pallas, 1766)	Greater Kudu	LC	LC
		Sylvicapra grimmia (Linnaeus, 1758)	Bush Duiker	LC	LC
		Syncerus caffer (Sparrman, 1779)	African Buffalo	LC	LC
		Tragelaphus scriptus (Pallas, 1766)	Cape Bushbuck	LC	LC

8.3 Mammals

Seventeen mammals are listed for the ¼-degree grid 2229DB (vmus.adu.org.za), including:

- one monkey species;
- one squirrel species;
- seven carnivore species; and
- eight even-toed ungulate species.

Three of the mammal species listed for the ¼-degree grid 2229DB are listed Red Data species (refer **Table 10**, **red**).

8.4 Red Data Animals of 2229DB

Five red data animals are listed for 2229DB, namely:

- Muller's Velvet Gecko, *Homopholis mulleri* Visser, 1987 (Vulnerable): **medium-high PoC**;
- Nile Crocodile, *Crocodylus niloticus* Laurenti, 1768 (Vulnerable): **low PoC**;
- Leopard, *Panthera pardus* (Linnaeus, 1758) (Vulnerable): **high PoC**;
- Brown Hyaena, *Parahyaena brunnea* (Thunberg, 1820) (Near Threatened): **high PoC**; and
- African Clawless Otter, *Aonyx capensis* (Schinz, 1821) (Near Threatened): **low PoC**.

Given the size of the study area, the habitat diversity, quality and unfragmented nature of the faunal habitats available in the study area and surrounds, all five species are considered potential inhabitants of the region. Based on the known geographical distribution of these five animals, as well as the habitat preferences of each species, the likelihood of each species occurring in the study area are estimated as follows:

Even though these are the only Red Data listed animals currently listed for the Q-degree grid 2229DB, other threatened or sensitive species are likely to persist within the study area's boundaries. The available datasets are by no means regarded comprehensive and new species distributions are added on a regular basis. Specific reference is made of the baboon spider burrows that were located on Farm Du Toit. Specific attention will be provided to locating community knowledge of the presence and abundance of these species across the study sites.

8.5 Preliminary Faunal Habitat Diversity

The close relationship between vegetation units and specific faunal composition has been noted in several scientific studies and broadly speaking, floristic macro-habitats are regarded representative of faunal habitat diversity for a given area. The preliminary macro-habitats described in this document (refer **Section 8.4**) are considered ecologically distinctive and descriptive of the faunal habitat diversity of the study area. The following general faunal habitats are expected to be found within the study site alternatives (based on brief site observations and from aerial imagery):

a) Transformed/ Deteriorated Woodland Habitat;
b) Untransformed Terrestrial Woodland Habitat; and
c) Faunal Wetland Habitat.

8.5.1 Transformed/ Deteriorated Woodland Habitat

Minor portions of the terrestrial woodland have been altered, mainly for agricultural purposes, comprising physiognomy that is atypical to the surrounding, natural woodland. The absence of a dominant woodland canopy, with tall and dominant trees are characteristic, rendering the faunal component that are likely to utilise these parts, atypical and compositional different to the normal animal constituents. Although atypical, it is not expected that any animal of conservation importance will utilise these parts for prolonged periods. It is likely that these areas will play a minor role in the ecological functionality of the immediate region, despite providing some contribution to the species richness through the presence of species that are not typically associated with the surrounding natural woodland. Alien and invasive species are typically associated with these parts. A low to moderately-low faunal sensitivity is typically ascribed to such habitat types.

8.5.2 Untransformed Terrestrial Woodland Habitat

Natural and untransformed woodland of the sites correspond to the Musina Mopane Bushveld regional vegetation community of the Central Bushveld Bioregion and Savanna Biome of South Africa. Observations made during the brief site visitation for the screening assessment indicated that the untransformed terrestrial woodland habitat of the study area is unlikely to include significant natural ecological variation and habitat feature diversity. A relatively high homogeneity is noted in terms of structural and compositional vegetatal aspects and this is likely to translate into a similar homogenous composition of the typical faunal constituents of the terrestrial woodland. Terrestrial woodland habitat is described as undifferentiated arid broad-leaved woodland on sandy soils, conforming to the regional ecological type and exhibiting a moderate to moderate-high sensitivity in terms of faunal components.

Minor and isolated variations are likely to occur because of habitat degradation, fragmentation, edge effects that results from variable ecological management. Habitat status, level of degradation, landscape connectivity, red data hosting ability and ecological diversity will likely determine the specific faunal sensitivity of each habitat fragment. The anticipated variation in the faunal sensitivities of these habitat fragments is likely to result in disparities in the suitability and development potential of these fragments within the project scope.

8.5.3 Wetland Habitat

The Bushveld region in which the study area is situated, normally receives about 400 mm of rain per year, most of which occur during midsummer. The arid nature of the region complicates wetland delineation and confounds an understanding of the ecological processes and biodiversity functions of the wetlands of the study area region. Wetlands of arid regions are seldom obvious and their processes not well understood. Within the arid landscape, wetlands are scarce and unique; the presence of arid wetlands significantly enhances the biodiversity and ecosystem process diversity of an area.

Wetlands (as per the formal definition) generally conform to seasonal drainage lines and localised depressions. These parts of the study area are considered to exhibit high faunal sensitivities, irrespective of the habitat status; wetlands are known to have high restoration potential and their ecological importance cannot be overestimated. A moderate-high to high sensitivity is likely to be ascribed to these parts of the sites and an extensive presence within a site is likely to render the option less preferable for the proposed development.

8.6 Development Option Comparison

The comparative evaluation of the proposed development options is largely based on the potential prevalence of Red Data animals. This assessment does consider the status and ecological functionality of habitat of each development portion.

Five red data animals are listed for 2229DB. Given the size of the study area, the habitat diversity, quality and unfragmented nature of the faunal habitats available in the study area and surrounds, all five species are considered potential inhabitants of the study area. Available habitat for these five animal inhabitants of 2229DB is regarded sensitive, and the presence/absence of potential habitat for one or more of these red data listed species within each site alternative strongly influences the faunal sensitivity of each site.

8.6.1 Homopholis mulleri Visser 1987 (Muller's Velvet Gecko)

Muller's Velvet Gecko is a very poor known species with a restricted range, inhabiting specialized habitat subjected to loss and degradation due to increasing land transformation for agriculture and urban development. It therefore qualifies for listing as Vulnerable B1 ab(iii). It is endemic to the Limpopo Province, South Africa, where it is restricted to Mopane veld around the Soutpansberg. The species is nocturnal, sheltering in holes in *Sclerocarya birrea* and *Vachellia nigrescens* trees in Mopane veld (www.iucn.org/details/10235/0, accessed 29 June 2017).

The study area includes all the known habitat requirements of the species; however, the available scoping-level data does not allow quantitative habitat comparisons between the site alternatives for Muller's Velvet Gecko. There is no obvious reason to assume any significance difference in terms of potential habitat of the species between the respective sites.

For the purposes of this assessment, the two sites are rated similar in terms of potential habitat for *H. mulleri*.

- Farm Du Toit: high habitat potential;
- Farm Vrienden: high habitat potential.

8.6.2 Crocodylus niloticus Laurenti, 1738 (Nile Crocodile)

The Nile Crocodile is threatened by human/crocodile conflict, exploitation by humans and habitat alteration. It inhabits rivers, lakes, swamps, estuaries and mangroves. Historically, Nile Crocodiles occurred as far south as East London, but today they extend only as far south as the Tugela River in KwaZulu-Natal (Alexander and Marais, 2007). The species is listed in South Africa as Vulnerable (SARCA 2014).

Surface water is limited in the study area. The Nile Crocodile is known from the Sand River system, and the northern part of Du Toit includes some surface water that is part of this surface water ecosystem. The same potential is not evident from Vrienden.

Therefore, the potential habitat of the Nile Crocodile varies between the two sites:

- Farm Du Toit: medium-high habitat potential;
- Farm Vrienden: low habitat potential.

8.6.3 Panthera pardus (Linnaeus, 1758) (Leopard)

Leopards are widely distributed across Africa and Asia, but populations have become reduced and isolated, and they are now extirpated from large portions of their historic range. The Leopard meets the A2cd criterion for Vulnerable, based on loss of habitat and prey, and exploitation. These causes of the suspected reduction are not well understood, have not ceased, and are likely to continue, and further decline is anticipated unless conservation actions are taken (www.iucn.org/details/15954/0, accessed 29 June 2017).

The study area includes all the known habitat requirements of the species; however, the available scoping-level data does not allow quantitative habitat comparisons between the site alternatives for Leopard. There is no obvious reason to assume any significance difference in terms of potential habitat of the species between the sit alternatives. Consequently, for the purposes of this assessment, the three site alternatives are rated the same in terms of potential habitat for *P. pardus.*

- Farm Du Toit: high habitat potential;
- Farm Vrienden: high habitat potential.

8.6.4 Parahyaena brunnea (Thunberg, 1820) (Brown Hyaena)

Brown Hyaenas are endemic to southern Africa with a marginal extension into the arid parts of southwestern Angola, southeastern Botswana and the Northern and Western Cape regions of the republic of South Africa. The species is found in dry areas, generally with annual rainfall less than 100 mm, particularly along the coast, semi-desert, open scrub and open woodland savanna with a maximum rainfall up to about 700 mm. The species is listed as Near Threatened as the mean global population size is estimated to be below 10 000 mature individuals, and it experiences a measure of deliberate and incidental persecution such that it may come close to meeting a continuing decline of 10 % over the next three generations. It

almost qualifies as threatened under criterion C1 (www.iucn.org/details/10276/0, accessed 29 June 2017).

The study area includes all the known habitat requirements of the species; however, the available scoping-level data does not allow quantitative habitat comparisons between the site alternatives for Brown Hyaena. There is no obvious reason to assume any significance difference in terms of potential habitat of the species between the sit alternatives.

Consequently, for the purposes of this assessment, the three site alternatives are rated the same in terms of potential habitat for *P. brunnea.*

- Farm Du Toit: high habitat potential;
- Farm Vrienden: high habitat potential.

8.6.5 Aonyx capensis (Schinz, 1821) (African Clawless Otter)

The African Clawless Otter is the most widely distributed otter species in Africa, with a range stretching from Senegal and Mali throughout most of West Africa to Sudan and Ethiopia, and then southwards throughout east Africa to the Western Cape of South Africa. They are predominantly aquatic and seldom found far from water. Freshwater is an essential habitat requirement. For various reasons, including the lack of effective conservation measures currently in place, the African Clawless Otter population is projected to decline by at least 20 % in the next three generations. The species has therefore been uplisted in 2014 from Least Concern to Near Threatened as it almost qualifies under criterion A2cde+3cde (www.iucn.org/details/1793/0, accessed 29 June 2017).

Surface water is very limited in the study area. The African Clawless Otter is known from the Sand River system, and the northern part of Du Toit includes some surface water that is part of this surface water ecosystem. The same potential is not evident from farm Vrienden.

Therefore, the potential habitat of the African Clawless Otter varies between the two sites:

- Site Alternative 1 (Du Toit): medium-high habitat potential;
- Farm Vrienden: low habitat potential.

8.6.6 Site Alternatives: Faunal Habitat Sensitivities & Preferences

Based on the above estimations of the presence/absence of potential habitat for the five known red data listed inhabitants of 2229DB within each of the three site alternatives, the following faunal habitat sensitivities and consequent project preferences are assigned to the three site alternatives:

- Farm Du Toit: high faunal sensitivity least preferred;
- Site Alternative 2 (Du Toit & Vrienden): medium-high sensitivity 2nd preferred;
- Farm Vrienden: medium sensitivity most preferred.

8.7 Anticipated Impacts on the Faunal Environment (Invertebrates, Herpetofauna & Mammals)

The construction and operation of the proposed coal-fired power plant and associated infrastructure is not expected to have any positive or advantageous impacts as far as the faunal communities of the study area and surrounds are concerned. Direct, indirect and cumulative adverse impacts on the fauna are expected during the construction and operation of the proposed power station.

8.7.1 Direct Impacts

Direct impacts represent those that are indisputably a result of the proposed project and unequivocally influencing the fauna of the region. They are immediate and physical in nature and often irreversible and permanent. Anticipated direct impacts of the proposed project on the fauna of the study area include:

a. Impacts on/ losses of fauna taxa of conservation importance and habitat associated with CI species;
b. Loss of natural habitat, including essential habitat refugia; and
c. Depletion of faunal diversity, human/ animal conflict situations.

8.7.2 Indirect Impacts

Indirect impacts are mostly "spill-over" impacts that are removed from direct impacts by time and/or space. They might occur later on, even post closure, or in faunal habitat fragments located next to or close to the directly affected area. Indirect impacts might be immediate or delayed, they are often not easily linked to the project itself and their manifestations are often subtle. Indirect impacts might also be irreversible and permanent or rescindable and temporary. Anticipated indirect impacts of the proposed project on the fauna of the study area and surrounds include:

d. Degradation of untransformed habitat in areas surrounding the project area;
e. Indirect impacts on movement/ migration patterns of animals, ecological interaction and processes, including the introduction of invasive and non-endemic species; and
f. An increase in edge effects in the project areas.

8.7.3 Cumulative Impacts

Cumulative impacts are the totality of impacts in a given area resulting from this and other projects that impact upon the fauna of a region for any reason. The exact nature, duration, significance and scale of cumulative impacts are difficult to quantify; they are in fact not always considered during impact assessments as a result. However, cumulative impacts are significant and require consideration during this process of mitigating impacts and managing the natural ecological environment of the region. Anticipated cumulative impacts of the proposed project on the fauna of the region include:

g. Cumulative losses and degradation of natural faunal habitat; and

h. Cumulative depletion of faunal taxa, assemblages and communities on a regional scale, with specific reference to the conservation status of certain fauna taxa.

8.7.4 Mitigation

Mitigation of adverse impacts should aim to constrain effects of impacts on faunal assemblages and taxa that persist naturally within the project area, the immediate surrounds as well as on a regional scale by means of specific and diverse measures. Mitigation might aim to change the 'where', 'how', 'when', 'how much' or the 'if', to regulate impact significance, duration, scale or all the above to acceptable levels. It is important to note that mitigation is not always successful or even possible; some impacts cannot be mitigated but only avoided by extreme means (such as preventing the project all together). Nevertheless, effective and applicable mitigation measures can often soften the blow considerably.

Mitigation measures are often impact specific and can therefore not be recommended prior to an impact assessment; the proper process of impact identification and evaluation needs to be implemented before specific and proper mitigation measures can be advised. For scoping purposes, the only appropriate mitigation measure would be to recommend the most appropriated development alternative (refer **Section 12.4.6**).

8.8 Preliminary assessment of impacts on the faunal environment

Table 11: Preliminary assessment of impacts on the faunal environment

Impact

a. Loss of fauna species of conservation importance (threatened taxa) and habitat associated with CI species

Desktop Sensitivity Analysis of the Site:

Results of the preliminary assessments indicated the highly likely presence of protected animals within the proposed sites, any habitat that is utilised on frequent basis is therefore regarded sensitive. Specifically, riparian zones and topographical variability are regarded sensitive habitat attributes

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Loss of conservation important animals, also with reference to habitat associated with these species	A localised depletion of numbers of Red Data and protected animal species is expected. The densities and presence of similar habitat and animals in the surrounding region is not known at this stage and the likelihood of significant effects on population numbers cannot be discounted at this stage.	Local/ Regional	Whilst no specific 'No-Go' areas were identified, areas of high ecological sensitivity, including riparian/ wetland habitat as well as topographically heterogeneous habitat should be avoided.

Description of expected significance of impact

Due to the nature of the development, land clearance will result in the complete removal of extensive areas of natural habitat within the footprint area, unavoidable (direct) impacts are therefore likely to result from land clearing activities on these animals as well as the typical habitat where these species abound. Direct losses (death) of protected and Red Data animals are regarded a significant impact on the ecological environment and should ideally be avoided at all costs, particularly since these impacts are of a permanent nature and cannot be reversed. Specific reference is made of sessile animals that are typically unable to vacate areas, such as baboon spiders, etc.

Gaps in knowledge & recommendations for further study

Presence/ absence and distributional patterns of protected and Red Data animals are not known at this stage and will be investigated in more detail during the specialist surveys during the EIA phase of the project. Collated data will inform the identification of sensitivity and recommendation of suitable development areas.

Impact

b. Loss of natural habitat, including essential habitat refugia

Desktop Sensitivity Analysis of the Site:

A moderate sensitivity is generally ascribed to the proposed sites because of the existing natural status of the receiving environment, no areas of deterioration and/ or transformation was identified and the receiving environment therefore comprises of a habitat that is representative of the regional ecological type

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Loss of natural habitat and habitat features typically occurring infrequently on a landscape scale that are often associated with specific faunal uses	Unaccounted losses of natural vegetation and sensitive habitat types could potentially result in significant impacts beyond the boundaries of the development footprint, also resulting in impacts on local and/ or regional conservation efforts. The presence of unique habitat features, such as large Baobab and termitaria, constitute unique habitat features	Local	Whilst no specific 'No-Go' areas were identified, areas of high ecological sensitivity, including riparian/ wetland habitat as well as topographically heterogeneous habitat should be avoided.

Description of expected significance of impact

Losses of natural habitat that typically is utilised by a high density and variability of animals, also with specific reference to habitat types of high sensitivity, is likely to result in impacts beyond the boundaries of the site. It is also mentioned that sensitive habitat types are known to be associated with animals of conservation importance/ concern and could therefore cumulatively contribute to impacts on these taxa, as well as ecological functionality of the surrounding region

Gaps in knowledge & recommendations for further study

Preliminary results obtained during the screening and scoping phases indicated the presence of extensive areas of natural habitat that is representative of the regional ecological types as well as the presence of habitat types of higher sensitivity. The identification, description and delineation of these habitat types will inform the identification of sensitivity and recommendation of suitable development areas.

Impact

c. Depletion of faunal diversity, human/ animal conflict situations, including the introduction of invasive and non-endemic species

Desktop Sensitivity Analysis of the Site:

Preliminary results obtained during the screening and scoping phases indicated a moderate to high faunal diversity within the proposed development footprints. Significant losses of animals on a local scale is therefore an unavoidable impact of the proposed development. Furthermore, the presence of a workforce within a natural environment will undoubtedly result in significant and numerous human-animal conflict situations, with specific reference to potentially dangerous animals, such as a snakes and predators.

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Direct losses and displacement of animals from the proposed development footprint.	Displacement of animals from development footprint and the presence of humans within a natural environment will result in unavoidable conflict situations with significant threat to life on either side. The local depletion of animals and the introduction of invasive species and the increased presence of opportunistic species is a typical effect	Local	No specific 'No-Go' areas were identified.

Description of expected significance of impact

Direct losses of animals and subsequent changes in diversity patterns are likely to result in impacts beyond the boundaries of the site. These impacts, although restricted to a relative small geographic scale, are generally regarded severe and irreversible due to the nature of the development. Mitigation is also not particularly successful and is generally reactive in nature, rather than proactive, mostly as a result of the unpredictable nature of animal movement and presence. Effects of the development is also regarded permanent in nature, however, a measure of recovery in the generally surrounds of the development footprint is typical.

Gaps in knowledge & recommendations for further study

As a high diversity of animals are expected within the development footprint, the EIA phase will inform the nature and extent of the expected impacts in view of the inability of certain animal groups to vacate

unfavorable habitat. Locational and distributional patterns need to be determined during the EIA phase

Impact

d. Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.

Desktop Sensitivity Analysis of the Site:

Whilst the general region does not exhibit a high conservation level, the natural status and high PES of the receiving environment nonetheless dictate a relative high sensitivity, particularly in view of low developmental patterns of the surrounds. Losses of, and deterioration of natural habitat within the eventual footprint and immediate surrounds is an unavoidable impact, with specific reference to linear infrastructure and perimeter areas

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Changes to and deterioration of remaining natural vegetation situated in proximity to development footprints, with specific reference to potentially sensitive habitat types	Deterioration of surrounding vegetation, with reference to structural and/ or species changes	Local/ regional	No specific 'No-Go' areas were identified.

Description of expected significance of impact

Anthropogenic developments are unavoidably associated with habitat deterioration of peripheral areas. Littering, surface disturbances, erosion, etc. generally occur along the perimeter and linear infrastructure that is required for the development. The deterioration of habitat could potentially affect sensitive habitat that are situated in proximity to the footprints as well as adversely impact on remaining ecological processes and functionality. While mitigation is possible, the success of required actions is not always successful and careful planning, monitoring and strict EMP guidance is generally required.

Gaps in knowledge & recommendations for further study

The EIA phase will inform the exact nature of risks to the surrounding environment and EMP guidelines will be adapted to allow for the correct identification and mitigation of issues.

Impact

e. Indirect impacts on movement/ migration patterns of animals and ecological interaction and processes

Desktop Sensitivity Analysis of the Site:

Uninterrupted natural habitat is a scarce commodity for animals and the sites and immediate surrounds (despite farm boundaries and fences) generally represent such a region where most species do exhibit the ability to migrate naturally across a region. The sites and immediate surrounds are therefore regarded as sensitive receptors in this regard.

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Creation of sterile landscapes where animals are unable to persist, with specific reference to required infrastructure that will contribute to habitat fragmentation and isolation on a local and regional scale	Numerous taxa will be unable to migrate across anthropogenic barriers, causing disruption and/ or isolation of populations on a local scale	Local/ regional	No specific 'No-Go' areas were identified, specific reference is nonetheless made of riparian zones

Description of expected significance of impact

Although the development might be nodal in nature, numerous linear developments are required as part thereof, including roads, conveyor lines, etc. Disruption of migrational patterns on a local scale is regarded significant and unavoidable. While certain allowances can be made towards accommodating movement patterns, mitigation thereof is generally problematic and costly.

Gaps in knowledge & recommendations for further study

The EIA phase will inform the exact nature of risks to the surrounding environment and EMP guidelines will be adapted to allow for the correct identification and mitigation of issues.

Impact

f. Exacerbated increases of edge effects of the project areas

Desktop Sensitivity Analysis of the Site:

A low level of habitat fragmentation and isolation of the environment is currently evident. The receiving environment is therefore regarded extremely sensitive towards this impact

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Construction and operation of	Loss and degradation of the	Regional	No specific 'No Go' areas

an industrial development in a largely untransformed natural environment will undoubtedly result in severe increases in habitat fragmentation levels, also taking cognisance of associated developments	natural receiving environment		were identified as part of this process

Description of expected significance of impact

Within a largely untransformed natural environment, the effects of this impact are generally accepted to be severe, unavoidable and impossible to mitigate against. While every effort could be made to limit the spread of developments and associated infrastructure across an untransformed landscape, the increase in anthropogenic developments, movement, transportation, effluents, discards, etc., will ultimately over the long-term result in a fragmented landscape on a local and regional scale.

Gaps in knowledge & recommendations for further study

The EIA phase will inform the exact nature of risks to the surrounding environment and EMP guidelines will be adapted to allow for the correct identification and mitigation of issues

Impact

g. Cumulative losses and degradation of natural habitat on a local and regional scale

Desktop Sensitivity Analysis of the Site:

A moderate sensitivity is generally ascribed to the proposed sites and immediate surrounds because of the existing natural status of the receiving environment, no areas of deterioration and/ or transformation was identified and the receiving environment therefore comprises of a habitat that is largely representative of the regional ecological type with low habitat transformation levels

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Loss of natural habitat and habitat features typically occurring infrequently on a landscape scale, also with specific reference to additional developments flowing from this particular development	Unaccounted losses of natural habitat and sensitive habitat types will result in deterioration and losses of beyond the boundaries of the development footprint, also resulting in impacts on local and/ or regional conservation efforts.	Regional	No specific 'No-Go' areas were identified at this stage

Description of expected significance of impact

Within a largely untransformed natural environment, effects of this impact are generally accepted to be severe, unavoidable and impossible to mitigate against. While every effort could be made to limit the spread of developments and associated infrastructure across an untransformed landscape, the increase in anthropogenic developments, movement, transportation, effluents, discards, etc., will ultimately over the long-term result in a fragmented landscape on a local and regional scale. This impact also represents a long-term effect

Gaps in knowledge & recommendations for further study

The EIA phase will inform the exact nature of risks to the surrounding environment and EMP guidelines will be adapted to allow for the correct identification and mitigation of issues

Impact

h. Cumulative depletion of faunal taxa, assemblages and communities, with specific reference to the conservation important species on a scale beyond the development

Desktop Sensitivity Analysis of the Site:

Results of the preliminary assessments indicated the highly likely presence of protected animals within the proposed sites, any habitat that is utilised on frequent basis is therefore regarded sensitive. The presence of these animals in a regional context is highly likely and constitute a sensitive aspect of the development in terms of cumulative impacts

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Loss of conservation important animals, also with reference to habitat associated with these species on a regional scale	Alteration of habitat caused by peripheral developments required by the project will undoubtedly result in impacts on conservation important species on a regional scale.	Local/ Regional	No specific 'No-Go' areas were identified at this stage

Description of expected significance of impact

Due to the nature of the development, appurtenant developments, housing projects, roads, ashing facilities, increase human densities and associated impacts on the faunal component of the region will result in severe

impacts on certain animal groups. Direct losses (death) of protected and Red Data animals are regarded a significant impact on the ecological environment and should ideally be avoided at all costs, particularly since these impacts are of a permanent nature and cannot be reversed.
Gaps in knowledge & recommendations for further study
Presence/ absence and distributional patterns of protected and Red Data animals are not known at this stage and will be investigated in more detail during the specialist surveys during the EIA phase of the project. Collated data will inform the identification of sensitivity and recommendation of suitable development areas.

Expected and likely impacts on the faunal environment are largely two-fold:

» Direct, severe, permanent and irreversibly impacts are expected to occur within the development footprint with significant impacts on the faunal attributes, specifically those animals that are not able to vacate unfavourable areas; and

» Indirect impacts that will render surrounding areas less suitable for a high diversity of animal species that typically inhabit the region. Specific reference is made of appurtenant infrastructure that will result in deterioration of existing habitat and the human-animal conflict situations that are created through the significant increase of human numbers in a natural environment.

Due to the vague nature of cumulative impacts, speculation dictate that the larger region will likely be affected adversely through the loss of natural habitat and severe deterioration of the PES of the area, as evidence from similar developments have suggested.

It is important to note that mitigation of most of these impacts are possible to some extent, but aspects such as habitat loss and deterioration are uncontrollable and beyond the scope of the project to manage, short of preventing the project altogether. However, no faunal attribute is currently know of the project area that would represent a 'Red flag' to the development and it is anticipated that significant and detailed management measures included in the EMP would ameliorate impacts to an acceptable level.

8.9 Faunal EIA Assessment: Recommended Plan of Study

The plan of study for the faunal assessment (EIA phase of the project) should be based on a reasonable time schedule and budgetary allowance; legislative requirements associated with EIA biodiversity assessments and due diligence appropriate to objective biodiversity assessors should be taken into consideration during the planning phase of the recommended faunal studies. However, extensive experience in faunal assessments as well as a detailed knowledge of the study area region might influence the plan of study and streamline the proposed field investigation methods, as suggested in following sections.

8.9.1 Invertebrates

The great majority of animal species are represented by invertebrates. They range from microscopic, single-cell protozoa to highly complex animals such as insects and spiders, but most of the twenty-three phyla of invertebrates are seldom used during invertebrate assessments. Reasons vary from sampling difficulties to identification impossibilities. In addition, most of these groups cannot be used to create an understanding of the ecological and biodiversity intricacies of a habitat (or when comparing subtle differences between habitats) and are therefore rarely considered during general invertebrate assessments. Even within the

"higher invertebrates" (i.e. insects, spiders, scorpions, etc.), not all groups are useful when performing invertebrate assessments with the aim of assessing areas in terms of faunal sensitivities and ecological or biodiversity importance.

A careful selection process of invertebrate groups for a specific area is therefore one of the most important phases of the invertebrate assessment process. For example, the use of Papilionidae butterflies when comparing different areas in the Kalahari Desert is a poor choice of invertebrate group given the geographical location of the study area. In comparison, scorpion diversity in the arid regions of South Africa is relatively high and the scorpion assemblage of a specific area in the Kalahari is likely to reveal significant information concerning the ecological quality and biodiversity health of the area. Pre-selection of the invertebrate groups of the invertebrate groups to be used is therefore fundamental to the success of an invertebrate assessment. Various factors should be considered during this selection process: geographical location, habitat diversity, habitat status, ecological connectivity, nature and duration of the impacts of the proposed project, size of the study area and practical aspects such as accessibility to the study area.

Taking cognisance of these aspects, it is therefore recommended that the following invertebrate groups are sampled and used as indicator groups for the invertebrate diversity and ecological integrity of the faunal habitats of the study area:

a) Dung Beetles and Fruit Chafers (Coleoptera: Scarabaeidae, in part);
b) Dragonflies and Damselflies (Insecta: Odonata);
c) Lacewings and Antlions (Insecta: Neuroptera);
d) Butterflies (Lepidoptera: Hesperiidae, Papilionidae, Pieridae, Nymphalidae and Lycaenidae);
e) Scorpions (Arachnida: Scorpiones); and
f) Baboon and Trapdoor spiders (Arachnida: Mygalomorphae).

As with other groups, when performing an assessment, it is critical to have a clear understanding of the requirements for data collation and how sampling results ultimately will be analysed and interpreted. Most often, invertebrate censuses aim to:

» Evaluate the invertebrate hosting ability of a specific habitat fragment and to identify the optimal invertebrate conservation strategy for the specific area;
» Monitor invertebrate assemblage and community changes; and
» Investigate the abundance of invertebrates as prey for vertebrates such as birds and small mammals.

The main aim of EIA invertebrate surveys will be to establish an optimal invertebrate conservation scenario by obtaining as much information as possible given the usual time and budget allowances. The main requirement for such an evaluation survey is that most or all habitats and microhabitats thought to be important to invertebrates at a site are sampled adequately. Evaluation surveys usually concentrate on searching specific habitats considered important for species of high conservation value. Such surveys often include a range of complementary techniques to maximise the range of species recorded.

Two major objectives are therefore recommended for the invertebrate EIA assessment to create an ecological image of the area to be investigated, namely:

» To compile an inventory species for specific groups of invertebrates (species inventory of groups listed above). Taxa within the target groups should be easily identified by either field investigators, or with readily accessible specialists from other institutions; and
» Sampling efforts should be stratified across a variety of habitats for specific groups to compare the species diversity (species numbers and relative abundances) of these areas with each other using species diversity indices such as Simpson's Index of Evenness.

The following sampling methods are proposed:
a) Searching and direct (ad hoc) observations;
b) Pitfall trapping;
c) Light trapping;
d) Digging;
e) Hand netting;
f) UV light sampling;
g) Rock turning;
h) Beating; and
i) Sweep netting.

8.9.2 Herpetofauna

It is proposed that all frogs are sampled using species-specific vocalizations of males as identification; also, active searches for active adults during early evenings. Snakes, lizards and other reptiles will be sampled by active searches in likely habitats such as rocks, inactive termitaria, etc. General sampling during early evenings and mornings by driving slowly on roads in the area and observing reptiles crossing the road (roadkills).

8.9.3 Mammals

Visual sightings as well as the use of ecological indicators such as tracks, dung, calls, and diggings will be used to compile a species inventory of the study area, and where possible, for each faunal habitat fragment within the study area. Baited UV field cameras will be used to assess the study area regarding the presence or absence of medium and large carnivores known to be present in the region of the study area. Driving at night and early morning on the roads and identifying species crossing the road as well as roadkills, when encountered.

9 AVIFAUNAL ATTRIBUTES

9.1 Background

The information provided in this report was principally sourced from the following sources/observations:

- relevant literature – see section below;
- observations made during a site visit (24 - 26 January 2017); and
- personal observations from similar habitat types in proximity to the study area, with emphasis on assessments conducted by Pachnoda Consulting (2009; 2015) of which the avifauna study was conducted by the author.

The avifaunal study will be completed in two phases, of which the first phase entails a literature review of the area accompanied by a brief site visit (24 - 26 January 2017). The first phase will then set a benchmark for detailed surveys that will form part of phase two (EIA phase).

The terms of reference for this screening assessment are therefore to:

- provide an overview of the *expected* bird assemblages that could occur on the study area;
- conduct a desktop and literature review of threatened, near threatened and conservation important bird species that could occur on the proposed study area;
- provide an indication on the preliminary avifaunal importance and ecological function of the study area;
- provide an indication of the "most feasible" farm for the proposed development from an avifaunal perspective; and
- provide an indication of potential 'Fatal flaws' on any of the proposed properties.

9.2 Literature survey and database acquisition

A desktop and literature review of the area under investigation was commissioned to collate as much information as possible prior to the detailed baseline survey. Literature consulted makes primarily use of small-scale datasets that are collected by citizen scientists and are located at various governmental and academic institutions (e.g. Animal Demography Unit & SANBI). These include (although are not limited to) the following:

- Hockey et. al. (2005), Harrison et. al. (1997) and Del Hoyo et. al. (1992-2011) were consulted for general information on the life history attributes of the relevant bird species. They also provide basic distributional information on a small scale;
- Marnewick et al (2015) was consulted for information regarding the biogeographic affinities of selected bird species that could be present on the study area;
- The conservation status of bird species was categorised according to the global IUCN Red List of threatened species (IUCN, 2017) and the regional conservation assessment of Taylor et al. (2015);
- Distributional data was sourced from the South African Bird Atlas Project (SABAP1) and verified against Harrison et al. (1997) for species corresponding to the quarter-degree grid cell (QDGC) 2229DB. *The information was then modified according to the prevalent*

habitat types present on the study area. The SABAP1 data provides a "snapshot" of the abundance and composition of species recorded within a quarter degree grid cell (QDGC) which was the sampling unit chosen (corresponding to an area of approximately 50x50 km). It should be noted that the atlas data makes use of reporting rates that were calculated from observer cards submitted by the public as well as citizen scientists. It therefore provides an indication of the thoroughness of which the QDGCs were surveyed between 1987 and 1991;

- Additional distributional data was also sourced from the SABAP2 database (http://www.sabap2.adu.org.za). *The information was then modified according to the prevalent habitat types present on the study area*. Since bird distributions are dynamic (based on landscape changes such as fragmentation and climate change), SABAP2 was born (and launched in 2007) from SABAP1 with the main difference being that all sampling is done at a finer scale known as pentad grids (5 min latitude x 5 min longitude, equating to 9 pentads within a QDGC). Therefore, the data is more site-specific, recent and more comparable with observations made during the site visit (due to increased standardisation of data collection). The pentad grids relevant to the current project include 2235_2945, 2240_2945 and 2240_2950;
- The choice of scientific nomenclature, taxonomy and common names were recommended by the International Ornithological Committee (the IOC World Bird List v. 7.1), unless otherwise specified (see www.worldbirdnames.org as specified by Gill & Donsker, 2017). Colloquial (common) names were used according to Hockey et. al. (2005) to avoid confusion;
- In addition, all observations obtained during the screening site visit of 24 - 26 January 2017 was submitted to the South African Bird Atlas Project (SABAP2).

9.3 Limitations and assumptions

To obtain a comprehensive understanding of the diversity and dynamics of avifaunal community on the study area, as well as the status of endemic, rare or threatened species in the area, assessments should always consider investigations at different time scales (across seasons/years) and through replication. However, due to time constraints such long-term studies are not feasible and are mostly based on instantaneous sampling bouts.

It should also be realised that bird distribution patterns fluctuate widely in response to environmental conditions (e.g. local rainfall patterns, nomadism, migration patterns, seasonality), meaning that a composition noted at a particular moment in time will differ during another time period at the same locality.

Due to the scope of the work presented in this assessment, a detailed investigation of all, or part of the proposed farms were not possible and is not perceived as part of the Terms of Reference for a scoping/screening level exercise.

Furthermore, additional information may become known during a later stage of the process or development. This company, the consultants and/or specialist investigators do not accept any responsibility for conclusions, suggestions, limitations and recommendations made in good

faith, based on the information presented to them, obtained from the surveys or requests made to them at the time of this report.

The following assumptions are relevant to the literature survey and database acquisition phase:

- It is assumed that third party information (obtained from government, academic/research institution, non-governmental organisations) is accurate and true;
- Some of the datasets are out of date and therefore extant distribution ranges may have shifted although these datasets could provide insight into historical distribution ranges of relevant species;
- The datasets are mainly small-scale and could not always consider azonal habitat types that may be present on the study area (e.g. small dams, pans and depressions). In addition, these datasets encompass surface areas larger than the study area that could include habitat types and species that is not present on the study area. Therefore, the potential to overestimate species richness is highly likely while it is also possible that certain cryptic or specialist species could have been overlooked in the past;
- Some of the datasets (e.g. SABAP2) managed by the Animal Demography Unit of the University of Cape Town were only recently initiated and therefore incomplete; and
- In addition, the study area is under private ownership and primarily inaccessible to the public. Since most of the species distribution ranges concerning the relevant datasets are subject to observations made by the public, it is likely that many bird species are overlooked or not formally catalogued for the area.

9.4 Species composition and patterns in diversity

9.4.1 Regional Vegetation Types – Regional Context

The study area corresponds to the Savanna Biome and more particularly to the Mopane Bushveld Bioregion as defined by Mucina & Rutherford (2006) and comprehends an ecological type known as Musina Mopani Bushveld (Mapping Unit SVmp 01; Mucina & Rutherford, 2006). This vegetation type extends from Baines Drift and Alldays in the west, eastwards and north of the Soutpansberg to Banyini Pan. It is predominantly located on undulating plains that are irregularly interspersed by tributaries of the Limpopo River. On the study area, it forms a moderately open, albeit arid savanna dominated by *Colophospermum (=Hardwickia) mopane*, *Terminalia prunioides, Commiphora* species, *Kirkia acuminata* and *Combretum apiculatum*. The graminoid layer is open and sparse, while the herbaceous layer is poor in species richness. *Adansonia digitata* and *Senegalia (=Acacia) nigrescens* are typical canopy constituents.

This vegetation type was widespread, least threatened and dominant on the study area.

The high palatability of the graminoid composition and the geographic position of the study area makes this vegetation type very suitable for game and livestock (mainly cattle) farming practices, which is also *responsible for the occurrences of large-bodied birds of prey (especially scavenging vultures*).

It should be realised that bird diversity is invariably positively correlated with vegetation structure, although floristic richness is not regarded to be the most important contributor of

bird abundance patterns. Therefore, grasslands are generally poor in woody plant species although it is considered an important habitat for many terrestrial bird species such as larks, pipits, korhaans and cisticolas. On the other hand, woodlands are rich in woody plant species and are an important constituent of the Savanna Biome that provides habitat for many bushveld bird species that are not partial to grassland habitat types (notably birds of prey).

However, in contrast to the Grassland Biome, the bird assemblages occupying the Savanna Biome are generally rich in Accipitriform taxa such as the Tawny Eagle (*Aquila rapax*), African White-backed Vulture (*Gyps africanus*), Brown Snake-eagle (*Circaetus cinereus*), Black-chested Snake-eagle (*Circaetus pectoralis*), African Harrier-hawk (*Polyboroides typus*), African Hawk Eagle (*Aquila spilogaster*) and Wahlberg's Eagle (*Hieraaetus wahlbergi*).

This regional habitat type supports a fairly high richness of bird species. However, it is evident that several smaller habitat units (depressions, seasonal drainage lines and cultivated land) are also prevalent and provide habitat for bird compositions that are different to those ecological types that dominate the region. It should be emphasised that the depressions provide ephemeral habitat for wetland-dependant bird species (mainly wading bird and wader species, which will be investigated in more detail during the EIA phase of the project) and has undoubtedly contributed to the avifaunal richness in the area. These wetland features also provide foraging habitat for threatened stork species.

9.4.2 Avifaunal Broad-scale Habitat Types

From an avifaunal perspective, five macro-habitat types are prominent in the area:

1. Undifferentiated arid broad-leaved woodland on sandy soils - Most of the study area consists of open, arid woodland located on sandy soils. It comprises of a well-developed woody layer consisting of *Colophospermum (=Hardwickia) mopane, Terminalia prunioides*, *Vachellia tortilis, Kirkia acuminata, Grewia bicolor, Boscia albitrunca, Lannea schweinfurthii* and various species of *Commiphora*. Typical canopy constituents include *Xanthocercis zambesiaca, Senegalia nigrescens* and *Adansonia digitata*. The graminoid layer includes dominant taxa such as *Panicum maximum, Schmidtia pappophoroides* and *Stipagrostis uniplumis*. Based on their distribution, the avifaunal assemblages occurring on the study area are likely to include a high proportion of taxa with evolutionary links to the Zambezian region and the Kalahari-Highveld basin (**Table 12**). The open structure and sparse graminoid layer (presumably due to grazing pressure and climatic factors such as unpredictable precipitation resulting in frequent aridity) favoured the colonisation of large terrestrial bird species such as the Kori Bustard (*Ardeotis kori*), Red-crested Korhaan (*Lophotis ruficrista*) and Secretarybird (*Sagittarius serpentarius*).

Some sections of the woodland type consist of dense *Grewia flavescens* and *Dichrostachys cinerea* shrub which are colonised by elusive and skulking warbler and robin taxa such as Marsh Warbler (*Acrocephalus palustris*) and Thrush Nightingale (*Luscinia luscinia*), especially when on passage. Both these species are easily overlooked and have not been recorded previously from the area.

Table 12: A list of biome-restricted and range-restricted species (according to Marnewick et al., 2015) expected to be present on the study areas

Species	*Common Name*	*Biome Affinity*	*Predicted Status*
Erythropygia paena	Kalahari Scrub-robin	Kalahari-Highveld	Common
Cossypha humeralis	White-throated Robin-chat	Zambezian Affinity	Uncommon
Poicephalus cryptoxanthus	Brown-headed Parrot	East African Coastal Affinity	Uncommon (study site is part of western edge of distribution)
Turdus libonyanus	Kurrichane Thrush	Zambezian Affinity	Common
Calamonastes fasciolatus	Barred Wren-warbler	Kalahari-Highveld	Common
Cinnyris talatala	White-bellied Sunbird	Zambezian Affinity	Common

2. *Seasonal drainage lines* - This habitat type represents a linear riparian zone along drainage lines, which were most prominent on the Farm Du Toit. The riparian vegetation consists of a dense canopy of *Schotia brachypetala, Xanthocercis zambesiaca, Peltophorum africanum*. The understorey is well defined and thicket-like, consisting of *Grewia flava, G. hexamita* and *Ziziphus mucronata*. *Panicum maximum* dominates the graminoid layer.

The high vertical heterogeneity and leaf litter deposition associated with the alluvial vegetation allow for avifaunal compositions not typically associated with adjacent dryland habitat types - thereby enhancing local biodiversity. From a functional perspective, these habitat types play an important role in maintaining genetic stability between bird populations along their entire length. These constitute important dispersal corridors for faunal species since it increases the probability of colonisation of areas outside of the study site, thereby reducing the isolation of residing populations.

Apart from the aforementioned habitat types, three important azonal habitat types were also prevalent and scattered across the study area:

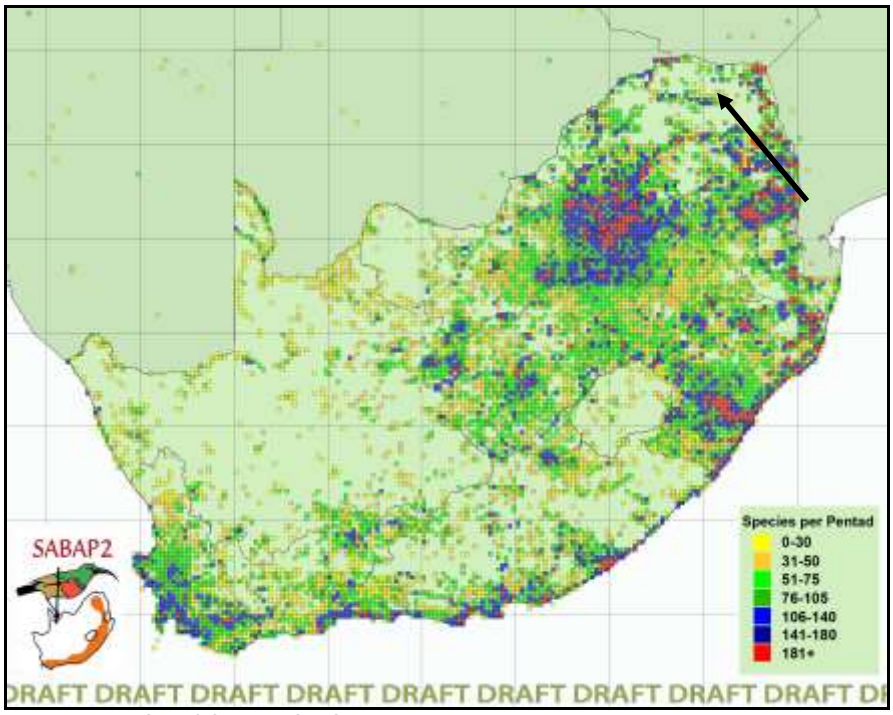
3. *Impoundments and natural depressions (pans)* – these respectively represent man made water bodies and shallow depressions. However, these waterbodies have undoubtedly benefit the colonisation and range expansion of many waterbird species that favours open water habitat (e.g. White-faced Duck - *Dendrocygna viduata*, Comb Duck - *Sarkidiornis melanotos* and Egyptian Goose - *Alopochen aegyptiacus*). They also provide foraging habitat for threatened stork species (e.g. Black Stork - *Ciconia nigra*).
4. *Large Adansonia digitata (Baobab) canopy constituents* – these include large baobab trees, which were scattered across the study area, but were particularly prominent on the Farm Vrienden. They provide optimal roosting and breeding habitat for a host of cavity-nesting bird species (including Brown-headed Parrot - *Poicephalus cryptoxanthus*). In addition, these trees are also the favourite breeding platforms used by Red-billed Buffalo Weavers (*Bubalornis niger*) and Red-headed Weavers (*Anaplectes rubriceps*). Lastly, they also function as important hunting and roosting posts for large birds of prey.
5. *Secondary woodland and areas that were historically cleared of vegetation* - These represent areas of secondary woodland previously used for agricultural purposes. The sequential colonisation by graminoid (grass) species makes it possible for terrestrial species (mainly Kori Bustard - *Ardeotis kori*) to utilise these areas.

Figure 8: A collage of images illustrating the different broad scale habitat types on the study area

(a-b) Undifferentiated arid broad-leaved woodland on sandy soils; note the poorly developed basal or graminoid layer, (c) dense *Grewia* thickets which provide suitable habitat for Palearctic migratory warbler taxa when on passage, (d) an inundated seasonal drainage line as viewed on the Farm Du Toit, (e) an ephemeral pan on the Farm Du Toit, (f) a large *Adansonia digitata* tree on the Farm Vrienden which provide breeding habitat for Red-billed Baffalo Weavers (*Bubalornis niger*) and Brown-headed Parrot (*Poicephalus cryptoxanthus*) and (g) secondary savannoid grassland along the edge of Farm Du Toit, the typical foraging habitat of the near threatened Kori Bustard (*Ardeotis kori*).

9.4.3 Species Richness and predicted summary statistics

Approximately 262 bird species are *expected* to occur on the study area (refer **Appendix 1** & **Table 13**). The expected richness was inferred from the South African Bird Atlas Project (SABAP1 & SABAP2)[5] (Harrison et al., 1997; www.sabap2.org) and the presence of suitable habitat on the study area. The expected richness is also strongly correlated with favourable environmental conditions (e.g. when ephemeral pans are inundated) when waterbird and wading bird taxa are anticipated to temporarily colonise the area (e.g. stork taxa). This equates to 27 % of the approximate 972[6] species listed for the southern African subregion[7] (and approximately 31 % of the 848 species recorded within South Africa[8]). However, the SABAP2 database (www.sabap2.adu.org.za) for the three pentad grids corresponding to the study area was significantly lower (*c*. 33-52 species/pentad), which emphasises the poor atlas coverage of the area. According to personal observations, the average number of species observed per pentad within a given time period (c. 2 hours) is approximately 90 - 100 species. This is much lower than the regional SABAP1 statistic, and best explained by the monotonous habitat structure that is prevalent across the two farms. On a national scale, the species richness per pentad on the study area is considered low refer (**Figure 9**).



Bird species richness per pentad grid for South Africa
(map courtesy of SABAP2 and the ADU)
The bird species richness per pentad grid in comparison to the study area (see arrow) (map courtesy of SABAP2 and the Animal Demography Unit). According to the SABAP2 database, the study area hosts between 31-50 species.

[5] The expected richness statistic was derived from the QDS 2229DB (Mopane) with a total of 233 bird species recorded (based on 14 cards submitted) AND three pentad grids (including adjacent pentad grids) totaling 358 bird species (based on 12 full protocol cards). The SABAP2 statistic was corrected by excluding erroneous submissions pertaining to the Damara Hornbill (*Tockus damarensis*) and hybrids with Southern Red-billed Hornbill (*T. rufilatus*), Orange River White-eye (*Zosterops pallidus*), Green-backed Camaroptera (*Camaroptera brachyura*) and Northern Grey-headed Sparrow (*Passer griseus*).
[6] *sensu* www.zestforbirds.co.za (Hardaker, 2016) with the addition of Rufous-tailed Scrub-Robin (*Erythropygia galactotes*) and Pied Flycatcher (*Ficedula hypoleuca*).
[7] A geographical area south of the Cunene and Zambezi Rivers (includes Namibia, Botswana, Zimbabwe, southern Mozambique, South Africa, Swaziland and Lesotho).
[8] With reference to South Africa (including Lesotho and Swaziland (BirdLife South Africa, 2017).

Table 13: Summary table of the statistics of birds expected to occur within the proposed study area	
Description	*Expected*
Total number of species	262 (31 %)
Number of Red Listed species (Taylor et al., 2015)*	13 (10 %)
Number of biome-restricted species (Marnewick et al., 2015) – Zambezian, African East Coast & Kalahari-Highveld)**	6 (23 %)
Number of endemics (Hockey et. al., 2005)**	0 (0 %)
Number of near-endemics (Hockey et. al., 2005)**	2 (7 %)

(Taylor et al., 2015; IUCN, 2017), endemics and biome-restricted species (Marnewick et al., 2015)
Percentage values in brackets refer to derived totals compared against the number of species in South Africa (BirdLife South Africa, 2017)9.
* - only in South Africa (including Lesotho and Swaziland).
** - only species in the geographic boundaries of South Africa (including Lesotho and Swaziland) were considered.

Although the expected richness of bird species for the area is higher than the observed richness, it is poorly represented by endemic and near-endemic species. It provides habitat for a single near-endemic species (*c*. Fiscal Flycatcher - *Sigelus silens*). In addition, the study area holds several geographically-restricted species, and it contains six biome-restricted (Zambezian, Kalahari-Highveld and East African Coastal biomes) species in South Africa.

9.4.4 Species of conservation concern

Table 14 provides an overview of the threatened and near-threatened bird species that could occur on the study area based on their respective distribution ranges and the presence of suitable habitat. According to **Table 14**, 13 species are known to occur in the region of which seven species are expected to be regular. Six of these 13 species are globally threatened species and two are globally near-threatened, while nine are regionally threatened species and three regionally near-threatened species. Noteworthy species include the regionally near-threatened Kori Bustard (*Ardeotis kori*), the endangered African White-backed Vulture (*Gyps africanus*), the endangered Bateleur (*Terathopius ecaudatus*), the vulnerable Secretarybird (*Sagittarius serpentarius*) and the vulnerable Black Stork (*Ciconia nigra*). The remaining species are regarded as uncommon residents or irregular and highly opportunistic foraging visitors to the area.

Table 14: Threatened and near-threatened bird species that could utilise the proposed study area based on their known distribution range and the presence of suitable habitat

Species	*Global Conservation Status**	*Regional Conservation Status***	*Preferred Habitat*	*Occurrence Status*
Aquila rapax (Tawny Eagle)	-	Endangered	Lowveld and Kalahari savannas, especially game farming areas and reserves.	An irregular foraging visitor. Its occurrence depends on the presence of carcasses.
Ardeotis kori (Kori Bustard)	Near-threatened	Near-threatened	Arid open lowland savanna and karroid shrub.	A fairly common resident and expected to be widespread on the study area (especially Farm Du Toit)
Bucorvus leadbeateri (Southern Ground Hornbill)	Vulnerable	Endangered	Open woodland and grassland habitat	An uncommon resident to the area.

[9] With reference to South Africa (including Lesotho and Swaziland (BirdLife South Africa, 2017).

Table 14: Threatened and near-threatened bird species that could utilise the proposed study area based on their known distribution range and the presence of suitable habitat

Species	*Global Conservation Status**	*Regional Conservation Status***	*Preferred Habitat*	*Occurrence Status*
Ciconia abdimii (Abdim's Stork)	-	Near-threatened	Open stunted grassland, fallow land and agricultural fields	A fairly common summer foraging visitor to areas consisting of secondary grassland or cleared of woodland. Could also utilise the depressions (pans) as ephemeral foraging habitat.
Ciconia nigra (Black Stork)	-	Vulnerable	Breeds on steep cliffs within mountain ranges; forages on ephemeral wetlands.	A fairly common summer visitor to the pan depressions in the area.
Falco biarmicus (Lanner Falcon)	-	Vulnerable	Varied, but prefers to breed in mountainous areas.	An occasional foraging visitor on the study area. Partial to pan depressions in open woodland (utilised as hunting habitat).
Gyps africanus (White-backed Vulture)	Critically Endangered	Critically Endangered	Breed on tall, flat-topped trees. Mainly restricted to large rural or game farming areas.	A common foraging visitor. Often roosts on top of large trees.
Gyps coprotheres (Cape Vulture)	Vulnerable	Endangered	Mainly confined to mountain ranges, especially near breeding site. Ventures far afield in search of food.	An uncommon foraging visitor (mainly individuals) - often in company with White-backed Vultures (*Gyps africanus*).
Leptoptilos crumeniferus (Marabou Stork)	-	Near-threatened	Varied, from savanna to wetlands, pans and floodplains – dependant of game farming areas	An irregular foraging visitor - often encountered at the pans.
Polemaetus bellicosus (Martial Eagle)	Vulnerable	Endangered	Varied, from open karroid shrub to lowland savanna.	An uncommon foraging visitor.
Sagittarius serpentarius (Secretarybird)	Near-threatened	Vulnerable	Prefers open grassland or lightly wooded habitat.	Regarded as a fairly common visitor to the secondary and open woodland.
Terathopius ecaudatus (Bateleur)	Vulnerable	Endangered	Lowveld and Kalahari savanna; mainly on game farms and reserves	A fairly common foraging visitor - access to carcasses regarded as important.
Aegypius tracheliotos (Lapped-faced Vulture)	Vulnerable	Endangered	Lowveld and Kalahari savanna; mainly on game farms and reserves	An irregular foraging visitor.

Conservation categories were used according to the IUCN (2017)* and Taylor et al. (2015)**.

A brief account of the important taxa is presented:

1. *Kori Bustard (Ardeotis kori)*

Ardeotis kori is globally listed as near-threatened (BirdLife International 2013a) while a recent conservation assessment has downgraded it from regionally vulnerable to near-threatened (Taylor et al., 2015). *A. kori* is a large terrestrial bird with a preference for lightly wooded savanna which is nowadays mainly encountered on larger conservation areas and game farms (Barnes, 2000; BirdLife International, 2013a). It is expected to be common on the study area, especially on open woodland and secondary grassland habitat. It should be emphasised that collision of birds with the game fence pose a real risk to the long-term survival of this species. However, it also utilises old cultivated land or areas cleared of woodland, which allows for unrestricted movement during foraging bouts and provides suitable habitat for this species. Therefore, this species has undoubtedly benefited from selective clearing of woodland areas, which facilitate unhindered movement and foraging of such a large-bodied species.

2. Storks (Ciconiidae)

Three (3) stork species of conservation concern are expected to be present on the study area, which include the regionally vulnerable Black Stork (*Ciconia nigra*), regionally near-threatened Abdim's Stork (*C. abdimii*) and the regionally near-threatened Marabou Stork (*Leptoptilos crumeniferus*). The occurrence of these species is opportunistic, and most individuals are attracted to the nearby agricultural activities. However, these species tend to utilise the depressions as important ephemeral foraging habitat.

3. *Martial Eagle (Polemaetus bellicosus)*

P. bellicosus is globally listed as vulnerable (BirdLife International, 2013b) while a recent conservation assessment has upgraded it from regionally vulnerable to endangered (Taylor et al., 2015) due to rapid declines in South Africa during the last 10 years (owing to habitat loss and poisoning; Taylor et al., 2015). Although it has an extensive range across most of sub-Saharan Africa, it is nowhere common and generally occurs at low densities. *P. bellicosus* is a large and charismatic species that is more numerous in large conservation bodies although it also occurs on large game farms, or areas where human densities and activities remain sparse. However, it is regarded as an uncommon foraging visitor on the study area and its status (including breeding status) on the study area requires verification. It requires exceptionally large home ranges in excess of 130 km^2 (Brown et. al., 1982) and sometimes even up to 1 000 km^2, accentuating the importance of additional foraging habitat for the long-term survival of this species.

4. *Scavenging Birds of Prey (genera Gyps, Aegypius, Aquila and Terathopius)*

Five species of large-bodied scavenging raptors are expected to be present. All of these were formerly listed as vulnerable or near threatened in South Africa (Barnes, 2000), but evidence according to regional declining trends has upgraded their status to the endangered and critically endangered categories (Taylor et al, 2015). Of these, only the White-backed Vulture (*Gyps africanus*) and Bateleur (*Terathopius ecaudatus*) are considered as regular foraging visitors to the study area. The remaining species (*c*. Cape Vulture - *Gyps coprotheres*, Lappet-faced Vulture - *Aegypius tracheliotos* and Tawny Eagle - *Aquila rapax*) are irregular and opportunistic since their occurrences are best explained by the presence of carcasses.

5. *Lanner Falcon (Falco biarmicus)*

F. biarmicus is a fairly common species within its global distribution range, where it occurs from south-eastern Europe to the Middle East, south-west Asia and across most of Africa (Jenkins, 2005). The global population consists of more than 30 000 breeding pairs with approximately 1 400 pairs confined to the eastern parts of South Africa (Tarboton & Allen, 1984). It was recently upgraded from near threatened to Vulnerable in South Africa due to persistent transformation of suitable foraging habitat (open areas) to make way for agricultural land. This species is often associated with ridges and mountain ranges where it prefers to nest on cliffs. It prefers to forage over open terrain and will hunt indiscriminately on almost any open area with suitable prey (mainly other terrestrial birds such as francolins and lapwings), although pans/water holes located within open woodland are preferred. Its occurrence on the study area is regarded as occasional.

6. Secretarybird (Sagittarius serpentarius)

This species was recently upgraded from near-threatened to vulnerable (Taylor et al., 2015; BirdLife International, 2013c) since recent evidence suggests that it has experienced rapid declines across its entire range due to habitat loss, anthropogenic disturbances and intensive grazing. Secretarybirds are widespread in Africa south of the Sahara, but have declined over most of their geographic distribution range. They prefer open areas, in particular open savanna and grassland, but tend to avoid areas of dense bush or very rocky areas. *S. serpentarius* is considered as a regular foraging visitor on the study area. Owing to its preference for open and secondary woodland units, it is predicted to share a habitat in common with the Kori Bustard (*Ardeotis kori*).

7. Southern Ground Hornbill (Bucorvus leadbeateri)

This species is listed as endangered (Taylor et al., 2015) with less than 1 500 mature individuals remaining within South Africa. They prefer open areas, specifically open savanna habitat where suitable natural cavities in trees are available. It is considered an uncommon resident in the area and its occurrence requires verification.

9.4.5 Key Avifaunal Features and Synthesis

Based on the results, the avifaunal community on the study area is summarised in terms of the following key features:

- The study area supports a high diversity of bird species representing approximately 31 % of the regional richness (irrespective of the SABAP2 statistic);
- In general, habitat diversity and heterogeneity were relatively low, and the woodland structure was monotonous across the area;
- The avifaunal community on the study area is not regionally unique (on a national level) and poorly represented by South African endemics and near-endemics. The dominant composition is widespread in the region;
- Several threatened and near threatened species (mainly scavenging bird of prey species and Kori Bustard - *Ardeotis kori*) is expected to be present. The majority of these species requires large home range sizes, with many species occupy low densities;
- Part of the woodland habitat consists of an open canopy structure which is expected to provide optimal foraging habitat for terrestrial large-bodied bird species (e.g. the near-threatened Kori Bustard - *Ardeotis kori* and vulnerable Secretarybird *Sagittarius serpentarius*);
- The depressions, pans and impoundment features on some of the farms (especially Farm Du Toit) have benefitted the colonisation of "specialised" bird taxa (mainly wader and wading bird species) that are of local importance and contribute towards the regional avifaunal diversity. It also provides ephemeral foraging habitat for threatened and near threatened stork taxa.

9.5 Potential Impacts on the avifaunal Environment

The construction and operation of the proposed power station and its associated infrastructure is expected to have a negative impact on the avifaunal community of the study area and its immediate surroundings. Direct, indirect and cumulative adverse impacts on the bird community are expected during the construction and operation of the proposed power station.

9.5.1 Potential Direct Impacts

Direct impacts represent those that are a result of the proposed project and unequivocally influencing the fauna of the region. Anticipated impacts include:

j) Loss and transformation of habitat resulting in displacement of bird species, especially large-bodied birds of prey and large terrestrial bird species requiring large home ranges (so-called K-selected species);
k) Loss of sensitive habitat (e.g. trees used as breeding platforms, pans and depressions) and subsequent loss of threatened and near-threatened species and habitat containing high avifaunal diversity and unique species compositions;
l) Changes in bird community structures due to habitat fragmentation (e.g. roads, loss of continuous woodland patches) and habitat loss;
m) Bird collisions and electrocution with fence structures and proposed overhead power lines (anticipated); and
n) Loss of migration/foraging corridors.

9.5.2 Indirect Impacts

Indirect impacts are mostly impacts that are unseen and often only expressed during a later stage of the project:

o) Loss of dispersal corridors owing to habitat alteration;
p) Subsequent habitat changes and changes to the local avifaunal community structure and composition (colonisation by generalists and secondary species); and
q) Urban sprawl based on "job-seeking" opportunities leading to the localised depletion of natural resources and direct persecution of bird taxa.

9.5.3 Cumulative Impacts

r) Cumulative impacts are often related to the "after-effect" when the project is decommissioned. It mainly pertains to rehabilitation effort, and how this relates to the residing avifaunal communities. Therefore, it is often witnessed that early successional habitat contributes to the establishment of a transient avifaunal community.

9.6 Preliminary assessment of impacts on the avifaunal environment

Table 15: Preliminary assessment of impacts on the faunal environment

Impact

a. Loss of species and transformation of habitat resulting in displacement of bird species, especially large-bodied birds of prey and large terrestrial bird species requiring large home ranges (so-called K-selected species)

Desktop Sensitivity Analysis of the Site:

Results of the preliminary assessments indicated the presence of several K-selected birds; habitat associated with these species is therefore regarded highly sensitive. Specifically, riparian zones and topographical variability are regarded sensitive habitat attributes

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Loss of conservation important bird taxa; also with reference to habitat associated with these species	A localised depletion of numbers of CI bird taxa and protected bird species is expected. Densities and presence of similar habitat and animals in the surrounding region is not known at this stage and the likelihood of significant effects on population numbers cannot be discounted at this stage.	Local/ Regional	All areas of high ecological sensitivity, including riparian/ wetland habitat as well as topographically heterogeneous habitat should be avoided.

Description of expected significance of impact

Due to the nature of the development, land clearance will result in the complete removal of extensive areas of natural habitat within the footprint area, unavoidable (direct) impacts are therefore likely to result from land clearing activities on these bird taxa as well as the typical habitat where these species abound. Direct losses (death) of these animals, although unlikely, might occur.

Gaps in knowledge & recommendations for further study

Presence/ absence and distributional patterns of K-selected species will be investigated in more detail during the specialist surveys during the EIA phase of the project. Collated data will inform the identification of sensitivity and recommendation of suitable development areas.

Impact

b. Loss of sensitive habitat (e.g. trees used as breeding platforms, pans and depressions) and subsequent loss of threatened and near-threatened species and habitat containing high avifaunal diversity and unique species compositions

Desktop Sensitivity Analysis of the Site:

A moderate sensitivity is generally ascribed to the proposed sites due to extensive natural habitat that exhibit variability in terms of specialised habitat types for selective bird species in terms of foraging and breeding purposes.

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Loss of natural habitat and habitat features typically occurring infrequently on a landscape scale that are often associated with specific avifaunal uses	Unaccounted losses of natural habitat with unique habitat features and sensitive habitat types could potentially result in significant impacts beyond the boundaries of the development footprint (community impacts), also resulting in impacts on local and/ or regional conservation efforts. The presence of unique habitat features, e.g. Baobab trees, constitute unique habitat features	Local/ Regional	Whilst no specific 'No-Go' areas were identified, areas of high ecological sensitivity, including riparian/ wetland habitat as well as topographically heterogeneous habitat should be avoided.

Description of expected significance of impact

Losses of unique habitat features will undoubtedly result in effects on specialised bird taxa that makes use of habitat features, it is also likely to result in impacts beyond the boundaries of the site. It is also mentioned that sensitive habitat types are known to be associated with birds of conservation importance/ concern and could therefore cumulatively contribute to impacts on these taxa, as well as ecological functionality of the surrounding region

Gaps in knowledge & recommendations for further study

Preliminary results obtained during the screening and scoping phases indicated the presence of extensive areas of natural habitat that is representative of the regional ecological types as well as the presence of habitat types of higher sensitivity and unique attributes. The identification, description and delineation of these habitat types will inform the identification of sensitivity and recommendation of suitable development areas.

Impact

c. Changes in bird community structures due to habitat fragmentation (e.g. roads, loss of continuous woodland patches) and habitat loss

Desktop Sensitivity Analysis of the Site:

Preliminary results obtained during the screening and scoping phases indicated a high avifaunal diversity within the proposed development footprints. Significant losses of birds and associated habitat on a local scale is likely to cause changes to community structures and abundance of species. This is likely to constitute an unavoidable impact of the proposed development as it is cause through sterilisation of extensive areas.

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Changes to community structures are likely to cause localised imbalances to the abundance of certain species. Additionally, the creation of atypical habitat will result in influx of atypical species	Displacement of birds from development footprint and the subsequent influx of atypical species cause imbalances in the natural abundance and persistence of the bird structures and communities	Local	No specific 'No-Go' areas were identified.

Description of expected significance of impact

Although the impact is likely to be restricted to the immediate environment, appurtenant infrastructures will cause localised imbalances and alteration of bird regimes. These impacts are generally unavoidable and extremely problematic to control beyond the boundaries of the site.

Gaps in knowledge & recommendations for further study

Cursory observations will be made during the EIA phase of the project to inform recommendations and EMP guidelines for the project.

Impact

d. Bird collisions and electrocution with fence structures and proposed overhead power lines

Desktop Sensitivity Analysis of the Site:

Typical effects and impacts associated with the construction and operation of a power facility within a natural environment where large-bodied birds make use of the structures and periodically collides with lines and structures

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Accidental death of large-bodied birds	Depletion of species typically occurring within the region, with specific reference to K-selected species	Local/ regional	No specific 'No-Go' areas were identified.

Description of expected significance of impact

Although the impact is likely to be restricted to the immediate environment, appurtenant infrastructures will cause localised imbalances and alteration of bird regimes on a regional scale. These impacts are generally unavoidable and extremely problematic to control beyond the boundaries of the site. Generic mitigation measures generally are included to ameliorate and restrict impacts on the avifaunal component as far as possible

Gaps in knowledge & recommendations for further study

The EIA phase will inform the exact nature of risks to the surrounding environment and EMP guidelines will be adapted to allow for the correct identification and mitigation of issues.

Impact

e. Loss of migration/foraging corridors

Desktop Sensitivity Analysis of the Site:

Uninterrupted natural habitat is a scarce commodity for animals and the larger region generally represent an area where most birds exhibit the ability to migrate naturally across a region. The proposed development footprint and immediate surrounds are therefore regarded as sensitive receptors in this regard.

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Creation of sterile landscapes where bird regimes exhibit an altered status and natural species generally do not persist or utilise for natural processes	Numerous taxa will be unable to migrate across anthropogenic barriers, causing disruption and/ or isolation of populations on a local scale, also with reference to collisions and accidental electrocutions	Local/ regional	No specific 'No-Go' areas were identified, specific reference is nonetheless made of riparian zones and other migration patterns on a local and regional scale

Description of expected significance of impact

The regional implications are regarded significant when the cumulative impacts of the development and appurtenant infrastructures are considered. Effects on migrational species are likely to exhibit significant impact levels

Gaps in knowledge & recommendations for further study

The EIA phase will inform the exact nature of risks to the affected species and surrounding environment. EMP guidelines will be adapted to allow for the correct identification and mitigation of issues.

Impact

f. Loss of dispersal corridors owing to habitat alteration

Desktop Sensitivity Analysis of the Site:

Uninterrupted natural habitat is a scarce commodity for animals and the larger region generally represent an area where most birds exhibit the ability to migrate naturally across a region. The proposed development footprint and immediate surrounds are therefore regarded as sensitive receptors in this regard.

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Creation of sterile landscapes where bird regimes exhibit an altered status and natural species generally do not persist or utilise for natural processes	Numerous taxa will be unable to migrate across anthropogenic barriers, causing disruption and/ or isolation of populations on a local scale, also with reference to collisions and accidental electrocutions	Local/ regional	No specific 'No-Go' areas were identified, specific reference is nonetheless made of riparian zones and other migration patterns on a local and regional scale

Description of expected significance of impact

The regional implications are regarded significant when the cumulative impacts of the development and appurtenant infrastructures are considered. Effects on migrational species are likely to exhibit significant impact levels

Gaps in knowledge & recommendations for further study

The EIA phase will inform the exact nature of risks to the affected species and surrounding environment. EMP guidelines will be adapted to allow for the correct identification and mitigation of issues.

Impact

g. Subsequent habitat changes and changes to the local avifaunal community structure and composition (colonisation by generalists and secondary species)

Desktop Sensitivity Analysis of the Site:

A moderate sensitivity is generally ascribed to the proposed sites and immediate surrounds because of the existing natural status of the receiving environment and existing avifaunal guilds. Habitat changes resulting from land clearance activities and appurtenant infrastructures are likely to cause severe changes to species composition on a local and regional scale

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Changes to habitat structure and composition are likely to result in reflective changes to the avifaunal guilds and species composition, reflected by exodus and influx of species.	Unaccounted losses of natural habitat and sensitive habitat types as well as changes (deterioration) of natural habitat will result in community structures and densities of beyond the boundaries of the development footprint, also resulting in impacts on local and/ or regional conservation efforts.	Regional	No specific 'No-Go' areas were identified at this stage

Description of expected significance of impact

Within a largely untransformed natural environment, effects of this impact are generally accepted to be moderately severe, unavoidable and impossible to mitigate against. While every effort could be made to limit the spread of developments and associated infrastructure across an untransformed landscape, the increase in anthropogenic developments, movement, transportation, effluents, discards, etc., will ultimately over the long-term result in a fragmented landscape on a local and regional scale. This impact also represents a long-term effect

Gaps in knowledge & recommendations for further study

The EIA phase will inform the exact nature of risks to the surrounding environment and EMP guidelines will be adapted to allow for the correct identification and mitigation of issues

Impact

h. Urban sprawl based on "job-seeking" opportunities leading to the localised depletion of natural resources and direct persecution of bird taxa

Desktop Sensitivity Analysis of the Site:

Results of the preliminary assessments indicated the highly likely presence of 'important' species within the proposed sites, the increased presence of humans will undoubtedly result in increased persecution and depletion of certain species. Areas surrounding the site and peripheral developments are regarded important in this regard

Issue	Nature of Impact	Extent of Impact	No-Go Areas
Human - animal conflict situations are likely to develop due to the presence of a high number of workers in the area, also with reference to subsequent developments	Direct and indirect impacts associated with conflict situations, persecution, hunting, trapping, illegal trade, etc.	Local/ Regional	No specific 'No-Go' areas were identified at this stage

Description of expected significance of impact

Impacts, although relatively localised, will be moderately severe, with specific reference to appurtenant developments, the construction phase when a high density of workers are present and the operational phase when cumulative developments will result in depletion of habitat and species. The likelihood that these impacts will occur is high and effects are generally irreversible. Mitigation measures are generally only effective on a local scale, but is problematical to implement and control in areas beyond the development perimeter.

Gaps in knowledge & recommendations for further study

Presence/ absence and distributional patterns of taxa in surrounding areas will be estimated based on collated data, results will inform the EMP and suitable guidelines will be presented.

Impact

i. Cumulative impacts associated with 'after-effects' of the development, with specific reference to decommissioning

Desktop Sensitivity Analysis of the Site:

The existing PES of the development is likely to be reduced significantly due to the nature of the project, also taking cognisance of the longevity of the project and accumulation of developments and impacts associated with the associated infrastructure and resource requirements.

Issue	Nature of Impact	Extent of Impact	No-Go Areas
The reduction of avifaunal diversity and richness and deterioration of habitat quality subsequent to the decommissioning of the project	Deterioration of habitat and subsequent changes to species presence/ absence and species richness due to the indirect and cumulative impacts associated with the projects	Regional	No specific 'No-Go' areas were identified at this stage

Description of expected significance of impact

Evidence of other projects would suggest significant and long-term effects on the avifaunal component of a region where a large industrial development has been operating for a long period. These effects are generally unavoidable and irreversible, given that the natural environment is unlikely to recover to a state similar to which it was prior to the impact. Also, cumulative impacts in this category also need to include the changes to the natural environment in spatial zones beyond the development footprint that resulted in successional patterns in the avifaunal composition and structures

Gaps in knowledge & recommendations for further study

Presence/ absence and distributional patterns of taxa in surrounding areas will be estimated based on collated data, results will inform the EMP and suitable guidelines will be presented. Evidence and results of previous studies of similar developments will be considered

Expected and likely impacts on the receiving environment are expected to result in severe, irreversible and significant effects on the avifaunal guilds of the area; direct results will generally be restricted to the site and immediate surrounds while indirect and cumulative effects will disperse across a wider geographical area surrounding the development footprint. It is emphasised that, due to the existing natural status of the site and surrounds, these impacts are regarded significant and will likely constitute permanent and irreversible impacts that are typically problematic (impossible) to control and mitigated.

The respective sites exhibit aspects of important avifaunal habitat, with reference to localised and restricted habitat types and unique habitat features. The loss of these areas and habitat are regarded significant on a local scale; the occurrence of similar habitat in the general surrounds is unclear at this stage. A high diversity of birds is known to occur in the region and the effect of the proposed development will undoubtedly have an adverse effect on abundance and diversity of birds in the region, also taking cognisance of cumulative impacts associated with the project. It is also evident that the habitat comprised in the study area exhibit typical habitat characteristics and avifaunal compositional attributes that is prevalent on a scale wider than the study area. No impacts of an unacceptable nature on habitat or singular species were recorded for the study area at this stage of the project, but collated data will inform subsequent statements to this effect. The application of generic and site-specific mitigation measures is expected to ameliorate impacts to an acceptable significance on a larger scale.

9.7 Analysis of Preferred Alternative/Farm Option

A preliminary analysis of alternative (based on the Farm options) was performed to evaluate avifaunal important and conservation value of the proposed Farm options (*c.* Du Toit and Vrienden) against east other. Therefore, the farm option with a low importance towards avifaunal diversity and conservation (when compared to each other) is considered the "most preferable" option for the proposed development.

The following avifaunal attributes were investigated and considered during the comparative analysis (see also **Table 16**):

- *Total surface area*: Farms with larger surface areas often correspond to higher habitat heterogeneity and provide additional foraging habitat for birds requiring larger home ranges. Therefore, farms with larger surface area are regarded to hold more important bird habitat and are of higher conservation value.
- *Extent of natural land cover* (based on the 2013-2014 national land cover dataset; Geoterraimage, 2015): Farms with a large surface cover of natural habitat types display less perturbed land and invariably host larger areas of intact habitat of higher ecological connectivity.
- *Extent of transformed land cover* (based on the 2013-2014 national land cover dataset; Geoterraimage, 2015): Farms with a large surface cover of transformed habitat often display arrested ecological connectivity. However, this argument is debatable since the occurrence of previously cultivated fields (on Farm Du Toit) provides ephemeral foraging habitat for stork taxa and bustards.

- *Number of natural land cover categories*: Farms with a high number of natural (untransformed) land cover categories are often characterised by high spatial habitat heterogeneity.
- *Approximate densities of breeding/roosting habitat for large birds of prey and hole-nesting birds*: Large canopy trees (including dead trees) such as *Adansonia digitata* and *Senegalia nigrescens* provide roosting and breeding opportunities for species of raptors, vultures and the hole-nesting guild. In addition, these resources are often patchily distributed in space. Therefore, the higher the density of large canopy trees, the higher the conservation value of the Farm.
- *Important habitat for threatened and near threatened bird taxa*: Complex farms with many habitat types, including azonal habitat such as pans, dams and secondary woodland is likely to provide habitat for a higher richness of threatened and near threatened bird species.
- *Occurrence of azonal habitat and drainage lines*: Azonal habitat such as dams and pans contribute towards local avifauna diversity (e.g. attracting waterbirds and wading birds). Many of these taxa will be absent from neighbouring "dryland" habitat. In addition, drainage lines are linear features, which facilitate avifaunal dispersal.
- *Approximate number of seasonal drainage lines* (according to topocadastral map information): Many drainage lines implies a higher ecological function based on facilitating avifaunal dispersal, facilitating habitat diversity and the potential to hold surface water during bouts of localised precipitation.
- *Approximate number of dams/impoundments* (according to topocadastral map information): Many manmade dams have contributed towards the colonisation and range expansion of waterfowl.

Table 16: Comparative analysis based on avifaunal attributes

Avifaunal Attribute	Farm Option	
	Du Toit	Vrienden
Total Surface Area	924.5	1 285.3
Natural land cover (ha - Geoterraimage, 2015)	871	1 285.3
Transformed land cover (ha - Geoterraimage, 2015)	53.6	None
Number of National Land Cover Categories	8	3
Approximate densities of breeding/roosting habitat for large birds of prey and hole-nesting birds (e.g. Baobabs)	Moderate-high	High
Important habitat for threatened and near threatened bird taxa (pans, open woodland)	High	Moderate
Occurrence of azonal habitat (pans and dams) and drainage lines	High	Low
Approximate number of seasonal drainage lines (according to topocadastral map information)	5	5
Approximate number of dams/impoundments (according to topocadastral map information)	2	0
Suitability outcome:	**Less preferable**	**More preferable**

According to **Table 12** it is evident that ***Farm Vrienden appears to be "more preferable***" for the proposed development when compared to Farm Du Toit. Although Farm Vrienden is larger than Farm Du Toit (c. 361 ha), it appears to be more uniform in habitat structure with fewer land cover categories. In addition, ***Farm Du Toit is the "less preferable"*** since it contains both distinct seasonal drainage lines holding surface water for extended periods of times, manmade dams and several depressions. It also provides optimal foraging habitat for

the near threatened Kori Bustard (*Ardeotis kori*) and threatened and near threatened stork taxa.

In addition, a preliminary comparison between the two farms suggested that the *habitat heterogeneity* on Du Toit was higher based on the occurrence of well-defined drainage lines, the presence of open surface water and areas of open woodland with a well-defined graminoid (grassy) layer. Likewise, the expected avifaunal richness on Farm Du Toit is expected to be marginally higher based on the occurrence of the presence of surface water when compared to Farm Vrienden.

The outcome of the preliminary comparison also showed that Farm Vrienden contains many *Adansonia digitata* trees which provide breeding opportunities for birds of prey and cavity-nesting bird species. It is important that this habitat remains intact during the proposed development.

The spatial arrangement of lower sensitivity areas across the available properties should dictate the placement of infrastructure and not necessarily property boundaries. It is strongly suggested that the most optimal footprint be located through a synthesis of available habitat and such a footprint could potentially extend across the boundaries of the properties and not necessarily be restricted to one of the properties. The spatial proximity to sensitive habitat, in terms of ecological attributes will dictate the recommendation of a suitable footprint location.

9.8 Recommended Plan of Study for EIA Avifaunal Assessment

The following methods are considered for the detailed baseline avifaunal survey:

Point Count Surveys

Data will be collected by means of point counts (Buckland et. al. 1993; Ralph et. al. 1995; Sutherland et. al. 2004) to determine indicator species and to delineate the dominant bird communities present. The use of point counts is the preferred method for detecting shy or elusive species. It is also preferred over line transect counts where access is problematic, or where terrain is complex or where transect methods are difficult to achieve. It is an appropriate method to use, and is very efficient for gathering a large amount of data in a short time period (Sutherland, 2006). Point counts will be spaced at least 200 m apart to improve the independence of observations. Each point count will be surveyed for a period of 10-15 minutes (depending on the structure of the vegetation and which will be determined when on site). The following data will be collected at each survey point:

- The species (identification) of each bird observed or heard; and
- The number of individuals observed for each species.

Random (ad hoc) surveys

To obtain a more complete inventory of bird species present (apart from those observed during the point counts), all bird species observed while moving between point counts will be identified and noted. Specific attention will be afforded to suitable roosting, foraging and nesting habitat for threatened or near-threatened species. Besides visual observations, bird species will also be identified by means of their calls and other signs such as nests, discarded egg shells and feathers.

Nocturnal bird surveys

Nocturnal bird species (owls and nightjars) will be searched for by driving slowly or walking (depending on safety and accessibility) on roads at night. Attention will be afforded to vocally active bird species such as owls and nightjars.

Playback/broadcasting of bird vocalisations

The probability of detecting skulking or elusive species will be verified by playback of bird calls/songs wherever suitable habitat was detected (e.g. Thrush Nightingale - *Luscinia luscinia* and possibly even River Warbler - *Locustella fluviatilis*, certain owl, nightjar and warbler taxa). Special care will be taken to keep disturbance to a minimum and not to affect the bird's natural behaviour (e.g. to prevent unnecessary habituation).

Detecting patterns in diversity and composition

The data generated from the point counts will be analysed according to Clarke & Warwick (1994). A comparison of the different point counts relative to the different habitat types/homogenous habitat units will be performed using multivariate community analyses of calculated Bray-Curtis similarity coefficients.

Dominant and indicator species will be determined according to Clarke & Warwick (1994). Species with high contributions (i.e. with high abundance values and consistency across sampling sites) to a specific habitat represent the typical/dominant species for a given community. In addition, the dissimilarity between the different habitat types will also be measured. A species with a high contribution to the dissimilarity between two habitat types is a good indicator species of the specific habitat.

Bird species richness and diversity will be measured by means of rarefaction and selective diversity indices. Species richness will be measured for each community (as delineated above) by calculating the total number of species recorded (S), the total number of individuals (N) and by means of the Shannon – Wiener diversity index (H' (loge))

Construction of bird guilds

Bird guilds are a better alternative to species lists or inventories. The bird community on the study site represents a "guild profile", consisting of an array of different feeding and nesting guilds, each represented by one or more species (Feinsinger, 2001). Since richness values and species composition alone are not as good ecological indicators, a "guild profile" may be more sensitive to the effects of human-induced activities. The "guild profile" of each bird community will be analysed and interpreted (e.g. dominant guilds vs. "missing" guilds).

10 PHOTOGRAPHIC EVIDENCE OF PERTINENT BIODIVERSITY ATTRIBUTES AND ASPECTS

Photo 1: Undifferentiated arid broad-leaved woodland on Farm Vrienden

Photo 2: Particularly large Baobab individual on Farm Vrienden

Photo 3: Undifferentiated arid broad-leaved woodland on Farm Vrienden

Photo 4: Hoodia individual on Farm Vrienden

Photo 5: Open water habitat on Farm Du Toit

Photo 6: Undifferentiated arid broad-leaved woodland on Farm Du Toit

Photo 7: Baboon spider burrow on Farm Du Toit

Photo 8: Particularly large Baobab individual on Farm Du Toit

11 APPENDIX 1: A SHORTLIST OF BIRD SPECIES EXPECTED TO BE PRESENT ON THE STUDY AREA

The list also provides an indication of the species occurrence according to SABAP1 and SABAP2 reporting rates.

Ref	Species name	Taxonomic name	SABAP2 Reporting Rate (%)			SABAP1 Reporting Rate (%)
			Full protocol	Adhoc protocol	Incidentals	
50	Cormorant, Reed	*Microcarbo africanus*				7.14
52	Darter, African	*Anhinga rufa*				7.14
54	Heron, Grey	*Ardea cinerea*	8.33			5.26
55	Heron, Black-headed	*Ardea melanocephala*	8.33			9.52
59	Egret, Little	*Egretta garzetta*				7.14
61	Egret, Western Cattle	*Bubulcus ibis*				17.86
67	Bittern, Little	*Ixobrychus minutus*				5.26
72	Hamerkop, Hamerkop	*Scopus umbretta*	8.33			23.21
73	Stork, Marabou	*Leptoptilos crumeniferus*				0.00
78	Stork, Abdim's	*Ciconia abdimii*	8.33			7.14
79	Stork, Black	*Ciconia nigra*	8.33			9.52
80	Stork, White	*Ciconia ciconia*				8.93
84	Ibis, Hadeda	*Bostrychia hagedash*	25			33.93
89	Goose, Egyptian	*Alopochen aegyptiacus*	41.67			21.43
91	Duck, Knob-billed	*Sarkidiornis melanotos*	8.33			7.14
105	Secretarybird	*Sagittarius serpentarius*				21.74
106	Vulture, Cape	*Gyps coprotheres*				12.31
107	Vulture, White-backed	*Gyps africanus*				12.12
108	Vulture, Lappet-faced	*Torgos tracheliotos*				21.43
114	Falcon, Lanner	*Falco biarmicus*	8.33			10.77
119	Falcon, Amur	*Falco amurensis*		10		14.29
122	Kestrel, Greater	*Falco rupicoloides*				5.26
123	Kestrel, Rock	*Falco rupicolus*				16.67
125	Kestrel, Lesser	*Falco naumanni*				11.11
127	Hawk, African Cuckoo	*Aviceda cuculoides*				4.35
129	Kite, Yellow-billed	*Milvus aegyptius*				10.71
130	Kite, Black-shouldered	*Elanus caeruleus*	25			10.71
134	Eagle, Tawny	*Aquila rapax*				13.04
136	Eagle, Lesser Spotted	*Clanga pomarina*				7.14
137	Eagle, Wahlberg's	*Hieraaetus wahlbergi*	16.67			21.54
141	Hawk-eagle, African	*Aquila spilogaster*	16.67	10		7.14
142	Eagle, Martial	*Polemaetus bellicosus*				17.39
144	Buzzard, Lizard	*Kaupifalco monogrammicus*				17.39
145	Snake-eagle, Brown	*Circaetus cinereus*	16.67			13.04
146	Snake-eagle, Black-chested	*Circaetus pectoralis*	25			11.76
149	Fish-eagle, African	*Haliaeetus vocifer*	8.33			14.29
151	Bateleur, Bateleur	*Terathopius ecaudatus*				13.51
154	Buzzard, Steppe	*Buteo buteo*	8.33	10		10.77
158	Sparrowhawk, Little	*Accipiter minullus*				8.70
161	Shikra, Shikra	*Accipiter badius*				17.39
162	Goshawk, Gabar	*Melierax gabar*	25			16.67
163	Goshawk, Dark Chanting	*Melierax metabates*	16.67	10		17.39
165	Goshawk, Southern Pale Chanting	*Melierax canorus*	25	10		30.95
171	Harrier-Hawk, African	*Polyboroides typus*	8.33			23.91
173	Francolin, Coqui	*Peliperdix coqui*				10.71
174	Francolin, Crested	*Dendroperdix sephaena*	58.33			47.69
183	Spurfowl, Natal	*Pternistis natalensis*	8.33			32.31
185	Spurfowl, Swainson's	*Pternistis swainsonii*	8.33			21.05
192	Guineafowl, Helmeted	*Numida meleagris*	75	20	1	55.38
196	Buttonquail, Kurrichane	*Turnix sylvaticus*				8.93
203	Crake, Black	*Amaurornis flavirostra*				14.29
217	Bustard, Kori	*Ardeotis kori*	16.67			39.13
224	Korhaan, Red-crested	*Lophotis ruficrista*	50	10		33.85

Ref	Species name	Taxonomic name	SABAP2 Reporting Rate (%)			SABAP1 Reporting Rate (%)
			Full protocol	Adhoc protocol	Incidentals	
228	Jacana, African	*Actophilornis africanus*				7.14
238	Plover, Three-banded	*Charadrius tricollaris*	8.33			5.41
242	Lapwing, Crowned	*Vanellus coronatus*	41.67			33.33
245	Lapwing, Blacksmith	*Vanellus armatus*	25			9.09
258	Sandpiper, Common	*Actitis hypoleucos*	8.33			14.29
263	Greenshank, Common	*Tringa nebularia*				14.29
264	Sandpiper, Wood	*Tringa glareola*	8.33			22.22
274	Thick-knee, Water	*Burhinus vermiculatus*				14.29
275	Thick-knee, Spotted	*Burhinus capensis*	16.67			39.13
277	Courser, Temminck's	*Cursorius temminckii*				14.29
280	Courser, Bronze-winged	*Rhinoptilus chalcopterus*	8.33			13.04
310	Sandgrouse, Double-banded	*Pterocles bicinctus*				16.67
311	Pigeon, Speckled	*Columba guinea*				33.33
314	Dove, Red-eyed	*Streptopelia semitorquata*				26.15
315	Dove, African Mourning	*Streptopelia decipiens*				28.57
316	e	*Spilopelia capicola*	75	40		52.31
317	Dove, Laughing	*Streptopelia senegalensis*	91.67	30		53.85
318	Dove, Namaqua	*Oena capensis*	66.67	20		35.38
321	Wood-dove, Emerald-spotted	*Turtur chalcospilos*	58.33			69.23
323	Green-pigeon, African	*Treron calvus*				14.29
327	Parrot, Meyer's	*Poicephalus meyeri*	8.33			14.29
328	Parrot, Brown-headed	*Poicephalus cryptoxanthus*	8.33			0.00
339	Go-away-bird, Grey	*Corythaixoides concolor*	66.67	20		52.31
341	Cuckoo, African	*Cuculus gularis*				21.74
343	Cuckoo, Red-chested	*Cuculus solitarius*	8.33			30.36
344	Cuckoo, Black	*Cuculus clamosus*	16.67	10		12.50
346	Cuckoo, Great Spotted	*Clamator glandarius*				7.69
347	Cuckoo, Levaillant's	*Clamator levaillantii*				13.04
348	Cuckoo, Jacobin	*Clamator jacobinus*	8.33			15.38
351	Cuckoo, Klaas's	*Chrysococcyx klaas*	16.67	10		18.46
352	Cuckoo, Diderick	*Chrysococcyx caprius*	16.67			21.54
359	Owl, Western Barn	*Tyto alba*				9.23
364	Scops-owl, Southern White-faced	*Ptilopsus granti*				28.57
365	Owlet, Pearl-spotted	*Glaucidium perlatum*	25	10		23.91
368	Eagle-owl, Spotted	*Bubo africanus*				10.87
371	Nightjar, European	*Caprimulgus europaeus*				7.14
372	Nightjar, Rufous-cheeked	*Caprimulgus rufigena*				16.22
373	Nightjar, Fiery-necked	*Caprimulgus pectoralis*	8.33			43.48
376	Nightjar, Square-tailed	*Caprimulgus fossii*				13.04
378	Swift, Common	*Apus apus*			1	7.14
383	Swift, White-rumped	*Apus caffer*	8.33		1	16.07
385	Swift, Little	*Apus affinis*				24.62
386	Swift, Alpine	*Tachymarptis melba*				33.33
387	Palm-swift, African	*Cypsiurus parvus*	8.33			16.67
390	Mousebird, Speckled	*Colius striatus*	8.33			44.62
392	Mousebird, Red-faced	*Urocolius indicus*	58.33			47.69
399	Kingfisher, Woodland	*Halcyon senegalensis*	16.67			13.85
401	Kingfisher, Grey-headed	*Halcyon leucocephala*				42.86
402	Kingfisher, Brown-hooded	*Halcyon albiventris*	50			49.23
403	Kingfisher, Striped	*Halcyon chelicuti*	8.33			28.26
404	Bee-eater, European	*Merops apiaster*	25	30		33.85
407	Bee-eater, Southern Carmine	*Merops nubicoides*	25	20		14.29
409	Bee-eater, White-fronted	*Merops bullockoides*	8.33			9.52
410	Bee-eater, Little	*Merops pusillus*	33.33	10		29.23
411	Bee-eater, Swallow-tailed	*Merops hirundineus*				10.53
412	Roller, European	*Coracias garrulus*	25	40	1	21.43
413	Roller, Lilac-breasted	*Coracias caudatus*	58.33	20		36.92

Ref	Species name	Taxonomic name	SABAP2 Reporting Rate (%)			SABAP1 Reporting Rate (%)
			Full protocol	Adhoc protocol	Incidentals	
415	Roller, Purple	*Coracias naevius*	16.67	10	2	20.00
418	Hoopoe, African	*Upupa africana*	16.67			46.15
419	Wood-hoopoe, Green	*Phoeniculus purpureus*	8.33			13.85
421	Scimitarbill, Common	*Rhinopomastus cyanomelas*	66.67	10	1	30.77
424	Hornbill, African Grey	*Lophocerus nasutus*	83.33			38.46
426	Hornbill, Southern Yellow-billed	*Tockus leucomelas*	91.67	30		55.38
430	Ground-hornbill, Southern	*Bucorvus leadbeateri*			8	21.74
431	Barbet, Black-collared	*Lybius torquatus*	25			50.00
432	Barbet, Acacia Pied	*Tricholaema leucomelas*	83.33	10		36.92
437	Tinkerbird, Yellow-fronted	*Pogoniulus chrysoconus*	8.33			29.41
439	Barbet, Crested	*Trachyphonus vaillantii*	25			27.69
440	Honeyguide, Greater	*Indicator indicator*				10.77
442	Honeyguide, Lesser	*Indicator minor*				18.46
443	Honeybird, Brown-backed	*Prodotiscus regulus*				8.11
446	Woodpecker, Bennett's	*Campethera bennettii*				28.57
447	Woodpecker, Golden-tailed	*Campethera abingoni*	33.33	10		23.08
450	Woodpecker, Cardinal	*Dendropicos fuscescens*	25			24.62
451	Woodpecker, Bearded	*Dendropicos namaquus*				14.29
457	Lark, Monotonous	*Mirafra passerina*	33.33	10		16.92
458	Lark, Rufous-naped	*Mirafra africana*	16.67			21.54
459	Lark, Fawn-coloured	*Calendulauda africanoides*	8.33	10		11.90
460	Lark, Sabota	*Calendulauda sabota*	50	10		32.31
464	Lark, Dusky	*Pinarocorys nigricans*	8.33			7.14
484	Sparrowlark, Chestnut-backed	*Eremopterix leucotis*	8.33			7.14
488	Lark, Red-capped	*Calandrella cinerea*				7.14
493	Swallow, Barn	*Hirundo rustica*	33.33	40	1	46.15
495	Swallow, White-throated	*Hirundo albigularis*				21.43
498	Swallow, Pearl-breasted	*Hirundo dimidiata*	8.33			7.14
501	Swallow, Red-breasted	*Cecropis semirufa*				7.14
502	Swallow, Greater Striped	*Cecropis cucullata*				11.90
503	Swallow, Lesser Striped	*Cecropis abyssinica*	16.67			38.46
507	House-martin, Common	*Delichon urbicum*	25	10		12.31
513	Cuckoo-shrike, Black	*Campephaga flava*				17.39
517	Drongo, Fork-tailed	*Dicrurus adsimilis*	66.67	10		50.77
519	Oriole, Eurasian Golden	*Oriolus oriolus*				13.04
520	Oriole, African Golden	*Oriolus auratus*	8.33			7.14
521	Oriole, Black-headed	*Oriolus larvatus*	50	10		47.69
522	Crow, Pied	*Corvus albus*	16.67	10	1	7.14
527	Tit, Southern Black	*Melaniparus niger*	83.33	20		49.23
530	Penduline-tit, Grey	*Anthoscopus caroli*				14.29
533	Babbler, Arrow-marked	*Turdoides jardineii*	33.33	10		38.10
536	Babbler, Southern Pied	*Turdoides bicolor*				30.95
545	Bulbul, Dark-capped	*Pycnonotus tricolor*	41.67	10		73.85
550	Greenbul, Yellow-bellied	*Chlorocichla flaviventris*	8.33	10		24.62
552	Thrush, Kurrichane	*Turdus libonyanus*				18.46
557	Thrush, Groundscraper	*Turdus litsipsirupa*	8.33			16.92
568	Wheatear, Capped	*Oenanthe pileata*				5.26
570	Chat, Familiar	*Oenanthe familiaris*	16.67			17.86
576	Stonechat, African	*Saxicola torquatus*	8.33			30.36
582	Robin-chat, White-throated	*Cossypha humeralis*				35.38
586	Scrub-robin, Kalahari	*Erythropygia paena*	25	10		16.92
588	Scrub-robin, White-browed	*Erythropygia leucophrys*	83.33	20		52.31
592	Nightingale, Thrush	*Luscinia luscinia*				0
595	Warbler, Garden	*Sylvia borin*				4.35
597	Warbler, Olive-tree	*Hippolais olivetorum*	8.33			7.14
599	Warbler, Willow	*Phylloscopus trochilus*	50	20		24.62

Ref	Species name	Taxonomic name	SABAP2 Reporting Rate (%)			SABAP1 Reporting Rate (%)
			Full protocol	Adhoc protocol	Incidentals	
600	Eremomela, Yellow-bellied	*Eremomela icteropygialis*	25			7.84
601	Eremomela, Burnt-necked	*Eremomela usticollis*	25	10		11.90
606	Reed-warbler, African	*Acrocephalus baeticatus*				4.76
607	Warbler, Marsh	*Acrocephalus palustris*	8.33			0.00
614	Wren-warbler, Barred	*Calamonastes fasciolatus*	58.33	10		16.92
621	Crombec, Long-billed	*Sylvietta rufescens*	83.33	10		53.85
625	Apalis, Yellow-breasted	*Apalis flavida*	8.33			21.54
628	Camaroptera, Grey-backed	*Camaroptera brevicaudata*	33.33	10		35.38
629	Cisticola, Zitting	*Cisticola juncidis*	16.67	10		4.76
630	Cisticola, Desert	*Cisticola aridulus*	16.67			12.12
637	Neddicky, Neddicky	*Cisticola fulvicapilla*				15.69
642	Cisticola, Rattling	*Cisticola chiniana*	58.33	30		41.54
649	Prinia, Tawny-flanked	*Prinia subflava*	33.33			41.54
650	Prinia, Black-chested	*Prinia flavicans*	16.67	10		25.00
654	Flycatcher, Spotted	*Muscicapa striata*	33.33	10		23.08
657	Tit-flycatcher, Grey	*Myioparus plumbeus*	8.33			0.00
658	Tit-babbler, Chestnut-vented	*Sylvia subcaeruleum*	8.33			16.67
661	Flycatcher, Marico	*Bradornis mariquensis*	58.33			26.15
662	Flycatcher, Pale	*Bradornis pallidus*				14.29
664	Flycatcher, Southern Black	*Melaenornis pammelaina*				7.14
665	Flycatcher, Fiscal	*Sigelus silens*				5.26
673	Batis, Chinspot	*Batis molitor*	91.67			56.92
682	Paradise-flycatcher, African	*Terpsiphone viridis*				29.41
685	Wagtail, African Pied	*Motacilla aguimp*				5.41
692	Pipit, African	*Anthus cinnamomeus*				9.52
699	Pipit, Bushveld	*Anthus caffer*				8.70
706	Shrike, Lesser Grey	*Lanius minor*	8.33			14.29
707	Fiscal, Common (Southern)	*Lanius collaris*				39.29
708	Shrike, Red-backed	*Lanius collurio*	33.33	10		40.00
709	Boubou, Southern	*Laniarius ferrugineus*	8.33			52.38
711	Shrike, Crimson-breasted	*Laniarius atrococcineus*	33.33	10		35.38
712	Puffback, Black-backed	*Dryoscopus cubla*	66.67	20		55.38
714	Tchagra, Brown-crowned	*Tchagra australis*	83.33	10		32.31
715	Tchagra, Black-crowned	*Tchagra senegalus*				16.07
719	Bush-shrike, Orange-breasted	*Chlorophoneus sulfureopectus*	25			32.31
723	Bush-shrike, Grey-headed	*Malaconotus blanchoti*	8.33			15.38
724	Shrike, Magpie	*Corvinella melanoleuca*	16.67			21.43
727	Helmet-shrike, White-crested	*Prionops plumatus*	41.67			26.15
728	Helmet-shrike, Retz's	*Prionops retzii*				10.53
730	Shrike, Southern White-crowned	*Eurocephalus anguitimens*	58.33	40	1	35.38
731	Brubru, Brubru	*Nilaus afer*	75			21.54
734	Myna, Common	*Acridotheres tristis*	16.67	10		0.00
735	Starling, Wattled	*Creatophora cinerea*	16.67			14.29
736	Starling, Violet-backed	*Cinnyricinclus leucogaster*	41.67	20		29.23
737	Starling, Cape Glossy	*Lamprotornis nitens*	66.67	20		43.08
738	Starling, Greater Blue-eared	*Lamprotornis chalybaeus*	16.67		1	13.85
745	Starling, Red-winged	*Onychognathus morio*	16.67			42.86
748	Oxpecker, Red-billed	*Buphagus erythrorhynchus*	25			6.06
755	Sunbird, Marico	*Cinnyris mariquensis*	58.33			23.81
763	Sunbird, White-bellied	*Cinnyris talatala*	83.33	10		52.31
772	Sunbird, Amethyst	*Chalcomitra amethystina*	8.33	10		38.10
774	Sunbird, Scarlet-chested	*Chalcomitra senegalensis*	8.33			6.25

Ref	Species name	Taxonomic name	SABAP2 Reporting Rate (%)			SABAP1 Reporting Rate (%)
			Full protocol	Adhoc protocol	Incidentals	
779	Buffalo-weaver, Red-billed	*Bubalornis niger*	33.33	10	1	36.92
780	Sparrow-weaver, White-browed	*Plocepasser mahali*	58.33		1	33.85
784	Sparrow, House	*Passer domesticus*	25			27.69
785	Sparrow, Great	*Passer motitensis*	8.33			0.00
786	Sparrow, Cape	*Passer melanurus*	25			10.77
788	Petronia, Yellow-throated	*Gymnoris superciliaris*				8.70
789	Finch, Scaly-feathered	*Sporopipes squamifrons*	33.33			45.24
792	Masked-weaver, Lesser	*Ploceus intermedius*				12.12
793	Weaver, Red-headed	*Anaplectes rubriceps*	41.67	10		20.00
797	Weaver, Village	*Ploceus cucullatus*				10.77
803	Masked-weaver, Southern	*Ploceus velatus*	75			29.23
805	Quelea, Red-billed	*Quelea quelea*	66.67		1	30.77
808	Bishop, Southern Red	*Euplectes orix*				6.06
820	Finch, Red-headed	*Amadina erythrocephala*	8.33			13.04
821	Finch, Cut-throat	*Amadina fasciata*	33.33	10		15.38
823	Mannikin, Bronze	*Spermestes cucullatus*				43.48
830	Pytilia, Green-winged	*Pytilia melba*	75	10		26.15
835	Firefinch, Jameson's	*Lagonosticta rhodopareia*				23.08
837	Firefinch, Red-billed	*Lagonosticta senegala*	16.67			21.54
838	Waxbill, Orange-breasted	*Amandava subflava*				6.06
839	Waxbill, Blue	*Uraeginthus angolensis*	100	30		55.38
840	Waxbill, Violet-eared	*Uraeginthus granatina*	16.67			35.71
841	Waxbill, Black-faced	*Estrilda erythronotos*	8.33	10		33.33
843	Waxbill, Common	*Estrilda astrild*				26.15
844	Quailfinch, African	*Ortygospiza atricollis*				4.35
846	Whydah, Pin-tailed	*Vidua macroura*	8.33			18.46
847	Whydah, Shaft-tailed	*Vidua regia*	8.33	10		21.43
849	Indigobird, Dusky	*Vidua funerea*				4.35
851	Indigobird, Village	*Vidua chalybeata*	8.33			7.14
852	Paradise-whydah, Long-tailed	*Vidua paradisaea*	25			29.23
859	Canary, Yellow-fronted	*Crithagra mozambicus*	75	10		53.85
860	Canary, Black-throated	*Crithagra atrogularis*				9.23
866	Canary, Yellow	*Crithagra flaviventris*				7.14
867	Seedeater, Streaky-headed	*Crithagra gularis*				30.36
871	Bunting, Lark-like	*Emberiza impetuani*	41.67	10		5.26
872	Bunting, Cinnamon-breasted	*Emberiza tahapisi*	33.33	10		32.31
874	Bunting, Golden-breasted	*Emberiza flaviventris*	50	10		30.77
940	Dove, Rock	*Columba livia*				7.14
977	Boubou, Tropical	*Laniarius major*	8.33	10		9.52
1172	White-eye, Cape	*Zosterops virens*				62.75
4129	Hornbill, Southern Red-billed	*Tockus erythrorhynchus (=rufirostris)*	75	50		24.62
4131	Coucal, Burchell's	*Centropus burchellii*	25			18.46
4142	Sparrow, Southern Grey-headed	*Passer diffusus*	66.67	10		32.31
14189	Kite, Black	*Milvus migrans*				7.14

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