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Terrestrial Biodiversity EIA Assessment for the proposed Tshivhaso Coal-Fired Power Plant near Lephalale, Limpopo Province©

B E C

Bathusi Environmental Consulting

Biodiversity Assessments

in collaboration with

Ecocheck Environmental Services cc
Mammal, Herpetological & Invertebrate Assessment

Pachnoda Consulting cc
Avifaunal Assessment

This report was produced for

Savannah ENVIRONMENTAL (PTY) LTD

SECTION A – ADMINISTRATION, PROJECT DETAILS & INTRODUCTORY COMMENTS

This report is compartmentalised as follows:

Section A Project introduction and administrative details, specialist introduction, report navigation, introductory section, Specialist Executive Summaries;

Section B The biophysical environment and available biophysical information and background;

Section C Botanical aspects of the receiving environment, botanical impact assessment, mitigation recommendations and EMP contributions;

Section D Mammalian, Invertebrate & Herpetofaunal aspects of the receiving environment, faunal impact assessment, mitigation recommendations and EMP contributions; and

Section E Avifaunal aspects of the receiving environment, avifaunal impact assessment, mitigation recommendations and EMP contributions.

I REPORT NAVIGATION

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Section A

IV PROJECT DETAILS

Table 1: Relevant Project Details	
Client:	Savannah Environmental (PTY) Limited, on behalf of Cynnergi
Report Name:	Terrestrial Biodiversity Scoping Assessment of the proposed Tshivhaso Coal-Fired Power Plant near Lephalale, Limpopo Province©
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VI REPORT CITATION

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

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VIII 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	
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Affiliation:	South African Council for Natural Scientific Professions
Fields of Expertise:	Botanical Scientist & Ecological Scientist
Registration Number:	*400005/03*
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Fields of expertise:	Ecological Scientist & Zoological Scientist
Registration number:	*400204/05*
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Fields of expertise:	Ecological Scientist & Zoological Scientist
Registration number:	*400095/06*

IX 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 proponent (Cynnergi) 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 to be 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.

Principal ecologist (Riaan A. J. Robbeson):

Bathusi Environmental Consulting cc (CK1999/052182/23)

Name of company:

12th September 2016

Date:

X EXECUTIVE SUMMARY – BOTANICAL ASSESSMENT

The study area corresponds to the Savanna Biome and more particularly to the Central Bushveld Bioregion as defined by Mucina & Rutherford (2006) and comprehends an ecological type known as Limpopo Sweet Bushveld (Mapping Unit SVcb 19; Mucina & Rutherford, 2006), currently afforded a Least Threatened conservation status, and comprising an extensive geographic coverage.

Historic sampling records indicate the known presence of approximately 333 plant species within the ¼-degree grids that are sympatric to the study area (2327CB and 2327DA), reflecting on a diverse floristic nature, but poor knowledge of the regional vegetation. The survey of the proposed development area yielded an Alpha Diversity of 216 taxa, which is regarded representative of the floristic diversity on a regional scale. The presence of a number of protected and conservation important taxa were recorded within the study area, including the following:

Taxon	*Family*	*Status*
Acacia erioloba	Fabaceae	Declining Status, Protected Tree (National Forest Act, 1998), edible parts, medicinal uses, firewood
Boscia albitrunca	Capparaceae	Protected Tree (National Forest Act)
Combretum imberbe Wawra	Combretaceae	Protected Tree (National Forest Act)
Elaeodendron transvaalensis (Burtt Davy) Codd	Celastraceae	Near Threatened status (subjected to permitting requirements – DAFF & LEMA)
Spirostachys africana Sond.	Euphorbiaceae	Protected (LEMA, 2003)
Sclerocarya birrea (A.Rich.) Hochst. ssp. *caffra* (Sond.) Kokwaro	Anacardiaceae	Protected Tree (National Forest Act, 1998), edible parts, traditional uses

In terms of legal compliance, any removal, relocation or damage to these species is subject to permitting authorisations from DAFF (NFA) and LEDET (LEMA).

Development of vegetation is generally a result of complex interacting driving forces that include climatic-, geological (soil), topographical- and moisture gradients typical of the savanna regions of southern Africa. Principally, the flora of the sites is recognised as the *Acacia erubescens – Stipagrostis ciliata* woodland that is typical and representative of the flora of the region. The TWINSPAN classification resulted in the recognition of three broad communities, namely:

» *Eragrostis rotifer - Echinochloa holubii* ephemeral pans representing small water bodies and shallow depressions that tend to hold surface water when inundated. This habitat type was uncommon on the study area and mainly confined to a few depressions located on the northern part of the Farm Graaffwater. A medium floristic sensitivity was ascribed to these parts of the study area;

» *Acacia mellifera - Acacia tortilis* microphyllous woodland on clay soils community, representing vegetation that is prominent along the drainage lines and on clay soils that are characterised by a high prominence of dense *Acacia* woodland. A medium floristic sensitivity was ascribed to these parts of the study area; and

» *Combretum zeyheri - Eragrostis pallens* undifferentiated broad-leaf woodland on sandy soils is prominent and by far the most dominant habitat on the study area. It corresponds to deep, highly leached sandy soils, and is earmarked by a high prominence

of medium to tall semi-deciduous woodland. These areas exhibit a medium-high floristic sensitivity.

Atypical habitat types include secondary, or degraded, woodland that exhibit significant evidence of deterioration in terms of structural and compositional aspects as well as transformed habitat that is associated with anthropogenic (industrial and linear infrastructure). Medium-low and low floristic sensitivities were ascribed to these parts of the study areas.

An appraisal of the potential and likely impacts on the floristic environment indicated the no immediate Red Flags were identified. However, an evaluation of impacts revealed that certain sensitive parts of the study area should be excluded from the proposed development. Furthermore, the application of detailed and site-specific mitigation measures is required to ameliorate significant impacts to an acceptable significance level. Direct impacts were generally assessed as the most significant as these would result in immediate and permanent losses of vegetation, species and habitat.

Impact	*Power Station*		*Ashing Facility - Graaffwater*		*Ashing Facility - Appelvlakte*		*Power Lines*	
	Without Mitigation	Without Mitigation	With mitigation	With mitigation	Without Mitigation	With mitigation	Without Mitigation	With mitigation
1. Loss of plant taxa (individuals, stands, populations) of conservation importance (threatened taxa) as well as plan taxa of conservation concern (declining status, provincially protected taxa)	**80**	**56**	**70**	**56**	**80**	**56**	**40**	**24**
2. Loss of natural vegetation (physical modifications, removal, damage) and local depletion of plant taxa, reduction of phytodiversity	**65**	**55**	**65**	**55**	**65**	**55**	**44**	**21**
3. Loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance	**52**	**33**	**39**	**33**	**52**	**33**	**20**	**7**
4. Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc., also including Impacts on habitat types that are associated with plants of conservation importance (decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.)	**48**	**27**	**48**	**24**	**44**	**24**	**27**	**14**

Impact	*Power Station*		*Ashing Facility - Graaffwater*		*Ashing Facility - Appelvlakte*		*Power Lines*	
	Without Mitigation	Without Mitigation	With mitigation	With mitigation	Without Mitigation	With mitigation	Without Mitigation	With mitigation
5. Altered quality and ecological functionality (including fire, erosion) of surrounding areas and natural habitat	**70**	**55**	**36**	**30**	**44**	**30**	**27**	**14**
6. Exacerbated encroachment of invasive, exotic and encroacher plant species	**52**	**30**	**30**	**27**	**40**	**27**	**40**	**18**
7. Decreased aesthetic appeal of the landscape	**50**	**36**	**40**	**36**	**36**	**32**	**36**	**14**
8. Increased exploitation of natural resources due to increased human presence and resource requirements	**36**	**24**	**36**	**22**	**30**	**22**	**16**	**7**
9. Exacerbation of existing levels of habitat fragmentation and isolation	**56**	**48**	**42**	**24**	**39**	**22**	**33**	**14**
10. Cumulative impacts on local/ regional and national conservation targets and obligations	**40**	**27**	**40**	**27**	**40**	**27**	**16**	**7**

Power Station (Farms Graaffwater & Goedehoop) - No particularly sensitive, unique or atypical habitat was recorded within the areas that could render the options as 'No-Go' alternatives. The impact assessment and significance evaluation confirmed the initial assumptions with (mostly) moderate significance ascribed to most impacts and high significance ascribed to impacts associated with the uncontrolled loss of conservation important plants, the habitat associated with these species as well impacts on the ecological integrity of the area. The implementation of a suitable mitigation hierarchy is expected to ameliorate likely and potential impacts to an acceptable nature. Considering the significance of these impacts, no impacts were identified that could constitute unacceptable impacts on a local or regional scale.

Ashing Facility (Graaffwater vs. Appelvlakte) - No clear alternative between either Appelvlakte or Graaffwater is presented at this stage. This is heavily dependent on the exact placement of the power station footprint and the availability of sufficient land for the ashing facility. However, considering the potential spread of industrial land uses on a local scale, a slight preference for Graaffwater is expressed, taking cognisance implications of technical feasibilities in terms of the Matimba Power Station. Furthermore, No particularly sensitive, unique or atypical habitat was recorded within either of the alternatives that would render either of the options as 'No-Go' alternatives. The impact assessment and significance evaluation confirmed the initial assumptions with (mostly) moderate significance ascribed to most impacts and high significance ascribed to impacts associated with the uncontrolled loss of conservation important plants, the habitat associated with these species as well impacts on the ecological integrity of the area. Considering the significance of these impacts, no impacts were identified that could constitute unacceptable impacts on a local or regional scale.

Power Line - No areas of particularly sensitive, unique or atypical habitat were recorded within the proposed servitude that would render the proposed servitude as a 'No-Go' alternative. The impact assessment and significance evaluation confirmed the initial assumptions with moderate to low significance ascribed to most impacts. The implementation of a suitable mitigation hierarchy is expected to ameliorate likely and potential impacts to an acceptable nature. Considering the significance of these impacts, no impacts constitute unacceptable effects on a local or regional scale.

Conclusion - Potential and likely impacts on the floristic receiving environment are expected to result in severe, but limited and localised effects on the flora of the site. While some impacts are unavoidable, such as habitat loss, loss of phytodiversity and protected tree species, most impacts could be mitigated to an acceptable level of significance and would not extend significantly beyond the development footprint. No impacts of an unacceptable nature could be identified during this process and it is therefore the considered opinion that the proposed development will not affect the floristic receiving environment in a manner that would elevate existing levels of protection of any species or habitat.

XI EXECUTIVE SUMMARY – FAUNAL ASSESSMENT

A faunal survey was conducted on the Farms Graaffwater, Goedehoop and Appelvlakte over two sampling periods, namely between 31 March and 7 April 2016 and between 23 and 26 May 2016. Based on results of the botanical assessment, three natural macro habitat types are found within the study area, namely the *Combretum zeyheri – Eragrostis pallens* broadleaf woodland on sandy soils, *Acacia mellifera – Acacia tortilis* microphyllous woodland on clay soils and the *Eragrostis rotifer – Echinochloa holubii* ephemeral pans. The study area also contains atypical habitat, manifesting as isolated portions of degraded woodland and various transformed segments that are associated with anthropogenic transformation.

Historic sampling records within the Q-grids of the study area indicate that 2 dragonflies, 1 antlion, 41 butterflies, 16 frogs, 35 reptiles and 18 mammals are listed at the Virtual Museum of the Animal Demography Unit of the University of Cape Town. Sampling records of the 2016 surveys indicated a diversity of 94 animal species for the study area, including:

» 59 invertebrates;
» 6 reptiles; and
» 29 mammals.

The invertebrates, herpetofauna and mammals (and assemblages) recorded in the study area are typical and representative of the region. No obvious indicator species were absent from the study area that would suggest significant habitat transformation or degradation. Conversely, no species were recorded in the study area that would indicate the presence of unique and particularly important or sensitive faunal habitats, such as extensive surface rocks or permanent bodies of surface water. The large contingent of mammals recorded in the study area is indicative of the preferred land use of the region (game farming). The presence of eight species of Carnivora, including three red data listed species, attest to the ecological connectivity of the study area to the larger region of untransformed woodland and the untransformed nature of most of the study area.

The confirmed animal inhabitants of the study area included the red data listed Serval, Brown Hyaena and Honey Badger. Additionally, three red data listed species are listed for the study area's Q-grids, based on historic sampling records. Previous sampling records of nearby developments, revealed a high probability of the persistence of Giant Bullfrog, Cheetah and Temminck's Ground Pangolin for the study area.

Based on habitat status, sensitivity, ecological connectivity, diversity and ability to host red data listed faunal species, it is estimated that the transformed faunal habitat has a low and the degraded woodland a medium-low faunal sensitivity. It is also considered that the broad-leafed sand woodland has a medium, the clay woodland a medium-high and the ephemeral pans a high faunal sensitivity.

A number of direct, indirect and cumulative (negative, adverse) impacts on the faunal components of the site and region are expected to result from the proposed project. An appraisal of the significance of these impacts prior to mitigation procedures, points toward a number of significant impacts; the majority of impacts are however of a moderate significance.

The following table presents a summary of expected and likely impacts on the faunal components of the study areas.

Impact	*Power Station*		*Ashing Facility – Graaffwater*		*Ashing Facility - Appelvlakte*		*Power Lines*	
	Without Mitigation	Without Mitigation	With mitigation	With mitigation	Without Mitigation	With mitigation	Without Mitigation	With mitigation
1. Loss of fauna species of conservation importance (threatened taxa) and habitat associated with CI species	72	36	60	33	64	36	48	27
2. Loss of natural habitat, including essential habitat refugia	65	55	65	55	65	55	40	21
3. Depletion of faunal diversity, human/ animal conflict situations, including the introduction of invasive and non-endemic species	52	27	52	30	52	30	40	21
4. Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.	48	27	48	27	60	36	44	14
5. Indirect impacts on movement/ migration patterns of animals and ecological interaction and processes	70	40	42	30	56	30	33	14
6. Exacerbated increases of edge effects of the project areas	52	30	48	30	52	30	30	14
7. Cumulative losses and degradation of natural habitat	48	30	48	30	48	30	32	21
8. Cumulative depletion of faunal taxa, assemblages and communities, with specific reference to the conservation important species	36	24	36	24	36	24	30	14

Power Station (Farms Graaffwater & Goedehoop) - Habitat comprised in the proposed study area represents typical woodland savanna of the region. No particularly sensitive, atypical or unique faunal habitat is present within the area and the faunal communities and assemblages therefore reflect the typical faunal compositional characteristics on a larger scale. Habitat is undoubtedly suited for a variety of conservation important species, which will persist within the development footprint. However, this is an attribute that is reflected throughout the region and considering alternative placements on a local or regional scale is unlikely to yield significantly different results. No red-flag impacts were identified on these sites, but care is advised to exclude sensitive habitat types from the development footprint.

Ashing Facility (Graaffwater vs. Appelvlakte) – Even though impacts remain largely similar, the estimated significance pre- and post-mitigation of these impacts for Graaffwater is significantly lower compared to Appelvlakte. Based on the ecological characteristics of Graaffwater, the expected effectiveness of mitigation measures will be significantly less on Graaffwater compared to Appelvlakte. In short, the farm Appelvlakte is recommended as the preferred alternative for the ashing facility site.

Power Line - Habitat comprised in the proposed servitude represents typical woodland savanna of the region, albeit largely deteriorated because of existing developments. No particularly sensitive, atypical or unique faunal habitat is present within the servitude and the faunal communities and assemblages therefore reflect the typical faunal compositional characteristics on a larger scale. No red-flag impacts were identified on these sites, but care is advised to exclude sensitive habitat types from the development footprint.

Conclusion - It is the conclusion of the author that the loss of habitat associated with the proposed developments is unlikely to represent significant impacts on the faunal attributes of the area on a local or regional scale. While losses of fauna species and natural habitat within the development footprints are unavoidable, the use of recommended alternatives and the implementation of proposed mitigation hierarchy will, in all probability, ameliorate unavoidable, potential and likely impacts to an acceptable significance.

XII EXECUTIVE SUMMARY – AVIFAUNAL ASSESSMENT

An avifaunal survey was conducted on the Farms Graaffwater, Goedehoop and Appelvlakte as well as the proposed power line servitude. Information provided in this report forms part of a baseline study that was obtained from:

1) relevant literature;
2) personal observations from similar habitat in close proximity to the study area; and
3) a number of site visits (March, April and May 2016).

The following key considerations were identified and noted:

» Various sampling techniques (including bird point counts) were employed to evaluate the bird composition, richness and ecological sensitivity on the study area;

» Two dominant habitat types were identified, which included undifferentiated broad-leaved woodland on sandy soils and microphyllous woodland on clay soils. In addition, four important azonal habitat types were present: depressions (and drainage lines), secondary open woodland, artificial game drinking holes and large dead trees. The microphyllous woodland was identified with high bird species richness, while most of the azonal habitat provided ephemeral habitat for low densities of "specialised" bird species (wading birds), large-bodied terrestrial species and scavenging birds of prey;

» A total of 294 bird species were expected to occur, of which 187 species were confirmed during the surveys;

» The avifaunal community on the study area was poorly represented by South African endemics, while the dominant composition is widespread in the region and consisted of many near-endemic species with high affinities to the Kalahari-Highveld biome;

» Fourteen (14) threatened and near threatened bird species were expected to be present; four of these conservation important species were confirmed during the surveys, including:

  * *Gyps africanus* (White-backed Vulture);
  * *Polemaetus bellicosus* (Martial Eagle);
  * *Terathopius ecaudatus* (Bateleur); and
  * *Aegypius tracheliotos* (Lapped-faced Vulture);

» Important species included the regionally near threatened Kori Bustard (*Ardeotis kori*), vulnerable Lanner Falcon (*Falco biarmicus*), critically endangered White-backed Vulture (*Gyps africanus*), endangered Cape Vulture (*G. coprotheres*), endangered Lappet-faced Vulture (*Torgos tracheliotos*), endangered Bateleur (*Terathopius ecaudatus*) and the endangered Martial Eagle (*Polemaetus bellicosus*);

» The study area was represented by two discrete avifaunal assemblages consisting of (1) an association confined to broad-leaved woodland ("sandveld") and (2) an association confined to microphyllous woodland ("thornveld");

» The avifaunal importance of the proposed study area for bird species are summarised below:

  * Numbers of scavenging bird of prey species utilise the study area. It was postulated that the occurrence and the wide distribution of these species on the study area and on nearby farms were due to the high similarity of habitat types in the region. These species have a high expected fidelity towards the study area based on its (1)

composition of open woodland interspersed by (2) depressions, (3) the presence of large roosting platforms (being tall trees) and (4) the occurrence of game;

* Part of the broad-leaved and microphyllous woodland habitat consisted of an open canopy structure, which provided potential foraging habitat for terrestrial large-bodied bird species (e.g. Kori Bustard - *Ardeotis kori* and Secretarybird *Sagittarius serpentarius*); and
* The depressions have benefitted the colonisation of "specialised" bird taxa (mainly wader and wading bird species) that were of local importance and contributed towards the regional avifaunal diversity when inundated.

Based on observations and an appraisal of collated data, no immediate Red Flags were identified. However, an evaluation of the expected and likely impacts on the avifaunal component of the study areas revealed that certain sensitive parts of the study area should be excluded from the proposed development. Furthermore, the application of detailed and site-specific mitigation measures is required to ameliorate significant impacts to an acceptable significance level. The following table presents a summary of the significance of expected and likely impacts on the avifaunal components of the study areas.

Impact	*Power Station*		*Ashing Facility - Graaffwater*		*Ashing Facility - Appelvlakte*		*Power Lines*	
	Without Mitigation	Without Mitigation	With mitigation	With mitigation	Without Mitigation	With mitigation	Without Mitigation	With mitigation
1. Loss of sensitive/important bird habitat and subsequent displacement/loss of threatened and near threatened bird species	85	75	85	75	75	65	80	39
2. Loss of natural habitat (physical modifications, removal, damage) containing high avifaunal diversity	65	55	65	55	65	55	39	33
3. Loss of azonal, and important habitat types or ecosystems of restricted abundance containing unique bird compositions (on a local scale)	60	39	60	39	52	33	68	39
4. Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc., also including Impacts on habitat types utilised by threatened or near-threatened bird species	56	33	56	33	56	33	56	30
5. Changes in the community structure due to habitat fragmentation (e.g. roads, loss of closed-canopy woodland) and altered habitat quality	70	55	75	60	70	55	40	24

Impact	*Power Station*		*Ashing Facility - Graaffwater*		*Ashing Facility - Appelvlakte*		*Power Lines*	
	Without Mitigation	Without Mitigation	With mitigation	With mitigation	Without Mitigation	With mitigation	Without Mitigation	With mitigation
6. Increased "urban sprawl" and exploitation of natural resources due to increased human presence and resource requirements	42	36	42	36	42	36	30	24
7. Exacerbation of existing levels of habitat fragmentation and isolation	64	56	64	56	64	56	39	30
8. Cumulative impacts on local/ regional and national conservation targets and obligations	52	30	52	30	48	27	44	24
9. Bird collisions with proposed overhead power line	n/a	n/a	n/a	n/a	n/a	n/a	80	36
10. Electrocution of large-bodied birds due to the use of inappropriate tower design	n/a	n/a	n/a	n/a	n/a	n/a	64	39

XIII 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
Ha/lsu	Hectares per large stock unit
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
MCWAP	Mokolo-Crocodile Water Augmentation Project - Phase 2
mmasl	Mean Meters Above Sea Level
NEMBA	National Environmental Management Biodiversity Act
NEnd	Near Endemic Species
NFA	National Forest Act
NT	Near Threatened
OCGT	Open Cycle Gas Turbine
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

XIV GLOSSARY OF TERMS

Ad hoc	Random, non sequential, opportunistic observations
Antelope	Swift running, deer-like ruminant with smooth hair and upward-pointing horns
Anthropogenic	Human induced
Austral	Southern hemisphere
Avifauna	Birds
Biodiversity	Diversity among and within plant and animal species in an environment
Bovid	A mammal of the cattle family (Bovidae)
Cannibalism	Eating of the flesh of an animal by another animal of the same kind/ species
Carnivore	Flesh eating animal
Commensal	A symbiotic relationship in which one species is benefited while the other is unaffected
Conspecific	Animals or plants belonging to the same species
Disjunct	Disjoined or distinct from one another
Diurnal	During the day
Endemic	Restricted to a certain geographic area
Eurytopic	Able to adapt to a wide range of environmental conditions; widely distributed (used for an animal or plant)
Fossorial	Animals adapted to burrowing
Granivore	Animals that eat seeds as the main part of their diet
Herbivorous	Animals that eat plants
Herpetofauna	Amphibians and Reptiles
Insectivorous	Animals that feed on insects as the main part of their diet
Lepidoptera	Butterflies
Mammal	A warm-blooded vertebrate animal of a class that is distinguished by the possession of hair or fur, females that secrete milk for the nourishment of the young and (typically) the birth of live young
Monitoring	The collection and analysis of repeated observations or measurements to evaluate changes in condition and progress toward meeting a conservation or management objective
Nomenclature	The devising or choosing of names for things, especially in a science or other discipline
Passerine	Relating to or denoting birds of a large order distinguished by having feet that are adapted for perching, including all songbirds
Phylogenetic	The evolution of a genetically related group of organisms as distinguished from the development of the individual organism
Primate	Animals characterized by large brains relative to other mammals, as well as an increased reliance on stereoscopic vision at the expense of smell, the dominant sensory system in most mammals
Putative species	Species that are assumed to exist, or reputed to have existed
Red Data	A taxon included in the UICN list of threatened species
Rodent	Gnawing mammal of an order that includes rats, mice, squirrels, hamsters, porcupines, and their relatives, distinguished by strong constantly growing incisors and no canine teeth. They constitute the largest order of mammals
Solitary	Animals that spend a majority of their lives without others of their species, with possible exceptions for mating and raising their young
Subterranean	Existing, living under the earth's surface
Sympatric	Animals or plant species or populations occurring within the same or overlapping geographical areas
Territorial	The sociographical area that an animal of a particular species consistently defends against conspecifics (or, occasionally, animals of other species). Animals that defend territories in this way are referred to as territorial. Territoriality is only shown by a minority of species.
Threatened	Species (including animals, plants, fungi, etc.) which are vulnerable to endangerment in the near future. Species that are threatened are sometimes characterised by the population dynamics measure of critical dispensation, a mathematical measure of biomass related to population growth rate

XV INTRODUCTION

Biodiversity is a series of relationships in a complex web, which is also referred to as 'the web of life'. Our natural environment includes rivers, wetlands, coastlines, mountains, plains, grasslands, woodlands, forests, etc., as well as all the life on earth, such as plants, animals, reptiles, insects, and birds. South Africa is blessed with an exceptionally rich biodiversity; we have the recognition as one of the world's few 'megadiverse' countries. In addition to having an entire floral kingdom, it also includes two globally significant biodiversity 'hot spots' (the Cape and succulent Karoo regions), six Centres of Plant Diversity, two Endemic Bird Areas and the richest temperate flora in the world (Cowling, 2000).

Pressure is continually being exerted on these valuable natural resources of South Africa because of uncontrolled growth of human population. Energy consumption has increased exponentially as well as the drive to extract more economically valuable resources at ever-faster rates. Natural habitats that harbour valuable biodiversity are being lost at increasingly faster rates and over progressively wider areas, while managed lands are undergoing increasing simplification. Projections show that the extinction of species and degradation of ecosystems are likely to continue, and likely accelerate and drastic action is needed to arrest the uncontrolled extinction of species on a global scale caused by modern lifestyles. Many would argue, from spiritual and ethical points of view, that the diversity of life on Earth has intrinsic value, and that it is worth protecting for its own sake.

However, implementing 'biodiversity friendly' practices remains challenging within the entire developmental sphere, especially for smaller companies and peripheral players. This is partly because governments, while perhaps committed on paper to biodiversity, have found it difficult to create the right incentives and apply the necessary regulations in a way that could encourage all players to conserve biodiversity (ICMM, 2004). Achieving a balance while doing this requires better understanding and recognition of conservation and development imperatives by all stakeholders, including governments, business and conservation communities.

Energy is essential for sustainable development. In many countries, including South Africa, economic growth and social needs are resulting in substantially greater energy demands, even taking into account continuing and accelerated energy efficiency improvements. The need for a stable supply of energy across South Africa is one of the most hotly debated topics; from governmental institutions, industries and developers, down to the common household. It is common knowledge that the demand for electricity in South Africa is rapidly growing and that South Africa needs to expand its electricity generating capacity; frequent interruptions and increasing electricity prices underline shortages currently experienced in the country. Independent Power Producers (IPP) plays a crucial role in the provision of some of the energy requirements through the development and operation of power generation operations. These activities include traditional coal-fired power stations, Open Cycle Gas Turbines (OCGT) as well as hydro-electricity and pumped storage schemes, and alternative sources such as wind generation and solar power plants.

Despite the significant potential for negative impacts on biodiversity, there is a great deal that companies can do to minimize or prevent impacts on our irreplaceable natural resources. There are also many opportunities for companies to enhance biodiversity conservation within their areas of operations. Being proactive in the assessment and management of biodiversity is important not only for new operations but also for those that have been operating for many years, usually under regulatory requirements that were less focused on the protection and enhancement of biodiversity.

In summary, the threats to biodiversity are compelling. Unless they are addressed in a holistic manner, which considers social and economic as well as scientific considerations, the benefits of ecosystem services will be substantially diminished for future generations. Furthermore, the next 50 years could see a further acceleration in the degradation of ecosystem services unless action is taken to reverse current trends.

XVI PROJECT SYNOPSIS

The availability of vast coal resources in the Lephalale region has seen to the historic development of the Matimba (Eskom) Power Station as well as the new Medupi (Eskom) Power Station and several other power stations planned for the area. Cennergi is therefore proposing the construction of a coal-fired power station on a site near Lephalale in the Limpopo Province. The power station would have a capacity of up to 600 MW and is to be known as the Tshivhaso Coal-fired Power Plant. Various options regarding siting of the power station and associated infrastructure are being investigated. Coal is proposed to be sourced from Exxaro Coal's Thabametsi Coal-Mine development, which is to be located near the study sites under investigation. The electricity generated from the power station will be fed into the Eskom electricity grid.

The main infrastructure proposed includes (specifications will be decided based on the technology selected):

- Access roads;
- Coal storage areas and bunkers;
- Coal mill (for grinding the coal into fine material);
- Pipeline for water supply. Water is expected to be available from the allocation to Exxaro Coal from the Mokolo-Crocodile Water Augmentation Project (MCWAP) Phase 2;
- Coal loading and offloading areas, as well as conveyor belts;
- Power plant production unit/s (boilers/ furnaces, turbines, generator and associated equipment, control room);
- Ash dump;
- Water infrastructure such as Raw-Water Storage Dam, purification works and reservoirs;
- A substation;
- An overhead power line to connect into the Eskom grid; and
- Office and maintenance area/s.

Towards this objective, Cennergi has appointed Savannah Environmental as the Environmental Assessment Practitioner (EAP) for the project to assist with the authorisation process. BEC has been appointed to conduct the biodiversity EIA assessment in order to advise the project as to

biological and environmental sensitivities surrounding the proposed project. The major aim of this study is to provide clarity regarding biodiversity attributes of the receiving environment and the estimated significance of likely and potential impacts associated with the project in the biological environment, informing the project regarding potential fatal flaws, opportunities and constraints.

The EIA phase of the project builds onto results of the Biodiversity Scoping Phase where a number of properties were subjected to a robust assessment in order to identify suitable options that were subjected to further scrutiny in this EIA Phase. The following site alternatives were investigated as part of the Biodiversity Scoping Phase:

» Power Plant Alternatives:
  * Option 1 – Graaffwater/ Goedehoop Option;
  * Option 2 – Eendrachtpan/ Gelykebult/ Voorui Option;
» Ashing Facility Alternatives
  * Option 1 – Goedehoop Option;
  * Option 2 – Appelvlakte Option;
  * Option 3 – Jackhalsvley Option;
  * Option 4 – Kalkvlakte & Elandsvley Option;
  * Option 5 – Voorui Option;
» Power Evacuation Alternatives:
  * Alternative 1 – Matimba – Witkop Loop-In; and
  * Alternative 2 – Matimba – Medupi Loop-In.

Results of a comprehensive, interdisciplinary assessment recommended the following alternatives as the preferred options:

» Power Plant Alternatives:
  * Option 1 – Graaffwater/ Goedehoop Option;
» Ashing Facility Alternatives
  * Option 1 – Graaffwater Option; or
  * Option 2 – Appelvlakte Option;
» Power Evacuation Alternatives:
  * Alternative 2 – Matimba – Medupi Loop-In.

These alternatives were subjected to detailed assessments in order to establish the inherent ecological sensitivity of the sites, the significance of potential and likely impacts of the proposed development and advise the project with regards to mitigation strategies and actions that will minimise the severity of the impacts on the biological environment.

SECTION B – BIOPHYSICAL ATTRIBUTES OF THE RECIEVING ENVIRONMENT

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

1 LOCATION & PROJECT LAYOUT

The proposed Tshivhaso Project will be situated within the Lephalale Municipality (LM), which is located in the northwestern part of Waterberg District of Limpopo Province of the Republic of South Africa. It borders with four local municipalities (Blouberg, Modimolle, Mogalakwena and Thabazimbi). The northwestern border of LM also forms part of the international border between South Africa and Botswana. LM is the biggest Municipality in the Limpopo province, covering approximately 14 000 km². The town of Lephalale is located approximately 280 km from Tshwane and is a recognized gateway to Botswana and other Southern African Countries. The town Lephalale (Ellisras/Onverwacht/Marapong) is situated between 23°30' and 24°00' south latitude 27°30' and 28°00' east longitude.

The proposed Tshivhaso Project will be situated approximately 15 km northwest from Lephalale and 25 km northeast from Steenbokpan. The Grootegeluk Coal Mine (Exxaro) is situated directly to the south of the proposed power plant site alternatives. Results of a comprehensive, interdisciplinary scoping assessment recommended the following alternatives as the preferred options:

» Power Plant Alternatives:
  * Option 1 – Graaffwater/ Goedehoop Option;
» Ashing Facility Alternatives
  * Option 1 – Graaffwater Option;
  * Option 2 – Appelvlakte Option;
» Power Evacuation Alternatives:
  * Alternative 2 – Matimba – Medupi Loop-In.

The regional location of the site alternatives is illustrated in **Figure 1**. A Google Earth image of the region is presented in **Figure 2**, also illustrating the geographic location of project alternatives.

2 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. Land cover categories of the general region are illustrated in **Figure 3**. For the purpose of 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 character of the general region is typified by significant recent developments. The result is nodal type developments dispersing from a central area. Historically the larger region was characterized by natural woodland and savanna habitat with extremely limited transformation levels. Land use in the region varies between game farming and cattle farming that utilized the natural savanna habitat. Extremely little arable agriculture is practiced, mainly because of

relatively low rainfall and poor soils that predominate in the region. Recent mining developments and associated infrastructure developments such as power stations, a more defined and intricate road infrastructure, housing, residential developments and a significant expansion of Lephalale, have resulted in large-scale transformation of natural habitat of the region.

The immediate region is characterized by mostly untransformed savanna woodland, but recently (past 10 years) has seen significant development in terms of road networks, mining related land transformation and power stations with the appurtenant infrastructure, such as power line servitudes, ashing facilities, water treatment plants, etc. Significant increases in habitat transformation, fragmentation and isolation have been noted in recent time. The project area is situated in the Lephalale Municipality, which comprises approximately 1 960 140 ha, of which 94.4 % is currently regarded untransformed (BGIS, 2009).

Lephalale Municipal area's contribution of mining to GDP is significant at 59.21 %. Electricity contributes 11.33 % to the GDP and its contribution to the Waterberg electricity sector is at 69.65 %. Other sectors that have a significant contribution to the Waterberg GDP per sector include agriculture, mining, and manufacturing. Agriculture (38.85 %) is the sector that employs the largest part of the workforce and is followed by community services (15.71 %) (Lephalale Municipality IDP, 2013). As part of the Waterberg biosphere, Lephalale area is blessed with pristine natural beauty and an abundance of fauna and flora. Lephalale offers a variety of scenic contrasts and encompass the unique Waterberg wilderness with extraordinary beauty, which boasts superb vistas, mountain gorges, clear streams and rolling hills. Rich in geological sites, rock art is a strong draw-card for the region, suggesting links to previous generations. Hence, the importance of tourism industry to the economy of the area is likely to continue to grow into the future. This is likely to be related to the hunting and ecotourism industries, but could also be linked to any expansion of the industrial operations and the related business tourism. Agriculture, especially red meat production, is one the potential economic activities which is likely to grow in the municipal area. Lephalale Local municipality has been blessed with natural resources that give it a competitive and comparative advantage in Mining, Energy, Tourism and Agriculture (Lephalale Municipality IDP, 2013).

3 DECLARED AREAS OF CONSERVATION

Currently, there are nine declared land-based protected areas in the Lephalale Municipality, comprising approximately 89 406 ha (4.6 % of municipality). However, there are no biospheres, conservancies or other declared areas of conservation present in the immediate surroundings of the proposed project. The closest area of conservation is the D'Njala Nature Reserve, situated approximately 18 km to the southeast. The roughly 8 281 ha D'Njala Reserve is located in the northern Waterberg range. Government acquired the Reserve in 1986 to allow for the construction of the Vaalwater - Lephalale road (R33). Lephalale is the last end route to Botswana from South Africa along the (shorter) alternative route leading to four border control posts. The R33 provincial road between Vaalwater and Lephalale traverses the reserve, dividing it into a western and eastern portion. The reserve's bushveld plains and broad floodplain areas afford excellent game viewing opportunities, and large specimens of trees including massive Baobabs and Nyala antelopes add to the scenic value and recreation/tourism resource. Apart from various management tracks, a 37 km gravel game

drive route has been developed on the eastern portion of the reserve (east of the R33 provincial road), along with two game viewing hides on the floodplain.

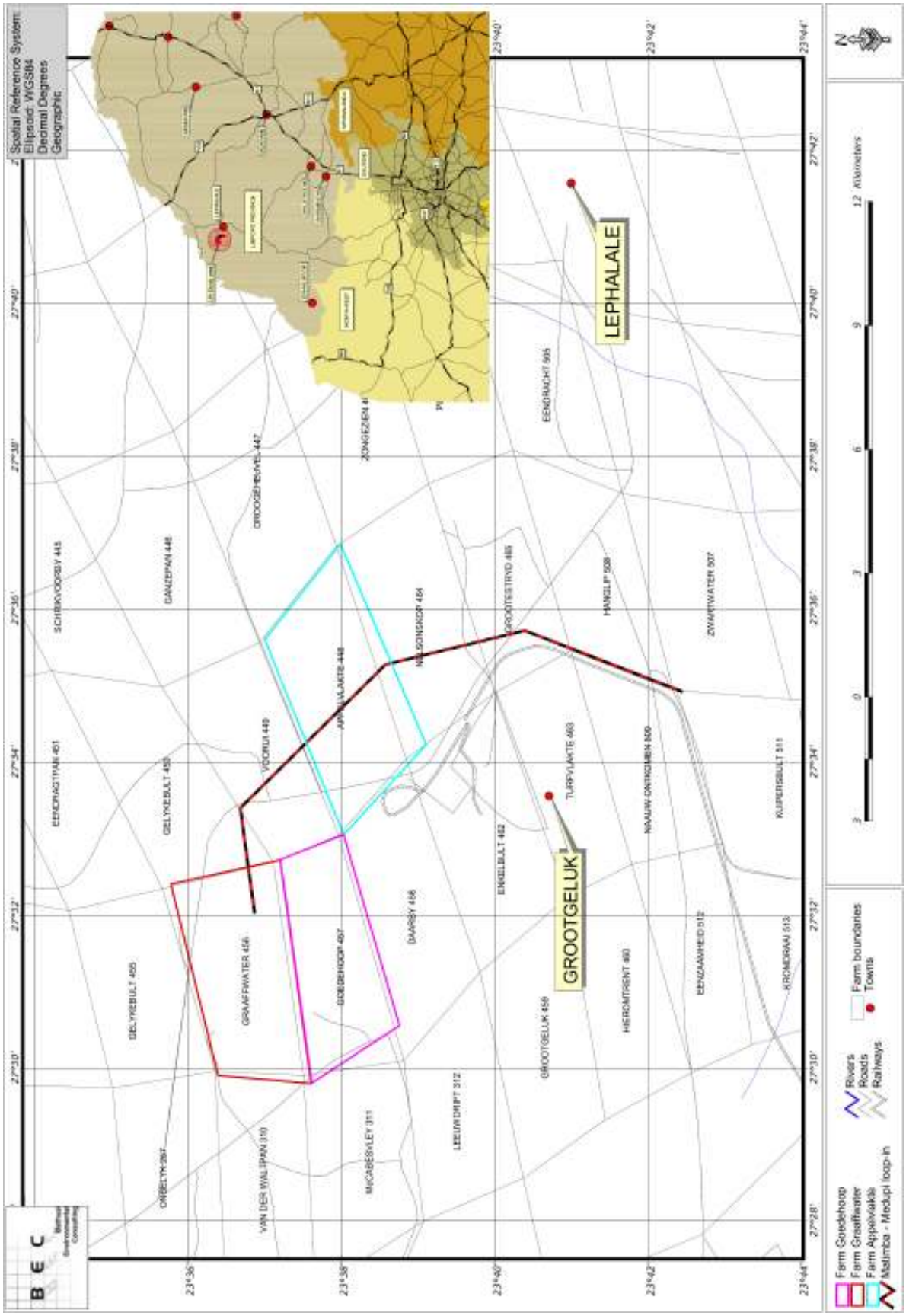


Figure 1: Geographic location of the proposed study sites

Section B

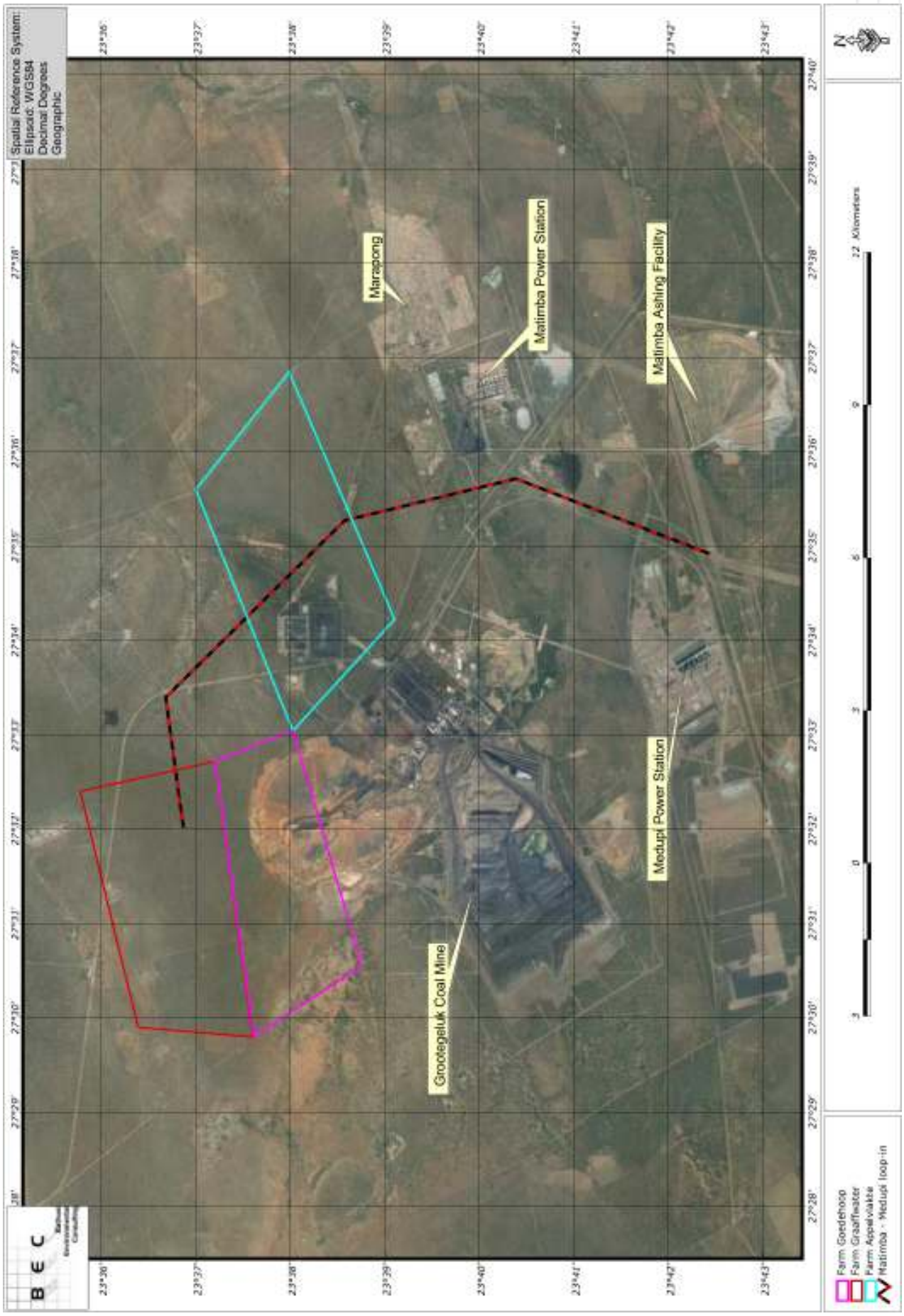


Figure 2: Aerial imagery of the immediate area
Imagery courtesy of www.googleearth.com

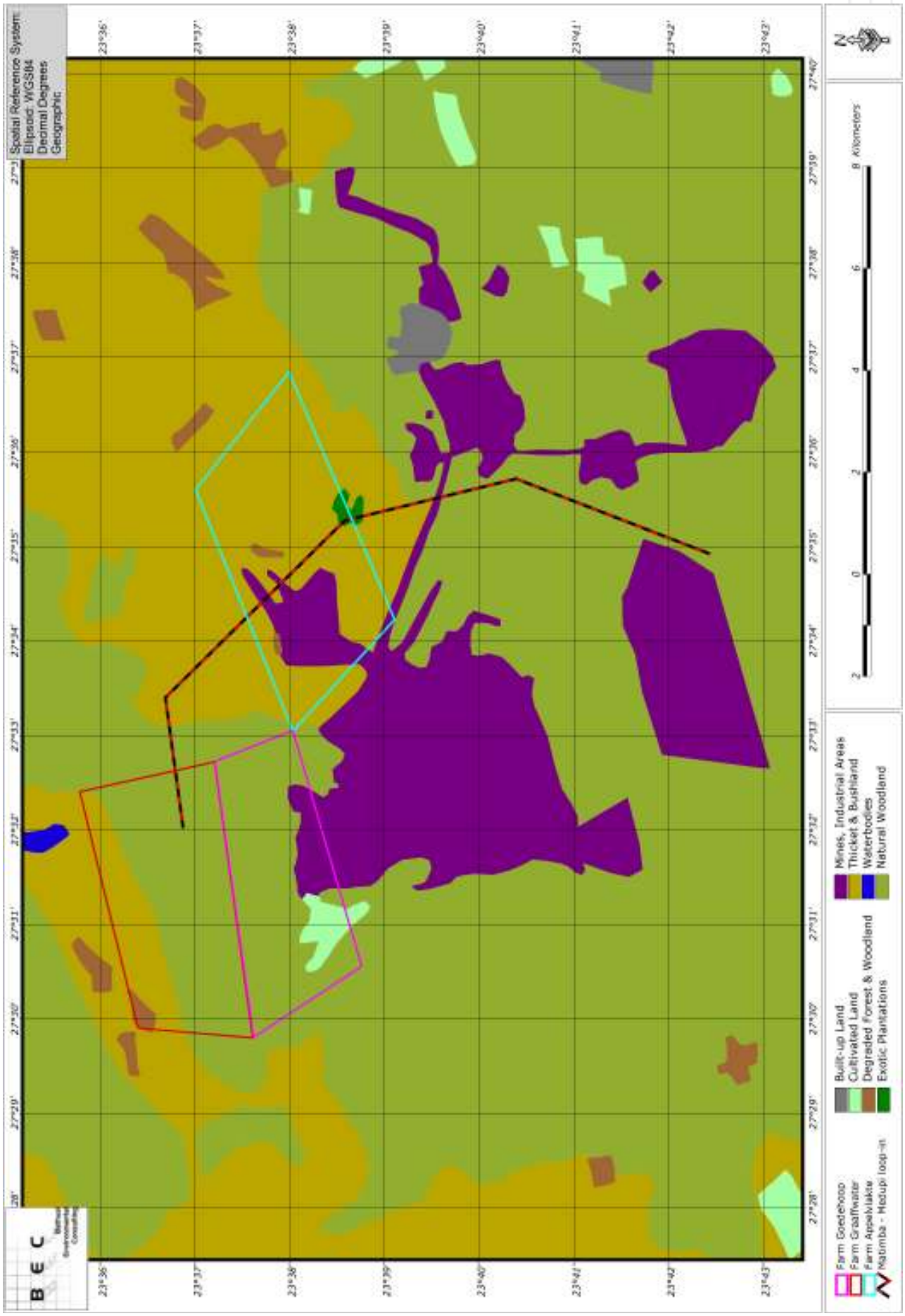


Figure 3: Land cover categories of the immediate region

Section B

4 LAND TYPES & SOILS

Although it is not in the scope of this report to present a detailed description of the soil types of the area, a basic description will suffice for this assessment as the association of habitat types and land types (soils) are typical of savanna vegetation. The various power plant, ashing facility and power line alternatives are situated within the following land type units (refer **Figure 4**):

» Ae252;
» Ah85;
» Ah86;
» Bc44; and
» Bd46.

Map units Aa to Ai refer to yellow and red soils without water tables and belonging in one or more of the following soil form: Inanda, Kranskop, Magwa, Hutton, Griffin and Clovelly. The map units refer to land that does not qualify as a plinthic catena and in which one or more of the above soil forms occupy at least 40 % of the area. In red and yellow soils, high base status indicates land with red and yellow soils, each of which covers more than 10 % of the area while dystrophic and/or mesotrophic soils occupy a larger area than high base status red-yellow apedal soils (Land Type Survey Staff, 1987).

The B- group includes a large area of the South African interior that is occupied by a catena, which in its perfect form is represented by (in order from highest to lowest in the upland landscape) Hutton, Bainsvlei, Avalon and Longlands forms. The valley bottoms are occupied by one or other gley soil. Soils with hard plinthite are common over sandstones in the moist climate zones in the eastern part of the country. Depending on the extent to which water tables have been operative over a landscape, Longlands, Avalon and related grey and yellow soils may predominate, even to the exclusion of red soils. Where water tables have not extended beyond the valley bottoms, red soils may predominate with plinthic soils restricted to narrow strips of land around valley bottoms or pans. For inclusion into Bc and Bd plinthic soils must cover more than 10 % of the area. Unit Bd indicates land in which the soils are generally eutrophic and red soils are not particularly widespread.

On a regional scale, parent material comprises quartzite sandstone, shale and gneisses amongst others. The climate area varies, becoming both warmer and drier from south to north. The long-term average annual rainfall is around 400-600 mm, while average daily temperatures vary between 17°C and 32°C in summer and between 4°C and 20°C in winter. As far as existing soil information is concerned, the only source of soil information for the area is land type maps (1:250 000). A difference is noted between land types in terms of both the soils occurring as well as the associated agricultural potential. There is also a significant difference in the dominance of the agricultural potential classes within each land type. More than 60 % of Lephalale Local Municipality area has moderate or better soil potential, but climate (especially rainfall) is the greatest limiting factor; irrigation is therefore the preferred method of cultivation to obtain long-term results. The municipal area is not one where significant zones of water-erodible soils occur, but wind erosion could be a serious problem if topsoil becomes exposed. The grazing capacity for Lephalale local Municipality (not for game farming) is around 8-12 ha/lsu (large stock unit).

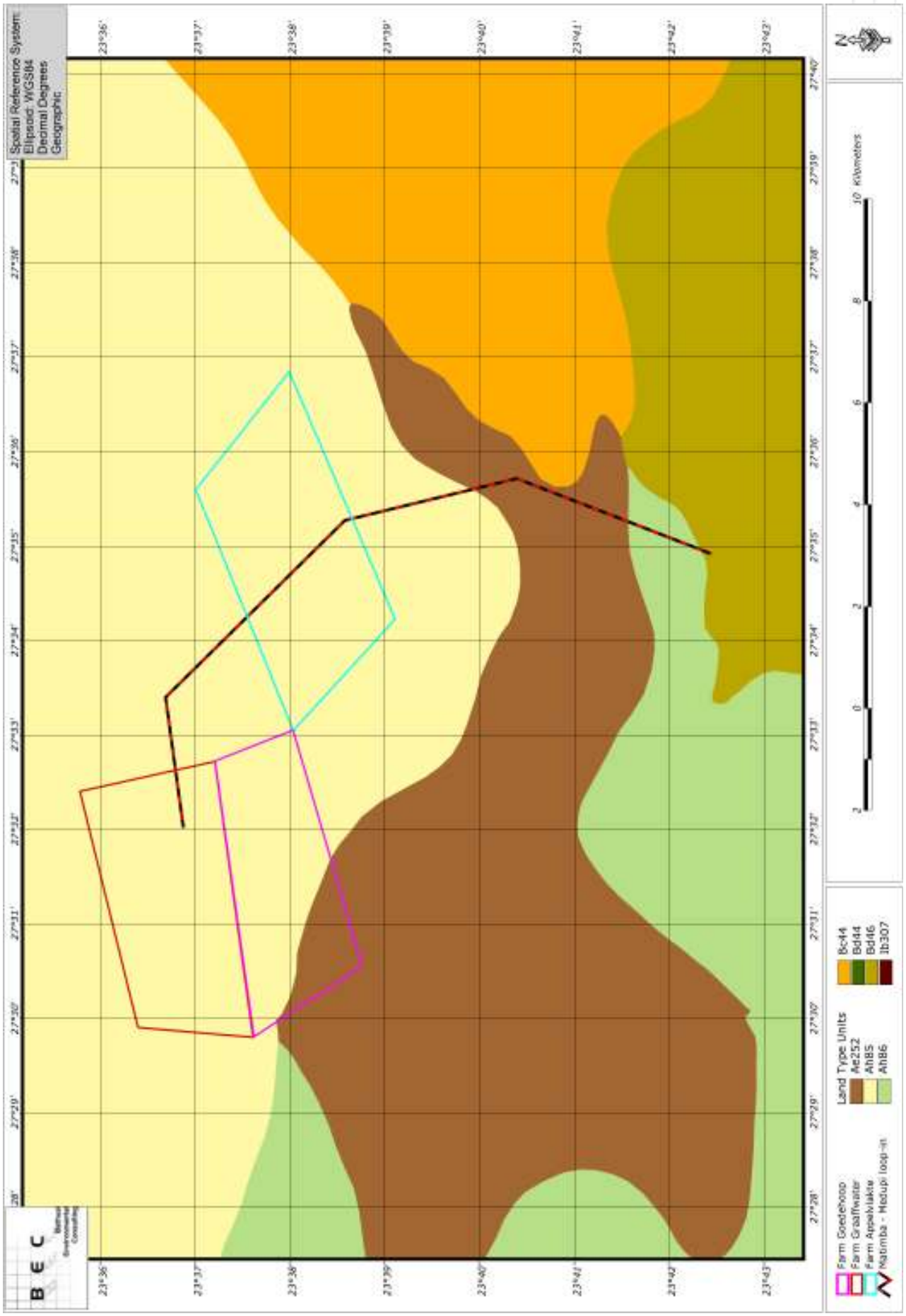


Figure 4: Land types of the immediate region

5 SURFACE WATER[1]

Water, salt and processes linked to concentration of both are the major controls of the creation, maintenance and development of peculiar habitats. Habitats formed in and around flowing and stagnant freshwater bodies, experience waterlogging (seasonal or permanent) and flooding (regular, irregular or catastrophic), leading to formation of special soil forms. Invariably, both waterlogged and salt-laden habitats appear as 'special', deviating strongly from the typical surrounding zonal vegetation. They are considered to be of azonal character (Mucina & Rutherford, 2006). Water, in conjunction with geology, soil, topography and climate, is responsible for the creation of remarkably many types of habitats. Water chemistry, temperature and temporary changes in both, together with the amount of water (depth of water column), timing of occurrence (regular tides or irregular floods) and speed of its movement (discharge, flow and stagnation) are the major factors shaping the ecology of biotic communities occupying such habitats (Mucina & Rutherford, 2006).

Areas of surface water contribute significantly towards the local and regional biodiversity due to atypical habitat that is present within ecotonal areas. Ecotones (areas or zones of transition between different habitat types) are occupied by species occurring in both the bordering habitats, and are generally rich in species due to the confluence of habitats. In addition to daily visitors that utilize the water sources on a frequent basis, some flora and fauna species are specifically adapted to exploit the temporal or seasonal fluctuation in moisture levels in these areas, exhibiting extremely low tolerance levels towards habitat variation. Ecotonal interface areas form narrow bands around areas of surface water and they constitute extremely small portions when calculated on a purely mathematical basis. However, considering the high species richness, these areas are extremely important on a local and regional scale. Rivers also represent important linear migration routes for a number of fauna species as well as a distribution method for plant seeds.

The alternative sites are situated within the Limpopo Catchment area. Major rivers of the surrounds include the Mogol River (approximately 13 km to the east of the project area) and the Limpopo River (approximately 40 km to the northwest of the project area). No significant areas of permanent surface water occur within the proposed project area. However, numerous small, non-perennial drainage lines and floodplains can be noted from aerial imagery. The description and mapping of the variety of wetland habitat types within the respective site alternatives is a subject that is being addressed by a wetland specialist in a separate report.

[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.

6 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.

Ridges and rocky outcrops are characterized by high spatial variability due to the range of differing aspects, slopes and altitudes all resulting in differing soil (*e.g.* depth, moisture, temperature, drainage, nutrient content), light and hydrological conditions. Temperature and humidity regimes of microsites vary on both a seasonal and daily basis. Moist cool aspects are more conducive to leaching of nutrients than warmer drier slopes. Variation in aspect, soil drainage and elevation/altitude has been found to be especially important predictors of biodiversity. It follows that ridges will be characterized by a particularly high biodiversity.

The project area is situated approximately 900 m above sea level. Topography of the region is described as 'Plains' and extremely little topographical heterogeneity is noted on a local and regional scale, contributing to the homogenous nature of the principal vegetation types.

7 GEOLOGY

The geology of the region comprises of the following geological strata:

- Clarens Arenite;
- Karroo Shales;
- Drakensberg Basalts; and
- Sandriviersberg & Mogalakwena Arenites.

The major geological formations of the region are illustrated in **Figure 5**. It would appear that the underlying geological patterns correspond to large-scale floristic patterns, probably relating to the overlying soils of the geological patterns. Furthermore, dissimilar patterns are observed that would be resultant from geological boundaries. In particular, the Arenites and Basalts formations appear to correlate to observed floristic patterns.

8 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 in order 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:

» Protected Areas - The formal protected area network (PAN) in Limpopo is 1 367 044 ha in extent. The major contributor to this is the Kruger National Park, which contributes 72 % to the provincial PAN. There are 62 formal protected areas (PAs) managed mostly by LEDET and SANParks;

» 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, make up 18 % of the province. CBA 2's 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 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 6 provides an illustration of the spatial representation of CBAs and ESAs within the project area and surrounds.

The LCP indicates that the proposed project alternatives are mostly comprised of ECA 1 and 'Other Natural Area' categories. The proximity of CBA 1 habitat to the south, north and east of the project area warrants particular care during the planning and development stages of the project, but inaccuracies in the database are noted in terms of accurately applying conservation categories to certain polygons.

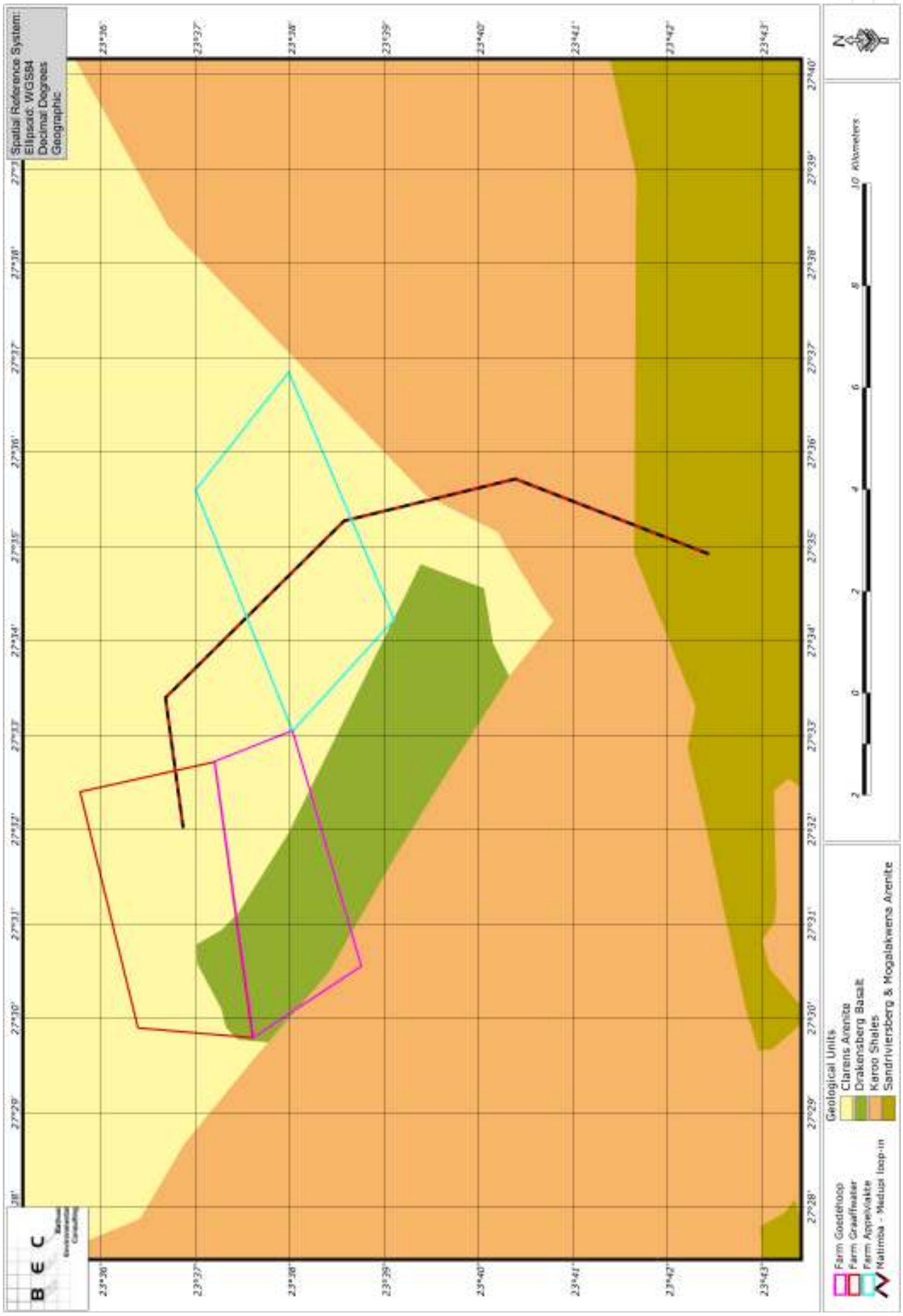


Figure 5: Geological patterns of the general region

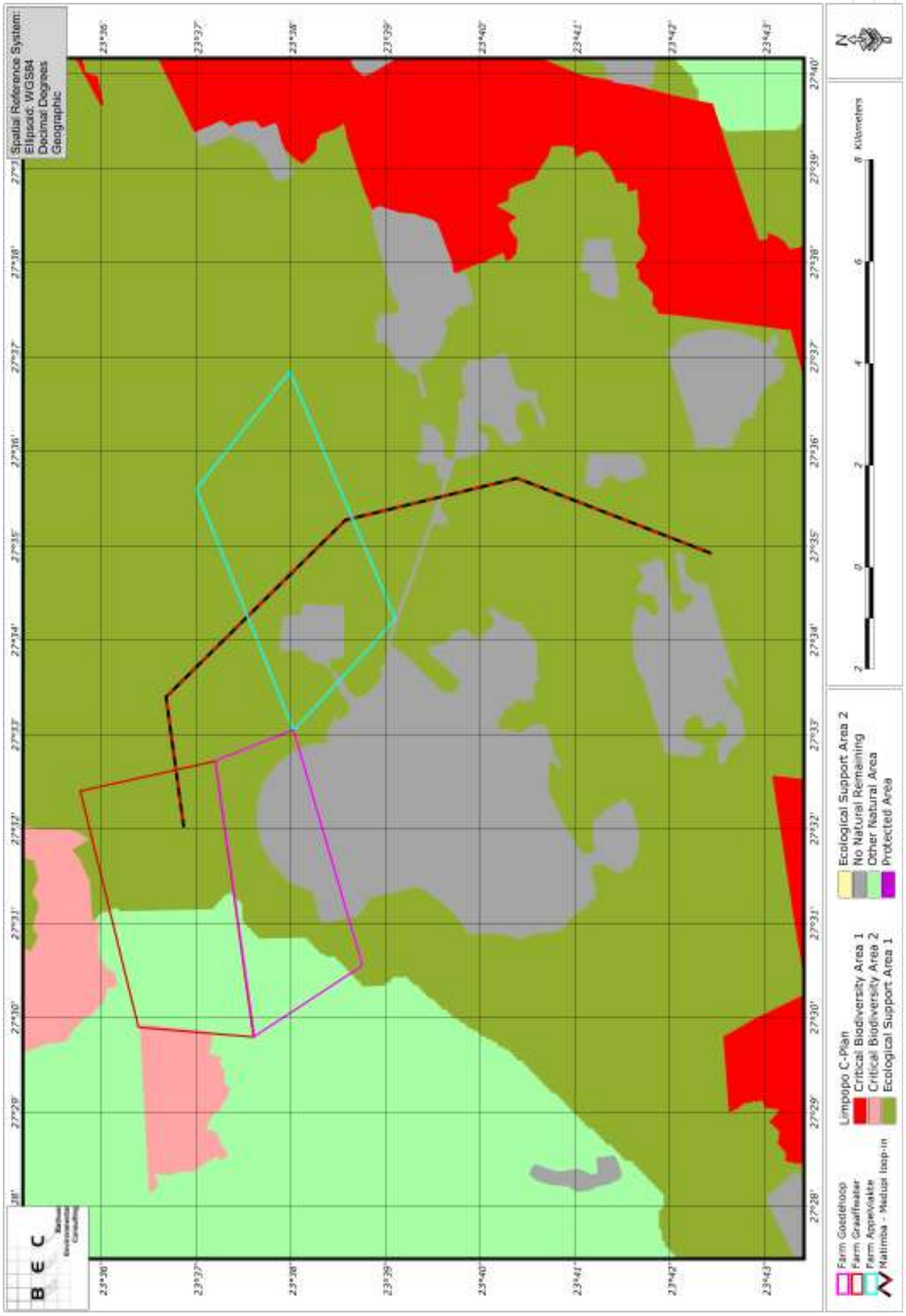


Figure 6: Illustration of regional conservation plan categories on a local scale

9 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. 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 Lephalale area falls in the summer rainfall region with an average annual rainfall 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).

SECTION C – BOTANICAL ATTRIBUTES OF THE RECIEVING ENVIRONMENT

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

10 ABRIDGED METHOD STATEMENT

10.1 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 in order 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. Particular reference is made to Red Data plants, which normally do not occur at great densities.

10.2 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 is a simple count of species, and it does not take into account the abundance of the species or their 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 takes into account the number of species present (species richness), as well as the abundance of each species (Evenness).

10.3 Data Processing

The combined floristic and faunal 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.

11 REGIONAL FLORISTIC ATTRIBUTES

11.1 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) and comprises an ecological type known as Limpopo Sweet Bushveld (Mapping Unit SVcb 19; Mucina & Rutherford, 2006). It is predominantly located on extensive plains that are irregularly interspersed by tributaries of the Limpopo River. This vegetation type extends from the lower reaches of the Crocodile and Marico Rivers down into the Limpopo River valley. It comprises short, open woodland dominated by *Acacia mellifera* and *Dichrostachys cinerea* as well as taller tree species such as *A. robusta*, *A. burkei, Terminalia sericea*, *A. erioloba* (Camel Thorn), *A nigrescens* (Knob Thorn). The high palatability of the graminoid stratum makes this vegetation type highly suitable for game and cattle farming land uses.

The Limpopo Sweet Bushveld is Least Threatened and extensive in geographic coverage. It is however poorly conserved (*e.g.* D'Nyala Nature Reserve) even though it straddles many privately owned game farms. Approximately 5 % is transformed by cultivation. Future threats include the mining of coal and urbanisation. Though limited by low rainfall, this is a good area for game and cattle farming due to the relatively high grazing capacity of sweet veld, but overgrazing frequently occurs. The Central Bushveld endemic herb *Piaranthus atrosanguinalis* occurs in this vegetation type. Important taxa include the following.

» **Trees**
Acacia robusta, A. burkei, Acacia erubescens, A. fleckii, A. nilotica, A. senegal var. *rostrata, Albizia anthelmintica, Boscia albitrunca, Combretum apiculatum,* and *Terminalia sericea.*

» **Tall Shrubs**
Catophractes alexandri, Dichrostachys cinerea, Phaeoptilum spinosum, Rhigozum obovatum, Cadaba aphylla, Combretum hereroense, Commiphora pyracanthoides, Ehretia rigida subsp. *rigida, Euclea undulata, Grewia flava,* and *Gymnosporia senegalensis.*

» **Low Shrubs**
Acacia tenuispina, Commiphora africana, Felicia muricata, Gossypium herbaceum subsp. *africanum,* and *Leucosphaera bainesii.*

» **Graminoids**
Digitaria eriantha subsp. *eriantha, Enneapogon cenchroides, Eragrostis lehmanniana, Panicum coloratum, Schmidtia pappophoroides, Aristida congesta, Cymbopogon nardus, Eragrostis pallens, E. rigidior, E. trichophora, Ischaemum afrum, Panicum maximum, Setaria verticillata, Stipagrostis uniplumis,* and *Urochloa mosambicensis.*

» **Herbs**
Acanthosicyos naudinianus, Commelina benghalensis, Harpagophytum procumbens subsp. *transvaalense, Hemizygia elliottii, Hermbstaedtia odorata, Indigofera daleoides, Kleinia fulgens,* and *Plectranthus neochilus.*

11.2 Regional Phytodiversity

The SANBI database was consulted to provide a brief account of the known regional phytodiversity; the presence of approximately 333 plant species within the ¼-degree grids that are sympatric to the study area (2327CB and 2327DA) is indicated, reflecting on the diverse floristic nature of the regional vegetation. However, in spite of a fairly high known phytodiversity, a paucity of regional and site specific floristic knowledge is indicated by the obvious absence of numerous common species from the database. A basic appraisal of available floristic sampling records (refer **Table 4**) indicates the structural prominence of the woody component of the vegetation; trees (25 species, 7.5 %) and shrubs (31 species, 9.3 %). The compositional dominance of the herbaceous layer is typical of the regional flora, comprising of 115 herb species (34.5 %), dwarf shrubs (45 species, 13.5 %), 42 grass species (12.6 %) and 16 succulent species (4.8 %).

Table 4: Growth form analysis of floristic sampling records (POSA, 2011)		
Growth Form	*Number*	*Percentage*
Bryophytes	8	2.4 %
Climbers	17	5.1 %
Cyperoids	8	2.4 %
Dwarf shrubs	45	13.5 %
Geophytes	14	4.2 %
Graminoids	42	12.6 %
Helophytes	3	0.9 %
Herbs	115	34.5 %
Hydrophytes	1	0.3 %
Parasites	5	1.5 %
Shrubs	31	9.3 %
Succulents	16	4.8 %
Suffrutex	3	0.9 %
Trees	25	7.5 %
Total	**333**	

11.3 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;
» National Forest Act of 1998; and
» Limpopo Environmental Management Act (Act no 7 of 2003).

11.3.1 Historic and Regional Sampling Records

- **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 infobase for ¼-degree grids 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 diversity knowledge for the region.

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

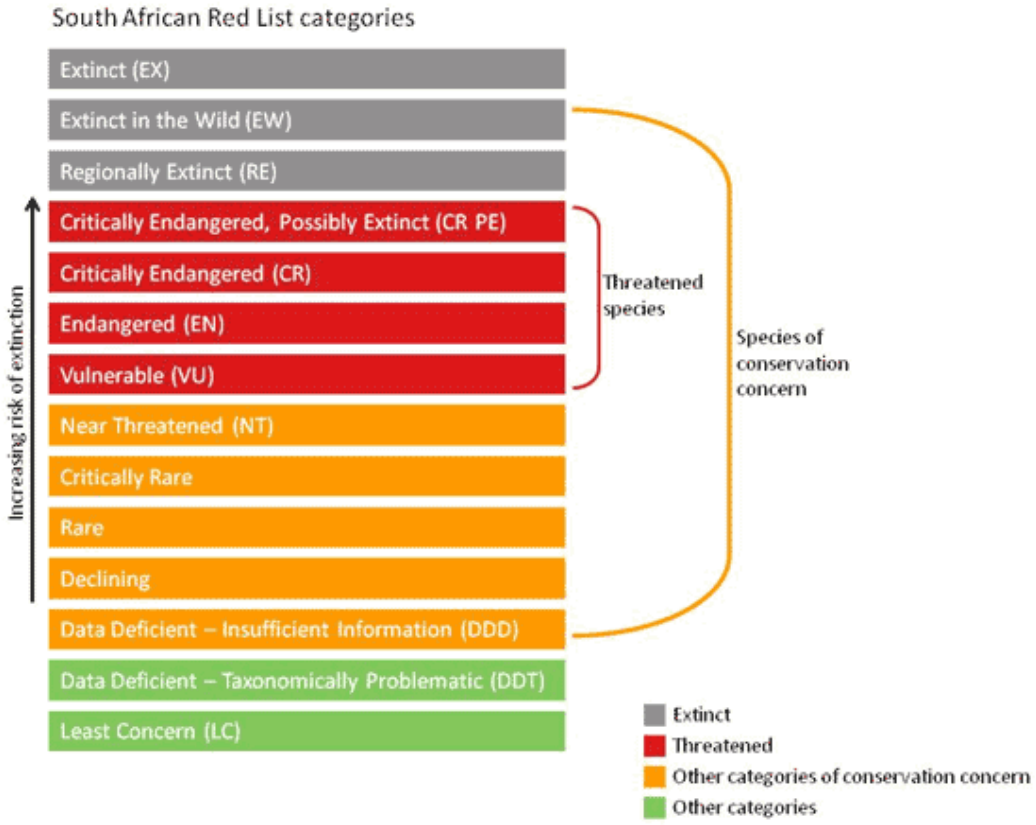


Table 5: Plant taxa of conservation importance (POSA, 2015)

Taxon	*Family*	*Status (IUCN)*
Acalypha caperonioides var. *caperonioides*	Euphorbiaceae	Data Deficient (Taxonomically Problematic)
Eulalia aurea	Poaceae	Near Threatened
Euphorbia waterbergensis	Euphorbiaceae	Rare
Corchorus psammophilus	Malvaceae	Threatened

Taking the habitat that is available as well as the status thereof into consideration, the possibility that any of these species could persist within the project area cannot be excluded at this stage of the process, although unlikely. Furthermore, the lack of site-specific floristic knowledge could also imply that other species of conservation concern are likely, or known to, persist in the region, with specific reference to obvious species such as *Acacia (Senegalia) erioloba* (Declining) and *Elaeodendron transvaalense* (Near threatened).

In addition to the species currently captured in the SANBI infobase (POSA, 2011), the following species were previously recorded during the brief site investigations, or are known to occur in the region (refer **Tables 6 and 7**).

» **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 (refer **Appendix 3**). **Table 6** presents a list of protected trees that have previously been recorded in the immediate vicinity of the study sites.

Table 6: Historic sampling records of protected trees in the region

Taxon	*Family*	*Status*
Acacia erioloba	Fabaceae	Declining, Protected tree (NFA, 1998))
Adansonia digitata	Bombaceae	Protected tree (NFA, 1998)
Boscia albitrunca	Capparaceae	Protected tree (NFA, 1998)
Combretum imberbe	Combretaceae	Protected tree (NFA, 1998)
Elaeodendron transvaalense	Celastraceae	Protected tree (NFA, 1998), Near Threatened IUCN)
Securidaca longipedunculata	Polygalaceae	Protected tree (NFA, 1998)
Sclerocarya birrea subsp. *africana*	Anacardiaceae	Protected tree, (NFA, 1998), Declining (IUCN)

Local umbrella species[2] were also 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.

» **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. In particular, Schedules 11 (Specially protected plants) and 12 (Protected plants) have relevance to this section. **Table 7** provides a list of protected plant taxa that are known to occur in the immediate region of the study sites.

Table 7: Regional sampling records of species trees in the region (LEMA, 2003)

Taxon	*Family*	*Status*
Duvalia polita N.E.Br.	Apocynaceae	Protected Species (LEMA, 2003)
Euphorbia waterbergensis R.A.Dyer	Euphorbiaceae	Rare (IUCN), Protected Species (LEMA, 2003)
Harpagophytum procumbens (Burch.) DC. ex Meisn. subsp. *transvaalense* Ihlenf. & H.E.K.Hartmann	Pedaliaceae	Protected Species (LEMA, 2003)
Huernia transvaalensis Stent	Apocynaceae	Protected Species (LEMA, 2003)
Huernia zebrina N.E.Br. subsp. *magniflora* (E. Phillips) L.C.Leach	Apocynaceae	Protected Species (LEMA, 2003)
Spirostachys africana Sond.	Euphorbiaceae	Protected Species (LEMA, 2003)

[2] 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.

11.4 Conservation Important Plants - Survey Results (2016)

This section provides details of plant species of conservation concern recorded on the proposed project development sites.

11.4.1 Union for Conservation of Nature (IUCN)

Table 8: Plant taxa of conservation importance (POSA, 2015) recorded during the surveys		
Taxon	*Family*	*Status*
Acacia erioloba	Fabaceae	Declining Status (IUCN), Protected Tree (National Forest Act, 1998), edible parts, medicinal uses, firewood
Elaeodendron transvaalensis (Burtt Davy) Codd	Celastraceae	Near Threatened (IIUCN), traditional and medicinal uses

11.4.2 National Forests Act of 1998

Table 9: Protected trees recorded in the study area (NFA, 1998) recorded during the surveys		
Binomial Name	*Family*	*Colloquial Name*
Acacia erioloba	Fabaceae	Camel Thorn (e), Kameeldoring (a)
Boscia albitrunca	Capparaceae	Sheperd's Tree (e), Witgat (a)
Combretum imberbe Wawra	Combretaceae	Leadwood (e), Hardekool (a)
Elaeodendron transvaalensis (Burtt Davy) Codd	Celastraceae	Bushveld Saffron (e), Bosveld-saffraan (a)
Sclerocarya birrea (A.Rich.) Hochst. ssp. *caffra* (Sond.) Kokwaro	Anacardiaceae	Marula (e), Maroela (a)

11.4.3 Limpopo Environmental Management Act (Act no 7 of 2003)

Table 10: Protected plants (LEMA) recorded during the surveys		
Taxon	*Family*	*Status*
Crinum species	Amaryllidaceae	Protected Species (LEMA, 2003)
Spirostachys africana Sond.	Euphorbiaceae	Protected Species (LEMA, 2003)

11.5 Recorded Phytodiversity (2016)

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 is a simple count of species, and it does not take into account the abundance of the species or their 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 2013 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 takes into account the number of species present (species richness), as well as the abundance of each species (Evenness).

11.5.1 Species Richness – Alpha Diversity

The survey yielded an Alpha Diversity of 216 taxa, which is regarded representative of the floristic diversity on a regional scale, but still reflects seasonal constraints of the survey and a typically relative low local floristic diversity. A list with the identified plant species, together with their growth forms, medicinal/ traditional uses and colloquial names is presented in **Appendix 1**. A basic synopsis of the growth forms recorded in the study area reflects the major physiognomic variations that are present in the study area (refer **Table 11**). The woodland physiognomy is dominated by a relatively diverse woody layer, comprising of 63 species (small trees, shrubs, trees (29.2 %). Typically, the herbaceous layer is prominent and diverse; comprising of 40 grass species (18.5 %), 46 forb species (21.3 %) and 18 prostrate herbs (8.3 %).

Table 11: Growth forms recorded in the study area

Growth Form	*Number*	*Percentage*
Climber	5	2.3 %
Dwarf shrub	21	9.7 %
Forb	46	21.3 %
Geophyte	7	3.2 %
Grass	40	18.5 %
Parasite	1	0.5 %
Prostrate herb	18	8.3 %
Sedge	7	3.2 %
Shrub	23	10.6 %
Small tree	15	6.9 %
Succulent	8	3.7 %
Tree	25	11.6 %
Total	**216**	

The diversity of plants within the study area is represented by 47 plant families (refer **Table 12**), dominated by Poaceae (graminoids, 40 species, 18% %) and Fabaceae (legume family, 32 species, 14.8 %).

Table 12: Plant families recorded in the study area

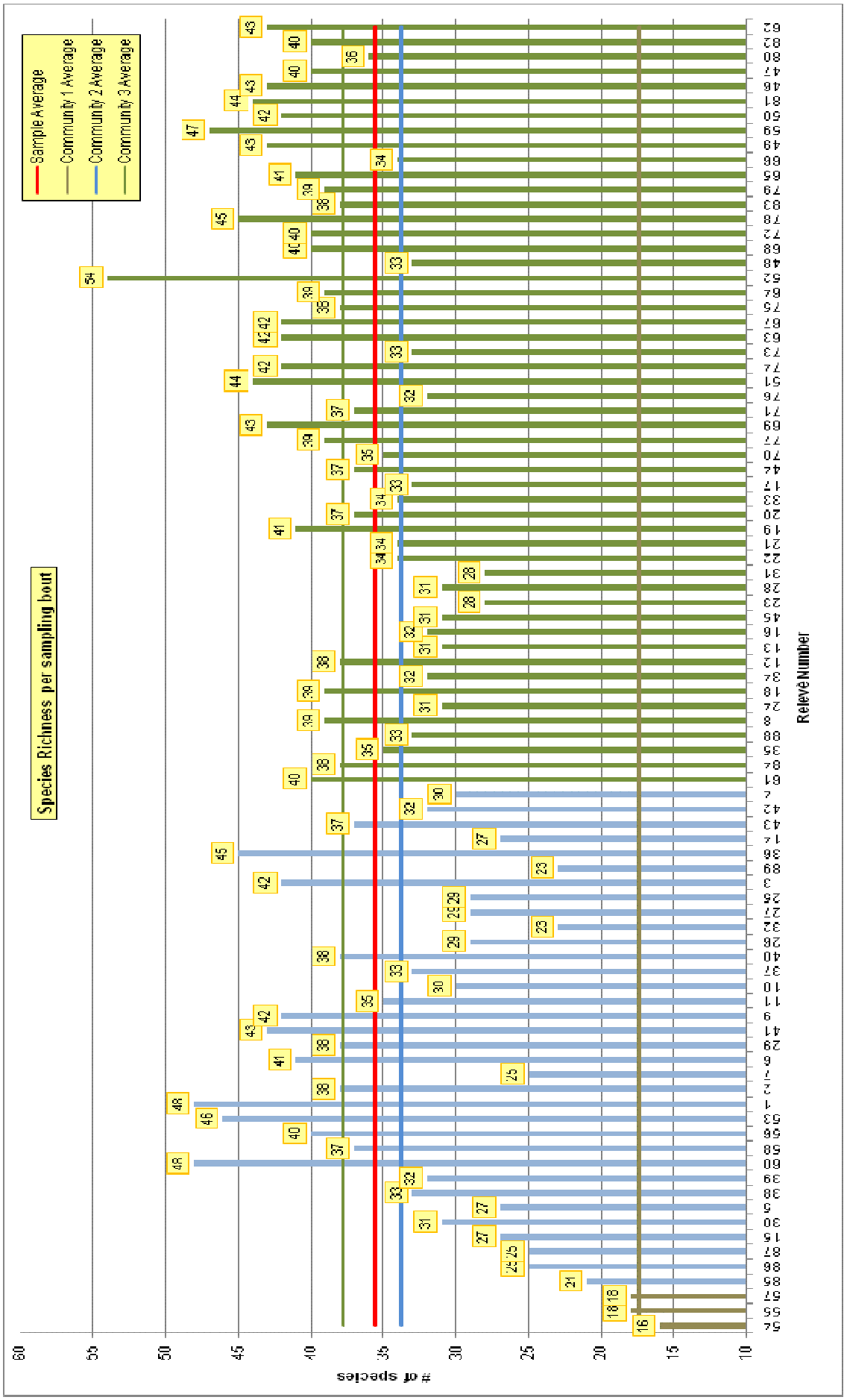
Family	*Number*	*Percentage*
Acanthaceae	7	3.2%
Aizoaceae	1	0.5%
Amaranthaceae	7	3.2%
Amaryllidaceae	2	0.9%
Anacardiaceae	3	1.4%
Apocynaceae	6	2.8%
Asteraceae	10	4.6%
Bignoniaceae	1	0.5%
Boraginaceae	1	0.5%
Burseraceae	2	0.9%
Cactaceae	2	0.9%
Caesalpiniaceae	4	1.9%

Table 12: Plant families recorded in the study area		
Family	*Number*	*Percentage*
Capparaceae	5	2.3%
Celastraceae	3	1.4%
Combretaceae	6	2.8%
Commelinaceae	3	1.4%
Convolvulaceae	5	2.3%
Crassulaceae	1	0.5%
Cucurbitaceae	2	0.9%
Cyperaceae	7	3.2%
Ebenaceae	2	0.9%
Ehretiaceae	1	0.5%
Euphorbiaceae	5	2.3%
Fabaceae	32	14.8%
Gisekiaceae	1	0.5%
Hyacinthaceae	1	0.5%
Illebracaceae	1	0.5%
Lamiaceae	2	0.9%
Liliaceae	8	3.7%
Loganiaceae	1	0.5%
Loranthaceae	1	0.5%
Malvaceae	9	4.2%
Ochnaceae	1	0.5%
Olacaceae	1	0.5%
Pedaliaceae	3	1.4%
Periplocaceae	1	0.5%
Poaceae	40	18.5%
Polygalaceae	1	0.5%
Polygonaceae	1	0.5%
Portulacaceae	3	1.4%
Rhamnaceae	1	0.5%
Rubiaceae	3	1.4%
Sapindaceae	1	0.5%
Scrophulariaceae	1	0.5%
Solanaceae	5	2.3%
Sterculiaceae	1	0.5%
Tiliaceae	7	3.2%
Verbenaceae	2	0.9%
Vulgariaceae	1	0.5%
Zygophyllaceae	1	0.5%

The average number of species recorded in releveès during the survey period is 35.6 per sampling bout (std. dev. = ±7.28). The lowest total was 16 (Rel 54), with 54 (Rel 52) the highest number of individuals (refer **Graph 1**).[3] The average number of species per sampling event correlates with other sampling events conducted in the vicinity of the study sites.

[3] Colour coding of sample releveès is set according to TWINSPAN communities, refer Section 11.5

Graph 1: Species richness per sampling bout



11.5.2 Species Diversity Indices

Estimate-S Analysis

While Alpha Diversity provides an indication of the total number of species that were recorded within a certain area (community or habitat) and along a number of repetitions (relevèes/ sampling bouts), it does not provide any information on how well each of the species is represented in the sampled area. Species diversity is a measure of both the number of species (species richness) and the relative contribution of each of these species to the total number of individuals in a community (evenness). Evenness is also an important characteristic that is used to assess the status of an area/ community or habitat. Pristine areas are generally characterised by a high evenness with a number of co-dominant species. Forms of degradation or human related impacts generally affect the abundance levels of species, with poor quality species increasing while sensitive species will decrease in abundance or disappear altogether. This effect is easily observed in areas where high grazing pressure is sustained; poor quality species dominate the species composition and physiognomy and good quality grasses and forbs that are mostly associated with pristine conditions generally disappear.

EstimateS (Colwell, 2006) was used to appraise the collated data. It is designed to determine the accuracy and comprehensiveness of the sampling procedure and, given the collated data, also provide an estimation of the number of species that should be present in the habitat. Species abundance values were replaced by presence/ absence indications prior to the analysis. Results are illustrated in **Graph 2**.

Comments

The X-axis represents the number of times the study area was sampled. The Y-axis represents species richness, or simply the number of species present or estimated. The bootstrap analysis of the observed species revealed the following aspects:

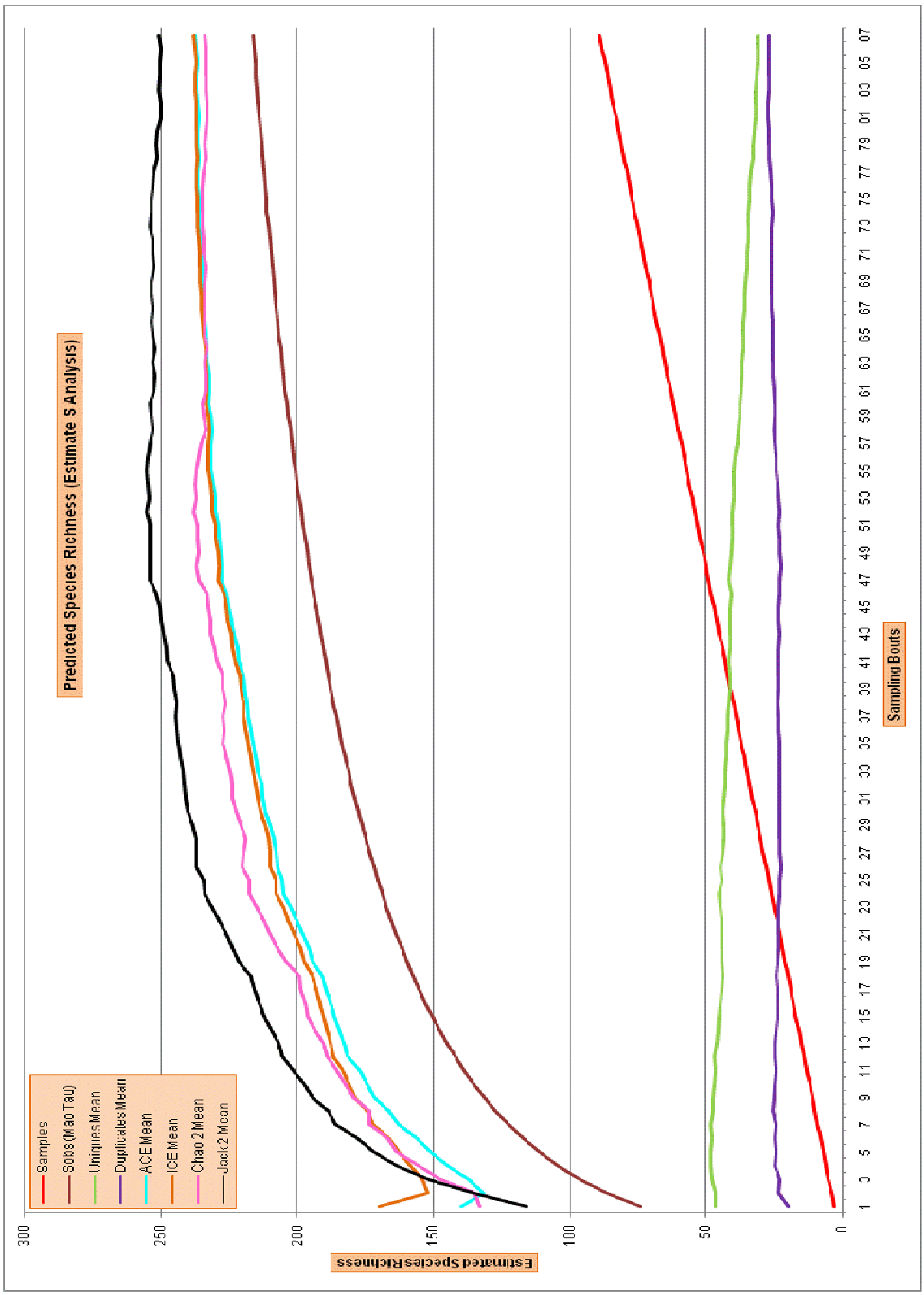
» Sobs (# of species observed) – The number of species is beginning to asymptote (levelling off). If the same species are being sampled throughout the sampling bouts, it is expected that the Sobs indicator will asymptote. In this particular case, the numbers continue to increase with each additional sampling event. It is therefore expected that, with additional sampling, the number of species identified within the study region will increase further, although not significantly.

» Uniques/ Duplicates - If the ratio of uniques to duplicates are assessed, it represents a comparison of the number of species that occurred once in the pooled sample plots to those that occurred twice. Simply put, if the number of uniques keeps on increasing, the expectation is that many new species are likely to be recorded. However, if the number of duplicates increases (usually when the uniques and duplicates lines cross), the sampling process is producing more of the same species instead of new ones. Evidence from **Graph 2** indicates that there is only a small difference between the number of uniques and duplicates, indicating that further sampling is not expected to produce significant numbers of additional new species.

» Estimator Calculators – the variety of estimator (bootstrap) calculators (ACE, ICE, Chao, Jack) used in the analysis provides predictions of the estimated number of species that could be expected given the sampling bouts. These estimators generate predictions

based largely on the total number of species found given a certain number of pooled samples and the ratio of uniques to duplicates found within the pooled sample. The actual number of species recorded during the sampling process is 216, while the predictors estimate a species richness of between 233 and 250 species, which correlates well with the recorded species richness of the relevant ¼-degree grid that is spatially represented in the study areas (333 species), considering the size of the study area.

Graph 2: Estimate S analysis of predicted species richness



Section C

» ***Shannon-Weiner Index (H')***

The Shannon-Weiner diversity index (H') looks at how species are distributed in an ecosystem or a community. This index therefore considers both the species richness and the relative abundance of each species in a community to determine the uncertainty that an individual picked at random will be of a given species. H is calculated with the following formula, where p_i is the proportion of species belonging to the *i*th type of letter in the string of interest. In ecology, p_i is often the proportion of individuals belonging to the *i*th species in the dataset of interest:

$$H' = -\sum_{i=1}^{R} p_i \log p_i$$

Biologically realistic H' values range from 0 (only one species present with no uncertainty as to what species each individual will be) to about 4.5 (high uncertainty as species are relatively evenly distributed). In general, it is thought that more disturbed and less stable environments should have lower H' values. The index is maximized when all species have the same number of species. Sampling bouts that display a high discrepancy between the numbers of individuals that inhabit a community will logically therefore display a low index value.

For this particular dataset, the average Braun-Blanquet values were used to calculate the index, as follows:

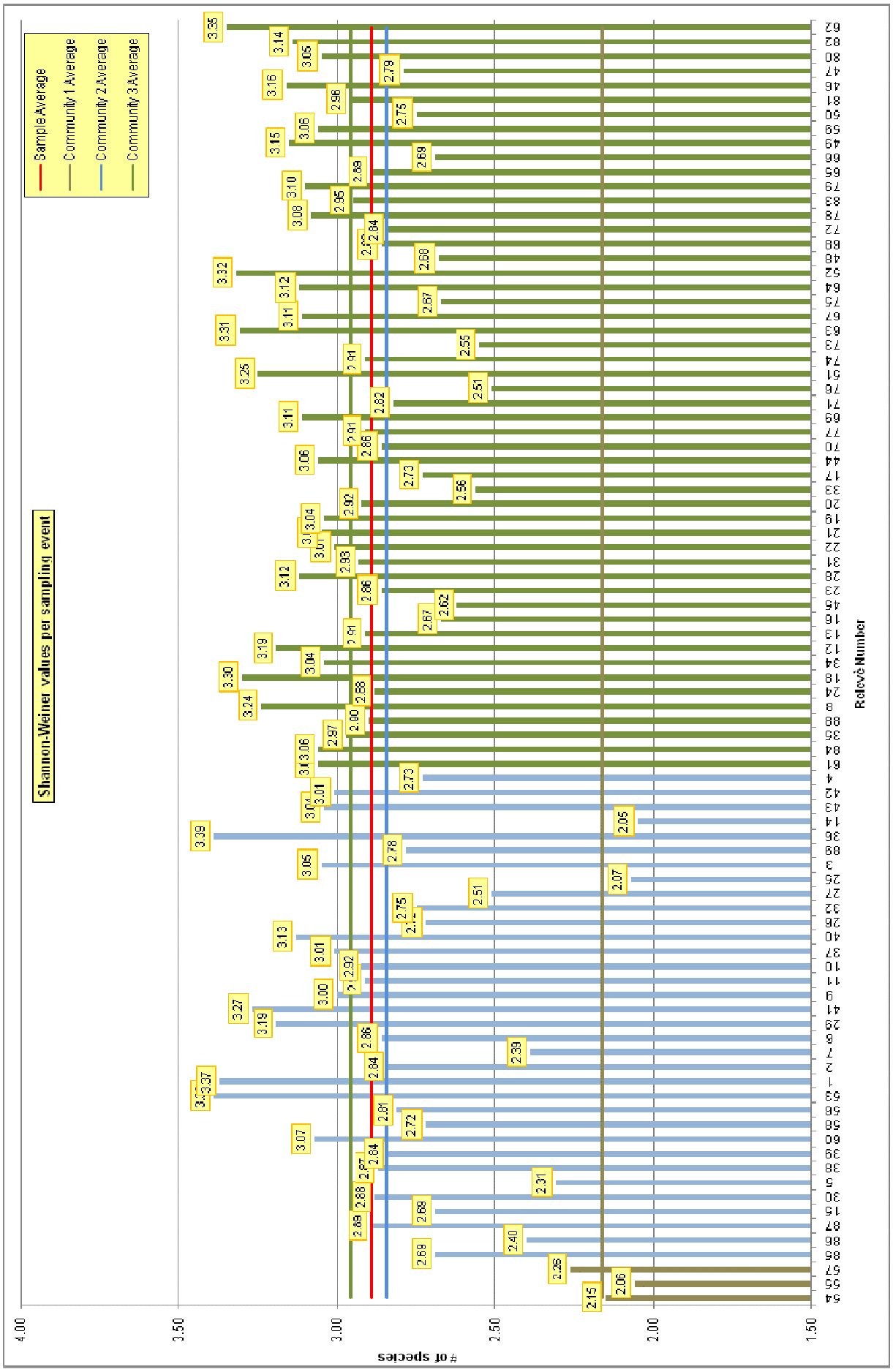
+ 1%;
1 3%;
2A 9%;
2B 18%;
3 38%; and
4 63%.

Comments

Results are illustrated in **Graph 3** (colour precedence and order of releveès are set according to TWINSPAN results, refer **Section 12.5)**.

Values range between a minimum of 2.05 (rel. 14, 27 species) and a maximum of 3.39 (rel 53, 46 species) (average 2.89, std. dev. = ±0.30), indicating a moderate to moderately low diversity of species within the study area. This correlates well with historic knowledge of the area on a local as well as regional scale. Previous studies conducted in the vicinity of this particular site yielded values of 3.00 and 3.01. Traditionally the area, also with reference to the Savanna Biome, is not known to exhibit high local floristic diversity values, mainly because of homogenous biophysical attributes. However, considered on a regional scale, the diversity of the Savanna Biome approximates that of the Grassland Biome.

Graph 3: Shannon-Weiner Index values for respective releveès



» ***Evenness Index***

Evenness (E) is an index that makes the H' values (Shannon-Weiner) comparable between releveès by controlling for the number of species found within the communities. H'max represents the highest possible value if you have a given number of species in a community (216 in this case) and each of the species was equally represented in the community. Therefore:

H'max = ln(S) (where S = total # of species)

H'max = ln(216)

H'max = 5.3752

Evenness for each of the releveès is therefore calculated by the following formula:

E = H' / H'max

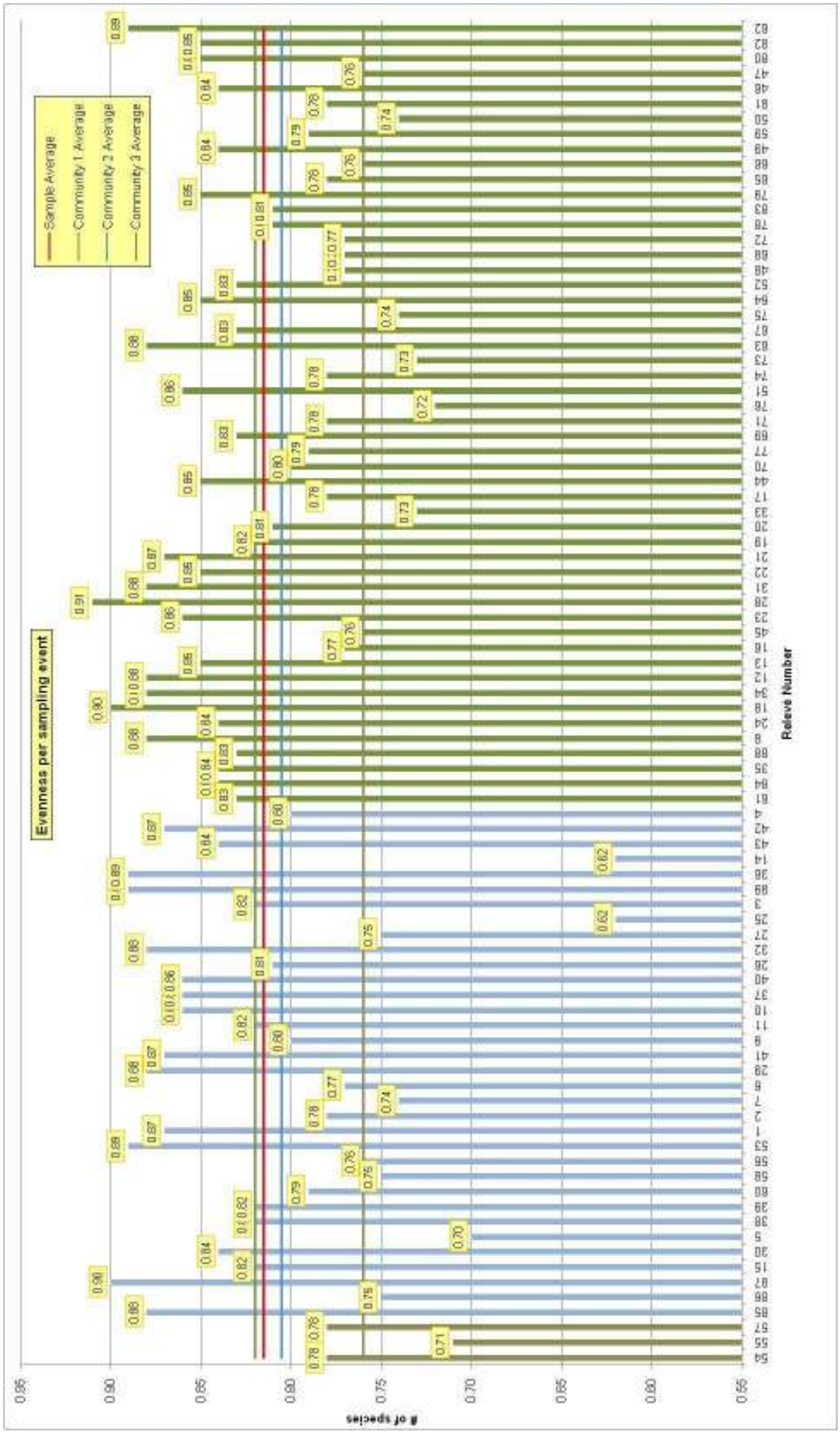
Evenness values of respective releveès are illustrated in **Graph 4**.

Comments

An average of 0.81 (std. dev. = ± 0.06) is calculated for the dataset. Typically, in areas that are disturbed, or where anthropogenic effects caused a disturbance in the species composition and abundance values, the Evenness will be characterised by low values. Similarly, in areas where the flora is dominated by a low number of species, the values are typically low. Particular reference is made of the ephemeral pans habitats where a dominant layer of grasses were recorded, exhibiting a low diversity.

A moderate degradation factor noted in the clay habitat renders the evenness values slightly lower compared to the broad-leaved woodland on sand community where a lower disturbance (lower utilisation factor) is noted.

Graph 4: Evenness Index for the sampling events



» ***Simpson's Diversity Index***

Simpson's Diversity Index is a measure of diversity. In ecology, it is often used to quantify the biodiversity of a habitat. It takes into account the number of species present (species richness), as well as the abundance of each species (evenness). Simpson's Index (D) measures the probability that two individuals randomly selected from a sample will belong to the same species (or some category other than species). The following formula is used to calculate Simpson's Index:

$$D = \frac{1}{\sum_{i=1}^{s} p_i^2}$$

With this index, 0 represents infinite diversity and 1 no diversity. That is, the bigger the value of D, the lower the diversity.

a) Simpson's Index of Diversity: 1 - D

The value of D, as calculated above is neither intuitive nor logical, so to counter this problem, D is often subtracted from 1. The value of this index still ranges between 0 and 1, but now, the greater the value, the greater the sample diversity.

b) Simpson's Reciprocal Index 1/D

Another way of overcoming the problem of the counter-intuitive nature of Simpson's Index is to take the reciprocal of the Index (1/D). The value of this index starts with 1 as the lowest possible figure. This figure would represent a community containing only one species. A higher calculated value therefore indicates a greater diversity. The maximum value is the number of species (or other category being used) in the sample. For example if there are five species in the sample, then the maximum value is 5.

Comments

Results are illustrated in **Graph 5**. Values ranges in a fairly narrow width, with an average of 11.39 for the entire sampling event; indicating a low of 1.4 in the ephemeral pan habitat and averages of 10.78 and 12.23 for the clay woodland and sand woodland communities respectively. The standard deviation for the sample set is ±4.613. The narrow width of Simpson's values across the sample set also correlates to the largely homogenous nature of the flora of the study sites.

Graph 5: Simpson's Diversity Index values for respective releveès

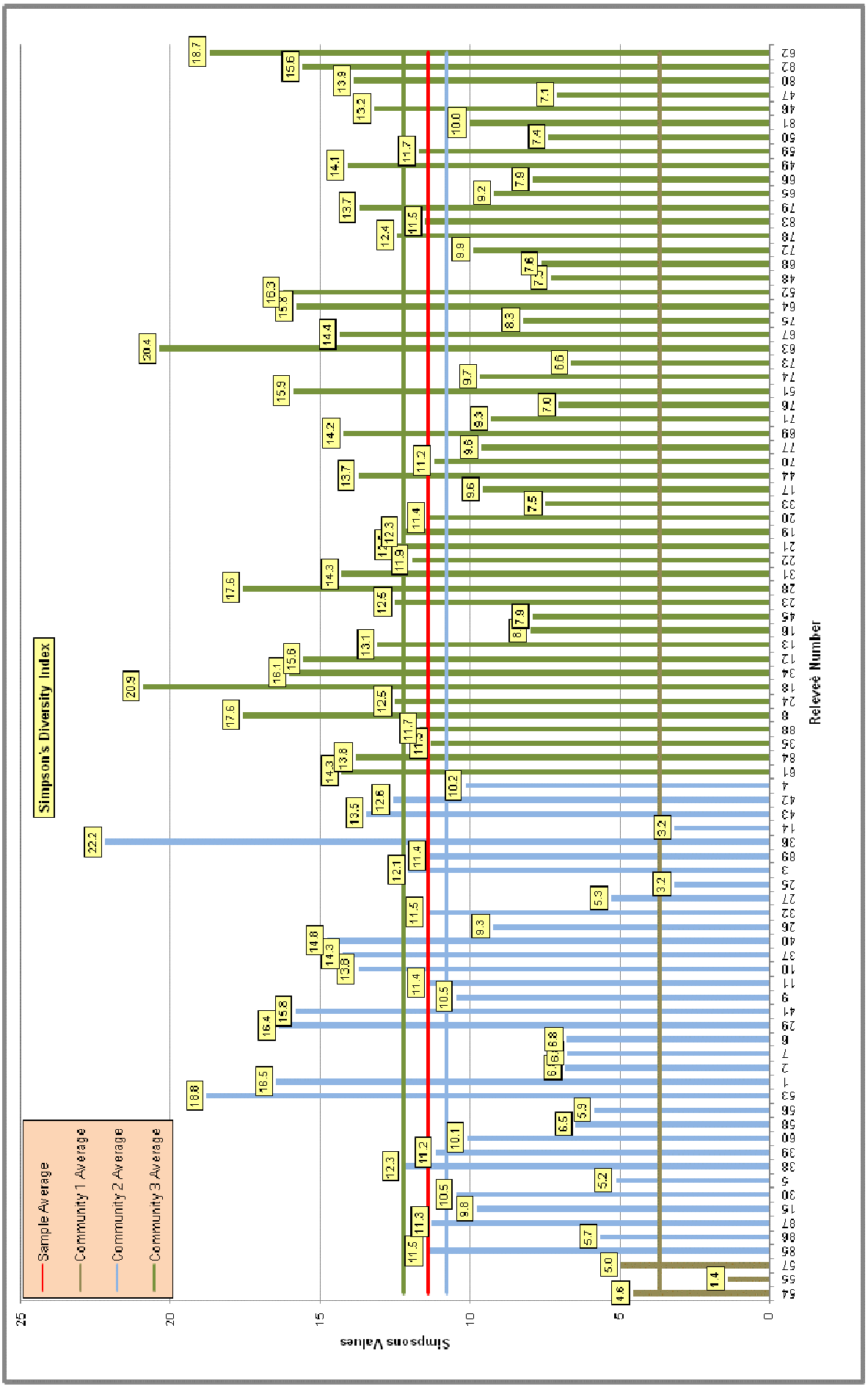


Table 13: Summary of Diversity Indices, indicating community averages				
Community	*Species Richness*	*Shannon Weiner Index*	*Evenness Index*	*Simpson's Index*
Eragrostis rotifer - Echinochloa holubii ephemeral pans	17.33	2.16	0.76	3.65
Acacia mellifera - Acacia tortilis clay woodland community	33.80	2.84	0.81	10.78
Combretum zeyheri - Eragrostis pallens sand woodland community	37.77	2.96	0.82	12.23
Sample Average	35.56	2.89	0.82	11.39

11.6 Plants with traditional and medicinal uses/ properties

Table 14 provides an annotated list of plants recorded within the study sites with traditional and medicinal uses.

Table 14: Plants with traditional medicinal values and uses recorded in the study area		
Binomial Name	*Family*	*Colloquial Name*
Acacia burkei Benth.	Black monkey thorn (e), Swartapiesdoring (a)	Medicinal uses
Acacia erioloba	Camel Thorn (e), Kameeldoring (a)	Declining Status, Protected Tree (National Forest Act, 1998), edible parts, medicinal uses, firewood
Acacia karroo Hayne	Sweet Thorn (e), Soetdoring (a)	Edible parts, dyes and tans, medicinal uses, firewood
Acacia mellifera	Black Thorn (e), Swarthaak (a)	Declared indicator of encroachment, medicinal uses, poison source
Acacia senegal var. *leiorachis*	Slender three-hook thorn (e), Slaploot (a)	Traditional use of the gum, commercially exploited
Acacia tortilis	Umbrella thorn (e), Hak-en-steek (a)	Medicinal uses (bark)
Ammocharis coranica (Ker Gawl.) Herb.	Sore eye lily (e), Seeroogblom (a)	Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998), poisonous alkaloids, medicinal uses
Arundinella nepalensis Trin.	River grass (e), Riviergras (a)	Indicator of wet conditions, medicinal properties (Lesotho), palatable
Bauhinia petersiana	Coffee neat's foot (e), Koffiebeesklou (a)	Medicinal uses, edible parts, substitute for coffee
Boscia foetida	Stink Bush (e), Stinkwitgat (a)	Medicinal uses, browsing value
Bulbine narcissifolia	Wild Kopieva (e), Wildekopieva (a)	Medicinal uses
Burkea africana Hook.	Wild seringa (e), Wildesering (a)	Medicinal properties, edible worms feeding on the bark
Cadaba aphylla (Thunb.) Wild	Desert Spray (e), Bobbejaanarm (a)	Medicinal properties, potentially poisonous
Carissa bispinosa	Forest num-num (e), Bosnoemnoem (a)	Edible parts, medicinal uses
Ceratotheca triloba (Bernh.) Hook.f.	Wild Foxglove (e), Vingerhoedblom (a)	Medicinal properties
Chascanum pinnatifidum var *pinnatifidum*	Dainty trumpets (e)	Traditional medicinal uses
Combretum imberbe Wawra	Leadwood (e), Hardekool (a)	Protected Tree (National Forest Act, 1998), firewood, medicinal uses
Combretum molle R.Br. ex G.Don	Velvet bushwillow (e), Fluweelboswilg (a)	Medicinal properties, traditional uses
Combretum zeyheri Sond.	Large-fruited bushwillow (e), Raasblaar (a)	Edible parts, timber, weaving, medicinal uses
Commelina africana	Yellow Wandering Jew (e), Geeleendagsblom (a)	Medicinal properties
Commiphora africana (A.Rich.) Engl.	Hairy corkwood (e), Harige kanniedood (a)	Water source, medicinal uses
Commiphora pyracanthoides	Common corkwood (e),	Edible parts, traditional uses

Table 14: Plants with traditional medicinal values and uses recorded in the study area		
Binomial Name	*Family*	*Colloquial Name*
Engl.	Gewone kanniedood (a)	
Corchorus asplenifolius Burch.	Gusha (e), Geel varingblaartjie (a)	Traditional and medicinal uses, edible parts
Dicerocaryum eriocarpum (Decne.) Abels	Devil's Thorn (e), Elandsdoring (a)	Medicinal uses, traditional uses
Dichrostachys cinerea	Sicklebush (e), Sekelbos (a)	Invader, medicinal properties, traditional uses, firewood, weaving
Dicoma capensis	Koorsbossie (a)	Medicinal uses
Dodonaea angustifolia L.f.	Sand olive (e), Sandolien a)	Medicinal properties
Elaeodendron transvaalensis (Burtt Davy) Codd	Bushveld Saffron (e), Bosveld-saffraan (a)	Near Threatened status, traditional and medicinal uses
Euclea natalensis A.DC. Subsp. *angustifolia* F.White	Bushveld hairy guarri (e), Bosveld harige guarrie (a)	Traditional and medicinal uses, edible parts
Gardenia volkensii	Savanna gardenia (e), Bosveldkatjiepiering (a)	Medicinal uses, carving, traditional uses
Gomphocarpus fruticosus (L.) Aiton f.	Milkweed (e), Melkbos (a)	Medicinal uses
Gossypium herbaceum subsp. *africanum*	Wild cotton (e), Wilde katoen (a)	Traditional uses
Grewia bicolor Juss.	White Raisin (e), Witrosyntjie (a)	Medicinal uses, edible parts
Grewia flava DC.	Velvet Raisin (e), Fluweelrosyntjiebos (a)	Edible parts, weaving, traditional uses, declared indicator of encroachment
Grewia occidentalis L.	Cross Berry (e), Kruisbessie (a)	Medicinal uses, larval host for *Eagris nottoana, Netrobalane canopus*
Gymnosporia buxifolia	Common spike-thorn (e), Gewone pendoring (a)	Traditional uses
Litogyne gariepina	Dwarf Sage (e), Blougifbossie (a)	Traditional uses
Lycium cinereum	Kriedoring (a), Slangbessie (a)	Traditional uses
Momordica balsamina L.	Balsam Pear (e), Laloentjie (a), Balsam Peer (a)	Edible parts, medicinal uses
Ochna pulchra Hook.	Peeling plane (e), Lekkerbreek (a)	Traditional uses
Peltophorum africanum Sond.	Weeping wattle (e), Huilboom (a)	Medicinal properties
Pergularia daemia	Bobbejaankambro (a), Kgaba	Medicinal uses
Pterocarpus rotundifolius (Sond.) Druce subsp. *rotundifolius*	Round-leaved bloodwood (e), Dopperkiaat (a)	Traditional uses, larval food for *Charaxes achaemenes achaemenes* and *Absantis venosa*
Sansevieria aethiopica Thunb.	Bowstring hemp (e), Skoonma-se-tong (a)	Medicinal properties, weaving, garden plants
Sarcostemma viminale (L.) R.Br.	Viny milkweed (e), Melktou (a)	Medicinal uses, potentially poisonous
Schkuhria pinnata (Lam.) Cabrera	Dwarf Marigold (e), Bitterbossie (a)	Medicinal uses, weed (S. America)
Sclerocarya birrea (A.Rich.) Hochst. ssp. *caffra* (Sond.) Kokwaro	Marula (e), Maroela (a)	Protected Tree (National Forest Act, 1998), edible parts, traditional uses
Securidaca longepedunculata var. *longepedunculata*	Violet tree (e), Krinkhout (a)	Medicinal uses, poisonous parts
Sericorema remotiflora (Hook.f.) Lopr.	Kwasbossie (a), Wolhaarbossie (a)	None
Setaria verticillata (L.) P.Beauv.	Bur Britle Grass (e), Klitsgras (a)	Edible parts, palatable grazing
Spirostachys africana Sond.	Tamboti (e), Tambotie (a)	Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998), timber, traditional uses, potentially poisonous
Talinum crispalatum	Wildevygie (a)	Edible parts, medicinal uses
Tarchonanthus camphoratus	Wild Camphor Bush (e),	Medicinal uses

Table 14: Plants with traditional medicinal values and uses recorded in the study area		
Binomial Name	*Family*	*Colloquial Name*
L.	Vaalbos (a)	
Terminalia sericea Burch. ex DC.	Silver cluster-leaf (e), Vaalboom (a)	Medicinal properties, timber
Tribulus terrestris L.	Common Dubbeltjie (e), Gewone Dubbeltjie (a)	Medicinal uses
Tylosema fassoglense (Schweinf.) Torre & Hillc.	Creeping Bauhinia (e), Gemsbokboontjie (a)	Medicinal uses, traditional uses
Xenostegia tridentata	Miniature Morning Glory (e), Frankhout (a)	Medicinal uses
Ziziphus mucronata	Buffalo-thorn (e), Blinkblaar-wag-'n-bietjie (a)	Edible parts, medicinal uses

11.7 Declared Alien & Invasive Species, Weeds and Encroacher Species

It should be noted that transformed and degraded areas were generally excluded from the surveys; this does therefore not represent a comprehensive catalogue of these plants. **Table 15** reflects the following weeds, encroacher and invasive plants recorded during the survey period.

Table 15: Exotic, invasive, weeds and encroacher species recorded in the study area		
Binomial Name	*Colloquial Name*	*Status*
Acacia mellifera	Black Thorn (e), Swarthaak (a)	Declared indicator of enchroachment, medicinal uses, poison source
*Achyranthes a*spera	Burrweed (e), Grootklitsbossie (a)	Naturalised exotic
Albuca seineri (Engl. & K.Krause) J.C.Manning & Goldblatt	--	Indicator of overgrazing
Alternanthera pungens Humb.	Khaki Weed (e), Dubbeltjie (a)	Weed, pioneer species
Bidens pilosa L.	Black-jack (e), Knapsekêrel (a)	Naturalised exotic, edible parts, Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)
Cereus jamacuru (L.) Mill.	Queen of the night (e), Nagblom (a)	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)
Crotalaria sphaerocarpa Perr. Ex DC. Subsp. *sphaerocarpa*	Mealie Crotalaria (e), Mielie-crotalaria	Sometimes a weed of cultivation
Cynodon dactylon (L.) Pers.	Common Couch Grass (e), Gewone kweekgras (a)	Indicator of disturbed areas, grazing potential
Cyperus esculentus	Yellow nutsedge (e), Geeluintjie (a)	Weed, edible parts (tuber)
Dichrostachys cinerea	Sicklebush (e), Sekelbos (a)	Invader, medicinal properties, traditional uses, firewood, weaving
Flaveria bidentis (L.) Kuntze	Smelter's bush, Smelterbossie (a)	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)
Gomphrena celosioides Mart.	Bachelor's button (e), Mierbossie (a)	Weed, South America
Grewia flava DC.	Velvet Raisin (e), Fluweelrosyntjiebos (a)	Edible parts, weaving, traditional uses, declared indicator of encroachment
Opuntia stricta Haw.	Pest pear of Australia (e)	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)
Schkuhria pinnata (Lam.) Cabrera	Dwarf Marigold (e), Bitterbossie (a)	Medicinal uses, weed (S. America)
Solanum elaeagnifolium Cav.	Silver-leaf bitter apple (e)	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)
Solanum species	Tamato (e), Tamatie (a)	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014) (see act for details)

12 VEGETATION DEVELOPMENT DRIVERS

Development of vegetation is generally a result of complex interacting driving forces that include climatic-, geological (soil), topographical- and moisture gradients typical of the savanna regions of southern Africa. The study area and the general surrounds are characterized by moderate to low levels of (recent) transformation that resulted from mining and industrial developments. Additionally, degradation of remaining natural woodland is evident on a local scale, resulting from livestock farming and suboptimal management strategies that tend to resulted in compositional changes of the herbaceous layer that reflected in dominance changes of the grass sward, also indicating a moderate divergence from the 'typical' composition of the primary flora type (Limpopo Sweet Bushveld, refer **Section 10.1**). Remaining natural woodland of the study area is however representative of the regional savanna vegetation. Locally, the development of vegetation patterns are likely to be driven by local soil characteristics and moisture content and inundation of the soils, generally reflected as mosaical gradients between woodland variations.

13 TWINSPAN CLASSIFICATION

The TWINSPAN classification resulted in the recognition of three broad communities. This recognition was achieved on the third cut-level of the classification (refer **Graph 6, Table 16**). Four aspects are noted in this regard:

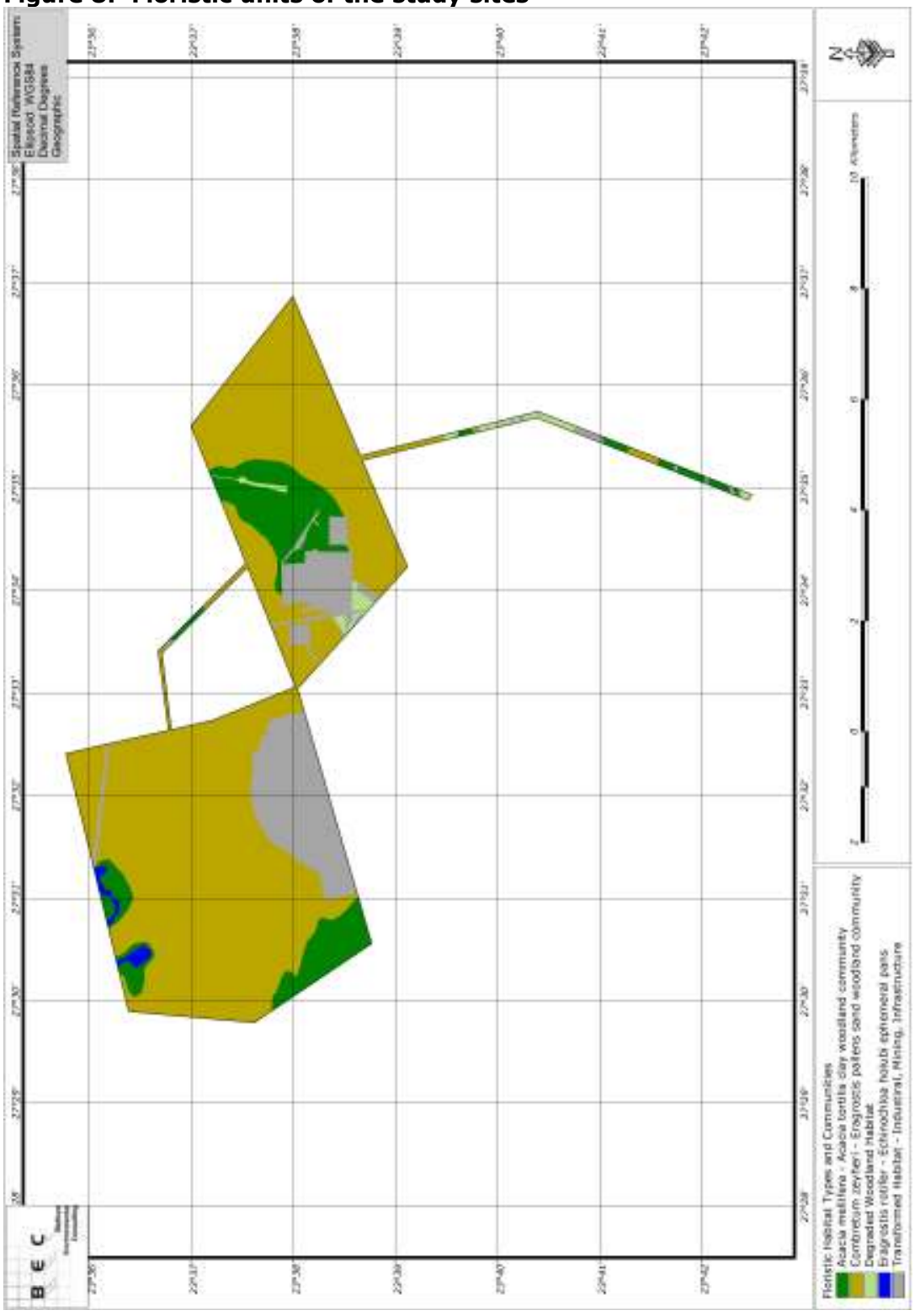
» Other, smaller variations are recognised from a visual interpretation of the physiognomy (aerial photographs). As these variations were not confirmed by the TWINSPAN results, the species composition indicated a similarity to relevant communities;
» Considering lower cut-levels, smaller variations are recognised from TWINSPAN results, but because of the characteristic species of these units comprising of low abundance forbs and low fidelity species types, these units become nonsensical and they do not translate to identifiable, distinctive and mappable units. Most often, these variations is a reflection of management and grazing patterns on a local scale;
» In the absence of detailed soil analysis and wetland delineation procedures, the mapping of units is based on a visual interpretation of the physiognomy as well as the interpretation of the TWINSPAN results. As soils and hydromorphic attributes are generally considered the driving forces behind vegetation development, the delineation of units would be more accurate should it be based on these actual borders; and
» In addition to the classified communities, other macro-habitat types were recognised, but due to a transformed and degraded state, were generally excluded from the surveys, but are illustrated on the accompanying vegetation map (refer **Figure 8**). These include:
  * Degraded woodland; and
  * Transformed habitat, including linear infrastructure, mining areas, industrial areas.

The flora of the sites is recognised as *Acacia erubescens – Stipagrostis ciliata* woodland that is typical of the region and representative of the flora of the region. The following communities were recognised from the TWINSPAN classification:

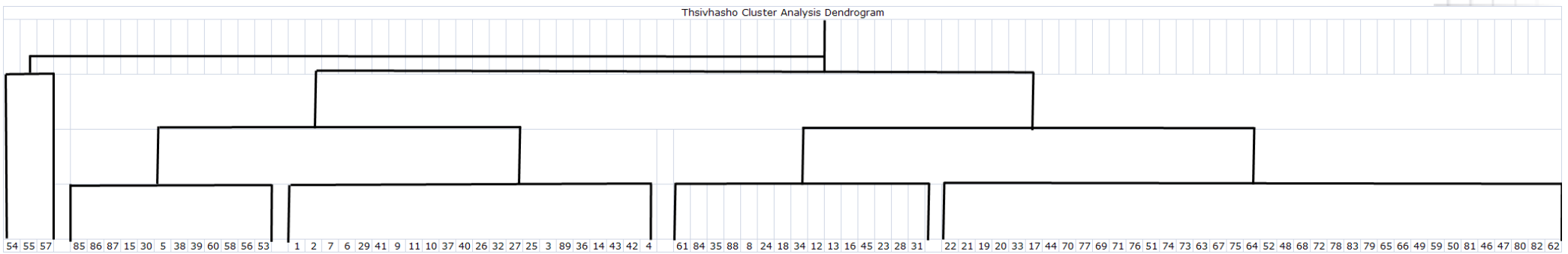
» *Eragrostis rotifer - Echinochloa holubii* ephemeral pans representing small water bodies and shallow depressions that tend to hold surface water when inundated. This habitat type was uncommon on the study area and mainly confined to a few depressions located on the northern part of the Farm Graaffwater;

» *Acacia mellifera - Acacia tortilis* microphyllous woodland on clay soils community, representing vegetation that is prominent along the drainage lines and on clay soils that are characterised by a high prominence of dense *Acacia* woodland; and
» *Combretum zeyheri - Eragrostis pallens* undifferentiated broad-leaf woodland on sandy soils is prominent and by far the most dominant habitat on the study area. It corresponds to deep, highly leached sandy soils, and is earmarked by a high prominence of medium to tall semi-deciduous woodland.

Figure 8: Floristic units of the study sites

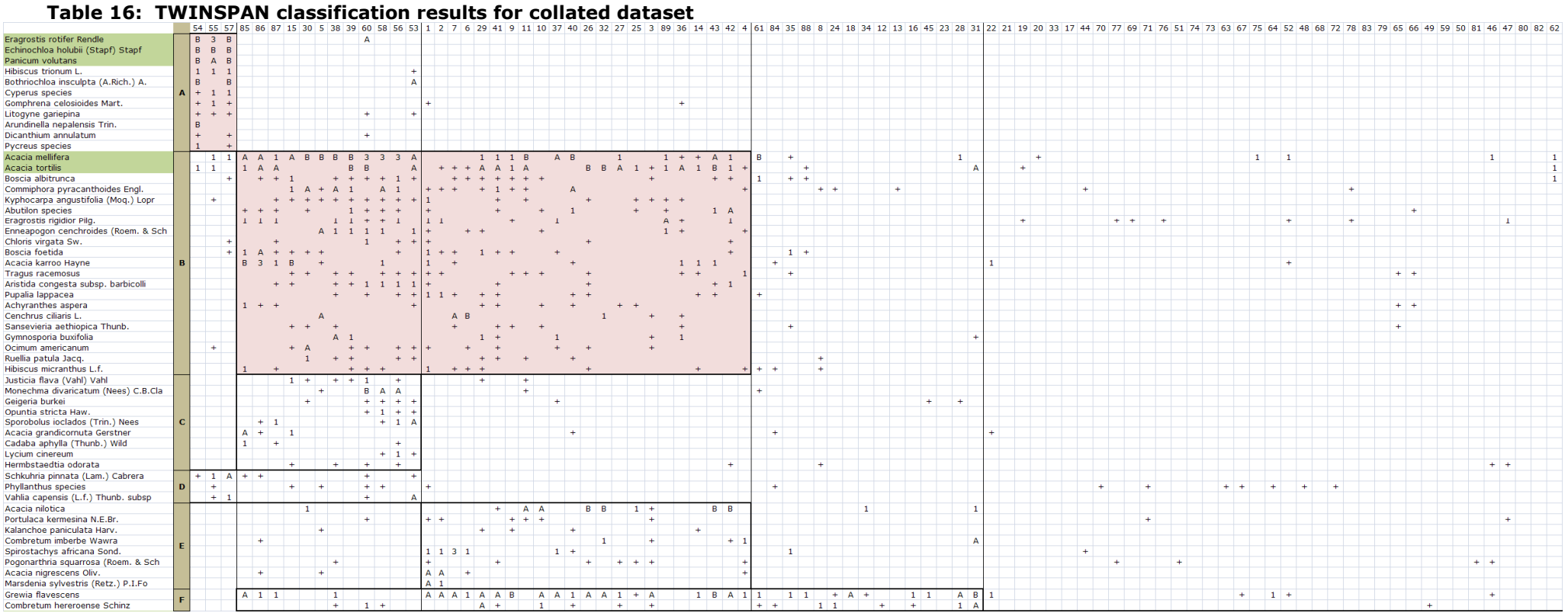


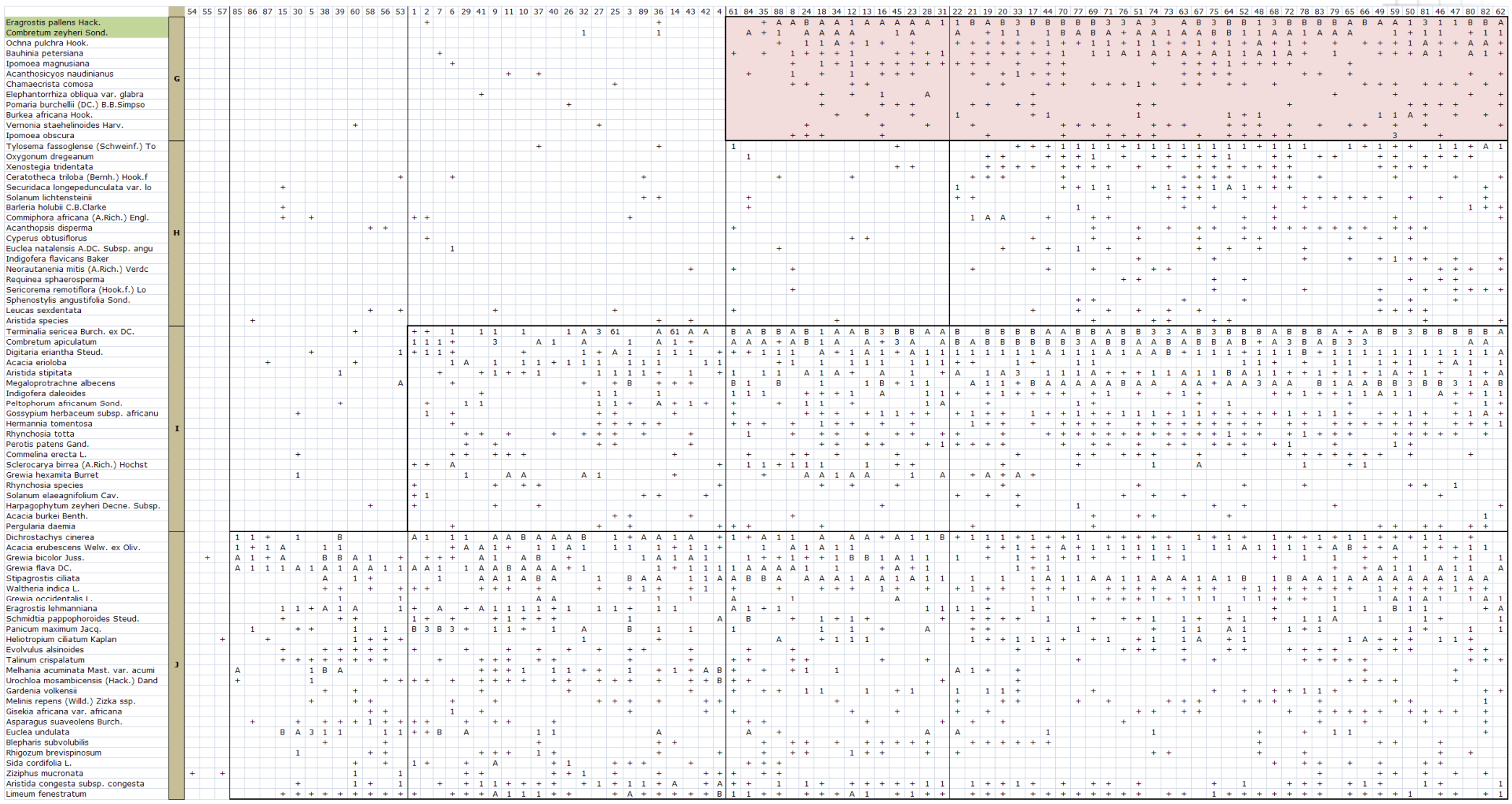
Section C



Graph 6: Cluster Analysis Dendrogram for the Twinspan analysis

Table 16: TWINSPAN classification results for collated dataset




Eragrostis pallens Hack.
Combretum zeyheri Sond.
Ochna pulchra Hook.
Bauhinia petersiana
Ipomoea magnusiana
Acanthosicyos naudinianus
Chamaecrista comosa
Elephantorrhiza obliqua var. glabra
Pomaria burchellii (DC.) B.B.Simpso
Burkea africana Hook.
Vernonia staehelinoides Harv.
Ipomoea obscura
Tylosema fassoglense (Schweinf.) To
Oxygonum dregeanum
Xenostegia tridentata
Ceratotheca triloba (Bernh.) Hook.f
Securidaca longepedunculata var. lo
Solanum lichtensteinii
Barleria holubii C.B.Clarke
Commiphora africana (A.Rich.) Engl.
Acanthopsis disperma
Cyperus obtusiflorus
Euclea natalensis A.DC. Subsp. angu
Indigofera flavicans Baker
Neorautanenia mitis (A.Rich.) Verdc
Requinea sphaerosperma
Sericorema remotiflora (Hook.f.) Lo
Sphenostylis angustifolia Sond.
Leucas sexdentata
Aristida species
Terminalia sericea Burch. ex DC.
Combretum apiculatum
Digitaria eriantha Steud.
Acacia erioloba
Aristida stipitata
Megaloprotrachne albecens
Indigofera daleoides
Peltophorum africanum Sond.
Gossypium herbaceum subsp. africanu
Hermannia tomentosa
Rhynchosia totta
Perotis patens Gand.
Commelina erecta L.
Sclerocarya birrea (A.Rich.) Hochst
Grewia hexamita Burret
Rhynchosia species
Solanum elaeagnifolium Cav.
Harpagophytum zeyheri Decne. Subsp.
Acacia burkei Benth.
Pergularia daemia
Dichrostachys cinerea
Acacia erubescens Welw. ex Oliv.
Grewia bicolor Juss.
Grewia flava DC.
Stipagrostis ciliata
Waltheria indica L.
Grewia occidentalis L.
Eragrostis lehmanniana
Schmidtia pappophoroides Steud.
Panicum maximum Jacq.
Heliotropium ciliatum Kaplan
Evolvulus alsinoides
Talinum crispalatum
Melhania acuminata Mast. var. acumi
Urochloa mosambicensis (Hack.) Dand
Gardenia volkensii
Melinis repens (Willd.) Zizka ssp.
Gisekia africana var. africana
Asparagus suaveolens Burch.
Euclea undulata
Blepharis subvolubilis
Rhigozum brevispinosum
Sida cordifolia L.
Ziziphus mucronata
Aristida congesta subsp. congesta
Limeum fenestratum
G
H
I
J

13.1 Degraded and Transformed Macro-Habitat Types

13.1.1 Degraded woodland

Isolated fragments of the study areas comprise of parts where anthropogenic activities resulted in woodland of a deteriorated state. These effects generally manifest as significant surface disturbances and an altered physiognomy, reflected in compositional and (importantly) structural variances in the vegetation. Although a moderate to strong divergence from the natural woodland physiognomy is often noted, the species composition of these parts might not necessarily always reflect the severity of the impacts; resultant recovery subsequent to disturbance often restores floristic attributes of the surrounding, natural vegetation to an extent.

However, the sequential colonisation of areas where severe surface clearance activities took place, by means of graminoid (grass) species, resulted in an altered floristic composition, while the absence of a dominant tree layer appears structurally atypical to surrounding natural vegetation of the region. Typically, after a prolonged lapse of time, restoration of a woody layer will often comprise of microphyllous species, including *Acacia* species and *Dichrostachys cinerea*. Because of the limited surface area that these fragments comprise, the presence of this macro-habitat type within a particular site alternative is not expected to be essential for recommendation purposes. The fortuitous inclusion of these parts within a recommended area will however result in less of the surrounding natural vegetation affected by the proposed development. Geographically, these areas are often spatially situated in relative proximity to existing developments and areas where intensive anthropogenic activities are taking place. A medium-low to low floristic sensitivity is frequently ascribed to these parts, depending on the level of transformation/ degradation and subsequent recovery of the vegetation.

13.1.2 Transformed habitat, including linear infrastructure, mining areas, industrial areas

Anthropogenic induced activities, mostly including mining and industrial developments and associated linear infrastructure, such as roads, railways, overland conveyors, etc. have resulted in the complete decimation of vegetation in parts of the project area. The absence of any remaining natural vegetation within these parts renders the floristic sensitivity low. These particular areas might not be technically and practically feasible for the proposed development and operation of a power plant.

An important aspect that is also considered in assessing the suitability of an area for the proposed development is the proximity of a particular site alternative to these areas of transformed habitat. The concentration of industrial developments into 'nodal' development areas (as opposed to widespread and isolated areas of development), is an important consideration in the cumulative effect that industrial developments have in the natural environment.

13.2 *Acacia erubescens – Stipagrostis ciliata* woodland

This macro-habitat type represents the typical vegetation of the Limpopo Sweet Bushveld. The absence of topographical variability and other significant biophysical attributes such as highly variable soils and underlying geological patterns are major factors in the physiognomically homogeneous appearance of this woodland type. However, on closer inspection, the variability in the vegetation composition and structure does become evident and numerous imbedded variations are present, typified by subtle disparities in the dominance of noteworthy trees and shrubs. These subtle variations that are recorded on ground level cannot always be differentiated from aerial imagery and is, most often, likely to be driven by localised (minor) variations in soil characteristics and slight topographical and hydromorphic variability. Local landscape undulations results in substrate variances, manifesting as lowlands with clayey soils, and slopes and crests where sandy soils prevail. Vague botanical patterns follow these trends in the soil typification, hence the differentiation of the two communities within the study areas.

A relatively high diversity of protected trees is known to be present across the region. This area contains a particular high density of Marula (*Sclerocarya birrea*), Camel thorn (*Acacia erioloba*) trees, while Tamboti (*Spirostachys africana*) and Leadwood (*Combretum imberbe*) are typically associated with non-perennial drainage lines and floodplain habitat types. Matopi (*Boscia albitrunca*) persist across a wide range of habitat types.

The following floristic variations are known to persist within the region:

1. Undifferentiated broad-leaved woodland on sandy soils - This habitat type is prominent corresponds to deep, highly leached sandy soils;
2. Microphyllous woodland on low-lying areas - This habitat type is characterised by a high prominence of dense *Acacia* woodland on clay soils such as *Acacia karroo* (Sweet Thorn), *A. luederitzii* (Brackish Thorn), *A. mellifera* (Black Thorn), *A. tortilis* (Umbrella Thorn), *Boscia albitrunca* (Shepherd's Tree) and *Commiphora pyracanthoides* (Common Kanniedood) ;and
3. Hydromorphic variations that are typically associated with ephemeral floodplains and areas where standing water persist for prolonged periods of the year. These areas are typically also associated with areas where high clay content in the soils prevails.

Other finer variations are noted on a local and regional scale and these are most often associated with local management variations and differentiations that result from different grazing strategies and stocking rates. For the purpose of this report, these variations are not recognised as important as similar compositional and structural aspects and, ultimately, sensitivity recommendations.

13.2.1 Eragrostis rotifer - Echinochloa holubii ephemeral pans

This unit comprises small parts of the study area, mainly situated in the northern section of the Farm and consisting of uncommon and isolated depressions located on the northern part of the Farm Graaffwater. The main developmental factors of these areas include clayey substrates that forms into ephemeral pans where water accumulates subsequent to raining events, containing water for prolonged periods of the year. Due to the availability of water, vegetation surrounding these parts is 'sweet' and most often well utilised by browsers and grazers. This community is also situated as embedded units within the *Acacia mellifera - Acacia tortilis* clay woodland community and is topographically slightly lower than surrounding woodlands, confirmed by the prominence of microphyllous (*Acacia* type) vegetation, more specifically *Acacia mellifera* and *Acacia tortilis.* Clayey areas are able to retain water for longer periods of the year and vegetation typical of these parts often develops in zonal patterns, depending of the distance and topographical placement from the lowest topographical point of the landscape (on a local scale).

Species that characterise this community include the grasses *Eragrostis rotifer, Echinochloa holubii, Panicum volutans, Bothriochloa insculpta*, and *Dichanthium annulatum*. Forbs that occur sporadically in this community include *Hibiscus trionum, Cyperus species, Gomphrena celosioides*, and *Schkuhria pinnata.*

The species diversity within these areas is low, compared to other communities (refer **Table 13**):

- Species diversity: 17.3 vs. 35.6 for the complete dataset;
- Evenness values: 0.76 vs. 0.815 for the complete dataset;
- Simpson's Diversity Index: 3.65 vs. 11.39 for the complete dataset; and
- Shannon Weiner values: 2.16 vs. 2.89 for the complete dataset.

In spite of the low diversity values for this community, the ecological importance and contribution that these areas make in a (largely) xeric environment, is extremely important. Faunal and avifaunal attributes associated with these areas are diverse and, similarly, important on a local and regional scale. Therefore, in spite of a moderate floristic sensitivity, the ecological value enhances the importance of these areas beyond the purely botanical attributes. The botanical sensitivity is therefore artificially enhanced to reflect the ecological importance of these parts of the study sites.

13.2.2 Acacia mellifera - Acacia tortilis microphyllous woodlands on clay soils

This unit comprises parts of the sites where clayey soils predominate. Due to the 'sweet' (or palatable) nature of the herbaceous layer that characterise these parts, high grazing pressure and subsequent habitat deterioration is frequently observed. The structural dominance of *Acacia* species in some parts, or an excessively dense woody stratum is characteristic of these areas. The dominance of *Acacia mellifera* in some parts is the result of competitive exclusion of other woody species. Due to the clayey disposition of soils in these parts, the moisture retaining characteristics of soils are highly efficient; more so than the surrounding sandy

plains. Structurally, this community comprises of a dominant woody layer within the 3 to 5 m height classes, with poorly developed herbaceous layer.

Vegetation, particularly the grass sward that typifies these areas, is 'sweet' and palatable. Naturally, the grazing of the grass sward is intense, particularly during the winter period. The presence of bare soils in some parts provides evidence of the intensive nature of utilisation of the vegetation in these parts. Severe and prolonged high stocking rates in these parts frequently lead to surface deterioration and erosion of the topsoils.

Protected trees that are known to occur in this habitat type include *Acacia erioloba, Boscia albitrunca, Combretum imberbe, Sclerocarya birrea,* and *Spirostachys africana.* In addition to the characteristic species, other noteworthy taxa include the woody species *Boscia albitrunca, Commiphora pyracanthoides, Boscia foetida, Acacia karroo, A. nilotica, A. erubescens, Grewia bicolor, G. flava, G. occidentalis, and the grasses Eragrostis rigidior, Enneapogon cenchroides, Chloris virgata, Tragus racemosus, Aristida congesta* subsp*. barbicollis, Eragrostis lehmanniana, Schmidtia pappophoroides, Panicum maximum*, as well as the forbs *Kyphocarpa angustifolia, Abutilon species, Limeum fenestratum* and *Melhania acuminata.*

Two variations are noted in this community (refer **Table 16**; compare Species Groups C & D vs. Species Groups E & I). The disparity in species composition of these variations represents a degradation gradient as well as an ecotonal variability between sandveld and clayveld woodland types (specifically Species Group I).

Diversity values of this community correspond with values of the study area in large, albeit slightly lower, also presenting similar values compared to the sandveld community of the area (refer **Table 13**):

» Species diversity: 33.8 vs. 35.6 for the complete dataset;
» Evenness values: 0.81 vs. 0.815 for the complete dataset;
» Simpson's Diversity Index: 10.78 vs. 11.39 for the complete dataset; and
» Shannon Weiner values: 2.84 vs. 2.89 for the complete dataset.

This community represents one of the typical variations that are encountered on a regional scale, although not comprising extensive parts of the regional vegetation type. In spite of a limited geographical representation, the ecological contribution is nonetheless important, as it is known that faunal and avifaunal diversity within these parts are high. Therefore, a moderate floristic sensitivity is ascribed, but the ecological contribution on a regional scale will generally exceed the floristic attributes. The presence of various protected tree species within this unit, albeit in similar densities to other variations and communities, renders this area moderately sensitive.

13.2.3 Combretum zeyheri - Eragrostis pallens broad-leafed woodland on sandy soils

This community is earmarked by a prominence of medium to tall woodland with an open canopy, corresponding to deep, highly leached sandy soils and is characterised by the presence of woody species such as *Combretum zeyheri, Ochna pulchra, Bauhinia petersiana, Burkea africana,* and other notable herbaceous taxa such as *Eragrostis pallens* and *Ipomoea magnusiana*. In addition to the characteristic species, other dominant, but common tree and shrub species include *Terminalia sericea, Combretum apiculatum, Acacia erioloba, Peltophorum africanum, Sclerocarya birrea, Dichrostachys cinerea, Acacia erubescens, Grewia bicolor,* and *Grewia flava*. Typical (dominant) grasses include *Digitaria eriantha, Aristida stipitata,* and *Eragrostis lehmanniana.* Dominant forbs include *Indigofera daleoides, Gossypium herbaceum* subsp*. africanus, Hermannia tomentosa, Rhynchosia totta, Waltheria indica,* and *Heliotropium ciliatum.*

Structurally, this community conforms to tall, open to closed, tall to high woodland. It would appear that historic pyrophytic events have affected parts of the region. As the vegetation, with particular reference to tall trees, do not display a particularly high resilience to fire events, the physical dimensions of trees in these parts are lower compared to areas where no recent fire events were experienced.

This community comprises the largest part of the study sites, and represents a typical woodland variation of the regional ecological type. The presence of protected trees within this unit renders the floristic sensitivity of the community moderate. No floristic attribute was recorded that would elevate the floristic importance and inherent sensitivity to a significant level. The homogenous nature of the biophysical and topographical features is reflected in the similarly homogenous nature of the vegetation. Floristic diversity in these parts is however comparatively high (refer **Table 13**):

» Species diversity: 37.8 vs. 35.6 for the complete dataset;
» Evenness values: 0.82 vs. 0.815 for the complete dataset;
» Simpson's Diversity Index: 12.23 vs. 11.39 for the complete dataset; and
» Shannon Weiner values: 2.96 vs. 2.89 for the complete dataset.

13.3 Photographic evidence of various habitat types and pertinent aspects

Photo 1: Degraded habitat that resulted in artificial impoundments

Photo 2: Typical broad-leafed woodland on sandy soils

Photo 3: Typical broad-leafed woodland on sandy soils

Photo 4: Nelsonskop outcrop situated in proximity to the proposed power line

Photo 5: Typical broad-leafed woodland on sandy soils; note particularly tall trees

Photo 6: Typical microphyllous woodland on clayey soils

Photo 7: Example of protected tree – *Securidaca longepedenculata*

Photo 8: Example of an ephemeral pan

Photo 9: Example of an ephemeral pan with surrounding microphyllous *Acacia* vegetation type

Photo 10: Typical microphyllous woodland on clayey soils; note severely degraded herbaceous stratum

Photo 11: Example of protected tree – *Boscia albitrunca*

Photo 12: Example of protected tree – *Combretum imberbe*

13.4 Floristic Sensitivity of the study area

For existing protected areas and species, the floristic importance ascribed to certain areas is obvious. Similarly, many countries will have differentiated the biodiversity importance of their protected areas (national or local) as part of their designation. Outside of protected areas, but within areas that are clearly of value for biodiversity, the evaluation of importance is more complex and vague. It is important to note that the absence of protected status should never be interpreted as low biodiversity importance; many areas of international importance for biodiversity lie outside of protected areas. The challenge is to include a suitable range of criteria to determine whether the site is of local, regional, national or international importance. Although no universal standard exists, some of the common criteria include the following:

» **Species/habitat richness:** In general, the greater the diversity of habitats or species in an area, the more valuable the area is. Habitat diversity within an ecosystem can also be very valuable. Habitat mosaics are extremely valuable, as some species that depend on different types of habitat may live in the transition zone between the habitats.
» **Species endemism:** Endemic species typically occur in areas where populations of a given species have been isolated for sufficiently long to evolve distinctive species-specific characteristics, which prevent out-breeding with other species populations.
» **Keystone species:** A keystone species is one that exerts great influence on an ecosystem relative to its abundance or total biomass. For example, a keystone predator may prevent its prey from overrunning an ecosystem. Other keystone species act as 'ecosystem engineers' and transfer nutrients between ecosystems.
» **Rarity:** The concept of rarity can apply to ecosystems and habitats as well as to species. Rarity is regarded as a measure of susceptibility to extinction, and the concept is expressed in a variety of terms such as vulnerable, rare, threatened or endangered.
» **Size of the habitat:** The size of a natural area is generally considered as important. It must be big enough to be viable, which relates to the resistance of ecosystems and habitats to activities at the margins, loss of species and colonization of unwanted species. Habitat connectivity is also of related importance and refers to the extent of linkages between areas of natural habitat – high levels of connectivity between different habitats or patches of the same habitat are desirable.
» **Population size:** For example, in international bird conservation, it has become established practice to regard 1 per cent of a species' total population as significant in terms of protective requirements. For some large predators, it is important to know that an area is large enough to encompass the home range of several individuals and allow them to persist successfully.
» **Fragility:** This refers to the sensitivity of a particular ecosystem or habitat to human-induced or natural environmental changes and its resilience to such changes.
» **Value of ecosystem services:** The critical importance of ecosystem services is widely appreciated.

Habitat sensitivity is categorised as follows:

Low No natural habitat remaining; this category is represented by developed/ transformed areas, nodal and linear infrastructure, areas of agriculture or cultivation, areas where exotic species dominate exclusively, mining land (particularly surface mining), etc. The possibility of

these areas reverting to a natural state is impossible, even with the application of detailed and expensive rehabilitation activities. Similarly, the likelihood of plant species of conservation importance occurring in these areas is regarded negligent.

Medium – low All areas where the natural habitat has been degraded, with the important distinction that the vegetation has not been decimated and a measure of the original vegetation remains, albeit dominated by secondary climax species. The likelihood of plant species of conservation importance occurring in these areas is regarded low. These areas also occur as highly fragmented and isolated patches, typical to cultivated fields, areas that have been subjected to clearing activities and areas subjected to severe grazing pressure. The species composition of these areas is typically low and is frequently dominated by a low number of species, or invasive plants.

Medium Indigenous natural habitat that comprises habitat with a high diversity, but is characterised by moderate to high levels of degradation, fragmentation and habitat isolation. Also includes areas where flora species of conservation importance could potentially occur, but habitat is regarded marginally.

Medium – high Indigenous natural vegetation that comprises a combination of the following attributes:

- The presence of habitat that is suitable for the presence of these species;
- Areas that are characterised by a high/ moderate-high intrinsic floristic diversity;
- Areas characterised by moderate to low levels of habitat fragmentation and isolation;
- Regional vegetation types that are included in the lower conservation categories, particularly prime examples of these vegetation types;
- Low to moderate levels of habitat transformation;
- A moderate to high ability to respond to disturbance factors;

It may also include areas that are classified as protected habitat, but that are of a moderate status.

High Indigenous natural vegetation that comprises a combination of the following attributes:

» The presence of plant species of conservation importance, particularly threatened categories (Critically Endangered, Endangered, Vulnerable);
» Areas where 'threatened' plants are known to occur, or habitat that is highly suitable for the presence of these species;
» Regional vegetation types that are included in the 'threatened' categories (Critically Endangered, Endangered, Vulnerable), particularly prime examples of these vegetation types;
» Habitat types are protected by national or provincial legislation (Lake Areas Act, National Forest Act, draft Ecosystem List of NEM:BA, Mountain Catchment Areas Act, Ridges Development Guideline, Integrated Coastal Zone Management Act, etc.);
» Areas that have an intrinsic high floristic diversity (species richness, unique ecosystems), with particular reference to Centres of Endemism;

These areas are also characterised by low transformation and habitat isolation levels and contribute significantly on a local and regional scale in the ecological functionality of nearby

and dependent ecosystems, with particular reference to catchment areas, pollination and migration corridors, genetic resources. A major reason for the high conservation status of these areas is the low ability to respond to disturbances (low plasticity and elasticity characteristics).

General floristic sensitivity estimations are calculated in **Table 17**. These estimations are used to ascribe a general floristic sensitivity value to units of the respective variations, illustrated in **Figure 9**. Additional aspects that are taken into consideration include surrounding habitat sensitivity, conservation potential, fragmentation and habitat isolation factors.

Table 17: Floristic sensitivity calculations								
Criteria	*RD species*	*Landscape sensitivity*	*Status*	*Species diversity*	*Functionality/ fragmentation*	*TOTAL*	*SENSITIVITY INDEX*	*SENSITIVITY CLASS*
Community	**Criteria Ranking**							
Eragrostis rotifer - Echinochloa holubii ephemeral pans;	4	10	7	6	10	222	69%	**Medium-high**
Acacia mellifera - Acacia tortilis clay woodland community; and	4	5	6	6	8	170	53%	**Medium**
Combretum zeyheri - Eragrostis pallens sand woodland community.	4	5	7	7	8	181	57%	**Medium**
Degraded woodland	2	5	2	3	2	93	29%	**Medium-low**
Transformed habitat, including linear infrastructure, mining areas, industrial areas	0	0	0	1	1	14	4%	**Low**

Figure 9: Floristic Sensitivity of the study sites

14 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.

14.1 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 losses of vegetation. 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:

» Loss of plant taxa (individuals, stands, populations) of conservation importance (threatened taxa) as well as plan taxa of conservation concern (declining status, provincially protected taxa);
» Loss of natural vegetation (physical modifications, removal, damage) and local depletion of plant taxa, reduction of phytodiversity; and
» Loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance.

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 significance 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 particular reference to the ecological interaction between plants and animals. The aesthetic appeal of the region, although a subjective and highly debatable attribute, is regarded a potential receiver of landscape changes through the addition of industrial developments, 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:

» Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc., also including Impacts on habitat types that are associated with plants of conservation importance (decreased habitat

quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.);
» Altered quality and ecological functionality (including fire, erosion) of surrounding areas and natural habitat;
» Exacerbated encroachment of invasive, exotic and encroacher plant species; and
» Decreased aesthetic appeal of the landscape.

Lastly, impacts of a cumulative nature places direct and indirect impacts of this project 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:
» Increased exploitation of natural resources due to increased human presence and resource requirements;
» Exacerbation of existing levels of habitat fragmentation and isolation; and
» Cumulative impacts on local/ regional and national conservation targets and obligations.

14.2 Quantification of Impacts on the Floristic Environment – Power Plant

Table 18: Quantification of impacts of the Power Plant on the floristic environment		
1. Nature of impact:	Direct impacts on or losses of flora species of conservation importance and concern and habitat associated with these species, with particular reference to protected tree species occurring in the study sites. Impacts are unavoidable because of land clearing activities, but are generally restricted to the immediate area. This impact is restricted to the construction phase, but is permanent	
	Without mitigation	***With mitigation***
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Definite (5)**	**Highly probable (4)**
Significance	**High (80)**	**Moderate (56)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Unavoidable impacts on protected trees/ conservation important plants will occur, irrespective of mitigation measures, albeit restricted to local footprint	
Mitigation Measures:	• Extent of impact likely to restricted to site only • Selected species and individuals should be rescued and replanted at suitable localities, with specific reference to required landscaping and rehabilitation of development areas • Permitting requirements need to be met prior to destruction/ removal of any protected plant species.	
Cumulative Impacts:	This impact contributes in a cumulative manner (regionally) to losses of protected species due to exacerbated developments and loss of natural habitat, decrease in habitat available for species of conservation concern and importance, potentially increase in threat level	
Residual Impacts:	Sterilised landscapes with no propensity for species of conservation concern, decline in population sizes and numbers, continual decline in habitat availability	
2. Nature of impact:	Losses of natural vegetation through physical transformation, modifications, removals and damage. Also includes the depletion of phytodiversity on a local scale and reduction in natural vegetation and species naturally occurring in the	

	region

	Without mitigation	With mitigation
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Definite (5)**	**Definite (5)**
Significance	**High (65)**	**Moderate (55)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, to some extent	
Can impacts be mitigated?	No	
Mitigation Measures:	• restrict losses of natural vegetation to footprints, • avoid peripheral or unnecessary losses of natural vegetation, • ensure proper rehabilitation and landscaping practices, • ensure nodal developments by grouping developments structures, • avoid uncontrolled spread of infrastructure	
Cumulative Impacts:	This impact contributes in a cumulative manner (regionally) to losses of natural vegetation due to exacerbated developments in the region. Exacerbated anthropogenic encroachment places increasing demands on resources, such as housing, water, etc.	
Residual Impacts:	Decreased aesthetic appeal, loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat	

3. Nature of impact:	Direct impacts on or losses of atypical, sensitive and conservation important habitat types or ecosystems of particularly restricted occurrence, also with reference to habitat types where conservation important plants are likely to persist

	Without mitigation	With mitigation
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (52)**	**Moderate (33)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Restrict footprints to areas where low floristic sensitivity has been indicated, avoid areas of higher floristic sensitivity. • Avoid peripheral or unnecessary losses of natural vegetation, • ensure proper rehabilitation and landscaping practices, • ensure nodal developments by grouping developments structures, • avoid the uncontrolled spread of infrastructure; access roads, power lines, conveyor lines, etc.	
Cumulative Impacts:	Loss and degradation of natural habitat within the surrounds for the development footprint, with particular reference to restricted or sensitive habitat receptors	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat	

4. Nature of impact:	Impact on surrounding areas of natural habitat, habitat deterioration, surface water runoff, fragmentation and habitat isolation, etc. It is generally expected to be of low significance due to a moderate sensitivity of surrounding areas. Also includes species changes brought about from alien and invasive encroachment

	Without mitigation	With mitigation
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (48)**	**Low (27)**

Status (positive or negative)	Negative
Reversibility	Moderately reversible, the nature of impacts are such that activities on the development site can be adapted to avoid impacts in surrounding areas
Irreplaceable loss of resources?	Low
Can impacts be mitigated?	Yes
Mitigation Measures:	• Restrict development to footprints areas • Avoid peripheral or unnecessary losses or deterioration of natural vegetation, • ensure proper rehabilitation and landscaping practices,
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, with particular reference to surrounding areas
Residual Impacts:	Increase in habitat fragmentation and isolation, loss and deterioration of natural habitat

5. Nature of impact:	Impacts on ecological connectivity and ecosystem functioning. Although the site is regarded homogenous in nature, it does contribute towards local ecological functionality in providing in the life requirements of numerous plants and animals	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Definite (5)**	**Definite (5)**
Significance	**High (70)**	**Moderate (55)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Limit development to footprint area, • avoid impacts, losses and deterioration of adjacent natural habitat, • implement biodiversity monitoring programmes, alien and invasive management programmes	
Cumulative Impacts:	Habitat loss, degradation, fragmentation & isolation of natural habitat	
Residual Impacts:	Fragmented, isolated portions of natural habitat, sterile landscapes, increased anthropogenic pressures on natural resources	

6. Nature of impact:	Encroachment of invasive, exotic and encroacher plant species	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Long term (4)**	**Long term (4)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (52)**	**Moderate (30)**
Status (positive or negative)	Negative	
Reversibility	Reversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• biodiversity monitoring programmes • alien and invasive management programmes • early detection and eradication programmes	
Cumulative Impacts:	Habitat degradation and deterioration, loss of species diversity and ecosystem functionality	
Residual Impacts:	Degraded landscapes, loss of aesthetic appeal, poor species diversity	

7. Nature of impact:	Loss of aesthetic appeal of the landscape	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Minor (2)**	**Minor (2)**
Probability	**Definite (5)**	**Highly probable (4)**

Significance	**Moderate (50)**	**Moderate (36)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	No	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Rehabilitation and landscaping that aims to simulate the natural environment • Make use of indigenous vegetation for rehabilitation • Make use of large, indigenous trees around development areas for screening purposes	
Cumulative Impacts:	Increase in anthropogenic activities that leads to further habitat losses and decreased aesthetic appeal on a wider scale	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	
8. Nature of impact:	Increased exploitation of natural resources due to increased human presence and resource requirements, also with reference to wood collection by local population	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Low (4)**	**Low (4)**
Probability	**Probable (3)**	**Improbable (2)**
Significance	**Moderate (36)**	**Low (24)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Public awareness programmes, • Implementation of biodiversity monitoring protocols, • Search and rescue operations, • Landscaping programmes making use of local species and vegetation	
Cumulative Impacts:	Loss of biodiversity on a local scale, continued/ exacerbated loss of protected species and natural vegetation, also with regards to the collection of firewood by local population	
Residual Impacts:	Decreasing floristic diversity, potential increase in threat status to certain taxa, exacerbated losses of phytodiversity, changes to local flora patterns	
9. Nature of impact:	Accelerated development patterns on a local and regional level implies significant increases in local and regional habitat fragmentation and isolation levels	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Highly probable (4)**
Significance	**Moderate (56)**	**Moderate (48)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to a limited extent	
Mitigation Measures:	• Contribute to the Waterberg Development Forum through submission of monitoring results and mitigation strategies; • Limit development to footprint area	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, intricate and excessive infrastructure, with particular reference to residential demands and linear infrastructure	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	
10. Nature of impact:	Cumulative impacts on conservation obligations & targets. The conservation status of ecological habitat is regarded Least Concerned and the loss of the site is not expected to result in an escalation of the threat level on a local or regional scale. Habitat loss is however, permanent and local development patterns indicate accelerated losses of natural habitat.	

	Without mitigation	With mitigation
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Minor (2)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (40)**	**Low (27)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to a limited extent	
Mitigation Measures:	• Containment, prevention of spread of impacts beyond site boundaries, • Contribute to local conservation collaborations, if available	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, loss of phytodiversity, decreased aesthetic appeal	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat, sterile landscapes	

14.3 Quantification of Impacts on the Floristic Environment – Ashing Facility – Appelvlakte

Table 19: Quantification of impacts of the Ashing Facility on the floristic environment		
1. Nature of impact:	Direct impacts on and losses of flora species of conservation importance and concern and habitat associated with these species, with particular reference to protected tree species occurring in the study sites. Impacts are unavoidable because of land clearing activities, but are generally restricted to the immediate area. This impact is restricted to the construction phase, but is permanent	
	Without mitigation	***With mitigation***
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Moderate (6)**
Probability	**Definite (5)**	**Highly probable (4)**
Significance	**High (70)**	**Moderate (56)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Unavoidable impacts on protected trees/ conservation important plants will occur, irrespective of mitigation measures, albeit restricted to local footprint	
Mitigation Measures:	• Extent of impact likely to restricted to site only • Selected species and individuals should be rescued and replanted at suitable localities, with specific reference to required landscaping and rehabilitation of development areas • Permitting requirements need to be met prior to destruction/ removal of any protected plant species.	
Cumulative Impacts:	This impact contributes in a cumulative manner (regionally) to losses of protected species due to exacerbated developments and loss of natural habitat, decrease in habitat available for species of conservation concern and importance, potentially increase in threat level. Existing industrial developments area already present on this farm	
Residual Impacts:	Sterilised landscapes with no propensity for species of conservation concern, decline in population sizes and numbers, continual decline in habitat availability	
2. Nature of impact:	Losses of natural vegetation through physical transformation, modifications, removals and damage. Also includes the depletion of phytodiversity on a local scale and reduction in natural vegetation and species naturally occurring in the region	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Definite (5)**	**Definite (5)**
Significance	**High (65)**	**Moderate (55)**

Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, to some extent	
Can impacts be mitigated?	No	
Mitigation Measures:	• Restrict losses of natural vegetation to development footprints, • Avoid peripheral or unnecessary losses of natural vegetation, • Ensure proper rehabilitation and landscaping practices, • Ensure nodal developments by grouping developments structures, • Avoid uncontrolled spread of infrastructure	
Cumulative Impacts:	This impact contributes in a cumulative manner (regionally) to losses of natural vegetation due to exacerbated developments in the region. Exacerbated anthropogenic encroachment places increasing demands on resources, such as housing, water, etc.	
Residual Impacts:	Decreased aesthetic appeal, loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat	
3. Nature of impact:	Direct impacts on/ losses of atypical, sensitive and conservation important habitat types or ecosystems of particularly restricted occurrence, also with reference to habitat types where conservation important plants are likely to persist	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Probable (3)**	**Probable (3)**
Significance	**Moderate (39)**	**Moderate (33)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Restrict footprints to areas where low floristic sensitivity has been indicated, avoid areas of higher floristic sensitivity. • Avoid peripheral or unnecessary losses of natural vegetation, • Ensure proper rehabilitation and landscaping practices, • Ensure nodal developments by grouping developments structures, • Avoid the uncontrolled spread of infrastructure; access roads, power lines, conveyor lines, etc.	
Cumulative Impacts:	Loss and degradation of natural habitat within the surrounds for the development footprint, with particular reference to restricted or sensitive habitat receptors	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat	
4. Nature of impact:	Impact on surrounding areas of natural habitat, such as habitat changes, surface water runoff, fragmentation and habitat isolation, etc. It is generally expected to be of low significance due to a moderate sensitivity of surrounding areas. Also includes species changes brought about from alien and invasive encroachment	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (48)**	**Low (24)**
Status (positive or negative)	Negative	
Reversibility	Moderately reversible, the nature of impacts are such that activities on the development site can be adapted to avoid impacts in surrounding areas	
Irreplaceable loss of resources?	Low	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Restrict development to footprints areas • Avoid peripheral or unnecessary losses or deterioration of natural vegetation, • Ensure proper rehabilitation and landscaping practices,	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, with particular	

	reference to surrounding areas	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss and deterioration of natural habitat	
5. Nature of impact:	Impacts on ecological connectivity and ecosystem functioning. Although the site is regarded homogenous in nature, it does contribute towards local ecological functionality in providing in the life requirements of numerous plants and animals	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Low (4)**	**Low (4)**
Probability	**Probable (3)**	**Probable (3)**
Significance	**Moderate (36)**	**Moderate (30)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Limit development to footprint area, • Avoid impacts, losses and deterioration of adjacent natural habitat, • Implement biodiversity monitoring programmes, alien and invasive management programmes	
Cumulative Impacts:	Habitat loss, degradation, fragmentation & isolation of natural habitat	
Residual Impacts:	Fragmented, isolated portions of natural habitat, sterile landscapes, increased anthropogenic pressures on natural resources	
6. Nature of impact:	Encroachment of invasive, exotic and encroacher plant species	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Long term (4)**	**Medium term (3)**
Magnitude	**Low (4)**	**Low (4)**
Probability	**Probable (3)**	**Probable (3)**
Significance	**Moderate (37)**	**Moderate (27)**
Status (positive or negative)	Negative	
Reversibility	Reversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Biodiversity monitoring programmes • Alien and invasive management programmes • Early detection and eradication programmes	
Cumulative Impacts:	Habitat degradation and deterioration, loss of species diversity and ecosystem functionality	
Residual Impacts:	Degraded landscapes, loss of aesthetic appeal, poor species diversity	
7. Nature of impact:	Loss of aesthetic appeal of the landscape	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Minor (2)**	**Minor (2)**
Probability	**Highly probable (4)**	**Highly probable (4)**
Significance	**Moderate (40)**	**Moderate (36)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	No	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Rehabilitation and landscaping that aims to simulate the natural environment • Make use of indigenous vegetation for rehabilitation • Make use of large, indigenous trees around development areas for screening purposes	

Cumulative Impacts:	Increase in anthropogenic activities that leads to further habitat losses and decreased aesthetic appeal on a wider scale	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	
8. Nature of impact:	Increased exploitation of natural resources due to increased human presence and resource requirements	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Low (4)**	**Low (4)**
Probability	**Probable (3)**	**Improbable (2)**
Significance	**Moderate (36)**	**Low (22)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Public awareness programmes, • Implementation of biodiversity monitoring protocols, • Search and rescue operations, • Landscaping programmes making use of local species and vegetation	
Cumulative Impacts:	Loss of biodiversity on a local scale, continued/ exacerbated loss of protected species and natural vegetation, also with regards to the collection of firewood by local population	
Residual Impacts:	Decreasing floristic diversity, potential increase in threat status to certain taxa, exacerbated losses of phytodiversity, changes to local flora patterns	
9. Nature of impact:	Accelerated developments patterns on a local and regional level implies significant increases in local and regional habitat fragmentation and isolation levels	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Probable (3)**	**Improbable (2)**
Significance	**Moderate (42)**	**Low (24)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to a limited extent	
Mitigation Measures:	• Contribute to the Waterberg Development Forum through submission of monitoring results and mitigation strategies; • Limit development to footprint area	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, intricate and excessive infrastructure, with particular reference to residential demands and linear infrastructure	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	
10. Nature of impact:	Cumulative impacts on conservation obligations & targets. The conservation status of ecological habitat is regarded Least Concerned and the loss of the site is not expected to result in an escalation of the threat level on a local or regional scale. Habitat loss is however, permanent and local development patterns indicate accelerated losses of natural habitat.	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Minor (2)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (40)**	**Low (27)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	

Can impacts be mitigated?	Yes, to a limited extent
Mitigation Measures:	• Containment, prevention of spread of impacts beyond site boundaries, • Contribute to local conservation collaborations, if available
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, loss of phytodiversity, decreased aesthetic appeal
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat, sterile landscapes

14.4 Quantification of Impacts on the Floristic Environment – Ashing Facility - Graaffwater

Table 20: Quantification of impacts of the Ashing Facility on the floristic environment

1. Nature of impact:	Direct impacts on and losses of flora species of conservation importance and concern and habitat associated with these species, with particular reference to protected tree species occurring in the study sites. Impacts are unavoidable because of land clearing activities, but are generally restricted to the immediate area. This impact is restricted to the construction phase, but is permanent	
	Without mitigation	***With mitigation***
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Definite (5)**	**Highly probable (4)**
Significance	**High (80)**	**Moderate (56)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Unavoidable impacts on protected trees/ conservation important plants will occur, irrespective of mitigation measures, albeit restricted to local footprint	
Mitigation Measures:	• Extent of impact likely to restricted to site only • Selected species and individuals should be rescued and replanted at suitable localities, with specific reference to required landscaping and rehabilitation of development areas • Permitting requirements need to be met prior to destruction/ removal of any protected plant species.	
Cumulative Impacts:	This impact contributes in a cumulative manner (regionally) to losses of protected species due to exacerbated developments and loss of natural habitat, decrease in habitat available for species of conservation concern and importance, potentially increase in threat level	
Residual Impacts:	Sterilised landscapes with no propensity for species of conservation concern, decline in population sizes and numbers, continual decline in habitat availability	
2. Nature of impact:	Losses of natural vegetation through physical transformation, modifications, removals and damage. Also includes the depletion of phytodiversity on a local scale and reduction in natural vegetation and species naturally occurring in the region	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Definite (5)**	**Definite (5)**
Significance	**High (65)**	**Moderate (55)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, to some extent	
Can impacts be mitigated?	No	
Mitigation Measures:	• Restrict losses of natural vegetation to development footprints, • Avoid peripheral or unnecessary losses of natural vegetation, • Ensure proper rehabilitation and landscaping practices, • Ensure nodal developments by grouping developments structures, • Avoid uncontrolled spread of infrastructure	
Cumulative Impacts:	This impact contributes in a cumulative manner (regionally) to losses of natural vegetation due to exacerbated developments in the region. Exacerbated anthropogenic encroachment places increasing demands on resources, such as	

	housing, water, etc.	
Residual Impacts:	Decreased aesthetic appeal, loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat	
3. Nature of impact:	Direct impacts on/ losses of atypical, sensitive and conservation important habitat types or ecosystems of particularly restricted occurrence, also with reference to habitat types where conservation important plants are likely to persist	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (52)**	**Moderate (33)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Restrict footprints to areas where low floristic sensitivity has been indicated, avoid areas of higher floristic sensitivity. • Avoid peripheral or unnecessary losses of natural vegetation, • Ensure proper rehabilitation and landscaping practices, • Ensure nodal developments by grouping developments structures, • Avoid the uncontrolled spread of infrastructure; access roads, power lines, conveyor lines, etc.	
Cumulative Impacts:	Loss and degradation of natural habitat within the surrounds for the development footprint, with particular reference to restricted or sensitive habitat receptors	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat	
4. Nature of impact:	Impact on surrounding areas of natural habitat, such as habitat changes, surface water runoff, fragmentation and habitat isolation, etc. It is generally expected to be of low significance due to a moderate sensitivity of surrounding areas. Also includes species changes brought about from alien and invasive encroachment	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (44)**	**Low (24)**
Status (positive or negative)	Negative	
Reversibility	Moderately reversible, the nature of impacts are such that activities on the development site can be adapted to avoid impacts in surrounding areas	
Irreplaceable loss of resources?	Low	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Restrict development to footprints areas • Avoid peripheral or unnecessary losses or deterioration of natural vegetation, • Ensure proper rehabilitation and landscaping practices	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, with particular reference to surrounding areas	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss and deterioration of natural habitat	
5. Nature of impact:	Impacts on ecological connectivity and ecosystem functioning. Although the site is regarded homogenous in nature, it does contribute towards local ecological functionality in providing in the life requirements of numerous plants and animals	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Low (4)**	**Low (4)**

Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (44)**	**Moderate (30)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Limit development to footprint area, • Avoid impacts, losses and deterioration of adjacent natural habitat, • Implement biodiversity monitoring programmes, alien and invasive management programmes	
Cumulative Impacts:	Habitat loss, degradation, fragmentation & isolation of natural habitat	
Residual Impacts:	Fragmented, isolated portions of natural habitat, sterile landscapes, increased anthropogenic pressures on natural resources	
6. Nature of impact:	Encroachment of invasive, exotic and encroacher plant species	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Long term (4)**	**Medium term (3)**
Magnitude	**Low (4)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (40)**	**Low (27)**
Status (positive or negative)	Negative	
Reversibility	Reversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Biodiversity monitoring programmes • Alien and invasive management programmes • Early detection and eradication programmes	
Cumulative Impacts:	Habitat degradation and deterioration, loss of species diversity and ecosystem functionality	
Residual Impacts:	Degraded landscapes, loss of aesthetic appeal, poor species diversity	
7. Nature of impact:	Loss of aesthetic appeal of the landscape	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Minor (2)**	**Minor (2)**
Probability	**Highly probable (4)**	**Highly probable (4)**
Significance	**Moderate (36)**	**Moderate (32)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	No	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Rehabilitation and landscaping that aims to simulate the natural environment • Make use of indigenous vegetation for rehabilitation • Make use of large, indigenous trees around development areas for screening purposes	
Cumulative Impacts:	Increase in anthropogenic activities that leads to further habitat losses and decreased aesthetic appeal on a wider scale	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	
8. Nature of impact:	Increased exploitation of natural resources due to increased human presence and resource requirements	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Regional (3)**
Duration	**Long term (4)**	**Long term (4)**
Magnitude	**Low (4)**	**Low (4)**
Probability	**Probable (3)**	**Improbable (2)**

Significance	**Moderate (30)**	**Low (22)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Public awareness programmes, • Implementation of biodiversity monitoring protocols, • Search and rescue operations, • Landscaping programmes making use of local species and vegetation	
Cumulative Impacts:	Loss of biodiversity on a local scale, continued/ exacerbated loss of protected species and natural vegetation, also with regards to the collection of firewood by local population	
Residual Impacts:	Decreasing floristic diversity, potential increase in threat status to certain taxa, exacerbated losses of phytodiversity, changes to local flora patterns	
9. Nature of impact:	Accelerated developments patterns on a local and regional level implies significant increases in local and regional habitat fragmentation and isolation levels	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Long term (4)**	**Long term (4)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Probable (3)**	**Improbable (2)**
Significance	**Moderate (39)**	**Low (22)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to a limited extent	
Mitigation Measures:	• Contribute to the Waterberg Development Forum through submission of monitoring results and mitigation strategies; • Limit development to footprint area	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, intricate and excessive infrastructure, with particular reference to residential demands and linear infrastructure	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	
10. Nature of impact:	Cumulative impacts on conservation obligations & targets. The conservation status of ecological habitat is regarded Least Concerned and the loss of the site is not expected to result in an escalation of the threat level on a local or regional scale. Habitat loss is however, permanent and local development patterns indicate accelerated losses of natural habitat.	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Minor (2)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (40)**	**Low (27)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to a limited extent	
Mitigation Measures:	• Containment, prevention of spread of impacts beyond site boundaries, • Contribute to local conservation collaborations, if available	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, loss of phytodiversity, decreased aesthetic appeal	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat, sterile landscapes	

14.5 Quantification of Impacts on the Floristic Environment – Power Line

Table 21: Quantification of impacts of the Power Line on the floristic environment		
1. Nature of impact:	Direct impacts on/ losses of flora species of conservation importance and concern and habitat associated with these species, with particular reference to protected tree species occurring in the study sites. Impacts are unavoidable because of land clearing activities, but are generally restricted to the immediate area. This impact is restricted to the construction phase, but is permanent	
	Without mitigation	***With mitigation***
Extent	**Local (2)**	**Site only (1)**
Duration	**Long term (4)**	**Medium-term (3)**
Magnitude	**Low (4)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (40)**	**Low (24)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Unavoidable impacts on protected trees/ conservation important plants will occur, irrespective of mitigation measures, albeit restricted to tower footprints	
Mitigation Measures:	• Limit impact to development footprint • Permitting requirements need to be met prior to destruction of any protected plant species • Limit the width of servitude clearance to standard 8 m along the centre line	
Cumulative Impacts:	This impact contributes in a cumulative manner (regionally) to losses of natural vegetation due to exacerbated developments in the region. Exacerbated anthropogenic encroachment places increasing demands on resources, such as housing, water, etc.	
Residual Impacts:	Degraded landscapes with little propensity for species of conservation concern, decline in population sizes and numbers, continual decline in habitat availability on a regional scale	
2. Nature of impact:	Losses of natural vegetation through physical transformation, modifications, removals and damage. Also includes the depletion of phytodiversity on a local scale and reduction in natural vegetation and species naturally occurring in the region	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Site only (1)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**3**
Significance	**Moderate (44)**	**Low (21)**
Status (positive or negative)	Negative	
Reversibility	Yes, to some extent	
Irreplaceable loss of resources?	Yes, limited to footprints	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Limit impact to development footprint • Permitting requirements need to be met prior to destruction of any protected plant species • Limit the width of servitude clearance to standard 8 m along the centre line • Restrict losses of natural vegetation to development footprints,	
Cumulative Impacts:	Loss of natural vegetation on a local and regional scale. Cumulative developments lead to exacerbation of anthropogenic encroachment and resource demands, such as housing, water, etc., which places remaining natural resources under increased pressure	
Residual Impacts:	Decreased aesthetic appeal, loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat	
3. Nature of impact:	Direct impacts on/ losses of atypical, sensitive and conservation important habitat types or ecosystems of particularly restricted occurrence, also with reference to habitat types where conservation important plants are likely to persist	
	Without mitigation	**With mitigation**

Extent	**Local (2)**	**Site only (1)**
Duration	**Long term (4)**	**Long term (4)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Improbable (2)**	**Very improbable (1)**
Significance	**Low (20)**	**Low (7)**
Status (positive or negative)	Negative	
Reversibility	Yes, to some extent	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Avoid areas of higher floristic sensitivity • Avoid peripheral or unnecessary losses of natural vegetation, • Ensure proper rehabilitation and landscaping practices, avoid the uncontrolled spread of infrastructure	
Cumulative Impacts:	Loss of natural habitat, with particular reference to restricted or sensitive habitat receptors	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of biodiversity on a local scale, increased pressure on natural resources, degraded landscapes, increased fragmentation of habitat	
4. Nature of impact:	Impact on surrounding areas of natural habitat, such as habitat changes, surface water runoff, fragmentation and habitat isolation, etc. It is generally expected to be of low significance due to a moderate sensitivity of surrounding areas. Also includes species changes brought about from alien and invasive encroachment	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Site only (1)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Minor (2)**	**Minor (2)**
Probability	**Probable (3)**	**Improbable (2)**
Significance	**Low (27)**	**Low (14)**
Status (positive or negative)	Negative	
Reversibility	Yes	
Irreplaceable loss of resources?	Low	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Restrict development to footprints areas • Avoid peripheral or unnecessary losses or deterioration of natural vegetation, • Ensure proper rehabilitation and landscaping practices	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	
5. Nature of impact:	Impacts on ecological connectivity and ecosystem functioning	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Site only (1)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Minor (2)**	**Minor (2)**
Probability	**Probable (3)**	**Improbable (2)**
Significance	**Low (27)**	**Low (14)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, to some extent	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Limit development to footprint area, avoid impacts in adjacent habitat, • Implement biodiversity monitoring programmes, alien and invasive management programmes	
Cumulative Impacts:	Habitat loss, degradation, fragmentation & isolation of natural habitat	
Residual Impacts:	Fragmented, isolated portions of natural habitat, sterile landscapes, increased anthropogenic pressures on natural resources	
6. Nature of impact:	Encroachment of invasive, exotic and encroacher plant species	
	Without mitigation	**With mitigation**

Extent	**Local (2)**	**Site only (1)**
Duration	**Long term (4)**	**Medium-term (3)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (40)**	**Low (18)**
Status (positive or negative)	Negative	
Reversibility	Reversible	
Irreplaceable loss of resources?	No	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Biodiversity monitoring programmes • Alien and invasive management programmes, • Early detection and eradication programmes	
Cumulative Impacts:	Habitat degradation and deterioration, loss of species diversity and ecosystem functionality	
Residual Impacts:	Degraded landscapes, loss of aesthetic appeal, poor species diversity	
7. Nature of impact:	Loss of aesthetic appeal of the landscape	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Site only (1)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Minor (2)**	**Minor (2)**
Probability	**Highly probable (4)**	**Improbable (2)**
Significance	**Moderate (36)**	**Low (14)**
Status (positive or negative)	Negative	
Reversibility	Yes	
Irreplaceable loss of resources?	No	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Rehabilitation and landscaping that aims to simulate the natural environment • Make use of indigenous vegetation for rehabilitation, • Make use of large, indigenous trees around development areas for screening purposes	
Cumulative Impacts:	Increase in anthropogenic activities that leads to further habitat losses and decreased aesthetic appeal on a wider scale	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	
8. Nature of impact:	Increased exploitation of natural resources due to increased human presence and resource requirements	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Site only (1)**
Duration	**Long term (4)**	**Long term (4)**
Magnitude	**Minor (2)**	**Minor (2)**
Probability	**Improbable (2)**	**Very improbable (1)**
Significance	**Low (16)**	**Low (7)**
Status (positive or negative)	Negative	
Reversibility	Yes	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Public awareness programmes, • Implementation of biodiversity monitoring protocols, • Search and rescue operations, • Landscaping programmes making use of local species and vegetation	
Cumulative Impacts:	Loss of biodiversity on a local scale, continued/ exacerbated loss of protected species	
Residual Impacts:	Low floristic diversity, potential increase in threat status to certain taxa, exacerbated losses of phytodiversity, changes to local flora patterns	
9. Nature of impact:	Accelerated developments patterns on a local and regional level implies significant increases in local and regional habitat fragmentation and isolation levels	

	Without mitigation	With mitigation
Extent	**Regional (3)**	**Local (2)**
Duration	**Long term (4)**	**Medium-term (3)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Probable (3)**	**Improbable (2)**
Significance	**Moderate (33)**	**Low (14)**
Status (positive or negative)	Negative	
Reversibility	Yes	
Irreplaceable loss of resources?	No	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Contribute to the Waterberg Development Forum through submission of monitoring results and mitigation strategies; • Limit development to footprint area	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, intricate and excessive infrastructure, with particular reference to residential demands and linear infrastructure	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	
10. Nature of impact:	Cumulative impacts on conservation obligations & targets. The conservation status of ecological habitat is regarded Least Concerned and the loss of the site is not expected to result in an escalation of the threat level on a local or regional scale. Habitat loss is however, permanent and local development patterns indicate accelerated losses of natural habitat.	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Site only (1)**
Duration	**Long term (4)**	**Long term (4)**
Magnitude	**Minor (2)**	**Minor (2)**
Probability	**Improbable (2)**	**Very improbable (1)**
Significance	**Low (16)**	**Low (7)**
Status (positive or negative)	Negative	
Reversibility	Yes	
Irreplaceable loss of resources?	No	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Containment, prevention of spread of impacts beyond site boundaries, • Contribute to local conservation collaborations, if available	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, loss of phytodiversity, decreased aesthetic appeal	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat, sterile landscapes	

Impact	*Power Station*		*Ashing Facility - Graaffwater*		*Ashing Facility - Appelvlakte*		*Power Lines*	
	Without Mitigation	Without Mitigation	With mitigation	With mitigation	Without Mitigation	With mitigation	Without Mitigation	With mitigation
1. Loss of plant taxa (individuals, stands, populations) of conservation importance (threatened taxa) as well as plan taxa of conservation concern (declining status, provincially protected taxa)	**80**	**56**	**70**	**56**	**80**	**56**	**40**	**24**
2. Loss of natural vegetation (physical modifications, removal, damage) and local depletion of plant taxa, reduction of phytodiversity	**65**	**55**	**65**	**55**	**65**	**55**	**44**	**21**
3. Loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance	**52**	**33**	**39**	**33**	**52**	**33**	**20**	**7**
4. Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc., also including Impacts on habitat types that are associated with plants of conservation importance (decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.)	**48**	**27**	**48**	**24**	**44**	**24**	**27**	**14**
5. Altered quality and ecological functionality (including fire, erosion) of surrounding areas and natural habitat	**70**	**55**	**36**	**30**	**44**	**30**	**27**	**14**
6. Exacerbated encroachment of invasive, exotic and encroacher plant species	**52**	**30**	**30**	**27**	**40**	**27**	**40**	**18**
7. Decreased aesthetic appeal of the landscape	**50**	**36**	**40**	**36**	**36**	**32**	**36**	**14**
8. Increased exploitation of natural resources due to increased human presence and resource requirements	**36**	**24**	**36**	**22**	**30**	**22**	**16**	**7**
9. Exacerbation of existing levels of habitat fragmentation and isolation	**56**	**48**	**42**	**24**	**39**	**22**	**33**	**14**

Impact	*Power Station*		*Ashing Facility - Graaffwater*		*Ashing Facility - Appelvlakte*		*Power Lines*	
	Without Mitigation	Without Mitigation	With mitigation	With mitigation	Without Mitigation	With mitigation	Without Mitigation	With mitigation
10. Cumulative impacts on local/ regional and national conservation targets and obligations	**40**	**27**	**40**	**27**	**40**	**27**	**16**	**7**

14.6 Concluding Impact Statement Comments

14.6.1 Power Station (Farms Graaffwater & Goedehoop)

These farms proposed for the Tshivhaso Power Station comprises of natural woodland that is, broadly speaking, representative of the regional ecological types. No particularly sensitive, unique or atypical habitat was recorded within the areas that could render the options as 'No-Go' alternatives. While a number of protected tree species are present throughout the sites, it resembles a similar situation on a local and regional scale; protected species are present across a wide region and irrespective of the placement of the power station, a number of these individuals will be lost.

However, moderately sensitive habitat is present in the northern part of the Farm Graaffwater (ephemeral pans) and these areas should be excluded from any development. The impact assessment and significance evaluation confirmed the initial assumptions with (mostly) moderate significance ascribed to most impacts and high significance ascribed to impacts associated with the uncontrolled loss of conservation important plants, the habitat associated with these species as well impacts on the ecological integrity of the area. The implementation of a suitable mitigation hierarchy is expected to ameliorate likely and potential impacts to an acceptable nature. It is a fact that losses of natural vegetation resulting from the development of a power station within 'greenfields' areas will inevitably lead to severe impacts on a local scale. Considering the significance of these impacts, no impacts were identified that could constitute unacceptable impacts on a local or regional scale.

14.6.2 Ashing Facility (Graaffwater vs. Appelvlakte)

The consideration of either of the farms Graaffwater or Appelvlakte as the preferred location for the ashing facility is based on the following key considerations:

- Both the farms comprise of largely natural savanna habitat that exhibits pristine characteristics of the regional ecological type (Limpopo Sweet Bushveld);
- Phytodiversity within the Appelvlakte and Graaffwater alternatives were found to be similar, with no particular areas of exceptional floristic diversity, atypical habitat or areas of specific floristic importance;
- The prevalence of protected and conservation important plant species, with particular reference to protected tree species, does not attain any significant differences across the entire study area. In fact, the distribution of conservation important plant taxa was generally found to be uniform across the study area;

- Graaffwater comprises of small, but highly sensitive habitat types in the northern part, which, when considered in isolation, would suggest that the losses of these habitat types would translate into unacceptable impacts;
- Appelvlakte comprises of the largest extent of transformed (industrial) habitat types, which, if considered in isolation, would suggest that the placement of the ashing facility on this area would translate into impacts of a moderate and more acceptable nature on the floristic environment.

However, in considering the suitability of either of the sites, the placement of the proposed power station on either of the farms Graaffwater and/ or Goedehoop also needs to be considered. The exact placement of the power station, in relation represents an important consideration in terms of either of the farms Graaffwater or Appelvlakte as a suitable ashing facility option.

Scenario 1: Should the placement of the power station allow for the ashing facility to be placed in an optimal position, the ashing facility could be placed in close proximity to the power station. This will negate the requirement of extensive conveyor lines and linear infrastructure between the power station and the ashing facility. However, in the event of a 'suboptimal' placement of the power station, the remaining environment becomes more sensitive, ultimately rendering the Farm Graaffwater as the least preferred option.
Scenario 2: The placement of the ashing facility on the Farm Appelvlakte inevitably requires appurtenant linear infrastructure. While this is not perceived as a particular important consideration on a local scale and limited, but controllable impacts are expected. Appelvlakte comprises of extensive areas of existing industrial development, notably the existing Matimba Power Station, which represents a significant technical consideration in the final placement of the ashing facility. Should the proximity of an ashing facility to Matimba not represent a technical difficulty, it is regarded an environmentally feasible alternative to utilised Appelvlakte as the ashing facility alternative. However, it is regarded more likely that Eskom requires the ashing facility to be placed a significant distance from Matimba Power Station, which would imply significant distances for linear infrastructure as well as cumulative spread of development towards the east.

Conclusion: No clear alternative between either Appelvlakte or Graaffwater is presented at this stage. This is heavily dependent on the exact placement of the power station footprint and the availability of sufficient land for the ashing facility. However, considering the potential spread of industrial land uses on a local scale, a slight preference for Graaffwater is expressed, taking cognisance implications of technical feasibilities in terms of the Matimba Power Station.

Furthermore, No particularly sensitive, unique or atypical habitat was recorded within either of the alternatives that would render either of the options as 'No-Go' alternatives. Moderately sensitive habitat is present in the northern part of the Farm Graaffwater (ephemeral pans) and these areas should be excluded from any development. The impact assessment and significance evaluation confirmed the initial assumptions with (mostly) moderate significance ascribed to most impacts and high significance ascribed to impacts associated with the uncontrolled loss of conservation important plants, the habitat associated with these species as

well impacts on the ecological integrity of the area. The implementation of a suitable mitigation hierarchy is expected to ameliorate likely and potential impacts to an acceptable nature. Considering the significance of these impacts, no impacts were identified that could constitute unacceptable impacts on a local or regional scale.

14.6.3 Power Line

The evacuation of power towards the Medupi Substation via the Matimba – Medupi Loop-in will affect mostly degraded and moderately degraded woodland habitat with limited extents of natural woodland. No areas of particularly sensitive, unique or atypical habitat were recorded within the proposed servitude that would render the proposed servitude as a 'No-Go' alternative.

The impact assessment and significance evaluation confirmed the initial assumptions with moderate to low significance ascribed to most impacts. The implementation of a suitable mitigation hierarchy is expected to ameliorate likely and potential impacts to an acceptable nature. Considering the significance of these impacts, no impacts constitute unacceptable effects on a local or regional scale.

14.6.4 Conclusion

Potential and likely impacts on the floristic receiving environment are expected to result in severe, but limited and localised effects on the flora of the site. While some impacts are unavoidable, such as habitat loss, loss of phytodiversity and protected tree species, most impacts could be mitigated to an acceptable level of significance and would not extend significantly beyond the development footprint. No impacts of an unacceptable nature could be identified during this process and it is therefore the considered opinion that the proposed development will not affect the floristic receiving environment in a manner that would elevate existing levels of protection of any species or habitat.

15 MITIGATION

The mitigation of negative impacts on biodiversity and ecosystem services is a legal requirement for authorisation purposes and must take on different forms depending on the significance of the impact and the area being affected. Mitigation requires proactive planning that is enabled by following the mitigation hierarchy, illustrated in **Figure 10**. Its application, is intended to strive to first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining significant residual negative impacts on biodiversity, where:

Avoiding or preventing impacts – refers to considering options in project location, siting, scale, layout, technology and phasing to avoid impacts on biodiversity, associated ecosystem services, and people. This is the best option, but is not always possible if mining is to take place. However, there are areas where the environmental and social constraints are too high and mining should not take place. Such areas are best identified early in the mining life cycle, so that impacts can be avoided and authorisations refused. In the case of areas where environmental constraints might be limiting, this includes some ecosystems, habitats, ecological corridors, or areas that provide essential ecosystem services and are of such significant conservation value or importance that their loss cannot be compensated for (i.e. there is no substitute). In such areas, it is unlikely to be possible or appropriate to rely on the latter steps in the mitigation hierarchy (e.g. rehabilitating or offsetting impacts) to provide effective remedy for impacts on biodiversity or ecosystem services. Information about the location of many such areas is available, often making it possible to avoid them.

Minimising impacts – refers to considering alternatives in the project location, siting, scale, layout, technology and phasing that would minimise impacts on biodiversity and ecosystem services. Even in areas where the environmental and social constraints are not particularly high for mining to proceed/take place every effort should still be made to minimise impacts.

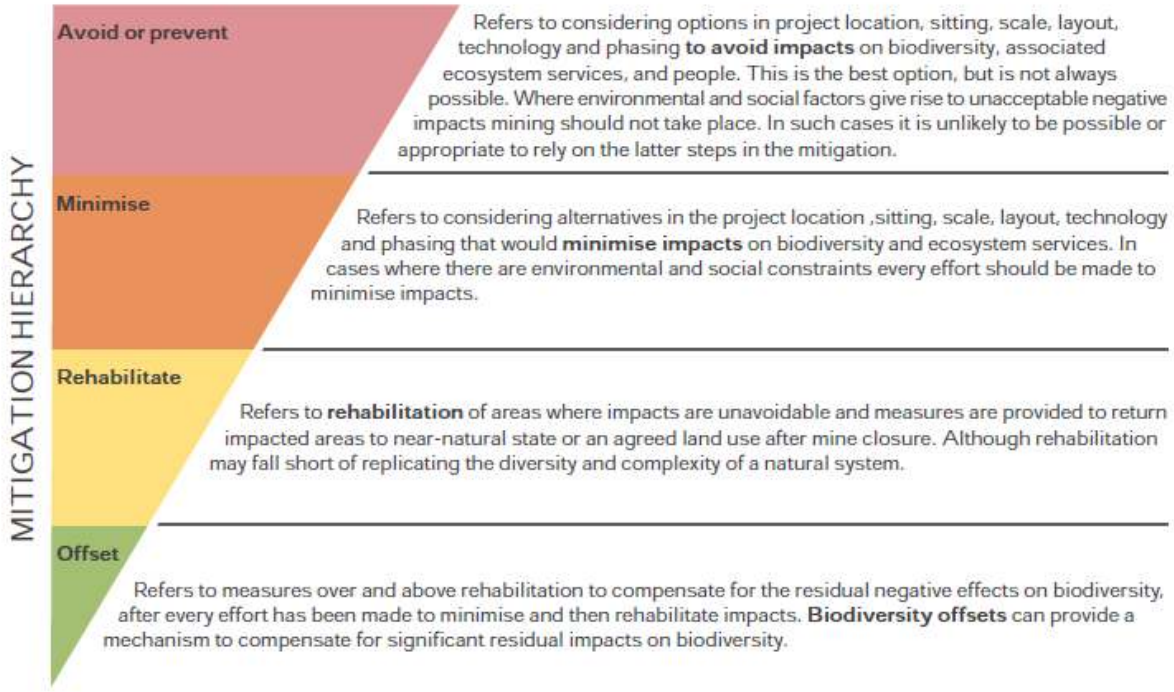
Rehabilitate impacts – refers to the rehabilitation of areas where impacts were unavoidable and measures are taken to return impacted areas to a condition ecologically similar to their 'pre-mining natural state' or an agreed land use after mine closure. Although rehabilitation is important and necessary, unfortunately even with significant resources and effort, rehabilitation is a limited process that usually falls short of replicating the diversity and complexity of a natural system. Instead, rehabilitation helps to restore some resemblance of ecological functioning in an impacted landscape, to avoid on-going negative impacts, and/or to provide some sort of aesthetic fix for a landscape. Rehabilitation should occur concurrently or progressively with the proposed activity, and/or on cessation of the activity.

Offset impacts –refers to compensating for remaining and unavoidable negative effects on biodiversity. When every effort has been made to minimise and then rehabilitate remaining impacts to a degree of no net loss of biodiversity against biodiversity targets, biodiversity offsets can provide a mechanism to compensate for significant residual negative impacts on biodiversity.

The mitigation hierarchy is inherently proactive, requiring the on-going and iterative consideration of alternatives of project location, footprint siting, scale, layout, technology and

phasing until the proposed development best 'suits' and can be accommodated without significant negative impacts in the receiving environment. In cases where the receiving environment cannot support the development (e.g. there is insufficient water) or where the project will eradicate unique biodiversity, the development may not be feasible; the earlier the developing company knows of these risks, and can plan to avoid them, the better. In cases where biodiversity impacts are likely to be severe, the guiding principle should therefore be to "anticipate and prevent" rather than "assess and repair".

Figure 10: Mitigation hierarchy for dealing with negative impacts on biodiversity



15.2 Site Specific Mitigation Measures

Mitigation Measure 1 - Exclude all areas of high ecological sensitivity from the proposed development;

Mitigation Measure 2 - Implement a suitable buffer zone (at least 30 m of natural, typical woodland habitat) between the edge of areas of high sensitivity and any type of development or surface disturbance;

Mitigation Measure 3 - Prevent contamination of natural grassland, wetland and endorheic pans from nearby stockpiling, conveyor lines, water treatment facilities or any other source of pollution;

Mitigation Measure 4 - Remove and relocate all plant species of conservation importance that are present within development areas (within reason).

15.3 General Aspects

Mitigation Measure 5 - Compile and implement a botanical monitoring programme, the aim of which should be ensuring long-term success of rehabilitation and prevention of environmental degradation. Biodiversity monitoring should be conducted at least twice per year (Summer, Winter) in order to assess the status of natural habitat and effects of the development on the natural environment;

Mitigation Measure 6 - Compile and implement an Alien and Invasive Management Programme;

Mitigation Measure 7 - Appoint an Environmental Control Officer (ECO) prior to commencement of construction. Responsibilities should include, but not necessarily be limited to, ensuring adherence to EMP specifications, compliance monitoring, reporting, etc.;

15.4 Fences & Demarcation

Mitigation Measure 8 - Demarcate construction areas by semi-permanent means/ material, in order to control movement of personnel and vehicles, providing boundaries for construction and operational sites;

Mitigation Measure 9 - No painting or marking of rocks or vegetation to identify locality or other information shall be allowed, as it will disfigure the natural setting. Marking shall be done by steel stakes with tags, if required. These must be removed once work in an area is completed;

Mitigation Measure 10 - Demarcate construction areas by semi-permanent means/ material, in order to control movement of personnel, vehicles, providing boundaries for construction sites in order to limit spread of impacts;

15.5 Fire

Mitigation Measure 11 - The Project team must compile a Fire Management Plan (FMP) and Contractors directed by the Environmental Officer/ Environmental Manager must submit a FMP;

Mitigation Measure 12 - The FMP shall include *inter alia* aspects such as relevant training, equipment on site, prevention, response, rehabilitation and compliance to the National Veld and Forest Fire Act, Act No. 101 1998;

Mitigation Measure 13 - Prohibit the use of uncontrolled and/ or open fires by workers/ personnel for cooking or personal purposes;

Mitigation Measure 14 - Provide demarcated fire-safe zones, smoking zones and facilities and suitable fire control measures;

Mitigation Measure 15 - Use of branches of trees, shrubs or any vegetation for fire making purposes is strictly prohibited;

Mitigation Measure 16 - The irresponsible use of welding equipment, oxy-acetylene torches and other naked flames, which could result in veld fires, or constitute a hazard and should be guided by safe practice guidelines;

Mitigation Measure 17 - The use of fire as a management tool in ecologically sensitive areas should be guided and instructed by a qualified ecologist.

15.6 Roads & Access

Mitigation Measure 18 - Road layout should take cognisance of the least environmentally costly options, ensuring that any habitat of sensitivity is not affected in any manner.

Mitigation Measure 19 - A road management plan should be compiled prior to the commencement of construction activities;

Mitigation Measure 20 - Access is to be established by vehicles passing over the same track on natural ground. Multiple tracks are not permitted;

Mitigation Measure 21 - Dust control on all roads should be prioritised during all stages of development and operation.

15.7 Workers & Personnel

Mitigation Measure 22 - Provide temporary on-site ablution, sanitation, litter and waste management and hazardous materials management facilities at the commencement of construction activities until such time that permanent solutions and facilities could be provided;

Mitigation Measure 23 - Abluting anywhere other than in provided toilets shall not be permitted. Under no circumstances shall use of the veld be permitted;

15.8 Vegetation Clearance & Operations

Mitigation Measure 24 - Conduct a protected species survey prior to the commencement of construction. Results of this survey must guide permitting requirements for the removal of protected trees and plant species from the selected property;

Mitigation Measure 25 - As far as possible, identify and relocate all plants of conservation concern that will be adversely affected as part of an ecological management plan for the area. It is emphasised that the removal and/ or relocation of any conservation important plant is subject to provincial permitting obligations;

Mitigation Measure 26 - The removal or picking of any protected or unprotected plants shall not be permitted and no horticultural specimens (even within demarcated working areas) shall be removed, damaged or tampered with;

Mitigation Measure 27 - The landowner must immediately take steps to remove alien vegetation as per NEM:BA guidelines and regulations. This should be done based on an alien invasive management strategy that should be compiled by a suitably qualified ecologist. The plan must make reference to:

- Uprooting, felling or cutting;
- Treatment with a weed killer that is registered for use in connection with such plants in accordance with the directions for the use of such a weed killer;
- The application of control measures regarding the utilization and protection of veld in terms of Regulation 9 of the Act;

- The application of control measures regarding livestock reduction or removal of animals in terms of Regulations 10 and 11 of the Act;
- Any other method or strategy that may be applicable and that is specified by the executive officer by means of a directive.
- According to the Conservation of Agricultural Resource Act (No. 43 of 1983) as amended, the person applying herbicide must be adequately qualified and certified as well as registered with the appropriate authority to apply herbicides.

Mitigation Measure 28 - The size of areas subjected to land clearance must be kept to a minimum;

Mitigation Measure 29 - Only areas within the development footprint (as defined on the site layout) and as instructed by the Site Manager must be cleared and grubbed;

Mitigation Measure 30 - Cleared vegetation and debris that has not been utilised must be collected and disposed of to a suitable waste disposal site. It must not be burned on site;

Mitigation Measure 31 - All vegetation not required to be removed must be protected against damage;

Mitigation Measure 32 - Removal of vegetation/ plants must be avoided until such time as soil stripping is required and similarly exposed surfaces must be re-vegetated or stabilised as soon as is practically possible;

Mitigation Measure 33 - Monitoring the potential spread of declared weeds and invasive alien vegetation to neighbouring land and vice versa and protection of the agricultural resources and soil conservation works (as regulated by the Conservation of Agricultural Resources Act (No 43 of 1983)) must be addressed on a continual basis, through an alien vegetation control and monitoring programme;

Mitigation Measure 34 - Remove and store topsoil separately in areas where excavation/ degradation takes place. Topsoil should be used for rehabilitation purposes in order to facilitate regrowth of species that occur naturally in the area. Removal of topsoil should take cognisance of the soil specialist reports, typically to be done to a depth of at least 300 mm;

Mitigation Measure 35 - Stored topsoil must be free of deleterious matter such as large roots, stones, refuse, stiff or heavy clay and noxious weeds, which would adversely affect its suitability for planting;

Mitigation Measure 36 - No spoil material may be dumped outside the defined site;

Mitigation Measure 37 - Disturbance of vegetation must be limited to areas of construction;

Mitigation Measure 38 - The removal or picking of any protected or unprotected plants shall not be permitted and no horticultural specimens (even within the demarcated working area) shall be removed, damaged or tampered with;

Mitigation Measure 39 - Ensure proper surface restoration and resloping in order to prevent erosion, taking cognisance of local contours and landscaping;

Mitigation Measure 40 - Exposed areas with slopes exceeding 1:3 should be rehabilitated with a grass mix that blends in with the surrounding vegetation;

Mitigation Measure 41 - The grass mix should consist of indigenous grasses adapted to the local environmental conditions;

Mitigation Measure 42 - Revegetated areas should be temporarily fenced to prevent damage by grazing animals;

Mitigation Measure 43 - Revegetated areas should be regularly inspected in order to establish/ ensure an adequate regrowth of vegetation within these parts. Subsequent to the successful establishing of a vegetatal cover, the diversity of these parts should be improved by means of the replanting of trees and shrubs to these areas;

Mitigation Measure 44 - Re-vegetated areas showing inadequate surface coverage (less than 30% within eight months after re-vegetation) should be prepared and re-vegetated from scratch;

Mitigation Measure 45 - Damage to re-vegetated areas should be repaired promptly;

Mitigation Measure 46 - As far as practically possible, only indigenous plant species that are endemic to the area/region are to be used in landscaping activities on the site, as these species are adapted to the specific conditions (climatic, soil, etc) of the area and would require the least amount of irrigation, pesticides, etc;

Mitigation Measure 47 - Exotic weeds and invaders that might establish on the re-vegetated areas should be controlled to allow the grasses to properly establish.

15.9 Waste

Mitigation Measure 48 - As far as possible, waste should be avoided, reduced, re-used and/or recycled. Where this is not feasible, all waste (general and hazardous) generated during the construction of the power station may only be disposed of at appropriately licensed waste disposal sites (in accordance with the National Environmental Waste Management Act 2008);

Mitigation Measure 49 - Prevent and advocate against the indiscriminate disposal of rubbish, litter or rubble;

Mitigation Measure 50 - The burning of general waste material under any circumstances is not to be allowed;

Mitigation Measure 51 - Waste must be sorted at source (i.e. the separation of tins, glass, paper etc); recycled waste of this sort will be collected by an accredited waste removal contractor;

Mitigation Measure 52 - A stormwater management plan must be compiled to address, inter alia, capturing and storage of stormwater;

Mitigation Measure 53 - All runoff water from fuel deposits, workshops, vehicles washing areas and other equipment must be collected and directed through oil traps to settlement ponds. These ponds must be suitably lined and should be cleaned as soon as practicable, and the sludge disposed off at a suitable waste site;

Mitigation Measure 54 - No wastewater or water containing any chemical or pollutant should be released from, or escape as effluent, from the site.

15.10 Botanical Management Action Plans

Biodiversity Action Plans are presented for each of the identified impacts. These Action Plans are by no means regarded as comprehensive and should be elaborated on, updated and detailed as needed during the various phases of the proposed development.

Impact 1: Loss of plant taxa (individuals, stands, populations) of conservation importance (threatened taxa) as well as plan taxa of conservation concern (declining status, provincially protected taxa)		
Objective:	Limit/ manage impacts on conservation important plants and protected tree species within the project area and adjacent areas	
Project Components:	Any infrastructure development that will cause loss of natural habitat where protected tree species and/ or conservation important plants occur	
Potential Impacts:	Uncontrolled loss of protected species from remaining areas of natural habitat, legal compliance with permitting requirements	
Activity/ Risk Source:	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective:	• Limit the impact on protected and conservation important plant species; • Prevent impacts on protected and conservation important plants in surrounding areas of natural habitat	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
Ensure that a comprehensive walkthrough of the site is conducted prior to commencement of activities in order to identify and count all protected plants that occur within the footprint	Construction Contractors, Environmental Team, Environmental Control Officer, Environmental Officer, Botanists	Prior to site preparation activities
Ensure compliance in terms of the NFA and LEMA requirements pertaining to removal, damage or destruction of protected and/ or conservation important plants and trees		Prior to site preparation activities
Ensure all activities that result in destruction of natural habitat are contained within the authorized footprint and do not spread beyond the boundaries of the site		Site preparation, Construction Phase
Identify trees that can be retained in position on the site in order to aid with landscaping and conservation of the species		Prior to site preparation activities
Identify individuals that would be suitable for rescue and relocation purposes to aid with landscaping and conservation		Prior to site preparation activities, construction phase, rehabilitation and revegetation
Performance Indicator:	No significant loss of protected trees and conservation important plants in natural habitat surrounding the site and infrastructure	
	The presence of protected trees within the project area that are used for aesthetic, rehabilitation purposes	
Monitoring:	Density counts of protected trees within adjacent areas of natural habitat, continued monitoring of conservation important plants in the natural environment	
Impact 2: Loss of plant taxa (individuals, stands, populations) of conservation importance (threatened taxa) as well as plan taxa of conservation concern (declining status, provincially protected taxa)		
Objective:	Limit/ manage the loss of natural vegetation (physical modifications, removal, damage) and local depletion of plant taxa, reduction of phytodiversity	
Project Components:	Any infrastructure development that will cause loss of natural habitat	
Potential Impacts:	Uncontrolled loss of natural habitat that would result in a reduction of local phytodiversity	
Activity/ Risk Source:	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective:	Allow for remaining areas of natural habitat to function effectively from an ecological perspective within the environment of industrial development	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
Clearly demarcate development footprint boundaries prior to footprint clearance by permanent means in order to control the movement of construction vehicles and personnel	Developer, environmentalists, ecologists, project environmental team	Site preparation, Construction phase
Develop and implement a road plan to accommodate planned and needed infrastructure, ensure the proper uses of roads, prohibit inappropriate establishment of additional and unneeded roads	Construction Contractors, Environmental Team, Environmental Officer	Site preparation, Construction phase
Plan, develop and demarcate needed laydown areas, waste management areas. Prevent the inappropriate use of natural areas outside the		Site preparation, Construction phase

development footprint for ad hoc activities		
Develop and implement a fire management programme in order to prevent and control accidental or inappropriate pyrophytic events in natural vegetation		Site preparation, Construction phase, Operational phase, rehabilitation and revegetation areas
Plan and develop a monitoring protocol in collaboration with the ECO in order to monitor and prohibit losses of natural habitat outside the approved and demarcated site development footprint		Site preparation, Construction phase, Operational phase, rehabilitation and revegetation areas
The implementation of periodic monitoring programme (annual, at least) should be aimed at assessing development impacts on the natural environment in close proximity to the development footprint, ensuring early identification and mitigation of observed impacts		Site preparation, Construction phase, Operational phase, rehabilitation and revegetation areas
Contribute information gained pertaining to the natural environment during the construction and operational phases to surrounding land users and appropriate role-players where possible		Site preparation, Construction phase, Operational phase, rehabilitation and revegetation areas
Performance Indicator:	• No significant loss of phytodiversity within areas of natural habitat surrounding the development footprint; • No significant changes in structural and compositional aspects within areas of natural habitat surrounding the development footprint	
	Effective ecological functionality of remaining areas of natural vegetation surrounding the development footprint, or remainder of the properties	
Monitoring:	Annual monitoring of phytodiversity in affected and surrounding areas of natural habitat as part of bio monitoring programme	
Impact 3: Loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance		
Objective:	To prevent/ mitigate the loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance	
Project Components:	Activities that will result in destruction of natural habitat, or degradation of habitat of restricted abundance on a local or regional scale, mostly during construction phase, secondarily during operational phases	
Potential Impacts:	Loss or degradation of natural woodland habitat outside the development footprint, where such habitat are likely to comprise species of conservation importance or habitat types of limited abundance	
Activity/ Risk Source:	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective:	Limit direct losses of natural habitat to development footprint, contain construction and operational impacts to development footprints, ensuring that natural woodland adjacent to development footprint continue to operate in an unaltered and natural manner	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
Clearly demarcate development footprint boundaries prior to footprint clearance by permanent means in order to control the movement of construction vehicles and personnel	Developer, environmentalists, ecologists, project environmental team	Site preparation, Construction phase
Develop and implement a road plan to accommodate planned and needed infrastructure, ensure the proper uses of roads, prohibit inappropriate establishment of additional and unneeded roads	Construction Contractors, Environmental Team, Environmental Officer	Site preparation, Construction phase
Plan, develop and demarcate needed laydown areas, waste management areas. Prevent the inappropriate use of natural areas outside the development footprint for ad hoc activities		Site preparation, Construction phase
Develop and implement a fire management programme in order to prevent and control accidental or inappropriate pyrophytic events in natural vegetation		Site preparation, Construction phase, Operational phase, rehabilitation and revegetation areas
Plan and develop a monitoring protocol in collaboration with the ECO in order to monitor and prohibit losses of natural habitat outside the approved and demarcated site development footprint		Site preparation, Construction phase, Operational phase, rehabilitation and revegetation areas
The implementation of periodic monitoring programme (annual, at least) should be aimed at assessing development impacts on the natural environment in close proximity to the development footprint, ensuring early identification and mitigation of observed impacts		Site preparation, Construction phase, Operational phase, rehabilitation and revegetation areas

Contribute information gained pertaining to the natural environment during the construction and operational phases to surrounding land users and appropriate role-players where possible		Site preparation, Construction phase, Operational phase, rehabilitation and revegetation areas
Performance Indicator:	• No significant loss of phytodiversity within areas of natural habitat surrounding the development footprint; • No significant changes in structural and compositional aspects within areas of natural habitat surrounding the development footprint	
	Effective ecological functionality of remaining areas of natural vegetation surrounding the development footprint, or remainder of the properties	
Monitoring:	Annual monitoring of phytodiversity in affected and surrounding areas of natural habitat as part of bio monitoring programme	
Impact 4: Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc., also including impacts on habitat types that are associated with plants of conservation importance (decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.)		
Objective:	To control and prevent a decrease in habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc., also including Impacts on habitat types that are associated with plants of conservation importance (decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.)	
Project Components:	Construction and development within a natural environment, also where natural environment of surrounding and adjacent areas will be affected through peripheral and uncontrolled impacts	
Potential Impacts:	Deterioration of adjacent natural habitat, spillages, contamination, exacerbation and infestation of weeds, encroacher and invasive species	
Activity/ Risk Source:	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective:	Ensure the conservation /preservation of natural habitat within adjacent areas, limit construction and operational impacts to footprints	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
Identify activities and project components that are likely to cause degradation of surrounding natural habitat	Project environmental team, Environmental Officer, Environmental Control Officer, Guidance through the EMP (with relevant contributions from EAP & Ecological Specialist)	Site preparation phase, Construction and Operational phases
Compile Standard Operating Procedures to deal with the prevention, timely identification, remediation and rehabilitation of adverse environmental events and occurrences		
Implement suitable buffer zones(recommended 30 m) around development footprints that will assist in preventing uncontrolled spread of impacts into adjacent areas of natural habitat		
Limit construction activities and personnel movement to development footprints through the use of permanent barricades/ boundaries constructed around approved development footprint prior to site preparation phase		
Establish best-practice guidelines and Standard Operational Procedures that will guide all operational activities within management areas, including aspects such as land clearance, roads and maintenance, movement and personnel presence, operational activities, waste management, etc. Implement as part of the EMP, update as necessary		
Identify and develop restoration and rehabilitation goals and objectives as part of the Biodiversity Monitoring Protocol that include objectives of the preservation of surrounding natural habitat		
Develop monitoring and feedback control mechanisms to identify and immediately remediate noted impacts outside control measures and boundaries		
Performance Indicator:	No visible or subjective changes to surrounding areas of natural habitat	
	Absence of invasive and encroacher species in surrounding areas of natural habitat	
	No significant changes to the structural and compositional aspects of natural habitat in proximity to the development footprint	
Monitoring:	Annual monitoring of adjacent and surrounding vegetation as part of bio monitoring programme	

Impact 5: Altered quality and ecological functionality (including fire, erosion) of surrounding areas and natural habitat		
Objective:	To sustain the existing/ improve on the existing quality and ecological functionality (including fire, erosion) of surrounding areas and natural habitat	
Project Components:	Construction and development within a natural environment, also where natural environment and ecological functionality of surrounding and adjacent areas will be affected through development and operational aspects	
Potential Impacts:	Deterioration of adjacent natural habitat, changes to local ecological functionality and quality	
Activity/ Risk Source:	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective:	Ensure the conservation /preservation of natural habitat and ecological functionality within adjacent areas, limit construction and operational impacts to footprints	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
Identify activities and project components that are likely to cause degradation of surrounding natural habitat	Construction Contractors, Environmental Team, Environmental Officer	Prior to site preparation activities
Identify areas where exceptional and/ or ecological attributes of importance to the ecological functionality of the local area persists within the site and retain these attributes as part of a conservation/ preservation programme		Site preparation, construction phase, operational phase
Compile Standard Operating Procedures to deal with the prevention, timely identification and rehabilitation of adverse environmental events and occurrences within areas of ecological importance		Planning, site preparation and construction phases
Compile and implement a biodiversity monitoring programme that aims to evaluate changes to the natural environment that would affect ecological functionality		Planning, site preparation and construction phases
Performance Indicator:	Persistence of ecological functionality of remaining areas of natural habitat within surrounds of the development footprint, operational areas	
	Retaining phytodiversity, ecological functionality. Also in collaboration with faunal avifaunal attributes	
Monitoring:	Development and implementation of bio monitoring programme	
Impact 6: Exacerbated encroachment of invasive, exotic and encroacher plant species		
Objective:	Control the persistence and occurrence of alien and invasive/ encroacher plant species within the development site and habitat situated in direct proximity to the development site	
Project Components:	All development activities that will cause sterilisation of natural habitat that becomes suitable for infestation by alien and invasive and encroacher plant species	
Potential Impacts:	Displacement of natural vegetation by alien and invasive plants, displacement of natural vegetation by locally endemic encroacher and alien and invasive species	
Activity/ Risk Source:	Site preparation, construction activities, operational activities/ environmental management	
Mitigation: Target/ Objective:	No alien and invasive/ encroacher plants within the development area, areas situated in direct proximity to the development site	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
Avoid the creation of sterile landscapes that are suitable for the infestation by alien and invasive plants through proper and timely rehabilitation and revegetation procedures	Construction Contractors, Environmental Team, Environmental Officer, Ecologist	Site preparation, Construction Phase, Operational phase
Avoid disturbance of natural habitat outside approved development footprint		Site preparation, Construction Phase, Operational Phase
Implement timely rehabilitation procedures subsequent to land clearing activities		Construction Phase
Compile and implement ongoing monitoring programme to detect and quantify alien species as per the Conservation of Agricultural Resources Act		Site preparation, Construction Phase, Operational Phase
Implement immediate eradication procedures		Site preparation, Construction Phase, Operational Phase
Performance Indicator:	• Absence of alien and invasive plants from the development site as well as surrounding natural habitat that is situated within immediate proximity to the development footprint boundary. The proliferation and invasive species could potentially be an effect of the development and needs to be monitored on surrounding areas as well. • Effective preventative and rehabilitation procedures during construction	

	and operational phases	
	Presence of natural vegetation within rehabilitated areas on site that is representative of regional ecological types and absence of weeds and invasive or encroacher species	
Monitoring:	Ongoing monitoring of area by Environmental Officer during construction and operational phases	
	Annual audit of project area and immediate surrounds by qualified botanist	
	Mapping, abundance, cover physical attributes of alien species. Results should be interpreted in terms of risk posed to environment.	
Impact 7: Decreased aesthetic appeal of the landscape		
Objective:	To limit the decrease in aesthetic appeal of the landscape resulting from the introduction of industrial components and infrastructure	
Project Components:	All development activities, land clearance, removal of natural vegetation, introduction of industrial components	
Potential Impacts:	Disfigurement of the natural environment beyond the development footprint	
Activity/ Risk Source:	Site preparation, construction activities, operational activities/ environmental management	
Mitigation: Target/ Objective:	Retain aesthetic appeal of the landscape through revegetation, rehabilitation. Prevent significant disfigurement	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
Avoid the creation of sterile landscapes, deterioration and/ or structural changes to remaining areas of natural vegetation	Construction Contractors, Environmental Team, Environmental Officer	Site preparation, Construction Phase
Limit disturbance of natural habitat in surrounding areas		Site preparation, Construction Phase, Operational Phase
Implement timely rehabilitation procedures subsequent to land clearing activities		Construction Phase
Reintroduce large trees in proximity to development areas		Site preparation, Construction Phase, Operational Phase
Take cognisance of the visual impact assessment recommendations		Site preparation, Construction Phase, Operational Phase
Performance Indicator:	Do not disturb natural vegetation in areas adjacent to development footprints, representative of the regional ecological types	
	Obscuring industrial and infrastructure components for visual observation lines/ points	
	Implementation of effective rehabilitation/ restoration programme	
Monitoring:	Ongoing monitoring of area by Environmental Officer during construction and operational phases	
Impact 8: Increased exploitation of natural resources due to increased human presence and resource requirements		
Objective:	Prevent the exploitation of natural resources due to increased human presence and resource requirements	
Project Components:	All development activities where natural habitat is accessible to personnel and or local population	
Potential Impacts:	Decline in abundance of protected and or naturally occurring plant species in the remaining areas of natural habitat	
Activity/ Risk Source:	Site preparation, construction activities, operational activities/ environmental management	
Mitigation: Target/ Objective:	Prevent harvesting of natural populations of species within property boundaries	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
Develop a suitable conservation strategy that aimed at the preservation of target species within property boundaries	Construction Contractors, Environmental Team, Environmental Officer	Site preparation, Construction phase, Operational phase
Develop a monitoring approach that will inform on the presence and abundance of target species within rehabilitated areas		Site preparation, Construction Phase, Operational Phase
Investigate the possibility of establishing nurseries that might provide/ supply the local demand of certain species		Site preparation, Construction Phase
Conduct search and rescue operations within areas of development		Site preparation, Construction Phase
Prevent harvesting of target species within areas where development will take place		Site preparation, Construction Phase
Performance Indicator:	Continued persistence of target species within remaining areas of natural vegetation within the development site	
	Improved quality of natural habitat within remaining areas of natural vegetation within the development site	
Monitoring:	Ongoing monitoring of area by Environmental Officer during construction and operational phases	
	Annual audit of project area and immediate surrounds by qualified botanist	

	Mapping, abundance, cover physical attributes of alien species. Results should be interpreted in term of risk posed to environment.	
Impact 9: Exacerbation of existing levels of habitat fragmentation and isolation		
Objective:	Ensure that natural habitat in immediate proximity to the development footprint do not deteriorate as a result of peripheral impacts from development activities and operational aspects	
Project Components:	All development activities that will cause sterilisation of natural habitat	
Potential Impacts:	Deterioration (structural and compositional) of natural habitat in direct proximity to the development footprint, infestation of weeds and invasive species, encroacher species, etc	
Activity/ Risk Source:	Site preparation, construction activities, operational activities/ environmental management, future developments, delay of rehabilitation and revegetation	
Mitigation: Target/ Objective:	Retain the PES of habitat in direct proximity to the development footprint/ property, avoidance of structural and compositional changes	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
Avoid the creation of sterile landscapes that are suitable for the infestation by alien and invasive plants	Construction Contractors, Environmental Team, Environmental Officer	Site preparation, Construction Phase
Limit disturbance of natural habitat to the development area		Site preparation, Construction Phase, Operational Phase
Ensure proper management and use of remaining areas of natural habitat within the property boundaries		Construction Phase
Collaborate with surrounding landowners to establish management objectives that would be beneficial to the biodiversity of the immediate area		Site preparation, Construction Phase, Operational Phase
Performance Indicator:	Continued presence of ecologically effective natural habitat within a region characterised by industrial and residential development	
	Preservation of ecological trends, PES and ecological indicators	
Monitoring:	Ongoing monitoring of area by Environmental Officer during construction and operational phases	
	Biodiversity monitoring protocol in areas surrounding developments	
	Local and regional development programmes, land use monitoring, EMF, etc	
Impact 10: Cumulative impacts on local/ regional and national conservation targets and obligations		
Objective:	Prevent exacerbation of conservation levels, including ecological types and animals, plants, sensitive landscapes, etc.	
Project Components:	All development activities that will cause sterilisation and/or degradation of natural habitat	
Potential Impacts:	Loss of natural habitat that will result in threats to ecological types, species conservation and habitat preservation	
Activity/ Risk Source:	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective:	Ensure the effective preservation of species and habitat on a local and regional scale	
Mitigation: Action/ Control	***Responsibility***	***Timeframe***
Identify activities and project components that are likely to cause degradation of surrounding natural habitat	Construction Contractors, Environmental Team, Environmental Control Officer	Site preparation, Construction Phase, Operational Phase
Identify areas where exceptional and/ or ecological attributes of importance to the ecological functionality of the local area persists within the site and retain these attributes as part of a conservation/ preservation programme		
Compile Standard Operating Procedures to deal with the prevention, timely identification and rehabilitation of adverse environmental events and occurrences within areas of ecological importance		
Compile and implement a biodiversity monitoring programme that aims to evaluate changes to the natural environment that would affect ecological functionality		
Performance Indicator:	Continued persistence of natural, representative habitat in areas in direct proximity to the development footprint that is unaffected by the development	
	Avoidance of undue losses or changes in habitat in areas directly adjacent to the development footprint	
Monitoring:	Development and implementation of bio monitoring programme for each development in the area	

15.11 Recommended Botanical Monitoring Programmes

To ensure the accurate gathering of data, the following techniques and guidelines (*inter alia*) should be followed:

» Fixed point monitoring should be applied as the preferred method of monitoring;
» All data gathered should be measurable (qualitative and quantitative);
» Monitoring report should be repeatable and temporally and spatially comparable;
» Data gathered should be an accurate representation of the PES of the study area, as well habitat units represented by each monitoring site;
» Data, when compared to previous sets, should show spatial and temporal trends; and
» General habitat unit overviews should also be undertaken to augment quantitative data.

As part of the proposed Botanical Monitoring Programme, the following aspects are recommended for inclusion into the monitoring programme:

» Temporal Monitoring of development related impacts;
» Floristic diversity & compositional monitoring;
» Floristic species richness monitoring;
» Compositional monitoring within affected areas;
» Conservation important plant monitoring programme;
» Plants with ethno-botanical properties monitoring programme;
» Alien and invasive plant monitoring;
» Structural and compositional monitoring for burning regime;
» Structural and compositional monitoring for stocking rates/ grazing potential;
» Structural and compositional monitoring; and
» Land change/ habitat loss and transformation monitoring programme.

The exact nature of a biological monitoring programme is subject to inputs from various role players; a representative workgroup should be established to determine the nature and detail of the relevant bio-monitoring protocol.

SECTION D – MAMMALIAN, INVERTEBRATE & HERPETOFAUNAL ATTRIBUTES OF THE RECIEVING ENVIRONMENT

Dewald Kamffer (Pr.Sci.Nat)

16 BACKGROUND

Biological diversity everywhere is at great risk as a direct result of an ever-expanding human population and its associated needs for energy, water, food and minerals. Landscape transformation needed to accommodate these needs inevitably leads to habitat loss and habitat fragmentation, resulting in the mosaical appearance of undisturbed habitat within a matrix of transformed areas. Remaining areas of natural habitat are frequently too small to support the biodiversity that previously occupied these areas, consequently the area and the region is constantly losing its ecological integrity and diversity (Kamffer 2004). The savannas of the Limpopo Province of South Africa are no exception and urban, mining energy production and energy distribution developments have had a significant impact on the biodiversity of the region between the Limpopo River and the Waterberg mountains between Ellisras, Steenbokpan and Stockpoort (*pers. obs*., D. Kamffer).

17 Method Statement

17.1 Desktop Investigation

Shapefiles of the study area was used in Google Earth Pro (www.google.co.za/download/gep/agree/html) to determine the Q-girds in which the study area is located. Lists of animals known to occur in the Q-grids of the study area were obtained from The Virtual Museum of the Animal Demography Unit of the University of Cape Town (vmus.adu.org.za; Animal Demography Unit 2016). Data on the following groups were included in the desktop investigation:

» Scorpions (Scorpiones);
» Spiders (Araneae);
» Lacewings and relatives (Megaloptera and Neuroptera);
» Dung Beetles (Scarabaeinae);
» Butterflies and Moths (Lepidoptera);
» Frogs (Anura);
» Reptiles (Reptilia); and
» Mammals (Mammalia)

A list of red data animals of the following IUCN categories (www.iucnredlist.org) was drafted from the known inhabitants of the study area's Q-grids:

» Data Deficient (DD);
» Near Threatened (NT);
» Vulnerable (VU);
» Endangered (EN); and
» Critically Endangered (CR).

The probabilities of occurrence (PoO) of the red data animals (listed for the Q-grids)within the study area were estimated using the known geographic distributions and habitat requirements of the species in comparison to the location of the study area and the diversity and statuses of the faunal habitats found within the study area. The following probabilities of occurrence categories were used:

» Low 0-19 %;
» Medium-low 20-39 %;
» Medium 40-59 %;
» Medium-high 60-79 %; and
» High 80-99 %.

17.2 Field Investigations

The field investigation was completed over two sampling periods, namely between 31st March and 7th April 2016, and between 23rd and 26th May 2016. Invertebrates were sampled using a handheld net and refugia such as rocks were investigated for the presence of Arachnids and other invertebrates. Herpetofauna were sampled by similar methods, including active searches of rocky areas as well as visual sightings of diurnal species. Wetlands were searched for frogs, using visual sightings and identification of the species-specific calls of males. Mammals were recorded by visual (*ad hoc*) sightings and by using ecological indications such as tracks, dung and digging activities. Invertebrates were photographed when possible; unknown species' images were submitted to The Virtual Museum for identifications. Well-known species were identified on visual sighting alone.

17.3 Faunal Habitat Sensitivities

The faunal sensitivities of the macro habitat types were estimated using five comparable and relevant ecological characteristics:

1. Habitat Status (ST): the level of habitat transformation and degradation vs. pristine faunal habitat;
2. Habitat diversity (DV): the number and frequency of different faunal micro habitats found within each of the macro habitat types;
3. Habitat linkage (LN): the degree to which a macro habitat type is linked to other natural areas enabling movement of animals to and from the habitat found in the study area;
4. Habitat sensitivity (SN): the relative presence of elements of inherently sensitive faunal habitats such as surface rock associated with outcrops and surface and underground water found in wetlands; and
5. Red data species (RD): the degree to which suitable habitat for the red data species likely to be found in the study area is located within each macro habitat type.

The following faunal sensitivity categories were used:

» Low 0-19 %;
» Medium-low 20-39 %;
» Medium 40-59 %;
» Medium-high 60-79 %; and
» High 80-99 %.

18 THE STUDY AREA

The proposed power station, ashing facility and loop-in alternative are located within two Q-degree grids; 2327CB and 2327DA (refer **Figure 11**). It is geographically placed approximately 22 km southeast of the Limpopo River near the Stockpoort Border Post. The vegetation of the area is described as Limpopo Sweet Bushveld of the Central Bushveld Bioregion (Savanna Biome) (Mucina and Rutherford, 2006). In 2006, only 0.6 % of the Limpopo Sweet Bushveld regional vegetation community was under formal protection (conservation target was 19 %); 94.9 % remained untransformed (Mucina and Rutherford 2006). The untransformed areas of Limpopo Sweet Bushveld in the region of the study area have diminished notably since 2006 (*pers. obs*., D. Kamffer).

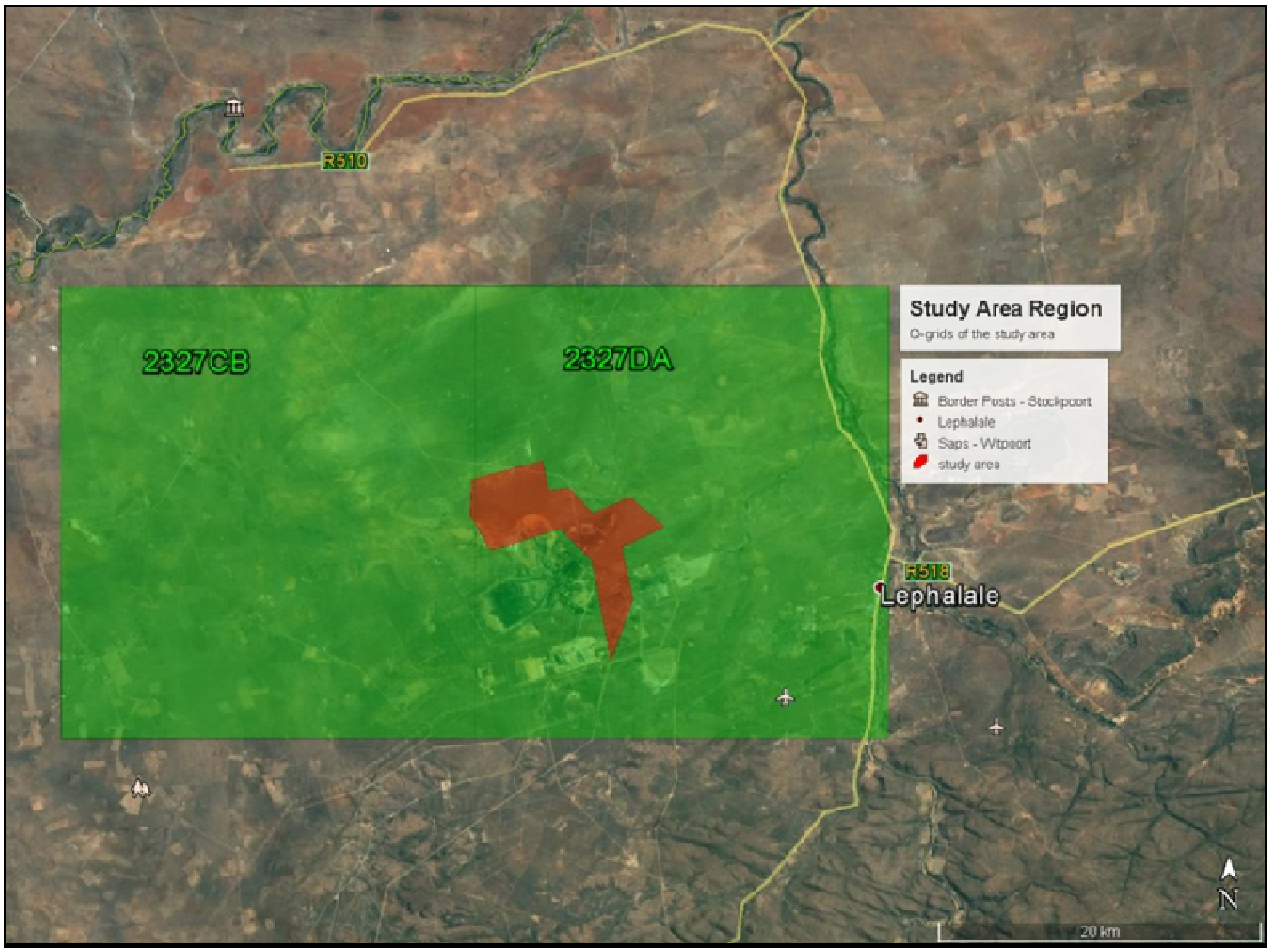


Figure 11: Q-degree grids of the study area (2327CB and 2327DA)

19 FAUNAL HABITAT TYPES

Animals do not exist in isolation within ecosystems; animals of terrestrial as well as aquatic ecosystems are closely linked to and significantly influenced by plant community structures and species diversities. Many aquatic species find refuge in extensive reedbeds that are frequently found within lowland wetland ecosystems (Sychra *et al* 2010). Furthermore, the structure and age of vegetal formation of ponds and impounds play a significant role in selecting species traits related to the population dynamics and feeding habits of species (Céréghinoa *et al.* 2008). Similarly, terrestrial animals' ecological reactions depend on plant community structure; studies on species richness have indicated that for spiders, local

processes are important, with assemblages in a particular patch being constrained by habitat structure (Borgesa and Browna 2004). Likewise, plant community structure is often influenced by primary consumers; herbivores are known key drivers of ecosystem function and nutrient dynamics within grazed plant communities (Duncan 2005). The plant communities described for the study area (please refer to Section C of this document for full details on the plant communities) are considered representative of the macro faunal habitat types (refer **Figure 12**):

» *Combretum zeyheri – Eragrostis pallens* sand Woodland Habitat;
» *Acacia mellifera – Acacia tortilis* clay Woodland Habitat; and
» *Eragrostis rotifer – Echinochloa holubii* Ephemeral Pan Habitat.

The study area also included degraded woodland as well as transformed areas.

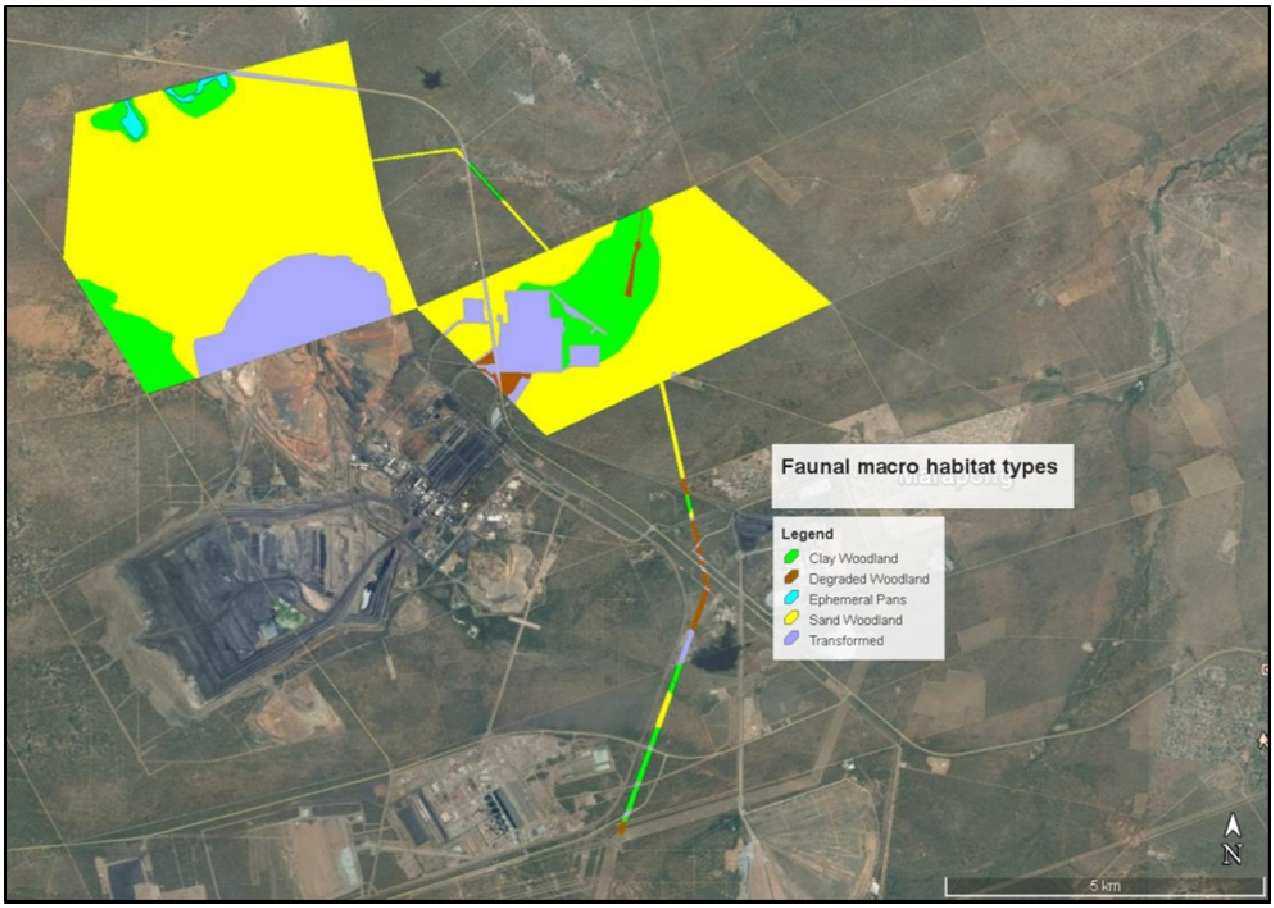


Figure 12: Macro faunal habitat types of the study area

19.2 Transformed & Degraded Habitats

Transformed habitats represent areas of an atypical nature; areas where the natural vegetation has been removed and replaced by various substitutes of either a sterile or an artificial nature. These substitutes typically include agricultural lands, stands of exotic trees and human structures such as buildings, roads, mining areas, etc. These areas have lost the ability to function ecologically efficient and bear no biological resemblance to the original faunal habitat associated with the Central Bushveld Bioregion's (Mucina & Rutherford, 2004) woodlands and associated wetlands. These areas have little or no conservation value and it is highly unlikely that any threatened faunal taxa would persist in these areas (other than

potentially passing through). Further transformation and degradation of the transformed faunal habitats is unlikely to lead to an accelerated loss of biodiversity or a significant negative impact on the faunal assemblages currently persisting in these areas. A low faunal sensitivity is ascribed to these parts.

While transformed habitat types constitute areas of little or no propensity for natural wildlife, degraded habitat comprises parts of the study area where the natural habitat has been degraded to a status where it no longer resembles the original status or type. However, the vegetatal cover within these parts still allows for the establishment of an artificial, or altered, faunal component to reside in these parts. It is however regarded unlikely that animals of conservation importance will persist in these parts, other than for opportunistic or migration purposes. A medium-low faunal sensitivity is ascribed to these parts.

19.3 Natural Woodland Habitats

The natural woodland habitats of the sites comprise those parts that still exhibit (to varying degrees) a significant proportion of the functional ecological characteristics of the original Limpopo Sweet Bushveld (Mucina and Rutherford 2004). In other words, these areas currently constitute untransformed, functioning faunal woodland habitat characteristic of the Central Bushveld Bioregion of South Africa. The natural (terrestrial) faunal woodland habitats of the site alternatives include:

» *Combretum zeyheri – Eragrostis pallens* sand Woodland Habitat;
» *Acacia mellifera – Acacia tortilis* clay Woodland Habitat; and
» *Eragrostis rotifer – Echinochloa holubii* Ephemeral Pan Habitat.

Ecological interaction of natural terrestrial woodland habitats is often very complex. Potentially, some woodland specialist species might be excluded from degraded woodlands and will only be limited to natural woodlands (depending on the level of degradation), while others might be unaffected by woodland habitat degradation (up to certain point). The level of habitat degradation that might be tolerated by woodland fauna species is different for each species; species loss rates compared to habitat degradation rates is also likely to differ between woodland habitat types. In a landscape matrix including fragments of natural, degraded and transformed terrestrial faunal habitats, it is often difficult to predict the faunal assemblages likely to persist in each fragment. Some fragments of a degraded (or even transformed) nature might (when considered in isolation) be of a poor ecological status or low biodiversity value, but when considered within the landscape matrix in relevance to other, natural habitat fragments, might be of considerable conservation value as a movement corridor or sink population source.

Sensitive terrestrial faunal species that are regarded likely to persist in the natural woodland of the sites (not necessarily recorded during the field investigation) include:

» *Panthera pardus* (Linnaeus, 1758) – Leopard;
» *Aquila rapax* (Temminck, 1828) – Tawny Eagle;
» *Elephantulus intufi* (A. Smith, 1836) – Bushveld Elephant Shrew;
» *Tatera leucogaster* (Peters, 1852) – Bushveld Gerbil;
» *Buphagus erythrorhynchus* (Stanley, 1814) – Red-billed Oxpecker;
» *Falco biarmicus* Temminck, 1825 – Lanner Falcon;

» *Mellivora capensis* (Schreber, 1776) – Honey Badger;
» *Parahyaena brunnea* (Thunberg, 1820) – Brown Hyaena;
» *Sagittarius serpentarius* (J.F. Miller, 1779) – Secretarybird;
» *Acinonyx jubatus* (Schreber, 1775) – Cheetah;
» *Ardeotis kori* (Burchell, 1822) – Kori Bustard;
» *Falco naumanni* Fleischer, 1818 – Lesser Kestrel;
» *Gyps africanus* Salvadori, 1865 – White-backed Vulture;
» *Manis temminckii* Smuts, 1832 – Ground Pangolin;
» *Polemaetus bellicosus* (Daudin, 1800) – Martial Eagle; and
» *Terathopius ecaudatus* (Daudin, 1800) – Bateleur.

The natural terrestrial woodland communities of the site alternatives therefore exhibit moderately high conservation characteristics; ecological functionality and biodiversity value of these woodlands are high and changes in the land use are likely to influence a significant number of sensitive and threatened faunal taxa. Based on the level of degradation, the woodland communities exhibit varying faunal sensitivities, as follows:
» *Combretum zeyheri – Eragrostis pallens* sand Woodland Habitat (Medium sensitivity);
» *Acacia mellifera – Acacia tortilis* clay Woodland Habitat (Medium-high sensitivity); and
» *Eragrostis rotifer – Echinochloa holubii* Ephemeral Pan Habitat (High sensitivity).

20 Results

20.1 Desktop Investigation

The study area is located within Q-grids 2327CB and 2327DA. Known species richness (The Virtual Museum) within these Q-grids is as follows (refer **Tables 22 - 24**):
» Dragonflies: 2 species;
» Antlions: 1 species;
» Butterflies: 41 species;
» Frogs: 16 species;
» Reptiles: 35 species; and
» Mammals: 18 species.

Four red data listed animals are known from the Q-grids 2327CB and 2327DA (refer **Table 25**). The red data listed species include animals regionally listed as (RS):
- Near Threatened (NT): 2 species; and
- Vulnerable (VU): 2 species.

The four red data listed animals have the following global statuses (GS):
» Least Concern (LC): 1 species;
» Near Threatened (NT): 1 species; and
» Vulnerable (VU): 2 species.

The following probabilities of occurrence (PoO) within the study area are estimated for the four red data listed species:
» High PoO: 3 species; and
» Confirmed presence: 1 species.

Table 22: Invertebrates of the Q-degree grids 2327DA & 2327CB

Order	*Family*	*Genus species*	*English Name*	*RS*
Odonata	Libellulidae	*Brachythemis leucosticta* Burmeister, 1839	Banded Groundling	NL
		Orthetrum trinacria Selys, 1841	Long Skimmer	NL
Neuroptera	Myrmeleontidae	*Hagenomyia tristis* (Walker, 1853)	Gregarious Antlion	NL
Lepidoptera	Hesperiidae	*Kedestes callicles* (Hewitson, 1868)	Pale Ranger	LC
		Spialia spio (Linnaeus, 1764)	Mountain Sandman	LC
	Lycaenidae	*Axiocerses amanga amanga* (Westwood, 1881)	Bush Scarlet	LC
		Cacyreus marshalli Butler, 1898b	Common Geranium Bronze	LC
		Chilades trochylus (Freyer, [1843])	Grass Jewel Blue	LC
		Euchrysops osiris (Hopffer, 1855)	Osiris Smoky Blue	LC
		Hypolycaena philippus philippus (Fabricius, 1793)	Purplebrown Hairstreak	LC
		Iolaus alienus alienus Trimen, 1898	Brown-line Sapphire	LC
		Iolaus pallene (Wallengren, 1857)	Saffron Sapphire	LC
		Lampides boeticus (Linnaeus, 1767)	Pea Blue	LC
		Tarucus sybaris sybaris (Hopffer, 1855)	Dotted Blue	LC
		Virachola antalus (Hopffer, 1855)	Brown Playboy	LC
	Nymphalidae	*Acraea natalica* Boisduval, 1847	Natal Acraea	LC
		Acraea neobule neobule Doubleday, [1847a]	Wandering Donkey Acraea	LC
		Acraea oncaea Hopffer, 1855	Rooibok Acraea	LC
		Byblia ilithyia (Drury, [1773])	Spotted Joker	LC
		Charaxes achaemenes achaemenes Felder C. & Felder R., [1867]	Bushveld Charaxes	LC
		Charaxes brutus natalensis Staudinger, 1885	White-barred Charaxes	LC
		Charaxes jasius saturnus Butler, 1866	Foxy Charaxes	LC
		Charaxes phaeus Hewitson, 1877d	Demon Charaxes	LC
		Charaxes varanes varanes (Cramer, [1777])	Pearl Charaxes	LC
		Danaus chryssipus orientis (Aurivillius, 1909)	African Monarch	LC
		Hamanumida daedalus (Fabricius, 1775)	Guineafowl Butterfly	LC
		Hypolimnas missipus (Linnaeus, 1764)	Common Diadem	LC
		Junonia hierta cebrene Trimen, 1870	Yellow Pansy	LC
		Junonia oenone oenone (Linnaeus, 1758)	Blue Pansy	LC
		Telchinia serena (Fabricius, 1775)	Dancing Acraea	LC
		Vanessa cardui (Linnaeus, 1758)	Painted Lady	LC
	Papilionidae	*Papilio dardanus cenea* Stoll, [1790]	Mocker Swallowtail	LC
		Papilio nireus lyaeus Doubleday, 1845a	Green-banded Swallowtail	LC
	Pieridae	*Belenois aurota* (Fabricius, 1793)	Brown-veined White	LC

		Catopsilla florella (Fabricius, 1775)	African Migrant	LC
		Colotis annae annae (Wallengren, 1857)	Scarlet Tip	LC
		Colotis evagore antigone (Boisduval, 1836)	Small Orange Tip	LC
		Colotis evenina evenina (Wallengren, 1857)	Orange Tip	LC
		Colotis regina (Trimen, 1863)	Queen Purple Tip	LC
		Colotis vesta argillaceus (Butler, 1877)	Veined Arab	LC
		Eurema brigitta brigitta (Stoll, [1780])	Broad-bordered Grass Yellow	LC
		Mylothris agathina agathina (Cramer, [1779])	Common Dotted Border	LC
		Pinacopteryx eriphia eriphia (Godart, [1819])	Zebra White	LC
		Teracolus agoye agoye (Wallengren, 1857)	Speckled Sulphur Tip	LC

Table 23: Herpetofauna of the Q-degree grids 2327DA & 2327CB

Order	*Family*	*Genus species*	*English Name*	*RS*
Anura	Brevicepitidae	*Breviceps adspersus* Peters, 1882	Bushveld Rain Frog	LC
	Bufonidae	*Amietophrynus garmani* Meek, 1897	Eastern Olive Toad	LC
		Amietophrynus gutturalis Power, 1927	Guttural Toad	LC
		Amietophrynus maculatus Hallowell, 1854	Flat-backed Toad	LC
		Amietophrynus rangeri Hewitt, 1935	Raucous Toad	LC
	Hyperoliidae	*Kassina senegalensis* Duméril and Bibron, 1841	Bubbling Kassina	LC
	Microhylidae	*Phrynomantis bifasciatus* Smith, 1847	Banded Rubber Frog	LC
	Phrynobatrachidae	*Phrynobatrachus natalensis* Smith, 1849	Snoring Puddle Frog	LC
	Pipidae	*Xenopus laevis* Daudin, 1802	Common Platanna	LC
	Ptychadenidae	*Hildebrantia ornata* Peters, 1878	Ornate Frog	LC
		Ptychadena anchietae Bocage, 1867	Plain Grass Frog	LC
	Pyxicephalidae	*Pyxicephalus adspersus* Tschudi, 1838	Giant Bullfrog	NT
		Pyxicephalus edulis Peters, 1854	African Bullfrog	LC
		Tomopterna cryptotis Boulenger, 1907	Tremelo Sand Frog	LC
		Tomopterna krugerensis Passmore and Carruthers, 1975	Knocking Sand Frog	LC
	Rhacophoridae	*Chiromantis xerampelina* Peters, 1854	Southern Foam Nest Frog	LC
Testudines	Pelomedusidae	*Pelomedusa subrufa* (Bonnaterre, 1789)	Central Marsh Terrapin	LC
	Testudinidae	*Psammobates oculifer* Kuhl, 1820	Serrated Tent Tortoise	LC
		Stigmochelys pardalis Valverde, 2005	Leopard Tortoise	LC
Squamata	Agamidae	*Acanthocercus atricollis atricollis* (Smith, 1849)	Southern Tree Agama	LC
		Agama aculeata distanti (Boulenger, 1902)	Distant's Ground Agama	LC
	Amphisbaenidae	*Zygaspis quadrifrons* Vanzolini, 1953	Kalahari Dwarf Worm Lizard	LC
	Atractaspididae	*Atractaspis bibronii* Smith, 1849	Bibron's Stiletto Snake	LC
	Chamaeleonidae	*Chamaeleo dilepis dilepis* Leach, 1819	Common Flap-neck Chameleon	LC

Table 23: Herpetofauna of the Q-degree grids 2327DA & 2327CB				
Order	*Family*	*Genus species*	*English Name*	*RS*
	Colubridae	*Lamprophis capensis* (Duméril & Bibron, 1854)	Brown House Snake	LC
		Dasypeltis scabra (Linnaeus, 1758)	Rhombic Egg-eater	LC
		Dispholidus typus (Smith, 1828)	Northern Boomslang	LC
		Lycodonomorphus inornatus (Duméril and Bibron, 1854)	Olive House Snake	LC
		Lycophidion capense capense (Smith, 1831)	Cape Wolf Snake	LC
		Prosymna bivittata Werner, 1903	Two-striped Shovel-snout	LC
		Psammophis subtaeniatus Peters, 1882	Western Yellow-bellied Sand Snake	LC
	Cordylidae	*Cordylus jonesii* (Boulenger, 1891)	Jones' Girdled Lizard	LC
	Elapidae	*Elapsoidea sundevallii longicauda* Broadley, 1971)	Long-tailed Garter Snake	NL
		Naja annulifera Peters, 1854	Snouted Cobra	LC
		Naja mossambica Peters, 1854	Mozambique Spitting Cobra	LC
	Gekkonidae	*Chondrodactylus turneri* (Gray, 1864)	Turner's Gecko	LC
		Hemidactylus mabouia (Moreau De Jonnès, 1818)	Common Tropical House Gecko	LC
		Lygodactylus capensis capensis (Smith, 1849)	Common Dwarf Gecko	LC
		Pachydactylus capensis (Smith, 1846)	Cape Gecko	LC
		Ptenopus garrulus garrulus (A. Smith, 1849)	Common Barking Gecko	LC
	Gerrhosauridae	*Gerrhosaurus multilineatus auritus* Boettger, 1887	Golden Plated Lizard	NL
	Lacertidae	*Heliobolus lugubris* Smith, 1838	Bushveld Lizard	LC
		Ichnotropis capensis Fitzsimons, 1943	Ornate Rough-scaled Lizard	LC
		Pedioplanis lineoocellata lineoocellata (Duméril & Bibron, 1839)	Spotted Sand Lizard	LC
	Pythonidae	*Python natalensis* Smith, 1840	Southern African Python	LC
	Scincidae	*Acontias occidentalis* Fitzsimons, 1941	Western Legless Skink	LC
		Panaspis wahlbergi (Smith, 1849)	Wahlberg's Snake-eyed Skink	LC
		Mochlus sundevalli (Smith, 1849)	Sundevall's Writhing Skink	LC
		Trachylepis punctatissima Smith, 1849	Speckled Rock Skink	LC
		Trachylepis varia (Peters, 1867)	Variable Skink	LC
	Varanidae	*Varanus albigularis albigularis* Daudin, 1802	Rock Monitor	LC

Table 24: Mammals of the Q-degree grids 2327DA & 2327CB				
Order	*Family*	*Genus species*	*English Name*	*RS*
Chiroptera	Molossidae	*Mops midas* (Sundevall, 1843)	Midas' Free-tailed Bat	LC
	Vespertilionidae	*Scotophilus dinganii* (A. Smith, 1833)	Yellow-bellied House Bat	LC
Lagomorpha	Leporidae	*Lepus saxatilis* F. Cuvier, 1823	Scrub Hare	LC
Carnivora	Felidae	*Acinonyx jubatus* (Schreber, 1775)	Cheetah	VU
		Caracal caracal (Schreber, 1776)	Caracal	LC

		Panthera pardus (Linnaeus, 1758)	Leopard	LC
	Hyaenidae	*Parahyaena brunnea* (Thunberg, 1820)	Brown Hyaena	NT
		Proteles cristatus (Sparrman, 1783)	Aardwolf	LC
	Canidae	*Canis mesomelas* Schreber, 1775	Black-backed Jackal	LC
		Otocyon megalotis (Desmarest, 1822)	Bat-eared Fox	LC
Pholidota	Manidae	*Smutsia temminckii* (Smuts, 1832)	Temminck's Ground Pangolin	VU
Artiodactyla	Suidae	*Phacochoerus africanus* (Gmelin, 1788)	Common Warthog	LC
	Bovidae	*Aepyceros melampus* (Lichtenstein, 1812)	Common Impala	LC
		Alcelaphus buselaphus (Pallas, 1766)	Hartebeest	LC
		Alcelaphus caama (Geoffroy Saint-Hilare, 1803)	Red Hartebeest	LC
		Taurotragus oryx (Pallas, 1766)	Common Eland	LC
	Giraffidae	*Giraffa camelopardalis camelopardalis* (Linnaeus, 1758)	Nubian Giraffe	LC
		Giraffa camelopardalis giraffa (Schreber, 1784)	The South African Giraffe	LC

Table 25: Red Data animals of the Q-degree grids 2327DA & 2327CB

Order	*Family*	*Genus species*	*English Name*	*Regional status*	*Global status*	*PoO*
Anura	Pyxicephalidae	*Pyxicephalus adspersus* Tschudi, 1838	Giant Bullfrog	NT	LC	high
Carnivora	Felidae	*Acinonyx jubatus* (Schreber, 1775)	Cheetah	VU	VU	high
	Hyaenidae	*Parahyaena brunnea* (Thunberg, 1820)	Brown Hyaena	NT	NT	confirmed
Pholidota	Manidae	*Smutsia temminckii* (Smuts, 1832)	Temminck's Ground Pangolin	VU	VU	high

21 ANNOTATIONS ON LIKELY RED DATA SPECIES FOR THE AREA

21.1 Giant Bullfrog

The Giant Bullfrog, *Pyxicephalus adspersus* Tschudi, 1838 (Anura: Pyxicephalidae), is a large robust and large frog, the largest in southern Africa. The male may grow up to 230 mm, with a maximum weight recorded at 1.075 kg. The species is unmistakable by its size and the presence of two razor-sharp projections on the lower jaw. Coloration is variable, mostly with a brown or dark green background, but a bright green component is usually present.

The species is widely distributed in the drier savannas, reaching the northeastern coastal plain. It usually occurs in seasonal, shallow pans, vleis and other rain-filled depressions. For most of the year, the species remains buried op to one-meter underground (aestivating). After significant rainfall events, the species may emerge when the male calls from shallow water. The very low-pitched "whoop" call resembles the bellowing of cattle, hence the colloquial name *bullfrog*. The Giant Bullfrog exhibits paternal care and an adult male is often found near the eggs and in or near a school of tadpoles. Male bullfrogs are known to dig channels of up to 15 meters long to release trapped tadpoles when smaller water bodies become unfavourable.

Bullfrogs are voracious, with one specimen recorded eating seventeen young Rinkhals and a small chicken. The species is mainly being predated on by birds, including Pink-backed Pelican, Saddle-billed Stork, White-headed Vulture, Yellow-billed Kite, Tawny Eagle, African Fish Eagle, Bateleur, Lesser Spotted Eagle and Yellow-billed Egret. Terrapins and Water Monitors are known to prey on tadpoles. Threats to the species include habitat loss due to crop agriculture and urbanization, road kills, the use of pesticides and the illegal collection for the pet trade (Channing 2001, Carruthers 2001, du Preez & Carruthers 2009). The species is listed as Near Threatened regionally (vmus.adu.org.za) and as Least Concern globally (www.iucnredlist.org).

21.2 Cheetah

The Cheetah, *Acinonyx jubatus* (Schreber, 1775) (Carnivora: Felidae), includes five subspecies of which the nominate subspecies, *Acinonyx jubatus jubatus* Schreber, 1775, is found in southern Africa. A single-locus genetic mutation produces the blotched tabby pattern of the so-called King Cheetah, once classified as a separate species.

Males typically weigh between 39 and 59 kg and females between 36 and 48 kg. Adult Cheetah have blunt claws that although retractable, remain exposed, lacking the skin sheaths found in most other felids, providing additional traction like a sprinter's spikes. Claw marks are therefore visible in the spoor of the species.

Cheetahs are primarily found throughout the drier parts of sub-Saharan Africa, avoiding forest and only thinly distributed in humid woodland. It is most frequently observed on open grassy plains, but may prefer a mosaic of woodland and grassland using bush, scrub and open woodlands. They specialize on gazelles and small to medium-sized antelopes as prey. In southern Africa, prey includes impala, springbok, kudu calves, warthog and reedbuck. Cheetahs often lose their kills to lions, leopards and hyenas. Top speed has been recorded at 102 km/h, but sprints rarely last longer than 200 to 300 meters, with a maximum of 600 meters.

It is primarily diurnal, when competing predators like lions and hyenas are less active. Territories and preferred routes are marked with sprays of urine, faeces and occasionally by claw raking. Lack of genetic diversity may render the Cheetah exceptionally vulnerable to changing environmental conditions and disease (Wilson & Mittermeier 2009).The species is listed as Vulnerable regionally (vmus.adu.org.za) and globally (www.iucnredlist.org).

21.3 Brown Hyaena

The Brown Hyaena, *Parahyaena brunnea* (Thunberg, 1820) (Carnivora: Hyaenidae), was formerly classified as *Hyaena brunnea*, but recent molecular work indicates that the species belongs to a separate genus than the Striped Hyaena. It is found in Namibia, Botswana, Zimbabwe, Mozambique, Swaziland, Lesotho and South Africa. Adult weights vary between 28 to 48 kg; the average shoulder height of males is 79 cm and females 74 cm

Brown Hyaenas are found in a variety of relatively arid habitats from open desert to semi-desert in the Namib and Kalahari, to dry, open scrub and woodland savanna, Mopani scrub and tree savanna as well as the bushveld of the northern Transvaal.

They forage alone at night and are extremely efficient scavengers with an omnivorous diet. They are opportunistic feeders on a range of vertebrates, primarily mammals, the vast majority of which are scavenged, often from the kills of other carnivores. Fruit, insects and reptiles can be important supplements when carcasses are rare. The species does not depend on standing water, although they will drink on a daily basis when water is available.

Brown Hyaena is generally considered widespread but rare. It is estimated that areas in excess of 1 000 km² are required to maintain a viable population of the species. Much of the

habitat where Brown Hyaena occur is situated outside protected areas and is used for livestock ranching Hyaenas are consequently heavily persecuted (shot, poisoned, trapped and hunted with dogs) in these areas because they are assumed to be livestock predators. This persecution, and habitat loss and fragmentation, are the primary threats to the persistence of Brown Hyaenas (Wilson & Mittermeier 2009). The species is listed as Near Threatened regionally (vmus.adu.org.za) and globally (www.iucnredlist.org).

21.4 Temminck's Ground Pangolin

Temminck's Ground Pangolin, *Smutsia temminckii* (Smuts, 1832) (Pholidota: Manidae), is widely, but patchily, distributed in open areas ranging from eastern Chad and northern Central African Republic to western Ethiopia and south through most of eastern Africa to South Africa, Namibia and Angola. It can exceed a meter in total body length and weigh more than 20 kg.

This species occurs in various types of woodland and savanna, often with dense undergrowth. It can also be found in floodplain grassland and farmed areas and may reach altitudes of 1 700 meters above sea level. Its range of suitable niches is likely conditioned by the abundance of specific groups of termites and ants that is preyed upon. This might explain their absence in northeastern and western Africa. The species is replaced by Giant Pangolin in forested areas of high rainfall. It is almost strictly myrmecophagous; genera preyed upon include *Acantholepis, Anoplepsis, Camponotus, Crematogaster, Monsmorium, Myrmicania, Paltothyreus, Pheidole, Polyrachis, Tapenonian, Technomyremex, Xiphomyremex* (ants), and to a lesser extent, *Odontotermes, Microcerotermes, Microtermes, Amitermes* and *Ancistotermes* (termites). The species may be locally highly selective on species ingested; it prefers eggs and larvae, probably because they are softer.

The activity patterns of Temminck's Ground Pangolin are poorly known. It is solitary, terrestrial and mostly nocturnal. During the day, this opportunistic species will rest in terrestrial shelters, termite mounds, Aardvark and Springhare burrows; they rarely dig their own burrows. It can walk on all fours (quadrupedal) or on the hind legs only (bipedal); the species is able to climb with the use of the lateral, sharp scales on the tail.

Temminck's Ground Pangolin is likely to decline in numbers locally because of hunting, pesticides (to which they are highly sensitive) and electric fences. It is supposedly close to extinction in the Free State and probably exterminated in several parts of its range (Wilson & Mittermeier 2011). The species is listed as Vulnerable regionally (vmus.adu.org.za) and globally (www.iucnredlist.org).

22 FIELD RESULTS

22.1 Diversity

Ninety-four animal species were confirmed for the study area during the field investigation; including three conservation important species (refer **Table 26**):

» 1 Millipede;
» 1 Tick;
» 7 Spiders;
» 4 Dragonflies;
» 1 Termite;
» 1 Grasshopper;
» 4 Beetles;
» 1 Fly;
» 36 Butterflies;
» 1 Moth;
» 1 Bee;
» 1 Ant;
» 1 Tortoise;
» 1 Snake;
» 4 Lizards; and
» 29 Mammals.

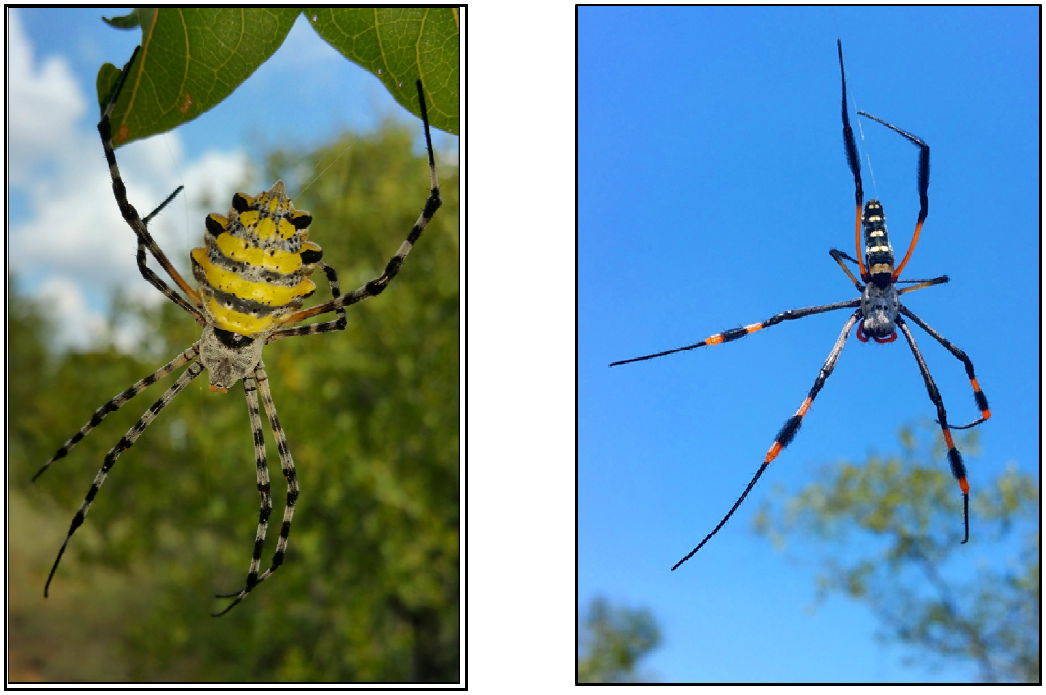


Figure 14: Examples of some spider species recorded in the study area
Left: Common Garden Orb-web Spider, *Argiope australis* (Walckenaer, 1841)
Right: Banded-legged Nephila, *Nephila senegalensis* (Walckenaer, 1841)

Figure 15: Examples of some beetle species recorded in the study area
Left: Giant Tiger Beetle, *Manticora* species
Right: The Giant Jewel Beetle, *Sternocera orissa* Buquet, 1837

Figure 16: Tracks of the Brown Hyaena, *Parahyaena brunnea* (Thunberg, 1820)

Table 26: Animals confirmed for the study area

Order	*Family*	*Genus species*	*English Name*	*Regional status*	*Global Status*
		Invertebrates			
Spirostreptida	Odontopygidae	*Spinotarsus* species	Slender Spined Millipede	NL	NL
Ixodida	Ixodidae	*Hyalomma* species	Hard-bodied Tick	NL	NL
Araneae	Araneidae	*Cyrtophora citricola* (Forsskål, 1775)	Tropical Tent-web Spider	NL	NL
		Isoxya species	Box Kite Spider	NL	NL
		Argiope australis (Walckenaer, 1805)	Common Garden Orb-web Spider	NL	NL
		Gasteracantha milvoides Butler, 1873	Milvoides long-winged Kite Spider	NL	NL
	Nephilidae	*Nephila senegalensis* (Walckenaer, 1841)	Banded-legged Nephila	NL	NL
	Eresidae	*Seothyra fasciata* Purcell, 1904	Buckspoor Spider	NL	NL
	Oxyopidae	*Peucetia* species	Green Lynx Spider	NL	NL
Odonata	Aeshnidae	*Anax imperator* Leach, 1815	Blue Emperor	NL	LC
	Libellulidae	*Brachythemis leucosticta* Burmeister, 1839	Banded Groundling	NL	LC
		Trithemis kirbyi Selys, 1891	Kirby's Dropwing	NL	LC
		Tramea basilaris Palisot de Beauvois, 1817	Keyhole Glider	NL	LC
Isoptera	Termitidae	*Macrotermes natalensis (*Haviland, 1898)	Large Fungus-growing Termite	NL	NL
Orthoptera	Pyrgomorphidae	*Zonocerus elegans* (Thunberg, 1815)	Elegant Grasshopper	NL	NL
Coleoptera	Carabidae	*Manticora* species	Giant Tiger Beetle	NL	NL
		Graphipterus species	Velvet Ground Beetle	NL	NL
	Buprestidae	*Sternocera orissa* Buquet, 1837	Giant Jewel Beetle	NL	NL
	Tenebrionidae	*Zophosis* species	Frantic Surface Beetle	NL	NL
Diptera	Muscidae	*Musca domestica* Linnaeus, 1758	House Fly	NL	NL
Lepidoptera	Hesperiidae	*Gomalia elma elma* (Trimen, 1862a)	Green-marbled Skipper	LC	NL
		Leucochitonea levubu Wallengren, 1857	White-cloaked Skipper	LC	NL
		Spialia diomus ferax (Wallengren, 1863)	Common Sandman	LC	NL
		Spialia spio (Linnaeus, 1764)	Mountain Sandman	LC	NL
	Papilionidae	*Papilio demodocus demodocus* Esper [1798]	Citrus Swallowtail	LC	NL
	Pieridae	*Belenois aurota* (Fabricius, 1793)	Brown-veined White	LC	NL
		Belenois gidica abyssinica (Lucas, 1852a)	African Veined White	LC	NL
		Catopsilla florella (Fabricius, 1775)	African Migrant	LC	LC
		Colotis annae annae (Wallengren, 1857)	Scarlet Tip	LC	NL
		Colotis antevippe gavisa (Wallengren, 1857)	Red Tip	LC	NL
		Colotis evagore antigone (Boisduval, 1836)	Small Orange Tip	LC	NL
		Colotis lais (Butler, 1876a)	Kalahari Orange Tip	LC	NL
		Colotis pallene (Hopffer, 1855)	Bushveld Orange Tip	LC	NL
		Colotis regina (Trimen, 1863)	Queen Purple Tip	LC	NL

Table 26: Animals confirmed for the study area

Order	*Family*	*Genus species*	*English Name*	*Regional status*	*Global Status*
		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	LC
	Nymphalidae	*Acraea axina* Westwood, 1881	Little Acraea	LC	NL
		Acraea neobule neobule Doubleday, [1847a]	Wandering Donkey Acraea	LC	NL
		Byblia ilithyia (Drury, [1773])	Spotted Joker	LC	NL
		Charaxes phaeus Hewitson, 1877d	Demon 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
	Lycaenidae	*Anthene amarah amarah* (Guérin-Méneville, 1849)	Black-striped Hairtail	LC	NL
		Azanus jesous (Guérin-Méneville, 1849)	Topaz Babul Blue	LC	NL
		Chilades trochylus (Freyer, [1843])	Grass Jewel Blue	LC	NL
		Cigaritis natalensis (Westwood, [1851-2])	Natal Bar	LC	NL
		Cigaritis phanes (Trimen, 1873)	Silvery Bar	LC	NL
		Cupidopsis jobates jobates Hopffer, 1855	Tailed Meadow Blue	LC	NL
		Lampides boeticus (Linnaeus, 1767)	Pea Blue	LC	LC
		Leptotes babaulti (Stempffer, 1935)	Babault's Zebra Blue	LC	NL
		Tarucus sybaris sybaris (Hopffer, 1855)	Dotted Blue	LC	NL
		Zizula hylax (Fabricius, 1775)	Tiny Grass Blue	LC	NL
	Arctiidae	*Utetheisa pulchella* (Linnaeus, 1758)	Crimson-speckled Footman	NE	NL
Hymenoptera	Apidae	*Apis mellifera scutellata* Lepeletier, 1836	African Honey Bee	NL	NL
	Formicidae	*Megaponera analis* (Latreille, 1802)	Matabele Ant	NL	NL
Herpetofauna					
Testudines	Testudinidae	*Stigmochelys pardalis* Valverde, 2005	Leopard Tortoise	LC	LC
Squamata	Colubridae	*Psammophis subtaeniatus* Peters, 1882	Western Yellow-bellied Sand Snake	LC	LC
	Lacertidae	*Heliobolus lugubris* Smith, 1838	Bushveld Lizard	LC	NL
		Ichnotropis capensis Fitzsimons, 1943	Ornate Rough-scaled Lizard	LC	NL
		Nucras intertexta (Smith, 1838)	Spotted Sandveld Lizard	LC	NL
		Pedioplanis lineoocellata (Duméril & Bibron, 1839)	Spotted Sand Lizard	LC	NL
Mammals					
Tubulidentata	Orycteropodidae	*Orycteropus afer* (Pallas, 1766)	Aardvark	LC	LC
Primates	Cercopithecidae	*Papio ursinus* (Kerr, 1792)	Chacma Baboon	LC	LC

Table 26: Animals confirmed for the study area

Order	*Family*	*Genus species*	*English Name*	*Regional status*	*Global Status*
		Chlorocebus pygerythrus (F. Cuvier, 1821)	Vervet Monkey	NL	LC
Rodentia	Pedetidae	*Pedetes capensis* (Forster, 1778)	South African Spring Hare	LC	LC
	Bathyergidae	*Fukomys damarensis* (Ogilby, 1838)	Damara Mole-rat	LC	LC
	Hystricidae	*Hystrix africaeaustralis* Peters, 1852	Cape Porcupine	LC	LC
Lagomorpha	Leporidae	*Lepus saxatilis* F. Cuvier, 1823	Scrub Hare	LC	LC
Carnivora	Felidae	*Felis silvestris* Schreber, 1777	Wildcat	LC	LC
		Leptailurus serval (Schreber, 1776)	Serval	NT	LC
	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
	Herpestidae	*Mungos mungo* (Gmelin, 1788)	Banded Mongoose	LC	LC
	Canidae	*Canis mesomelas* Schreber, 1775	Black-backed Jackal	LC	LC
	Mustelidae	*Mellivora capensis* (Schreber, 1776)	Honey Badger	NT	LC
Perissodactyla	Equidae	*Equus quagga* Boddaert, 1758	Plains Zebra	NL	LC
Artiodactyla	Suidae	*Phacochoerus africanus* (Gmelin, 1788)	Common Warthog	LC	LC
	Giraffidae	*Giraffa camelopardalis camelopardalis* (Linnaeus, 1758)	Nubian Giraffe	LC	LC
	Bovidae	*Aepyceros melampus* (Lichtenstein, 1812)	Impala	LC	LC
		Alcelaphus caama (Geoffroy Saint-Hilare, 1803)	Red Hartebeest	LC	NL
		Connachaetes taurinus (Burchell, 1823)	Blue Wildebeest	LC	LC
		Damaliscus lunatus (Burchell, 1823)	Common Tsessebe	LC	LC
		Damaliscus pygargus phillipsi Harper, 1939	Blesbok	LC	LC
		Kobus ellipsiprymnus (Ogilby, 1833)	Ellipsen Waterbuck	LC	LC
		Oryx gazella (Linnaeus, 1758)	Gemsbok	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

23 FAUNAL HABITAT SENSITIVITY

The following faunal sensitivities were estimated for the macro habitat types identified in the study area (refer **Table 27**, illustrated in **Figure 17**):

Table 27: Faunal sensitivities of the macro habitat types of the study area

Status	*Habitat type*	*ST*	*DV*	*LN*	*SN*	*RD*	*AVE*	*Sens Class*
Transformed	Transformed areas	1	1	1	1	1	10%	**low**
Degraded	Degraded Woodland	3	3	5	4	4	38%	**medium-low**
Natural	Sand Woodland	6	5	6	6	6	58%	**medium**
	Clay Woodland	7	7	6	7	6	66%	**medium-high**
	Ephemeral Pans	8	8	8	9	8	82%	**high**

Figure 17: Faunal Sensitivity of the study areas

24 ANTICIPATED IMPACTS ON THE FAUNAL ENVIRONMENT

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.

24.1 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:

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

24.2 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:

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

24.3 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:

» Cumulative losses and degradation of natural faunal habitat; and
» Cumulative depletion of faunal taxa, assemblages and communities on a regional scale, with specific reference to the conservation status of certain fauna taxa.

24.3.1 Quantification of Impacts on the Faunal Environment – Power Plant

Table 28: Quantification of impacts of the Power Plant on the faunal environment		
1. Nature of impact:	Direct impacts on/ losses of fauna species of conservation importance and concern and habitat associated with these species. Impacts are unavoidable because of land clearing activities, but are generally restricted to the immediate area. This impact is restricted to the construction phase, but is permanent. Animals are generally mobile and will evacuate towards other suitable areas, but unforeseen losses are expected	
	Without mitigation	***With mitigation***
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Medium term (3)**
Magnitude	**Very high (10)**	**Moderate (6)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	***High (72)***	**Moderate *(36)***
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Unavoidable impacts on conservation important animals will occur, irrespective of mitigation measures, albeit restricted to local footprint	
Mitigation Measures:	• Restrict extent of impact likely to site only; • Ensure the absence of sensitive species, particularly, sessile species, by means of a thorough walkdown (search and rescue) of development areas; • Ensure the absence of larger animals through frequent patrols, particularly prior to development and during construction	
Cumulative Impacts:	• Continued losses of protected species on a local and regional scale; • Decrease in habitat available for species of conservation concern and importance; • Potentially increase in threat level; • depletion of animal diversity on a local scale	
Residual Impacts:	Sterilised landscapes with no propensity for species of conservation concern, decline in population sizes and numbers, continual decline in habitat availability	
2. Nature of impact:	Losses of natural habitat through physical transformation, modifications, clearance and deterioration. Also includes the losses of natural refugia, such as termitaria, dead trees, etc.	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Definite (5)**	**Definite (5)**
Significance	***High(65)***	**Moderate (55)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, to some extent	
Can impacts be mitigated?	No	
Mitigation Measures:	• Restrict losses of natural habitat to development footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation of areas outside development footprints; • Ensure nodal developments by grouping developments structures; • Avoid the uncontrolled spread of infrastructure; • Implement biodiversity monitoring programmes; • Ensure proper restoration and rehabilitation of construction areas subsequent to construction	
Cumulative Impacts:	• Cumulative loss of natural habitat on a local and regional scale; • Cumulative developments lead to exacerbation of anthropogenic encroachment and resource demands, such as housing, water, etc., which places remaining natural habitat under increased pressure	
Residual Impacts:	Decreased aesthetic appeal, loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat	
3. Nature of impact:	Depletion of faunal diversity through direct losses, evacuation of unfavourable habitat by animals, including the introduction of invasive and non-endemic	

	species. Construction and operation creates opportunities for human/ animal conflict situations, with reference to potentially dangerous animals, snaring, trapping and killing (vehicular events)

	Without mitigation	With mitigation
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Medium term (3)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (52)**	**Low (27)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Compile and institute awareness programmes; • Ensure minimal conflict situation through control of human movement in adjacent natural habitat; • Frequent boundary patrols and removal of snares; • Biological monitoring programmes and animal control (vervet monkeys, feral cats, rats, baboons, dogs, etc); • Ecological sound management of construction areas, with reference to waste management, food sources, etc.	
Cumulative Impacts:	Changes to faunal structures, assemblages, communities, depletion of faunal diversity, disappearance of certain species, introduction of invasive species in natural areas, changes to genetic populations	
Residual Impacts:	Depletion of faunal diversity, presence of invasive species, genetic modification of population, increased presence of unwanted (opportunistic) species	

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

	Without mitigation	With mitigation
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (48)**	**Low (27)**
Status (positive or negative)	Negative	
Reversibility	Moderately reversible, the nature of impacts are such that activities on the development site can be adapted to avoid impacts in surrounding areas	
Irreplaceable loss of resources?	Low	
Can impacts be mitigated?	Yes	
Mitigation Measures:	Implement biodiversity monitoring programme and mitigation measures that are aimed at identifying and preventing the uncontrolled spread of impacts into adjacent areas of natural habitat from development footprint	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation in natural habitat in direct proximity to development footprint	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat and deterioration of surrounding natural habitat, loss of biological diversity	

5. Nature of impact:	Indirect impacts on movement/ migration patterns of animals and ecological interaction and processes

	Without mitigation	With mitigation
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Definite (5)**	**Highly probable (4)**
Significance	***High* (70)**	**Moderate (40)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Low	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Limit development to footprint area; • Avoid impacts in adjacent habitat;	

	• Implement biodiversity monitoring programmes; • Alien and invasive management programmes
Cumulative Impacts:	Habitat loss, degradation, fragmentation & isolation of natural habitat
Residual Impacts:	Fragmented, isolated portions of natural habitat, sterile landscapes, increased anthropogenic pressures on natural resources, changes to normal migration patterns on a local scale

6. Nature of impact:	Exacerbated increases of edge effects of the project areas	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Long term (4)**	**Long term (4)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (52)**	**Moderate (30)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	No	
Mitigation Measures:	• Restrict losses of natural habitat to development footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation of areas outside development footprints; • Ensure nodal developments by grouping developments structures; • Avoid the uncontrolled spread of infrastructure; • Implement biodiversity monitoring programmes; Ensure proper restoration and rehabilitation of construction areas subsequent to construction	
Cumulative Impacts:	Habitat degradation and deterioration, loss of species diversity and ecosystem functionality	
Residual Impacts:	Degraded landscapes, loss of aesthetic appeal, poor faunal diversity	

7. Nature of impact:	Accelerated developments patterns on a local and regional level implies significant increases in local and regional habitat fragmentation and isolation levels	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (48)**	**Moderate (30)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	No	
Mitigation Measures:	• Restrict losses of natural habitat to development footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation of areas outside development footprints; • Ensure nodal developments by grouping developments structures; • Avoid the uncontrolled spread of infrastructure; • Implement biodiversity monitoring programmes; Ensure proper restoration and rehabilitation of construction areas subsequent to construction	
Cumulative Impacts:	Habitat degradation and deterioration, loss of species diversity and ecosystem functionality	
Residual Impacts:	Degraded landscapes, loss of aesthetic appeal, poor faunal diversity	

8. Nature of impact:	Cumulative depletion of faunal taxa, assemblages and communities, with specific reference to the conservation important species	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Low (4)**	**Low (4)**
Probability	**Probable (3)**	**Improbable (2)**

Significance	**Moderate (36)**	**Low (24)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Compile and implement public awareness programmes; • Implement biodiversity monitoring protocols, search and rescue operations	
Cumulative Impacts:	Loss of biodiversity on a local scale, continued/ exacerbated loss of CI species	
Residual Impacts:	Low faunal diversity, potential increase in threat status to certain taxa, exacerbated losses of faunal diversity, changes to local faunal patterns	

24.3.2 Quantification of Impacts on the Faunal Environment – Ashing Facility (Appelvlakte)

Table 29: Quantification of impacts of the Ashing Facility on the faunal environment		
1. Nature of impact:	Direct impacts on/ losses of fauna species of conservation importance and concern and habitat associated with these species. Impacts are unavoidable because of land clearing activities, but are generally restricted to the immediate area. This impact is restricted to the construction phase, but is permanent. Animals are generally mobile and will evacuate towards other suitable areas, but unforeseen losses are expected	
	Without mitigation	***With mitigation***
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Medium term (3)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	***High (60)***	**Moderate *(33)***
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Unavoidable impacts on conservation important animals will occur, irrespective of mitigation measures, albeit restricted to local footprint	
Mitigation Measures:	• Restrict extent of impact likely to site only; • Ensure the absence of sensitive species, particularly, sessile species, by means of a thorough walkdown (search and rescue) of development areas; • Ensure the absence of larger animals through frequent patrols, particularly prior to development and during construction	
Cumulative Impacts:	• Continued losses of protected species on a local and regional scale; • Decrease in habitat available for species of conservation concern and importance; • Potentially increase in threat level; • depletion of animal diversity on a local scale	
Residual Impacts:	Sterilised landscapes with no propensity for species of conservation concern, decline in population sizes and numbers, continual decline in habitat availability	
2. Nature of impact:	Losses of natural habitat through physical transformation, modifications, clearance and deterioration. Also includes the losses of natural refugia, such as termitaria, dead trees, etc.	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Definite (5)**	**Definite (5)**
Significance	***High (65)***	**Moderate (55)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, to some extent	
Can impacts be mitigated?	No	
Mitigation Measures:	• Restrict losses of natural habitat to development footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation of areas outside development footprints;	

	• Ensure nodal developments by grouping developments structures; • Avoid the uncontrolled spread of infrastructure; • Implement biodiversity monitoring programmes; • Ensure proper restoration and rehabilitation of construction areas subsequent to construction
Cumulative Impacts:	• Cumulative loss of natural habitat on a local and regional scale; • Cumulative developments lead to exacerbation of anthropogenic encroachment and resource demands, such as housing, water, etc., which places remaining natural habitat under increased pressure
Residual Impacts:	Decreased aesthetic appeal, loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat

3. Nature of impact:	Depletion of faunal diversity through direct losses, evacuation of unfavourable habitat by animals, including the introduction of invasive and non-endemic species. Construction and operation creates opportunities for human/ animal conflict situations, with reference to potentially dangerous animals, snaring, trapping and killing (vehicular events)	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (52)**	**Moderate (30)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Compile and institute awareness programmes; • Ensure minimal conflict situation through control of human movement in adjacent natural habitat; • Frequent boundary patrols and removal of snares; • Biological monitoring programmes and animal control (vervet monkeys, feral cats, rats, baboons, dogs, etc); • Ecological sound management of construction areas, with reference to waste management, food sources, etc.	
Cumulative Impacts:	Changes to faunal structures, assemblages, communities, depletion of faunal diversity, disappearance of certain species, introduction of invasive species in natural areas, changes to genetic populations	
Residual Impacts:	Depletion of faunal diversity, presence of invasive species, genetic modification of population, increased presence of unwanted (opportunistic) species	

4. Nature of impact:	Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (48)**	**Low (27)**
Status (positive or negative)	Negative	
Reversibility	Moderately reversible, the nature of impacts are such that activities on the development site can be adapted to avoid impacts in surrounding areas	
Irreplaceable loss of resources?	Low	
Can impacts be mitigated?	Yes	
Mitigation Measures:	Implement biodiversity monitoring programme and mitigation measures that are aimed at identifying and preventing the uncontrolled spread of impacts into adjacent areas of natural habitat from development footprint	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation in natural habitat in direct proximity to development footprint	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat and deterioration of surrounding natural habitat, loss of biological diversity	

5. Nature of impact:	Indirect impacts on movement/ migration patterns of animals and ecological interaction and processes

	Without mitigation	With mitigation
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Probable (3)**	**Probable (3)**
Significance	**Moderate (42)**	**Moderate (30)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Low	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Limit development to footprint area; • Avoid impacts in adjacent habitat; • Implement biodiversity monitoring programmes; • Alien and invasive management programmes	
Cumulative Impacts:	Habitat loss, degradation, fragmentation & isolation of natural habitat	
Residual Impacts:	Fragmented, isolated portions of natural habitat, sterile landscapes, increased anthropogenic pressures on natural resources, changes to normal migration patterns on a local scale	
6. Nature of impact:	Exacerbated increases of edge effects of the project areas	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Long term (4)**	**Long term (4)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (48)**	**Moderate (30)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	No	
Mitigation Measures:	• Restrict losses of natural habitat to development footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation of areas outside development footprints; • Ensure nodal developments by grouping developments structures; • Avoid the uncontrolled spread of infrastructure; • Implement biodiversity monitoring programmes; Ensure proper restoration and rehabilitation of construction areas subsequent to construction	
Cumulative Impacts:	Habitat degradation and deterioration, loss of species diversity and ecosystem functionality	
Residual Impacts:	Degraded landscapes, loss of aesthetic appeal, poor faunal diversity	
7. Nature of impact:	Accelerated developments patterns on a local and regional level implies significant increases in local and regional habitat fragmentation and isolation levels	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (48)**	**Moderate (30)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	No	
Mitigation Measures:	• Restrict losses of natural habitat to development footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation of areas outside development footprints; • Ensure nodal developments by grouping developments structures; • Avoid the uncontrolled spread of infrastructure; • Implement biodiversity monitoring programmes;	

	Ensure proper restoration and rehabilitation of construction areas subsequent to construction	
Cumulative Impacts:	Habitat degradation and deterioration, loss of species diversity and ecosystem functionality	
Residual Impacts:	Degraded landscapes, loss of aesthetic appeal, poor faunal diversity	
8. Nature of impact:	Cumulative depletion of faunal taxa, assemblages and communities, with specific reference to the conservation important species	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Low (4)**	**Low (4)**
Probability	**Probable (3)**	**Improbable (2)**
Significance	**Moderate (36)**	**Low (24)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Compile and implement public awareness programmes; • Implement biodiversity monitoring protocols, search and rescue operations	
Cumulative Impacts:	Loss of biodiversity on a local scale, continued/ exacerbated loss of CI species	
Residual Impacts:	Low faunal diversity, potential increase in threat status to certain taxa, exacerbated losses of faunal diversity, changes to local faunal patterns	

24.3.3 Quantification of Impacts on the Faunal Environment – Ashing Facility (Graaffwater)

Table 30: Quantification of impacts of the Ashing Facility on the faunal environment

1. Nature of impact:	Direct impacts on/ losses of fauna species of conservation importance and concern and habitat associated with these species. Impacts are unavoidable because of land clearing activities, but are generally restricted to the immediate area. This impact is restricted to the construction phase, but is permanent. Animals are generally mobile and will evacuate towards other suitable areas, but unforeseen losses are expected	
	Without mitigation	***With mitigation***
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Medium term (3)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	***High (64)***	**Moderate *(36)***
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Unavoidable impacts on conservation important animals will occur, irrespective of mitigation measures, albeit restricted to local footprint	
Mitigation Measures:	• Restrict extent of impact likely to site only; • Ensure the absence of sensitive species, particularly, sessile species, by means of a thorough walkdown (search and rescue) of development areas; • Ensure the absence of larger animals through frequent patrols, particularly prior to development and during construction	
Cumulative Impacts:	• Continued losses of protected species on a local and regional scale; • Decrease in habitat available for species of conservation concern and importance; • Potentially increase in threat level; • depletion of animal diversity on a local scale	
Residual Impacts:	Sterilised landscapes with no propensity for species of conservation concern, decline in population sizes and numbers, continual decline in habitat availability	
2. Nature of impact:	Losses of natural habitat through physical transformation, modifications, clearance and deterioration. Also includes the losses of natural refugia, such as termitaria, dead trees, etc.	
	Without mitigation	**With mitigation**

Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Definite (5)**	**Definite (5)**
Significance	***High* (65)**	**Moderate (55)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, to some extent	
Can impacts be mitigated?	No	
Mitigation Measures:	• Restrict losses of natural habitat to development footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation of areas outside development footprints; • Ensure nodal developments by grouping developments structures; • Avoid the uncontrolled spread of infrastructure; • Implement biodiversity monitoring programmes; • Ensure proper restoration and rehabilitation of construction areas subsequent to construction	
Cumulative Impacts:	• Cumulative loss of natural habitat on a local and regional scale; • Cumulative developments lead to exacerbation of anthropogenic encroachment and resource demands, such as housing, water, etc., which places remaining natural habitat under increased pressure	
Residual Impacts:	Decreased aesthetic appeal, loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat	
3. Nature of impact:	Depletion of faunal diversity through direct losses, evacuation of unfavourable habitat by animals, including the introduction of invasive and non-endemic species. Construction and operation creates opportunities for human/ animal conflict situations, with reference to potentially dangerous animals, snaring, trapping and killing (vehicular events)	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (52)**	**Moderate (30)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Compile and institute awareness programmes; • Ensure minimal conflict situation through control of human movement in adjacent natural habitat; • Frequent boundary patrols and removal of snares; • Biological monitoring programmes and animal control (vervet monkeys, feral cats, rats, baboons, dogs, etc); • Ecological sound management of construction areas, with reference to waste management, food sources, etc.	
Cumulative Impacts:	Changes to faunal structures, assemblages, communities, depletion of faunal diversity, disappearance of certain species, introduction of invasive species in natural areas, changes to genetic populations	
Residual Impacts:	Depletion of faunal diversity, presence of invasive species, genetic modification of population, increased presence of unwanted (opportunistic) species	
4. Nature of impact:	Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Definite (5)**	**Highly probable (4)**
Significance	**Moderate (60)**	**Moderate (36)**
Status (positive or negative)	Negative	

Reversibility	Moderately reversible, the nature of impacts are such that activities on the development site can be adapted to avoid impacts in surrounding areas
Irreplaceable loss of resources?	Low
Can impacts be mitigated?	Yes
Mitigation Measures:	Implement biodiversity monitoring programme and mitigation measures that are aimed at identifying and preventing the uncontrolled spread of impacts into adjacent areas of natural habitat from development footprint
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation in natural habitat in direct proximity to development footprint
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat and deterioration of surrounding natural habitat, loss of biological diversity
5. Nature of impact:	Indirect impacts on movement/ migration patterns of animals and ecological interaction and processes
	Without mitigation / **With mitigation**
Extent	**Regional (3)** / **Local (2)**
Duration	**Permanent (5)** / **Long term (4)**
Magnitude	**Moderate (6)** / **Low (4)**
Probability	**Highly probable (4)** / **Probable (3)**
Significance	**Moderate (56)** / **Moderate (30)**
Status (positive or negative)	Negative
Reversibility	Irreversible
Irreplaceable loss of resources?	Low
Can impacts be mitigated?	Yes, to some extent
Mitigation Measures:	• Limit development to footprint area; • Avoid impacts in adjacent habitat; • Implement biodiversity monitoring programmes; • Alien and invasive management programmes
Cumulative Impacts:	Habitat loss, degradation, fragmentation & isolation of natural habitat
Residual Impacts:	Fragmented, isolated portions of natural habitat, sterile landscapes, increased anthropogenic pressures on natural resources, changes to normal migration patterns on a local scale
6. Nature of impact:	Exacerbated increases of edge effects of the project areas
	Without mitigation / **With mitigation**
Extent	**Regional (3)** / **Local (2)**
Duration	**Long term (4)** / **Long term (4)**
Magnitude	**Moderate (6)** / **Low (4)**
Probability	**Highly probable (4)** / **Probable (3)**
Significance	**Moderate (52)** / **Moderate (30)**
Status (positive or negative)	Negative
Reversibility	Irreversible
Irreplaceable loss of resources?	Yes, but only on a local scale
Can impacts be mitigated?	No
Mitigation Measures:	• Restrict losses of natural habitat to development footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation of areas outside development footprints; • Ensure nodal developments by grouping developments structures; • Avoid the uncontrolled spread of infrastructure; • Implement biodiversity monitoring programmes; Ensure proper restoration and rehabilitation of construction areas subsequent to construction
Cumulative Impacts:	Habitat degradation and deterioration, loss of species diversity and ecosystem functionality
Residual Impacts:	Degraded landscapes, loss of aesthetic appeal, poor faunal diversity
7. Nature of impact:	Accelerated developments patterns on a local and regional level implies significant increases in local and regional habitat fragmentation and isolation levels
	Without mitigation / **With mitigation**
Extent	**Regional (3)** / **Regional (3)**
Duration	**Permanent (5)** / **Permanent (5)**

Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (48)**	**Moderate (30)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	No	
Mitigation Measures:	• Restrict losses of natural habitat to development footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation of areas outside development footprints; • Ensure nodal developments by grouping developments structures; • Avoid the uncontrolled spread of infrastructure; • Implement biodiversity monitoring programmes; Ensure proper restoration and rehabilitation of construction areas subsequent to construction	
Cumulative Impacts:	Habitat degradation and deterioration, loss of species diversity and ecosystem functionality	
Residual Impacts:	Degraded landscapes, loss of aesthetic appeal, poor faunal diversity	
8. Nature of impact:	Cumulative depletion of faunal taxa, assemblages and communities, with specific reference to the conservation important species	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Low (4)**	**Low (4)**
Probability	**Probable (3)**	**Improbable (2)**
Significance	**Moderate (36)**	**Low (24)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Compile and implement public awareness programmes; • Implement biodiversity monitoring protocols, search and rescue operations	
Cumulative Impacts:	Loss of biodiversity on a local scale, continued/ exacerbated loss of CI species	
Residual Impacts:	Low faunal diversity, potential increase in threat status to certain taxa, exacerbated losses of faunal diversity, changes to local faunal patterns	

24.3.4 Quantification of Impacts on the Faunal Environment – Power Lines

Table 31: Quantification of impacts of the Power Line on the floristic environment		
1. Nature of impact:	Direct impacts on/ losses of fauna species of conservation importance and concern and habitat associated with these species. Impacts are unavoidable because of land clearing activities, but are generally restricted to the immediate area. This impact is restricted to the construction phase, but is permanent. Animals are generally mobile and will evacuate towards other suitable areas, but unforeseen losses are expected	
	Without mitigation	***With mitigation***
Extent	**Local (2)**	**Local (2)**
Duration	**Long term (4)**	**Medium term (3)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (*48*)**	**Low (*27*)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Unavoidable impacts on conservation important animals will occur, irrespective of mitigation measures, albeit restricted to local footprint	
Mitigation Measures:	• Restrict extent of impact likely to site only; • Ensure the absence of sensitive species, particularly, sessile species, by means of a thorough walkdown (search and rescue) of development areas;	

	• Ensure the absence of larger animals through frequent patrols, particularly prior to development and during construction
Cumulative Impacts:	• Continued losses of protected species on a local and regional scale; • Decrease in habitat available for species of conservation concern and importance; • Potentially increase in threat level; • depletion of animal diversity on a local scale
Residual Impacts:	Sterilised landscapes with no propensity for species of conservation concern, decline in population sizes and numbers, continual decline in habitat availability

2. Nature of impact:	Losses of natural habitat through physical transformation, modifications, clearance and deterioration. Also includes the losses of natural refugia, such as termitaria, dead trees, etc.	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Long term (4)**	**Medium term (3)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (40)**	**Low (21)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, to some extent	
Can impacts be mitigated?	No	
Mitigation Measures:	• Restrict losses of natural habitat to development footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation of areas outside development footprints; • Ensure nodal developments by grouping developments structures; • Avoid the uncontrolled spread of infrastructure; • Implement biodiversity monitoring programmes; • Ensure proper restoration and rehabilitation of construction areas subsequent to construction	
Cumulative Impacts:	• Cumulative loss of natural habitat on a local and regional scale; • Cumulative developments lead to exacerbation of anthropogenic encroachment and resource demands, such as housing, water, etc., which places remaining natural habitat under increased pressure	
Residual Impacts:	Decreased aesthetic appeal, loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat	

3. Nature of impact:	Depletion of faunal diversity through direct losses, evacuation of unfavourable habitat by animals, including the introduction of invasive and non-endemic species. Construction and operation creates opportunities for human/ animal conflict situations, with reference to potentially dangerous animals, snaring, trapping and killing (vehicular events)	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Long term (4)**	**Medium term (3)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (40)**	**Low (21)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Compile and institute awareness programmes; • Ensure minimal conflict situation through control of human movement in adjacent natural habitat; • Frequent boundary patrols and removal of snares; • Biological monitoring programmes and animal control (vervet monkeys, feral cats, rats, baboons, dogs, etc); • Ecological sound management of construction areas, with reference to waste management, food sources, etc.	
Cumulative Impacts:	Changes to faunal structures, assemblages, communities, depletion of faunal diversity, disappearance of certain species, introduction of invasive species in natural areas, changes to genetic populations	

Residual Impacts:	Depletion of faunal diversity, presence of invasive species, genetic modification of population, increased presence of unwanted (opportunistic) species	
4. Nature of impact:	Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Long term (4)**	**Medium term (3)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Improbable (2)**
Significance	**Moderate (44)**	**Low (14)**
Status (positive or negative)	Negative	
Reversibility	Moderately reversible, the nature of impacts are such that activities on the development site can be adapted to avoid impacts in surrounding areas	
Irreplaceable loss of resources?	Low	
Can impacts be mitigated?	Yes	
Mitigation Measures:	Implement biodiversity monitoring programme and mitigation measures that are aimed at identifying and preventing the uncontrolled spread of impacts into adjacent areas of natural habitat from development footprint	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation in natural habitat in direct proximity to development footprint	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat and deterioration of surrounding natural habitat, loss of biological diversity	
5. Nature of impact:	Indirect impacts on movement/ migration patterns of animals and ecological interaction and processes	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Long term (4)**	**Medium term (3)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Probable (3)**	**Improbable (2)**
Significance	**Moderate (33)**	**Low (14)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Low	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Limit development to footprint area; • Avoid impacts in adjacent habitat; • Implement biodiversity monitoring programmes; • Alien and invasive management programmes	
Cumulative Impacts:	Habitat loss, degradation, fragmentation & isolation of natural habitat	
Residual Impacts:	Fragmented, isolated portions of natural habitat, sterile landscapes, increased anthropogenic pressures on natural resources, changes to normal migration patterns on a local scale	
6. Nature of impact:	Exacerbated increases of edge effects of the project areas	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Long term (4)**	**Medium term (3)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Probable (3)**	**Improbable (2)**
Significance	**Moderate (30)**	**Low (14)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	No	
Mitigation Measures:	• Restrict losses of natural habitat to development footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation of areas outside development footprints; • Ensure nodal developments by grouping developments structures; • Avoid the uncontrolled spread of infrastructure;	

	• Implement biodiversity monitoring programmes; Ensure proper restoration and rehabilitation of construction areas subsequent to construction
Cumulative Impacts:	Habitat degradation and deterioration, loss of species diversity and ecosystem functionality
Residual Impacts:	Degraded landscapes, loss of aesthetic appeal, poor faunal diversity

7. Nature of impact:	Accelerated developments patterns on a local and regional level implies significant increases in local and regional habitat fragmentation and isolation levels	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Long term (4)**	**Medium term (3)**
Magnitude	**Minor (2)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (32)**	**Low (21)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	No	
Mitigation Measures:	• Restrict losses of natural habitat to development footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation of areas outside development footprints; • Ensure nodal developments by grouping developments structures; • Avoid the uncontrolled spread of infrastructure; • Implement biodiversity monitoring programmes; Ensure proper restoration and rehabilitation of construction areas subsequent to construction	
Cumulative Impacts:	Habitat degradation and deterioration, loss of species diversity and ecosystem functionality	
Residual Impacts:	Degraded landscapes, loss of aesthetic appeal, poor faunal diversity	

8. Nature of impact:	Cumulative depletion of faunal taxa, assemblages and communities, with specific reference to the conservation important species	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Long term (4)**	**Medium term (3)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Probable (3)**	**Improbable (2)**
Significance	**Moderate (30)**	**Low (14)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Compile and implement public awareness programmes; • Implement biodiversity monitoring protocols, search and rescue operations	
Cumulative Impacts:	Loss of biodiversity on a local scale, continued/ exacerbated loss of CI species	
Residual Impacts:	Low faunal diversity, potential increase in threat status to certain taxa, exacerbated losses of faunal diversity, changes to local faunal patterns	

Table 32: Summary table for impact significance on the faunal components

Impact	*Power Station*		*Ashing Facility – Graaffwater*		*Ashing Facility - Appelvlakte*		*Power Lines*	
	Without Mitigation	Without Mitigation	With mitigation	With mitigation	Without Mitigation	With mitigation	Without Mitigation	With mitigation
1. Loss of fauna species of conservation importance (threatened taxa) and habitat associated with CI species	72	36	60	33	64	36	48	27

Section D

Table 32: Summary table for impact significance on the faunal components

Impact	*Power Station*		*Ashing Facility – Graaffwater*		*Ashing Facility - Appelvlakte*		*Power Lines*	
	Without Mitigation	Without Mitigation	With mitigation	With mitigation	Without Mitigation	With mitigation	Without Mitigation	With mitigation
2. Loss of natural habitat, including essential habitat refugia	65	55	65	55	65	55	40	21
3. Depletion of faunal diversity, human/ animal conflict situations, including the introduction of invasive and non-endemic species	52	27	52	30	52	30	40	21
4. Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.	48	27	48	27	60	36	44	14
5. Indirect impacts on movement/ migration patterns of animals and ecological interaction and processes	70	40	42	30	56	30	33	14
6. Exacerbated increases of edge effects of the project areas	52	30	48	30	52	30	30	14
7. Cumulative losses and degradation of natural habitat	48	30	48	30	48	30	32	21
8. Cumulative depletion of faunal taxa, assemblages and communities, with specific reference to the conservation important species	36	24	36	24	36	24	30	14

24.4 Concluding Impact Statement

24.4.1 Power Station (Farms Graaffwater & Goedehoop)

Habitat comprised in the proposed study area represents typical woodland savanna of the region. No particularly sensitive, atypical or unique faunal habitat is present within the area and the faunal communities and assemblages therefore reflect the typical faunal compositional characteristics on a larger scale. Habitat is undoubtedly suited for a variety of conservation important species, which will persist within the development footprint. However, this is an attribute that is reflected throughout the region and considering alternative placements on a local or regional scale is unlikely to yield significantly different results. No red-flag impacts were identified on these sites, but care is advised to exclude sensitive habitat types from the development footprint.

24.4.2 Ashing Facility (Graaffwater vs. Appelvlakte)

The farm Appelvlakte includes the Matimba Power Station and associated infrastructure and Appelvlakte shooting range and also exhibits significant areas of transformed habitat

(Industrial, Mining and Infrastructure), as well as areas of degraded woodland. These areas have low and medium-low estimated faunal sensitivities, comprising mostly of sand woodland (medium estimated faunal sensitivity). Appelvlakte is ecologically isolated to the west, southwest and south. The current ecological status of the farm is a result of significant habitat fragmentation and edge effects; it is relatively isolated and the residual and cumulative impacts of Marapong, Matimba and Grootegeluk are ecologically evident on the farm. The farm Appelvlakte does not include any ephemeral pans (high estimated faunal sensitivity).

The farm Graaffwater is geographically situated to the north of Grootegeluk coalmine, surrounded on all sides by game farms comprising of mostly natural faunal habitats. Graaffwater is mostly characterised by untransformed sand woodland, but also includes significant areas of clay woodland (medium-high estimated faunal sensitivity). Importantly, Graaffwater also includes the only two ephemeral pans in the study area (high estimated faunal sensitivity). Graaffwater is ecologically intact and has not been isolated or fragmented; it remains a segment of natural savanna within the larger region of untransformed faunal habitat to the north of the transformed mining, industrial and power utility areas. It is currently also an important ecological buffer between these transformed areas and associated operational impacts and the game farming community to the north.

Recommendation - Even though impacts remain largely similar, the estimated significance pre- and post-mitigation of these impacts for Graaffwater is significantly lower compared to Appelvlakte. Based on the ecological characteristics of Graaffwater, the expected effectiveness of mitigation measures will be significantly less on Graaffwater compared to Appelvlakte. In short, the farm Appelvlakte is recommended as the preferred alternative for the ashing facility site.

24.4.3 Power Line

Habitat comprised in the proposed servitude represents typical woodland savanna of the region, albeit largely deteriorated because of existing developments. No particularly sensitive, atypical or unique faunal habitat is present within the servitude and the faunal communities and assemblages therefore reflect the typical faunal compositional characteristics on a larger scale. No red-flag impacts were identified on these sites, but care is advised to exclude sensitive habitat types from the development footprint.

24.4.4 Conclusion

It is the conclusion of the author that the loss of habitat associated with the proposed developments is unlikely to represent significant impacts on the faunal attributes of the area on a local or regional scale. While losses of fauna species and natural habitat within the development footprints are unavoidable, the use of recommended alternatives and the implementation of proposed mitigation hierarchy will, in all probability, ameliorate unavoidable, potential and likely impacts to an acceptable significance.

24.5 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', in order to regulate impact significance, duration, scale or all of 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.

24.5.1 Site Specific Mitigation Measures

Mitigation Measure 1 - Exclude all areas of sensitive faunal habitat from the proposed development, please refer to **Figure 17** and **Section 24.2**;

Mitigation Measure 2 - Implement a suitable buffer zone (at least 30 m) between the edge of sensitive habitat types and any type of development or surface disturbance;

Mitigation Measure 3 - Prevent contamination of natural woodland, wetlands, etc. that are not included in the development footprint, from any source of pollution from stockpiling areas, conveyor lines, water treatment facilities, etc.;

Mitigation Measure 4 - Develop an integrated management plan to deal with aspects such as littering, inappropriate discarding of food, the infestation of invasive and problem animal species, including rats, mice, vervet monkeys, baboons, etc.;

Mitigation Measure 5 - Develop and implement a site-specific approach to litter and discard control by means of animal proof bins and litter control measures, with particular reference to discarded food, food containers, etc.;

Mitigation Measure 6 - All development structures, with particular reference to temporary office buildings during construction phase, shall be developed and constructed in a manner that prevents habituation and infestation by opportunistic species such as rats, snakes, burrowing animals, etc. I.e. no small gaps and openings should be avoided that could be utilised as burrows and hiding spaces;

24.5.2 Roads & Access

Mitigation Measure 7 - Access is to be established by vehicles passing over the same track on natural ground. Multiple tracks are not permitted;

Mitigation Measure 8 - A road management plan should be compiled prior to the commencement of construction activities;

Mitigation Measure 9 - No roads should be allowed within ecologically sensitive areas. The use of roads around ecologically sensitive areas for the purpose of buffers should be done with circumspect particularly in view of accidental killing of animals;

Mitigation Measure 10 - Vehicular traffic should not be allowed after dark in order to limit accidental killing of nocturnal animals;

Mitigation Measure 11 - Speed of vehicles should be limited to allow for sufficient safety margins;

24.5.3 Animals

Mitigation Measure 12 - Ensure the absence of conservation important sessile animal species, such as baboon spiders, from the site through a walkthrough procedure prior to the commencement of construction activities;

Mitigation Measure 13 - No animal may be hunted, trapped, snared or killed for any purpose whatsoever. Fences and boundaries should be patrolled weekly in order to ensure the removal of snares;

Mitigation Measure 14 - Dangerous animals should be handled by a competent person;

Mitigation Measure 15 - No indiscriminate killing of animals should be allowed;

Mitigation Measure 16 - Compile a graphic list of potentially dangerous animals and present this to all workers as part of site induction;

Mitigation Measure 17 - Ensure that a competent snake handler is available at all times to remove and relocate snakes from the construction site;

Mitigation Measure 18 - Ensure that proper treatment facilities and competent personnel is available in cases of snake bites;

Mitigation Measure 55 - Fences and boundaries should be patrolled weekly in order to locate and remove snares/ traps;

Mitigation Measure 56 - Sensitize all personnel to the presence, characteristics and behaviour of animals on the site;

Mitigation Measure 57 - Include suitable procedures in the event of encountering potentially dangerous animals on the site;

Mitigation Measure 58 - No domestic pets should be allowed on the site whatsoever.

24.6 Faunal Management Action Plans

Biodiversity Action Plans are presented for each of the identified impacts. These Action Plans are by no means regarded as comprehensive and should be elaborated and detailed as needed during the various phases of the proposed development.

Impact 1: Loss of fauna species of conservation importance (threatened taxa) and habitat associated with CI species		
Objective:	Limit/ manage impacts on fauna species of conservation importance	
Project Components	Any infrastructure development that will cause loss of natural habitat where conservation important species are likely to occur or activities that could cause the disturbance of populations or individuals of these species	
Potential Impacts	Loss of habitat suitable for populations of conservation important species or direct impacts and losses of populations or individuals of these species	
Activity/ Risk Source	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective	Limit the impact on conservation important animals, prevent impacts on animals in remaining areas of natural habitat	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
1. Compile a list of conservation important animals that are known to occur in the region	Construction Contractors, Environmental Team, Environmental Control Officer	Prior to site preparation activities
2. Implement awareness programmes for all contractors and workers on site		Site preparation, Construction Phase
3. Compile Standard Operational Procedures for the effective handling, capture, release and/ or relocation of animals, should they be threatened by construction/ operational activities		Prior to site preparation activities
4. Adapt operational activities to prevent direct impacts on these animals, including personnel presence in areas of natural habitat and vehicular movements/ speeds		Prior to site preparation activities
Performance Indicator	No significant losses of conservation important animals as a result of construction or operational activities	
	The persistence of individuals and populations of protected animals in natural habitat surrounding the development	
Monitoring	Yearly monitoring of presence/ abundance of conservation important animals as part of bio monitoring programme	
Impact 2: Loss of natural habitat, including essential habitat refugia		
Objective:	Limit/ manage the loss of natural vegetation (physical modifications, removal, damage) and local depletion of animal diversity	
Project Components	Any infrastructure development that will cause loss of natural habitat, land clearance	
Potential Impacts	Uncontrolled loss of natural habitat that would result in a reduction of local animal diversity and habitat	
Activity/ Risk Source	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective	Allow for remaining areas of natural habitat surrounding development footprints to function ecologically effective within the environment of industrial development	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
1. Clearly demarcate development footprint boundaries prior to footprint clearance by permanent means in order to control the movement of construction vehicles and personnel	Construction Contractors, Environmental Team, Environmental Control Officer	Prior to site preparation activities
2. Develop and implement a road plan to accommodate planned and needed infrastructure, prohibit inappropriate establishment of additional and unneeded road infrastructure		
3. Plan, develop and demarcate needed laydown areas, waste management areas. Prevent the inappropriate use of natural areas outside the development footprint for *ad hoc* activities		Site preparation, Construction Phase
4. Plan and develop a monitoring protocol in collaboration with the ECO in order to		

monitor and prohibit losses of natural habitat outside the approved and demarcated site development footprint		
5. The implementation of periodic monitoring programme (annual, at least) should be aimed at assessing development impacts on the faunal environment in close proximity to the development footprint, ensuring early identification and mitigation of observed impacts		
Performance Indicator	No significant loss of faunal diversity on a local or regional scale, the implementation of a management strategy that will preserve faunal diversity in natural habitat areas adjacent to development footprint	
	Effective ecological functionality of remaining areas of natural habitat surrounding an environment of industrial development	
Monitoring	Annual monitoring of faunal diversity in affected and surrounding areas of natural habitat as part of biodiversity monitoring programme	
Impact 3A: Depletion of faunal diversity, human/ animal conflict situations, including the introduction of invasive and non-endemic species		
Objective:	Facilitate effective displacement of animals from the development site, prevent continuous impacts on animals surrounding the development	
Project Components	All activities that will result in decimation of natural habitat occupied by animal species, activities that are likely to result in deaths of animals, activities that might attract animals to development/ construction sites	
Potential Impacts	Uncontrolled/ accidental death of animals that occupy natural habitat within the development site or temporarily occupy parts of the site/ infrastructures	
Activity/ Risk Source	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective	Limit the direct impacts on animals occupying natural habitat where development will take place, limit the presence/ occurrence of animals within construction/ operational areas, effect removal and relocation to suitable areas	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
1. Identify animals present within the development footprint, with particular reference to spiders, snakes, scorpions, large mammals, etc.	ECO, appointed specialist	Prior to site preparation activities
2. Compile and implement a capture and relocation programme prior to construction phase		Prior to site preparation activities
3. Compile Standard Operating Procedures for the capture and relocation of animals during the construction phase		Site preparation, construction and operational phases
Performance Indicator	No significant losses of animals, successful relocation and release of animals captured on site	
	Continued presence of a high diversity of animals in immediate surrounds	
Monitoring	Development and implementation of bio monitoring programme	
Impact 3B: Minimise human/ animal conflict situations, including the introduction of invasive and non-endemic species		
Objective:	Minimise human-animal conflict situations	
Project Components	The presence of personnel within a development area that is occasionally occupied by opportunistic species, the presence of personnel remaining areas of natural habitat occupied by animals	
Potential Impacts	Uncontrolled/ accidental death of animals caused by uninformed and/or deliberate actions of personnel	
Activity/ Risk Source	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective	Limit adverse human-animal conflict opportunities, promote high awareness of personnel with accurate and constructive information	

Mitigation: Action/ Control	**Responsibility**	**Timeframe**
1. Identify target species likely to result in conflict situations, such as snakes, spiders, bats, owls, rodents, feral cats & dogs, etc	ECO, appointed specialist	Prior to site preparation activities
2. Compile and implement a capture and relocation programme		Prior to site preparation activities
3. Compile Standard Operating Procedures for preventing the influx of opportunistic / invasive species and dealing with the presence of invasive and opportunistic species		Site preparation, construction and operational phases
4. Compile and implement awareness programmes to prevent accidental and/		Site preparation, construction and operational phases

uninformed killing of animals, with particular reference to snaring, traditional beliefs, capturing, introduction of pets, etc.		
Performance Indicator	No significant losses of animals, successful relocation and release of animals captured on site	
	Absence of opportunistic and invasive species from the site and immediate surrounds during all phases from the development, effective waste control measures, animal proof waste containers, litter free construction and operational environment	
	Absence of snares from site fences and trapping of animals	
	Continued presence of a high diversity of animals in immediate surrounds	
Monitoring	Development and implementation of bio monitoring programme	
Impact 4: Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.		
Objective:	Limit the effect of construction and operational activities in surrounding areas of natural habitat	
Project Components	Any infrastructure development or activity that could result in adverse impacts on adjacent areas of natural habitat	
Potential Impacts	Depletion of faunal diversity within areas of natural habitat surrounding the development, deterioration of natural habitat within immediate surrounds	
Activity/ Risk Source	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective	Prevent impacts from spreading into adjacent areas of natural habitat, prevent degradation of surrounding habitat	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
1. Construct development footprint boundaries to prevent inadvertent and irresponsible impacts in areas outside the development footprint	Construction Contractors, Environmental Team, Environmental Control Officer	Prior to site preparation activities
2. Identify activities and project components that are likely to cause degradation of surrounding natural habitat		Site preparation, Construction Phase
3. Compile Standard Operating Procedures to deal with the prevention, timely identification and rehabilitation of adverse environmental events and occurrences		Prior to site preparation activities
Performance Indicator	Natural habitat on the perimeter of the development footprint functioning in an ecologically effective manner, preservation of faunal diversity	
	Containment of impacts to development footprint	
Monitoring	Development and implementation of bio monitoring programme	
Impact 5: Indirect impacts on movement/ migration patterns of animals and ecological interaction and processes		
Objective:	Prevent disruptions on the movement patterns of animals within the surrounding region, directly adjacent to development footprint, remainder of property	
Project Components	Construction and development within a natural environment, also where natural environment and ecological functionality of surrounding and adjacent areas will be affected through development and operational aspects	
Potential Impacts	Disruption of migration patterns that will lead to depletion of faunal diversity	
Activity/ Risk Source	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective	To maintain existing habitat diversity and patterns that will sustain migration patterns of a high faunal diversity	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
1. Identify and delineate areas within the remainder of the property that are important for animal migration patterns, i.e., watering holes, atypical habitat, etc. and provide for the preservation and enhancement (management) of these areas through a management programme	Construction Contractors, Environmental Team, Environmental Control Officer, Ecologist	Prior to site preparation activities
2. Ensure all activities that result in destruction of natural habitat are contained within the authorized footprint and do not spread beyond the boundaries of the site		Site preparation, construction phase, operational phase
3. Identify habitat that can be retained within the development footprint in order to aid with effective migration patterns		Planning, site preparation and construction phases
4. Allow for the development/ management of 'stepping stones' within the larger region through effective ecological management of		Planning, site preparation and construction phases

remaining habitat		
5. Rehabilitation, revegetation and landscaping should consider faunal diversity and needs, e.g. invertebrate landscaping		Planning, site preparation and construction phases
Performance Indicator	High diversity of fauna species, including disciplines of mammals, avifauna, invertebrates and herpetofauna	
	Seasonal variation of diversity	
Monitoring	Annual diversity monitoring protocol	
Impact 6: Exacerbated increases of edge effects of the project areas		
Objective:	Limit the effects of development within surrounding habitat	
Project Components	All development activities that will cause sterilisation of natural habitat that becomes suitable for infestation by alien and invasive and encroacher plant species	
Potential Impacts	Deterioration of remaining natural habitat adjacent to development footprints that will lead to depletion of faunal diversity	
Activity/ Risk Source	Site preparation, construction activities, operational activities/ environmental management	
Mitigation: Target/ Objective	Prevent edge effects and habitat deterioration of adjacent areas of natural habitat	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
1. Identify activities and project components that are likely to cause degradation of surrounding natural habitat	Construction Contractors, Environmental Team, Environmental Control Officer	Site preparation, Construction Phase
2. Identify areas where exceptional and/ or ecological attributes of importance to the ecological functionality of the local area persists and retain these attributes as part of a conservation/ preservation programme		Site preparation, Construction Phase, Operational Phase
3. Compile Standard Operating Procedures to deal with the prevention, timely identification and rehabilitation of adverse environmental events and occurrences within areas of ecological importance		Construction Phase
4. Compile and implement a biodiversity monitoring programme that aims to evaluate changes to the natural environment that would affect ecological functionality		Site preparation, Construction Phase, Operational Phase
Performance Indicator	High diversity of fauna species, including disciplines of mammals, avifauna, invertebrates and herpetofauna	
	Comparable habitat diversity and status to regional and local ecological types	
Monitoring	Biodiversity monitoring protocol	
Impact 7: Cumulative losses and degradation of natural habitat		
Objective:	Prevent cumulative depletion and degradation of remaining areas of natural habitat on a local and regional scape	
Project Components	All development activities, land clearance, removal of natural vegetation, introduction of industrial components	
Potential Impacts	Habitat loss and degradation larger than development footprint	
Activity/ Risk Source	Site preparation, construction activities, operational activities/ environmental management	
Mitigation: Target/ Objective	Prevent edge effects and habitat deterioration of adjacent areas of natural habitat	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
1. Construct development footprint boundaries to prevent inadvertent and irresponsible impacts in areas outside the development footprint	Construction Contractors, Environmental Team, Environmental Control Officer	Site preparation, Construction Phase, Operational Phase
2. Identify activities and project components that are likely to cause degradation of surrounding natural habitat		
3. Compile Standard Operating Procedures to deal with the prevention, timely identification and rehabilitation of adverse environmental events and occurrences		
4. The implementation of periodic monitoring programme (annual, at least) should be aimed at assessing development impacts on the faunal environment in close proximity to the development footprint, ensuring early identification and mitigation of observed		

impacts		
4. Avoid the creation of sterile landscapes and limit disturbance of remaining natural habitat		
5. Ensure the proper and effective restoration/ rehabilitation of affected areas		
Performance Indicator	Sustained high faunal diversity in adjacent natural habitat	
	Comparable habitat diversity and status of habitat in immediate surrounds of the development footprint to regional and local ecological types	
	Biodiversity monitoring protocol	
Monitoring	Annual biodiversity monitoring protocol	
Impact 8: Cumulative depletion of faunal taxa, assemblages and communities, with specific reference to the conservation important species		
Objective:	Sustain the current population and species diversity in areas adjacent to the development footprint	
Project Components	All development activities where natural habitat is accessible to personnel and or local population	
Potential Impacts	Depletion of faunal habitat and species diversity through degradation of remaining natural habitat in immediate surrounds	
Activity/ Risk Source	Site preparation, construction activities, operational activities/ environmental management	
Mitigation: Target/ Objective	Ensure containment of impacts to development footprint and maintain the PES of remaining natural habitat in immediate surrounds	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
1. Compile a list of conservation important fauna species that are known to occur in the region, establish faunal diversity patterns in areas immediately surrounding development footprint	Construction Contractors, Environmental Team, Environmental Control Officer	Site preparation, Construction Phase, Operational Phase
3. The implementation of periodic monitoring programme (annual, at least) should be aimed at assessing development impacts on the faunal environment in close proximity to the development footprint, ensuring early identification and mitigation of observed		
3. The implementation of periodic monitoring programme that aims to establish variations in faunal diversity in areas adjacent to the development footprint in order to ensure the effectiveness of implemented mitigation hierarchy		
4. Compile Standard Operational Procedures to deal with the effective capture and relocation of these animals, should they be threatened by construction/ operational activities		
5. Adapt operational activities to prevent direct impacts on these animals, including personnel presence in areas of natural habitat and vehicular movements/ speeds		
Performance Indicator	Continued presence of a high diversity of animals in surrounding areas of natural habitat, including species of conservation concern	
Monitoring	Annual biodiversity monitoring protocol	

SECTION E – AVIFAUNAL ATTRIBUTES OF THE RECIEVING ENVIRONMENT

Lukas J. Niemand (Pr.Sci.Nat)

25 BACKGROUND

25.1 Terms of Reference

25.1.1 Providing a Baseline Avifauna (bird) Assessment

The focus areas include the entire surface area of the Farm Graaffwater 456 LQ, Goedehoop 457 LQ and Appelvlakte 448 LQ, comprising a total surface area of approximately 3 243 ha. It includes the Matimba to Medupi loop-in power line of approximately 14.5 km in length.

An avifaunal assessment must therefore be conducted per identified homogenous vegetation unit identified from aerial photographs and/ or plant communities identified during the vegetation assessment within the relevant farms. The assessment must be conducted in such a way that the correlation between vegetation of the identified plant communities and the associated avifaunal community is reflected in the results.

A detailed method description will be used during the assessment, as well as equipment to be used.

25.1.2 Objectives

Determination of the current ecological status of the avifaunal environment, the evaluation of the extent of site-related effects in terms of certain ecological indicators, as well as identification of specific important ecological attributes such as rare and threatened species, protected species and endemic species.

A detailed desktop study (conducted during the scoping phase) and baseline avifaunal assessment are required in order to address the following objectives:

a. Identification of all bird species that might potentially be present based on the results of detailed desktop studies;
b. Identification, documentation and distribution of all bird species recorded during a detailed assessment;
c. Identification of all threatened, near threatened, protected and conservation important bird species and distribution maps and GPS coordinates of their distribution.

The detailed desktop study should include historical bird records, their national and global IUCN (Red Data) status and protected status according to the NEMBA (TOPS List) and the LEMA Act.

25.1.3 Scope of Work

A desktop study of bird species that may potentially be present, as well as species recorded in the past (e.g. SABAP1) needs to be included. A detailed list of birds recorded in the past within the relevant quarter degree grid in which the respective farms are situated is required. Any protected species recorded in the past within the relevant quarter degree grid, their scientific names and colloquial names, and protected status according to IUCN red data lists,

NEMBA TOPS list and LEMA are required. The potential of these protected species to be present needs to be evaluated and included.

The following must be recorded during the avifaunal baseline survey:

a. All bird species encountered or noted during the survey must be recorded;
b. A list of the most prominent birds encountered, and possible species that can be expected to be present;
c. A list of protected, threatened and near threatened species encountered (according to IUCN red data list, NEMBA TOPS list and provincial legislation) during the baseline survey and GPS coordinates where these were recorded;
d. Possible migratory or nomadic species that are not detected during the baseline survey must be assessed from literature surveys; and
e. An inventory of all the birds that can possibly be present within the relevant grid in which the farms are situated must be compiled.

In addition, the following are also provided:

a. Impact assessment of the proposed new activities on the avifaunal community; and
b. Mitigation measurements to manage the existing and expected impacts.

25.2 Methods & Approach

The information provided in this report was principally sourced from:

a. relevant literature (see section below)
b. a baseline survey of the area (March, April and May 2016)
c. personal observations from similar habitat types in close proximity to the study area, with particular emphasis on a recent assessment of EkoInfo & Associates (2013) of which the avifauna study was conducted by the contributing author.

25.3 Literature Survey & Data Acquisition

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

» Hockey et al. (2005), Harrison et al. (1997) and Del Hoyo et al. (1992-2011) was consulted for general information on the life history attributes of the relevant bird species. They also provide basic distributional information at small geographic scales;
» Marnewick et al. (2015) was consulted for information regarding the biogeographic affinities (*sensu* Important Bird and Biodiversity Areas) 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, 2016) and a recent regional conservation assessment of Taylor et al. (2015);

» The list of threatened and protected species under sections 56(1), 57(2) and 57(4)(a) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004) was consulted to identify those species that are threatened or in need of protection (updated 2015);
» Schedule 2, 3 and 4 of the LEMA (Act No 7 of 2003) was consulted to identify species with provincial protective status;
» 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 cells (QDGC) 2327DA and 2327CB. *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 15 min lat and 15 min long). 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 lat x 5 min long, 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 2335_2725, 2335_2730, 2335_2735 as well as 2340_2730 and 2340_2735; and
» The choice of scientific nomenclature, taxonomy and common names were recommended by the International Ornithological Committee (the IOC World Bird Names, v.6.3), unless otherwise specified (see www.worldbirdnames.org as specified by Gill & Donsker, 2016). The updated nomenclatural sequence of Hackett et al. (2008) and del Hoyo et al. (2014) was adopted according to a recent upsurge of phylogenetic studies, which differs from the more traditional classification of Sibley & Ahlquist (1990). Colloquial (common) names were used according to Hockey et al. (2005) to avoid confusion.

25.4 Baseline survey

A series of site visits (during 31 March - 8 April 2016 and 23 - 26 May 2016) were conducted to obtain baseline information on the avifaunal composition and relative species abundance residing on the study area and immediate surroundings. An inventory of bird species along with their COMMON and SCIENTIFIC NAMES observed during the surveys is included (refer **Appendix 2**). All observations were processed and submitted to the South African Bird Atlas Project (SABAP2).

The baseline avifaunal survey was conducted by means of the following techniques:

» *Point Counts*

Bird data was collected by means of 49 point counts (Buckland et al. 1993) (refer **Figure 18**). Data from the point counts was analysed to determine indicator species and to delineate the different communities present. The use of point counts is advantageous since it is the preferred method to use for cryptic or elusive species. In addition, this method is preferred to line transect counts in areas where access is problematic, or when the terrain appears to be complex. It is a good method to use, and very efficient for gathering a large amount of data in a short period of time (Sutherland 2006).

At each point, all the bird species seen within approximately 50 m from the centre was recorded along with their respective abundance values using a Swarovski 8.5x42 EL binoculars and a Swarovski 30-70x95 ATX spotting scope. Each point count lasted approximately 10 minutes while the area within the immediate vicinity was slowly traversed to ensure that all bird species were detected (according to Watson, 2003). To ensure the independence of observations, points were positioned at least 200 m apart.

Broadcasting of *Glaucidium perlatum* (Pearl-spotted Owlet) calls was performed for approximately 30 seconds at each point count to facilitate the detection of 70 % of the passerine bird species in the vicinity of the point count. Most passerine bird species are attracted to the calls of Pearl-spotted Owlets since it is perceived as a predatory intruder, which they try to drive away by mobbing it. However, broadcasting was limited and used with caution and was not repeated or used for extended time periods.

Data generated from the point counts was analysed according to Clarke & Warwick (1994) based on the computed percentage contribution (%) of each species, including the consistency (calculated as the similarity coefficient/standard deviation) of its contribution. Hierarchical Agglomerative Clustering (a cluster analysis based group-average linkages; Clarke & Warwick 1994) was performed on calculated Bray-Curtis coefficients derived from the data. A cluster analysis is used to assign "species associations" between samples with the aim to objectively delineate groups or assemblages. Therefore, sampling entities that group together (being more similar) are believed to have similar compositions.

The species diversity of each species association was analysed by means of rarefaction, while richness measures (such as the total number of species recorded (S) and various diversity indices) were calculated to compare the associations with each other. The advantage of rarefaction is that it adjusts the number of species expected from each sample if all were reduced to a standard size.

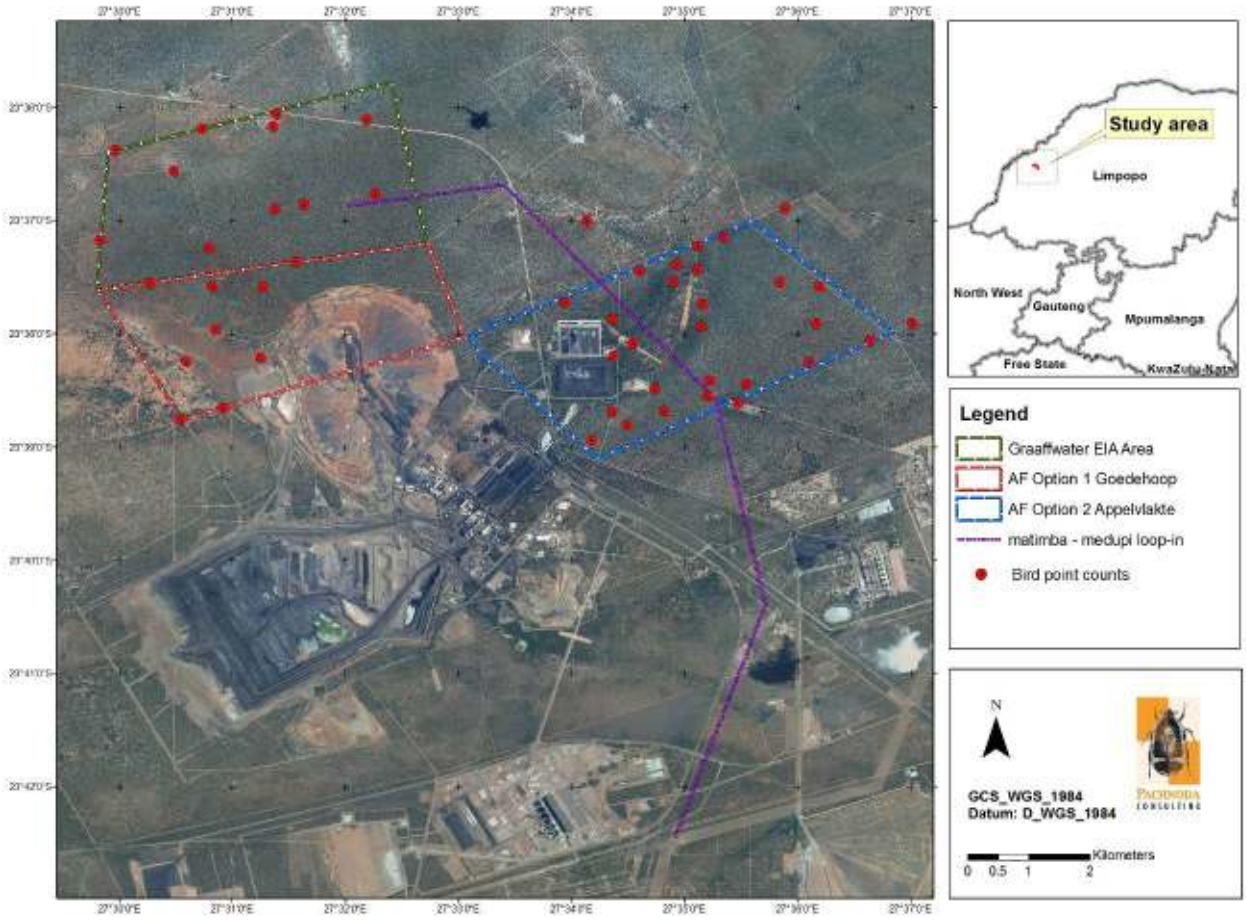


Figure 18: Spatial position of 49 bird point counts conducted within the study area

» *Random (ad hoc) surveys*

To obtain an inventory of bird species present (apart from those observed during the point counts), all bird species observed/detected while moving between point counts were identified and noted. Particular attention was devoted to suitable roosting, foraging and nesting habitat for threatened or near threatened species. Besides visual observations, bird species was identified by means of their calls and other signs such as nests, discarded eggshells and feathers.

» *Nocturnal bird surveys*

Nocturnal bird species (owls and nightjars) was searched for by driving slowly or walking (depending on safety and accessibility) on roads at night. Attention was paid to calling bird species such as owls and nightjars. Nocturnal surveys were only conducted during the April site visits.

» *Playback/broadcasting of bird vocalisations*

The probability of detecting skulking or elusive species was verified by playback of bird calls/songs wherever suitable habitat was detected (e.g. *Cisticola rufilatus*). Special care was taken to keep disturbance to a minimum and not to affect the bird's natural behaviour (e.g. to prevent unnecessary habituation).

25.5 Avifaunal sensitivity analysis

An avifaunal sensitivity analysis was performed for each habitat type on the study site based on its inherent ecosystem service (ecological function) and the preservation of bird diversity (avifaunal importance).

25.5.1 Ecological Function

The extent to which a habitat type is ecologically connected to the surrounding area is an important determinant of the sensitivity analysis. Habitat with a high degree of landscape connectivity or with extensive drainage systems amongst one another are perceived to be more sensitive and will be those contributing to important avifaunal flyways.

25.5.2 Avifaunal Importance

Avifaunal importance relates to species diversity, endemism and the presence of topographical features or primary habitat units with the intrinsic ability to sustain conservation important species.

25.5.3 Sensitivity Scale

Very High - Sensitive habitat with either low inherent resistance or low resilience towards disturbance factors. These habitat types represent ecosystems with high connectivity and support high bird diversities while providing suitable habitat for a number of threatened or near-threatened species.

High – Highly dynamic habitat considered important for the maintenance of ecosystem integrity. These habitat types support high bird diversities and provide suitable habitat for at least one or more threatened or near-threatened species.

Medium – These are slightly modified habitat types, which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems, OR habitat types with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species.

Low –Disturbed/transformed habitat with little ecological function and is generally very poor in species diversity with a dominant composition of unspecialised and widespread species.

Very Low - Severely modified habitat where ecosystem service is arrested or non-functional. Species diversity is extremely low and often dominated by very few bird species.

25.6 Limitations and assumptions

» 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, which could include habitat types and species that are 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 be overlooked in the past; and
» Some of the datasets (e.g. SABAP2) managed by the Animal Demography Unit of the University of Cape Town were recently initiated and therefore incomplete.

26 SPECIES COMPOSITION & PATTERNS IN DIVERSITY

26.1 Regional Vegetation Types – Regional Context

The study area corresponds to the Savanna Biome and more particularly to the Central Bushveld Bioregion as defined by Mucina & Rutherford (2006) and comprehends an ecological type known as Limpopo Sweet Bushveld (Mapping Unit SVcb 19; Mucina & Rutherford, 2006).

This vegetation type extends from the lower reaches of the Crocodile and Marico Rivers down to the Limpopo River valley and into Botswana on the other side of the border. It is predominantly located on extensive plains that are irregularly interspersed by tributaries of the Limpopo River. It is short, open woodland dominated by *Acacia mellifera* (Black Thorn) and *Dichrostachys cinerea* (Sickle Bush), as well as taller tree species such as *A. erioloba* (Camel Thorn), *A. nigrescens* (Knob Thorn) and *Terminalia sericea* (Silver Cluster-leaf).

The high palatability of the graminoid composition makes this vegetation type very suitable for game farming practices, which is also *directly responsible for the regular occurrences of large-bodied birds of prey (especially scavenging vultures*). The Limpopo Sweet Bushveld is Least Threatened and extensive in geographic coverage. It is however poorly conserved (e.g. D'Nyala Nature Reserve) even though it straddles many privately owned game farms. It is transformed by cultivation, but future threats include the mining of coal and urbanisation.

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. Conversely, woodlands are rich in woody plant species and are an important constituent of the Savanna Biome that provides habitat for a large number of bushveld bird species that are not partial to grassland habitat types (notably birds of prey).

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 high richness of bird species. However, it is evident that a number of smaller habitat units (pan depressions and old cultivated land) are also prevalent and provide habitat for bird compositions that are different to the 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 – to be discussed in more detail) which have subsequently contributed to the avifaunal richness in the area. These wetland features (many being waterholes for game species) often provide foraging habitat for threatened stork species.

26.2 Regional Vegetation Types – Local Context

From an avifaunal perspective, two dominant broad-scale habitat types are prominent in the area based on the dominant soil texture, which is a major driver of the observed vegetation composition:

1. *Undifferentiated broad-leaved woodland on sandy soils* - This habitat type is prominent and by far the most dominant habitat on the study area. It corresponds to deep, highly leached sandy soils, which is synonymous with the *Combretum zeyheri - Eragrostis pallens* sand woodland community (refer **Figures 19 and 20**). It is earmarked by a high prominence of medium to tall semi-deciduous woodland, and is dominated by woody tree species such as *Terminalia sericea* (Silver Cluster leaf), *Combretum apiculatum* (Red Bush-willow), *Grewia flava* (Common Grewia), *Gardenia volkensii* (Savanna Gardenia), *Tarchonanthus camphoratus* (Camphor Bush), *Combretum zeyheri* (Large-fruited Bush-willow), *Bauhinia petersiana* (Peter's Bauhinia) and *Peltophorum africanum* (Weeping Wattle). Bird densities are often low and sparse, and typified by the presence of mixed-species flocks of insectivorous birds. In contrast to the sandveld habitat from nearby farms (especially those with large grazers), bird richness was low although it is an important habitat for bird species with Kalahari-Highveld affinities (refer **Table 32**). It was the only habitat where the inconspicuous Tinkling Cisticola (*Cisticola rufilatus*) was recorded.

Table 33: A list of biome-restricted species[4] (according to Marnewick et al., 2015) expected to be present on the study area.

Species	*Common Name*	*Biome Affinity*	*Predicted Status*
Pterocles burchelli	Burchell's Sandgrouse	Kalahari-Highveld	Common
Erythropygia paena	Kalahari Scrub-robin	Kalahari-Highveld	Common
Cossypha humeralis	White-throated Robin-chat	Zambezian Affinity	Uncommon
Turdus libonyanus	Kurrichane Thrush	Zambezian Affinity	Common
Calamonastes fasciolatus	Barred Wren-warbler	Kalahari-Highveld	Common
Lamprotornis australis	Burchell's Starling	Kalahari-Highveld	Fairly common
Cinnyris talatala	White-bellied Sunbird	Zambezian Affinity	Common

2. *Microphyllous woodland on clay soils* - This habitat type was prominent along the drainage lines and clay soils. It is synonymous with the *Acacia mellifera - Acacia tortilis* clay woodland community (refer **Figures 19 and 21**). These were characterised by a high prominence of dense *Acacia* woodland dominated by *Acacia karroo* (Sweet Thorn), *A. luederitzii* (Brackish Thorn), *A. mellifera* (Black Thorn), *A. tortilis* (Umbrella Thorn), *Boscia albitrunca* (Shepherd's Tree) and *Commiphora pyracanthoides* (Common

[4] A species with a breeding distribution confined to a single biome or

Kanniedood). This habitat supports a distinct and rich avifaunal composition of "thornveld" species such as the Crimson-breasted Shrike (*Laniarius atrococcineus*), Chestnut-vented Titbabbler (*Sylvia subcaeruleum*), Southern Pied Babbler (*Turdoides bicolor*), Black-faced Waxbill (*Estrilda erythronotos*), Ashy Tit (*Parus cinerascens*), Shaft-tailed Whydah (*Vidua regia*) and Barred Wren-Warbler (*Calamonastes fasciolatus*). The *Acacia* trees, in particular *A. mellifera*, provide important habitat for many Palaearctic warblers on passage, which include the Olive-tree Warbler (*Hippolais olivetorum*), Icterine Warbler (*H. icterina*) and Common Whitethroat (*Sylvia communis*) (*pers. obs.*, L. Niemand).

Part of this habitat also contains dense *Dichrostachys cinerea - Grewia flavescens* thicket that contains a number of bird species that are confined to dense closed woodland and generally scarce in the Central Bushveld Bioregion. Typical species include the Yellow-bellied Greenbul (*Clorocichla flaviventris*), White-throated Robin-chat (*Cossypha humeralis*) and Grey-backed Camaroptera (*Camaroptera brevicaudata*) (see habitat labelled as "thicket"; refer **Figure 19**).

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

1. *Depressions (pans)* – these represent small water bodies and shallow depressions which tend to hold surface water when inundated. This habitat type was uncommon on the study area and mainly confined to a few depressions located on the northern part of the Farm Graaffwater (*c. Eragrostis rotifer - Echinochloa holubii* ephemeral pans) (refer **Figures 19 and 22**). However, these depressions 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*). These water bodies also provide a refuge for waterbird species during prolonged periods of drought. In addition, they may also provide foraging habitat for threatened stork species (e.g. Yellow-billed Stork - *Mycteria ibis* and Black Stork - *Ciconia nigra*);
2. *Old cultivated land and secondary open woodland*: These represent secondary open woodland previously used for agricultural purposes. This habitat was not located on the proposed study area although small patches of open secondary woodland are present along the western and northern borders of the Farm Graaffwater (refer **Figure 22**). It should not be confused with Degraded Woodland Habitat, of which the latter conforms to a closed woodland dominated by short *Terminalia sericea* (refer **Figure 19**). The open structure and sparse graminoid layer (presumably due to grazing pressure in combination with climatic factors such as unpredictable precipitation and 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*). This habitat is characterised by a high potential to absorb and irradiate solar heat owing to its sparse vegetation cover, thereby creating thermal air movement, which are often utilised by large birds of prey (e.g. vultures);
3. *Artificial game drinking holes*: These watering points provide drinking water to livestock and game species. However, they act as congregation areas for many of the smaller

passerine bird species, which in turn attract numbers of hunting birds of prey. Some of these areas are characterised by large trees (e.g. *Acacia erioloba, A. nigrescens* and *Combretum imberbe*), which provide occasional roosting sites for scavenging bird species (e.g. African White-backed Vulture - *Gyps africanus*). A particular important area includes the drainage line in close proximity to the proposed Matimba - Medupi Loop-in (see "hotspot" area; refer **Figure 19 and 22**); and

4. *Large dead trees*: This habitat type consists of large dead trees that are largely scattered in the study site, although good examples are present along depressions and drainage lines, especially the dead *Combretum imberbe* trees in close proximity of the proposed Matimba - Medupi Loop-in (see "hotspot" area; refer **Figure 19 and 22**). These dead trees provide essential roosting and breeding habitat for hole- and cavity-nesting species including the Red-billed Oxpecker (*Buphagus erythrorynchus*).

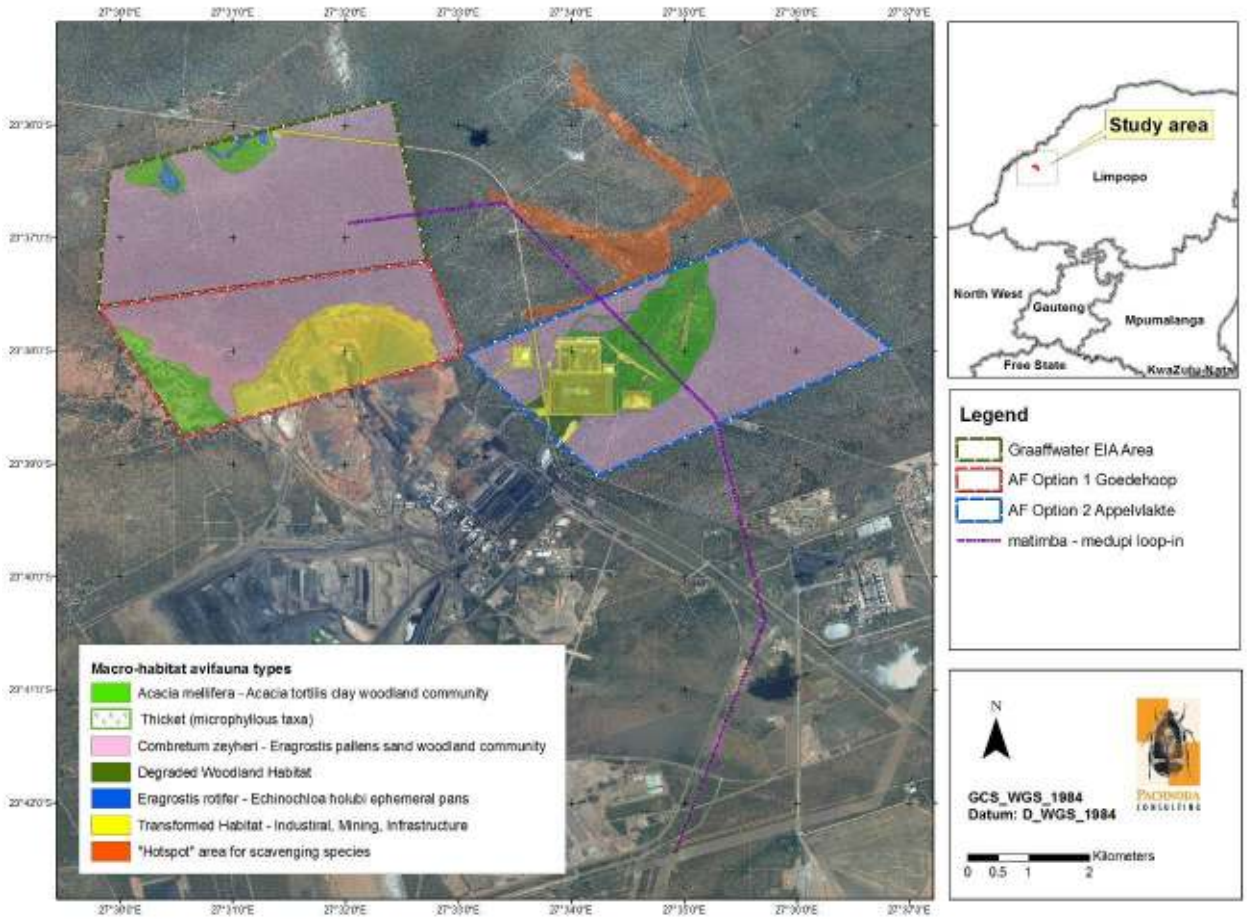


Figure 19: An illustration of the major habitat types on the proposed study area based on the dominant floristic composition and structure

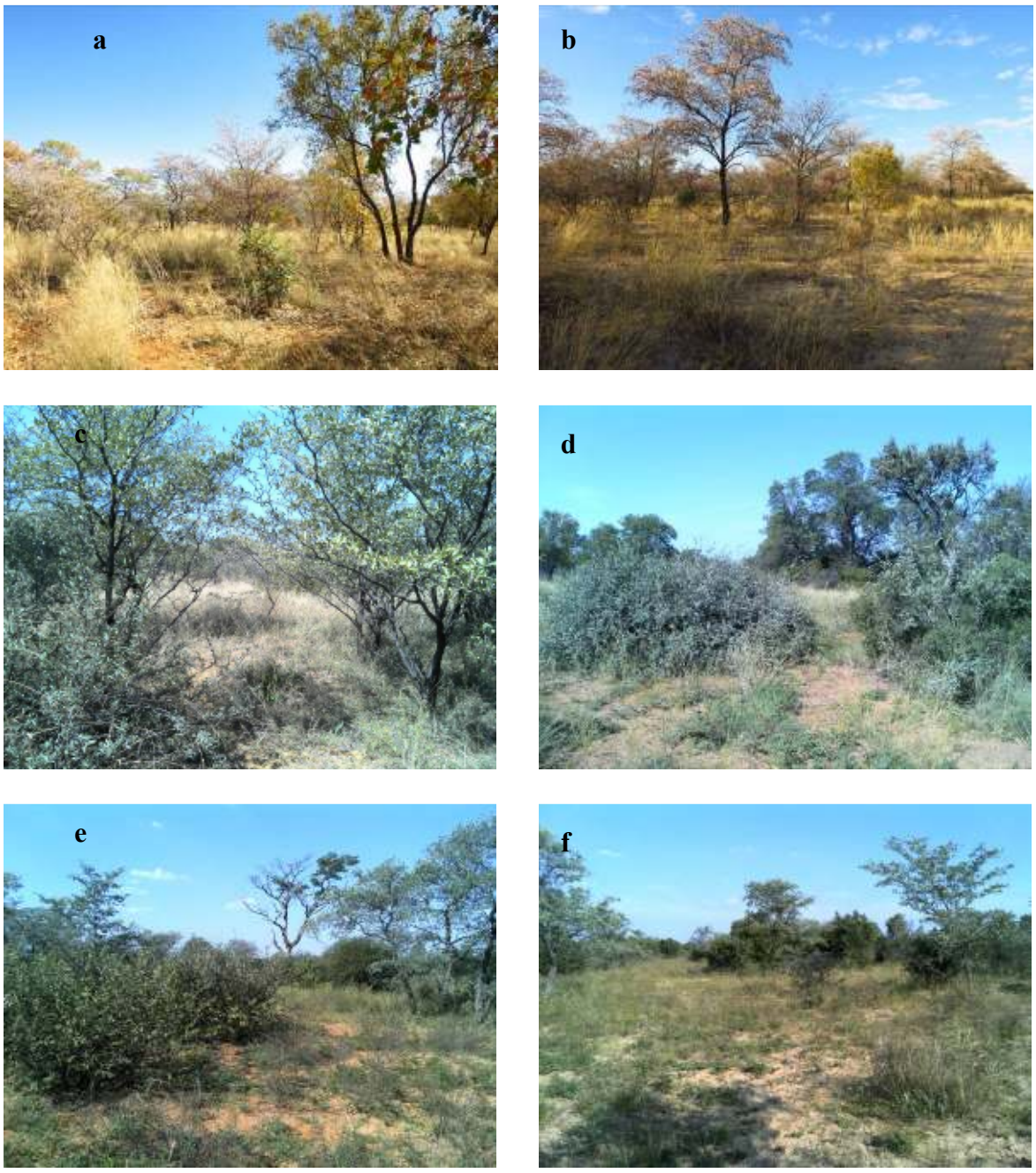


Figure 20: Image collage illustrating the structure of the undifferentiated broad-leaved woodland on sandy soils

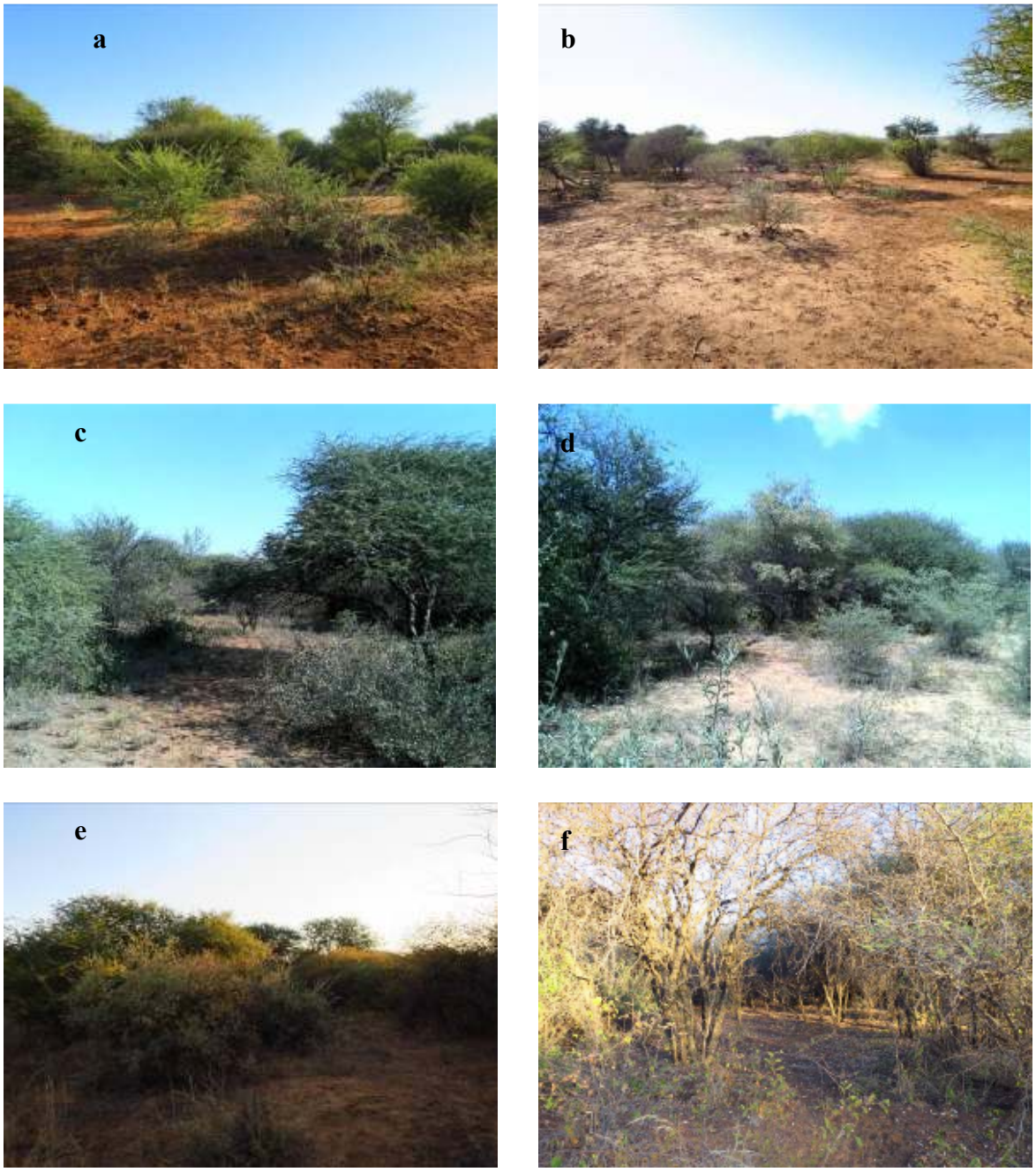


Figure 21: Image collage illustrating the structure of the microphyllous woodland on clay soils
*Images **e-f** represents thicket vegetation dominated by Dichrostachys cinerea and Grewia flavescens*

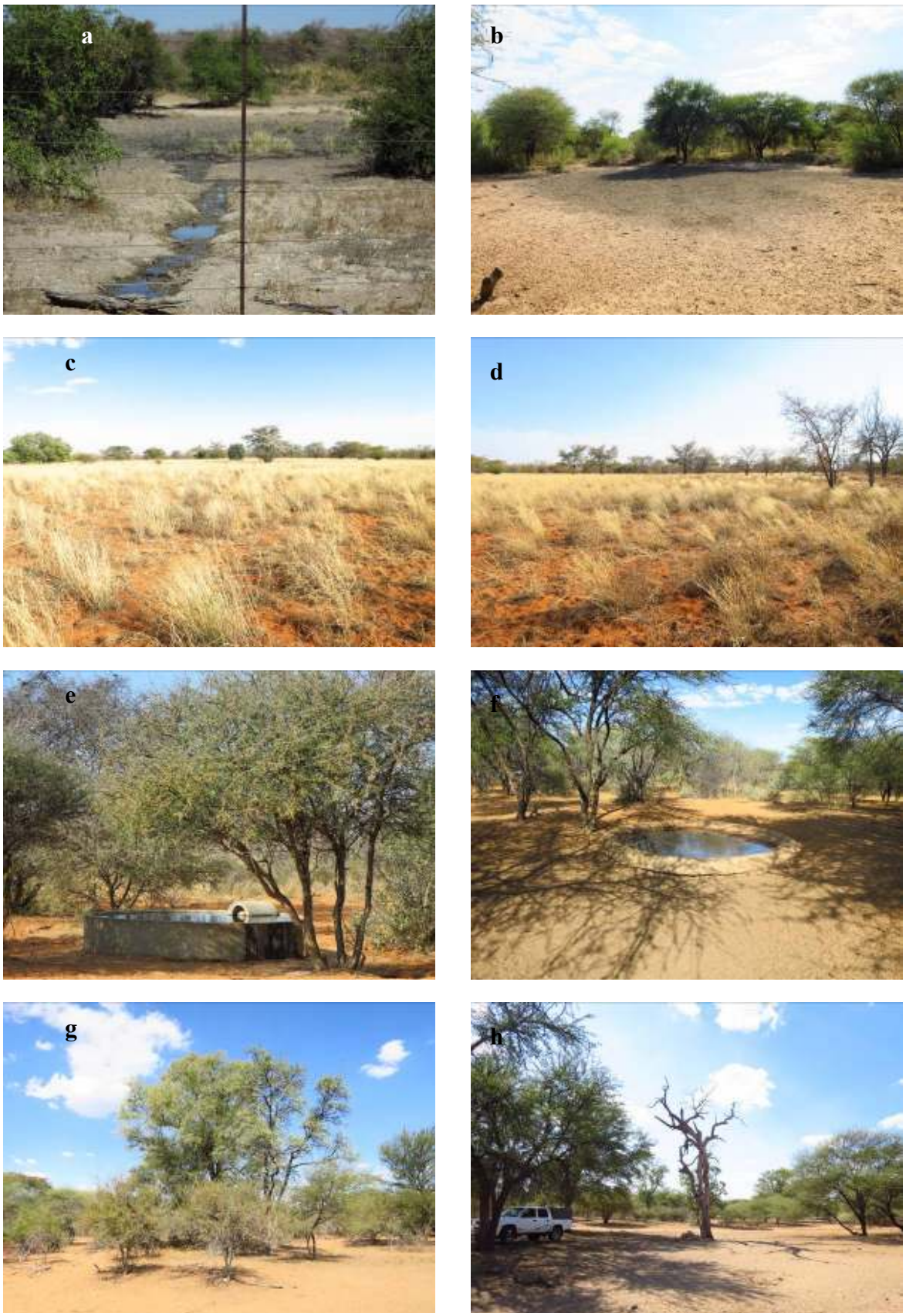


Figure 22: Image collage illustrating different azonal habitat types on the study area
Figures (a-b) depressions (pans), (c-d) secondary open woodland as viewed adjacent to Farm Graaffwater, (e - f) artificial game drinking holes and (g-h) an area along a drainage line containing large trees (including dead trees) that provides roosting habitat for large scavenging birds of prey.

26.3 Species Richness and predicted summary statistics

26.3.1 Regional Perspective: Richness

According to the South African Bird Atlas Project (SABAP1 (Harrison et al., 1997) & SABAP2), approximately 318[5] bird species have been recorded in the quarter degree square that are sympatric to the study region. This equates to approximately 31 % of the approximate 972[6] species listed for the southern African subregion[7] (and approximately 27 % of the 849[8] species recorded within South Africa[9]). However, recent records suggest that the study area is more likely to sustain on average 108 species[10] (www.sabap2.adu.org.za). The SABAP2 statistic was obtained from five coinciding pentad grids. On a national scale, the species richness on the study area is considered *high* (refer **Figure 23**).

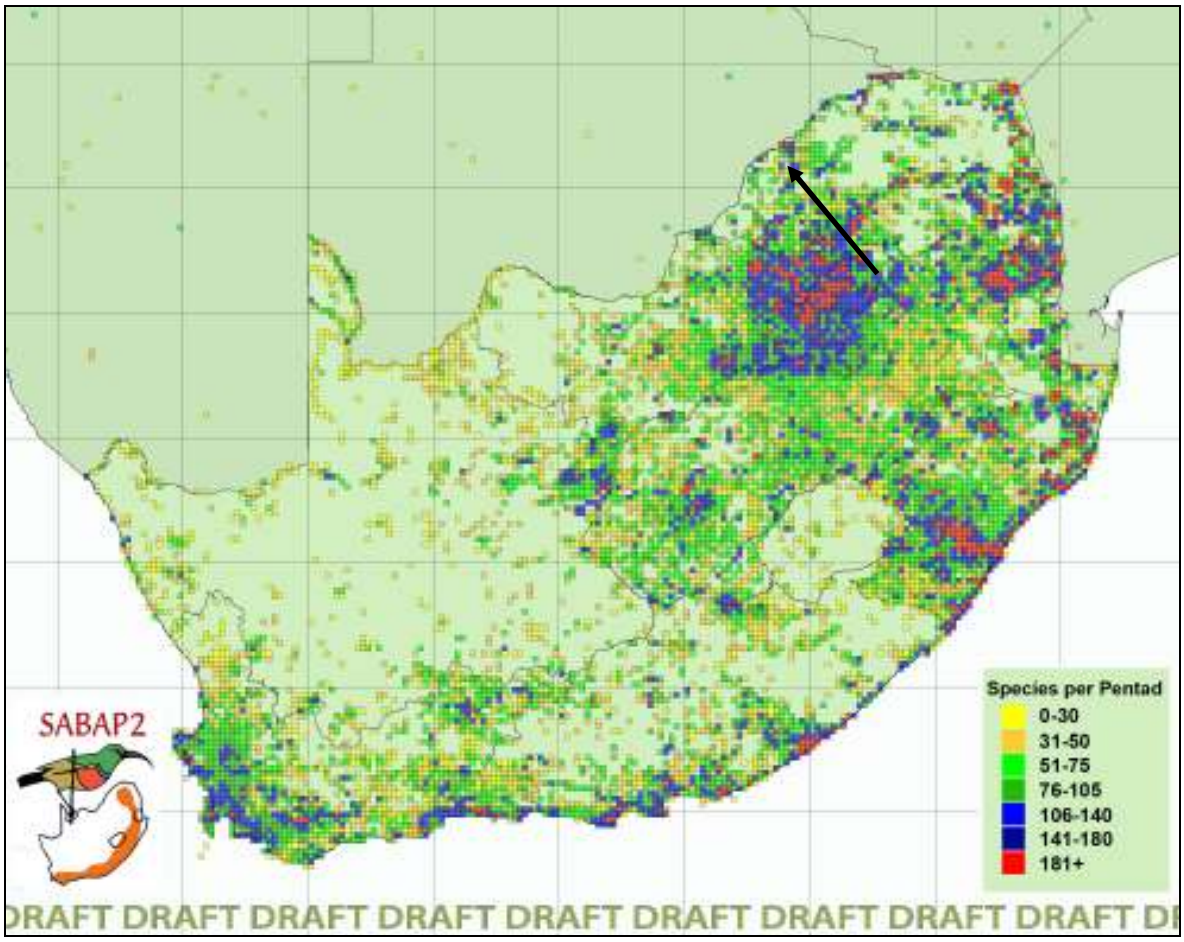


Figure 23: Figure 1: The bird species richness per pentad grid in comparison to the study area (see arrow)

[5] The statistic was corrected by excluding erroneous submissions pertaining to the Damara Hornbill (*Tockus damarensis*) and hybrids with Southern Red-billed Hornbill (*T. rufilatus*), Northern Grey-headed Sparrow (*Passer griseus*) and Orange River White-eye (*Zosterops pallidus*).
[6] *sensu* www.zestforbirds.co.za (Hardaker, 2016) with the addition of Rufous-tailed Scrub-Robin (*Erythropygia galactotes*).
[7] A geographical area south of the Cunene and Zambezi Rivers (includes Namibia, Botswana, Zimbabwe, southern Mozambique, South Africa, Swaziland and Lesotho).
[8] *sensu* BirdLife South Africa (2016) with the addition of Rufous-tailed Scrub-Robin (*Erythropygia galactotes*).
[9] With reference to South Africa (including Lesotho and Swaziland).
[10] 20 - 147 species based on 19 full protocol card submissions (20 - 95 species per card/observed).

Map courtesy of SABAP2 and the Animal Demography Unit. According to the SABAP2 database, the proposed study area hosts between 141-180 species.

26.3.2 Local Perspective: Richness

The proposed study area is expected to support 294 bird species of which 187 species were recorded during the respective surveys (refer **Appendix 2**). Therefore, the observed number of species represents 64 % of the expected number of species (refer **Table 33**). The observed species richness is more than 50 % higher than that of the SABAP2 results, and equates to 22 % of the approximate 849 species listed for South Africa (including Lesotho and Swaziland).

Table 34: Summary table of the total number of species, Red Listed species (Taylor et al., 2015; IUCN 2016), endemics and biome-restricted species (Marnewick et al., 2015) expected to occur and observed within the proposed study area

Note	*Expected*	*Observed*
Total number of species*	294 (22 %)	187 (64 %)
Number of Red Listed species (Taylor et al., 2015 & IUCN 2016)*	14 (10 %)	4 (29 %)
Number of biome-restricted species (Marnewick et al., 2015 – Zambezian & Kalahari-Highveld)*	7 (50 %)	7(100 %)
Number of local endemics (Hockey *et al.* 2005)*	0	0
Number of local near-endemics (Hockey *et al.* 2005)*	2 (7 %)	21 (100 %)
Number of regional endemics (Hockey *et al.* 2005)**	8 (8 %)	5 (63 %)
Number of regional near-endemics (Hockey *et al.* 2005)**	25 (40 %)	20 (80 %)

** only species in the geographic boundaries of South Africa (including Lesotho and Swaziland) were considered.*

*** only species in the geographic boundaries of Southern African sub-region (including Namibia, Botswana, Zimbabwe and Mozambique south of the Zambezi River)*

Percentage values in brackets refer to derived totals compared against the South African avifauna (Expected) and those species expected to occur on the study area (Observed)

The observed totals are well within the limit (> 50 %; refer **Table 33**) of the number of expected species, and provide a realistic indication of the thoroughness and general coverage of the study area during the respective surveys (refer **Figure 24**). Although the expected richness of bird species for the area is high, it is poorly represented by local and regional endemic species. However, it contains many regional near-endemic species. The latter are mainly arid thornveld species with distribution ranges centred on the Kalahari Basin. Many of these species are reaching their eastern distributional limits in the study area. In addition, the study area is also an important area for geographically-restricted species, and it contains seven of the 14 biome-restricted (Zambezian and Kalahari-Highveld biome) species in South Africa. In addition, four of the seven species are restricted to the Kalahari-Highveld biome.

Please note that the expected species composition include a number of waterfowl taxa (Anatidae), some Palaearctic waders and stork species (Ciconiidae) which will only be present during exceptionally wet years. Normally these species are absent or rare on the study area due to the absence of suitable habitat. In addition, the study site is also colonised by a number of Acrocephalid warblers (warbler species of the genus *Acrocephalus*) due to the presence of damp conditions and *Phragmites* reedbeds in close proximity to the pollution control dam on the Farm Appelvlakte.

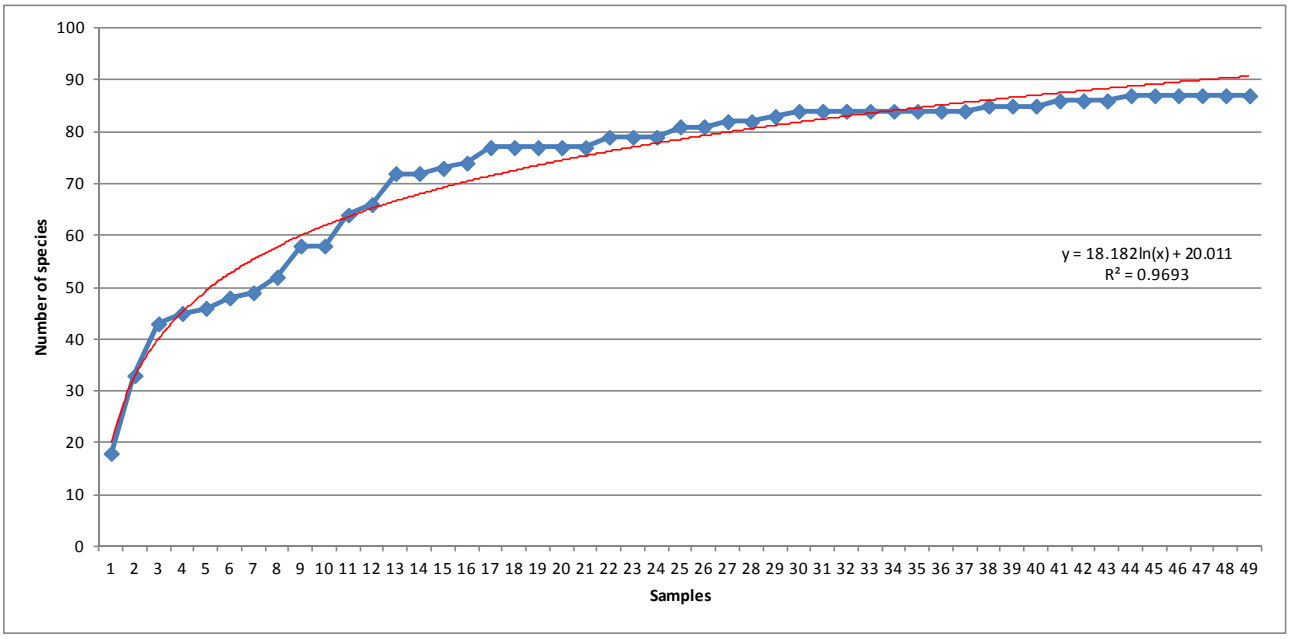


Figure 24: Species accumulation curve based on 49 sample point counts

26.3.3 Dominance & Rarity (low abundance species)

The dominant (typical) species on the proposed study area are presented in **Table 34**. Only those species that cumulatively contributed to more than 90% of the overall similarity are presented. It is evident that the five most dominant species (#1-5 in **Table 34**) are insensitive towards habitat type and structure, but attain highest numbers in broad-leaved woodland units. The remaining species (# 6-10) are prominent microphyllous woodland. However, most of the species are widespread in the Savanna Biome and are present in nearly every Bushveld Bioregion as defined by Mucina and Rutherford (2006), with the exception of Barred Wren-warbler (*Calamonastes fasciolatus*). The latter is restricted to the Kalahari-Highveld biome (Marnewick et al., 2015) and is abundant on the study area.

Table 35: Dominant bird species recorded in the study area

Species	*Average abundance*	*Consistency*	*Percentage Contribution*
1. Cape Turtle Dove (*Streptopelia capicola*)	1.20	0.83	27.32 %
2. Chinspot Batis (*Batis molitor*)	1.57	0.83	21.75 %
3. White-browed Scrub Robin (*Erythropygia leucophrys*)	0.82	0.58	11.22 %
4. Grey Go-away-bird (*Corythaixoides concolor*)	1.08	0.46	9.73 %
5. Golden-breasted Bunting (*Emberiza flaviventris*)	1.02	0.40	6.53 %
6. Blue Waxbill (*Uraeginthus angolensis*)	1.90	0.42	4.48 %
7. Long-billed Crombec (*Sylvietta rufescens*)	0.61	0.27	2.35 %
8. Southern Yellow-billed Hornbill (*Tockus leucomelas*)	0.43	0.20	1.42 %
9. Barred Wren-warbler (*Calamonastes fasciolatus*)	0.31	0.23	1.29 %
10. Marico Flycatcher (*Bradornis mariquensis*)	0.55	0.21	1.20 %

Most of the low abundance species include taxa with unspecified (non-selective) foraging requirements, although they are specific to their breeding habitat. For example, many of the species listed in **Table 35** (*c.* 30 %) are cavity-nesting species and are dependent on dead trees confined to inundated depressions and pans. These habitat types are patchy in the landscape and have a "density-dependant" effect on their numbers.

In addition, many of the other low abundant species are in fact widespread, but their numbers on the study area are severely limited due to the scarcity of their preferred habitat (e.g. impoundments and shoreline habitat).

Table 36: Low abundance (rare) species on the study area with contributions of < 0.01 %

Species	*Av. Abundance*	*Habitat preference*
Tinkling Cisticola (*Cisticola rufilatus*)	0.01	Broad-leaved woodland
Village Weaver (*Ploceus cucullatus*)	0.04	Unspecified
Red-headed Weaver (*Anaplectes rubriceps*)	0.02	Broad-leaved woodland
Shaft-tailed Whydah (*Vidua regia*)	0.02	Microphyllous woodland
Southern White-crowned Shrike (*Eurocephalus anguitimens*)	0.06	Unspecified
Orange-breasted Bush-shrike (*Chlorophoneus sulfureopectus*)	0.02	Unspecified
Red-billed Qualea (*Quelea quelea*)	0.12	Unspecified/nomadic
Icterine Warbler (*Hippolais icterina*)	0.01	Microphyllous woodland
Jameson's Firefinch (*Lagonosticta rhodopareia*)	0.08	Microphyllous woodland
Lesser Honeyguide (*Indicator minor*)	0.01	Unspecified
Lilac-breasted Roller (*Coracias caudatus*)	0.02	Unspecified
Little Bee-eater (*Merops pusillus*)	0.01	Unspecified
Little Grebe (*Tachybaptus ruficollis*)	0.04	Aquatic-associated
Familiar Chat (*Oenanthe familiaris*)	0.02	Unspecified
Fawn-colored Lark (*Calendulauda africanoides*)	0.02	Habitat on deep sand
Fiscal Flycatcher (*Sigelus silens*)	0.02	Microphyllous woodland
Great Sparrow (*Passer motitensis*)	0.04	Microphyllous woodland
Green Woodhoopoe (*Phoeniculus purpureus*)	0.04	Unspecified
Grey Heron (*Ardeola cinerea*)	0.02	Aquatic-associated
Cardinal Woodpecker (*Dendropicos fuscescens*)	0.04	Unspecified
Black-crowned Tchagra (*Tchagra senegalus*)	0.02	Broad-leaved woodland
Blacksmith Lapwing (*Vanellus armatus*)	0.06	Aquatic-associated/shoreline
Burchell's Starling (*Lamprotornis australis*)	0.06	Microphyllous woodland/ltall trees
African Pied Wagtail (*Motacilla aguimp*)	0.02	Aquatic-associated/shoreline

Many of these species were only recorded once during the point count surveys. However, the majority is widespread, but occurs naturally at low densities

26.3.4 Community Structure & Species Composition

A cluster analysis of the bird abundance values and composition suggests two distinct bird associations (apart from an outlier group) based on vegetation structure (e.g. microphyllous vs. broad-leaved woodland) and soil texture (clay soils vs. sandy soils) (refer **Figure 25**). It was evident that the contribution of the depressions, dams and the secondary open woodland towards the differentiation between the different bird associations was negligible. Although some of these habitat types (e.g. the pollution control dam) hold aquatic-associated species, these occurred at such low abundances that they do not influence the analysis. In addition, these habitat types are geographically "embedded" within the microphyllous woodland and are spatially auto-correlated to the dominant bird composition (refer **Figure 26**). The depressions are also invariably located on soil forms with high clay content, which were responsible for the dominance of microphyllous woodland and subsequent colonisation of typical "thornveld" bird species.

A third and poorly defined association is represented by outliers. These include short dense broad-leaved woodland colonised by various bird taxa which include both "sandveld" and "thornveld" elements.

The main avifaunal associations on the study site are as follow (according to a clustering ordination, refer **Figure 25**):

1 *An association confined to broad-leaved woodland (Sandveld)*: This association is widespread and prominent on the study area and often referred to as a "Sandveld" association. It is characterised by well-structured multi-species flocks, which tend to forage together and minimizing inter-specific competition between them by exploiting different niches (by feeding in different ways and different levels in the canopy). The bird composition is typified by Cape Turtle Dove (*Streptopelia capicola*), Golden-breasted Bunting (*Emberiza flaviventris*), Chinspot Batis (*Batis molitor*) and White-browed Scrub Robin (*Erythropygia leucophrys*). In summer, it provides habitat for large numbers of Spotted Flycatcher (*Muscicapa striata*) and Willow Warbler (*Phylloscopus trochilus*).

Indicator species (species largely restricted to this habitat on the study area) include Red-crested Korhaan (*Lophotis ruficrista*), Neddicky (*Cisticola fulvicapilla*), Southern Black Tit (*Paris niger*), Yellow-throated Petronia (*Gymnoris superciliaris*), Pale Flycatcher (*Bradornis pallidus*) and "Sandveld' specialists such as Tinkling Cisticola (*Cisticola rufilatus*) and Fawn-colored Lark (*Calendulauda africanoides*). Apart from these species, the presence of large *Burkea africana* trees provide potential nesting habitat for Wahlberg's Eagle (*Hieraaetus wahlbergi*)[11], a common summer visitor to the study area.

[11] Breeding and/ or the presence of nests could not be confirmed during the surveys.

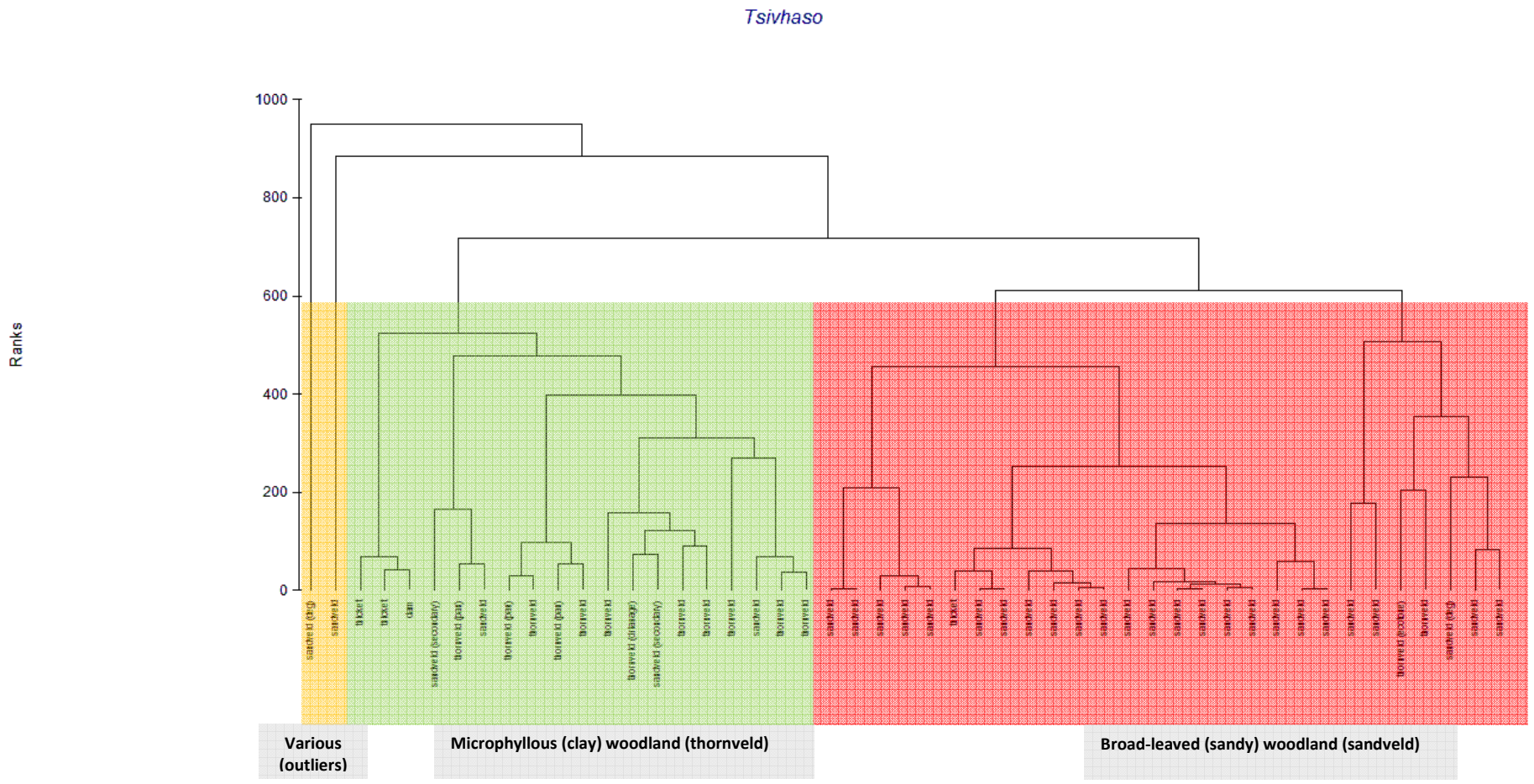


Figure 25: Dendrogram based on hierarchical agglomerative clustering of the abundances and composition of bird species on the proposed study area

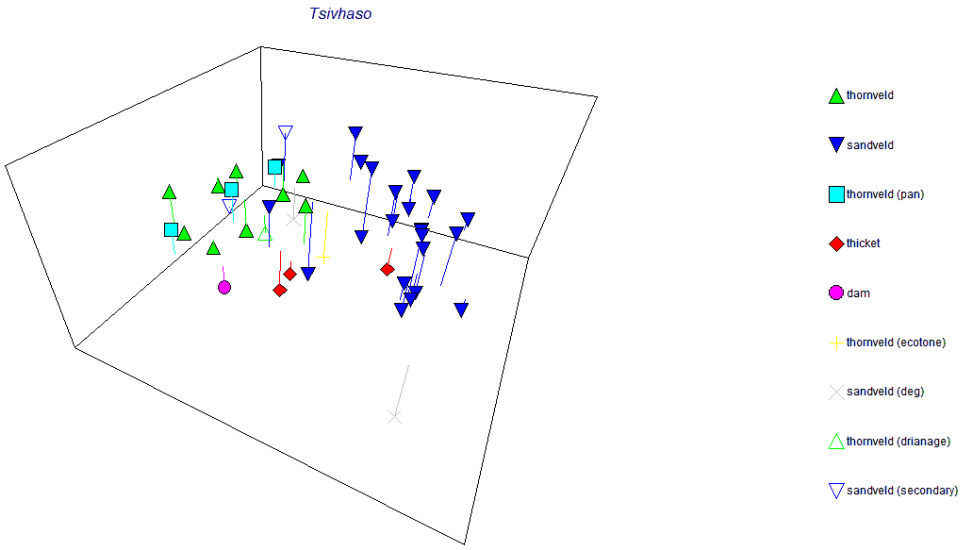


Figure 26: A non-metric multidimensional scaling ordination illustrating the bird association relative to the different habitat types on the proposed study area

2 *An association confined to microphyllous woodland (Thornveld)*: This association is prominent on the microphyllous woodland units and is often referred to as a "thornveld" association. It is characterised by a high richness of bird species, and is particularly well represented by granivores pertaining Estrildidae (waxbills) and Viduidae (whydahs). The typical species include Blue Waxbill (*Uraeginthus angolensis*), Barred-wren Warbler (*Calamonastes fasciolatus*), Marico Flycatcher (*Bradornis mariquensis*), Chestnut-vented Tit-babbler (*Sylvia subcaeruleum*) and Long-billed Crombec (*Sylvietta rufescens*).

Indicator species include Great Sparrow (*Passer motitensis*), Crimson-breasted Shrike (*Laniarius atrococcineus*), Green-winged Pytilia (*Pytilia melba*), Violet-eared Waxbill (*Uraeginthus granatina*), Black-faced Waxbill (*Estrilda erythronotos*), Marico Sunbird (*Cinnyris mariquensis*), Scaly-feathered Finch (*Sporopipes squamifrons*) and Shaft-tailed Whydah (*Vidua regia*). In summer, the composition is augmented by Palearctic warblers on passage, which include the Olive-tree Warbler (*Hippolais olivetorum*), Icterine Warbler (*H. icterina*) and Common Whitethroat (*Sylvia communis*). This association includes a composition confined to dense *Dichrostachys cinerea - Grewia flavescens* thicket, namely Yellow-bellied Greenbul (*Chlorocichla flaviventris*), White-throated Robin-chat (*Cossypha humeralis*), Grey-backed Camaroptera (*Camaroptera brevicaudata*) and Black-backed Puffback (*Dryoscopus cubla*).

26.4 Species Diversity & Richness

The microphyllous woodland units support a high bird richness along with high numbers of individuals (refer **Figure 27 & Table 36**) when compared to the broad-leaved woodland habitat (sandveld). Realistically, the highest bird diversity (when also measuring the equitability among bird individuals or evenness), was observed on the microphyllous woodland units (refer **Figure 27**). The low diversity values on the broad-leaved woodlands are a result of patchy resources due to a system with low productivity (it is often referred to as sourveld and is in general unpalatable to herbivores). Therefore, the best strategy for birds to survive in the broad-leaved woodlands is to form multi-species flocks. These bird flocks in the broad-leaved woodland tend to experience regular changes in bird numbers, depending on the spatial distribution of suitable resources (e.g. irruptions of invertebrate prey).

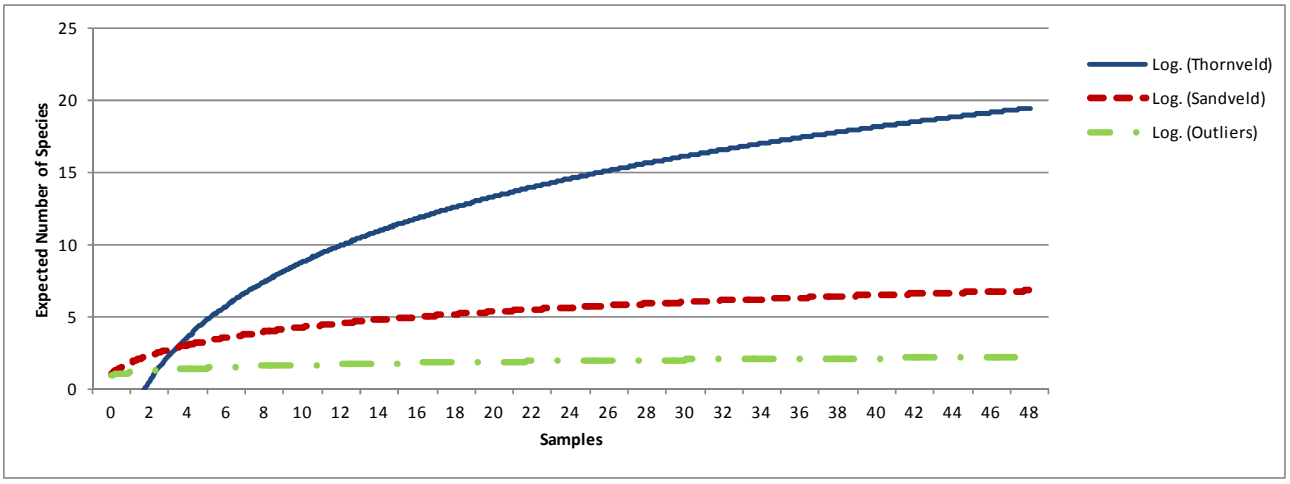


Figure 27: Figure 2: Rarefaction curves for four bird communities in the study area

Table 37: Summary of the observed species richness for four prominent bird compositions

Habitat	*Number of species*	*Mean number of individuals*	*H'*	*Expected number of species (n=40)*
Microphyllous woodland ("thornveld")	79	22.26	3.84	22.99
Broad-leaved woodland ("sandveld")	47	18.30	3.29	7.67
Outliers (unspecified compositions)	6	3.61	1.73	2.39

H' – Shannon-Weaver diversity index (H_{loge})

26.5 Species of Conservation Concern

Table 37 provides an overview of the threatened and near threatened bird species that could occur on the study area based on their respective historical and known distribution ranges and the presence of suitable habitat. According to **Table 37**, 20 species are known to occur in the region of which 14 species are expected to occur, and four species were confirmed during the surveys. Seven of the 20 species are globally threatened species and five are globally near-threatened, while 12 are regionally threatened species and seven regionally near-threatened species. Noteworthy species include the regionally near-threatened Kori Bustard (*Ardeotis kori*), the critically endangered African White-backed Vulture (*Gyps africanus*), the endangered Martial Eagle (*Polemaetus bellicosus*), the endangered Bateleur (*Terathopius ecaudatus*) and the endangered Lappet-faced Vulture (*Torgos tracheliotos*) - all considered to be regular to

fairly regular foraging visitors on the study area (with the exception of the Lappet-faced Vulture and Bateleur which are considered as irregular or uncommon foraging visitors to the area).

The remaining species are highly irregular visitors to the area as evidenced by their low reporting rates (*sensu* SABAP1), rarity (absent to low number of records; SABAP2) or the absence of optimal foraging/breeding habitat. In addition, some of the species (mainly stork taxa) are only expected to be present on or near depressions during exceptional wet years.

Table 38: Threatened and near threatened bird species that could utilise the proposed study area based on their known and historical distribution range and the presence of suitable habitat

Species	*Global Conservation Status**	*Regional Conservation Status***	*Recorded during SABAP1*	*Recorded during SABAP2*	*Referred Habitat*	*Occurrence Status*
Aquila rapax (Tawny Eagle)	-	Endangered	Yes	No	Lowveld and Kalahari savannas, especially game farming areas and reserves.	An irregular foraging visitor. Its occurrence depends on the presence of carcasses.
*Aquila nipalensis (*Steppe Eagle*)*	Endangered	-	Yes	No	Varied, but mainly associated with savanna and open woodland within its non-breeding range (where it often feeds on termites during mass alate emergences or on large flocks of queleas). Main threats restricted to its breeding grounds (especially eastern Europe).	Highly irregular summer foraging visitor and foraging individuals can appear anywhere (known from a few observations near Steenbokpan).
*Aquila verreauxii (*Verreaux's' Eagle*)*	-	Vulnerable	Yes	Yes, from adjacent pentads	Mountainous areas or areas with prominent outcrops with a high prey base (e.g. hyrax).	Highly irregular foraging visitor. Most observations stem from vagrant birds.
Ardeotis kori (Kori Bustard)	Near-threatened	Near-threatened	Yes	Yes, from adjacent pentads	Arid open lowland savanna and karroid shrub.	A fairly common resident and expected to be widespread on the study area (optimal habitat was observed along the western and northern boundaries of Farm Graaffwater and Goedehoop).
Bucorvus leadbeateri (Southern Ground Hornbill)	Vulnerable	Endangered	No	Yes	Mainly open woodland and large trees for roosting.	An uncommon resident (only known from a single incidental record - 2335_2735).
Ciconia abdimii (Abdim's Stork)	-	Near-threatened	Yes	No	Open stunted grassland, fallow land and agricultural fields.	A fairly common summer foraging visitor to agricultural land in the area (e.g. especially in close proximity to the Farms Zonderwater and Van Wyks Pan). Could utilise the depressions as ephemeral foraging habitat when inundated.
Ciconia nigra (Black Stork)	-	Vulnerable	Yes	Yes, from adjacent pentads	Breeds on steep cliffs within mountain ranges; forages on ephemeral wetlands.	An uncommon summer visitor to the nearby agricultural land and depressions in the area (has been recorded on the Farm Zonderwater).

Table 38: Threatened and near threatened bird species that could utilise the proposed study area based on their known and historical distribution range and the presence of suitable habitat

Species	*Global Conservation Status**	*Regional Conservation Status***	*Recorded during SABAP1*	*Recorded during SABAP2*	*Referred Habitat*	*Occurrence Status*
Falco biarmicus (Lanner Falcon)	-	Vulnerable	No	No	Varied, but prefers to breed in mountainous areas.	An occasional foraging visitor on the study area. Partial to depressions and open woodland (utilised as hunting habitat).
Glareola nordmanni (Black-winged Pratincole)	Near-threatened	Near-threatened	Yes	No	A species preferring extensive open grassland, usually near wetlands. Often forages over agricultural land and pastures.	Considered to be vagrant to the study area.
Gyps africanus (White-backed Vulture)	Critically Endangered	Critically Endangered	Yes	Yes	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, especially near depressions and drainage lines (most often observed on the northern parts of Farm Graaffwater and on nearby Farm Gelykebult).
Gyps coprotheres (Cape Vulture)	Endangered	Endangered	No	Yes	Mainly confined to mountain ranges, especially near breeding colonies. Ventures far afield in search of food.	A fairly regular visitor in low densities (mainly individuals) - often in company with White-backed Vultures (*Gyps africanus*).
Leptoptilos crumeniferus (Marabou Stork)	-	Near-threatened	Yes	No	Varied, from savanna to wetlands, pans and floodplains – dependant of game farming areas.	An irregular foraging visitor - often encountered at large depressions and carcasses (it has been observed on the nearby Farm Zonderwater).
Mycteria ibis (Yellow-billed Stork)	-	Endangered	Yes	No	Wetlands, pans and flooded grassland.	An uncommon foraging visitor to the ephemeral depressions when inundated (it was observed from the nearby Farm Zonderwater).
Oxyura maccoa (Maccoa Duck)	Near-threatened	Near-threatened	Yes	No	Large saline pans and shallow impoundments.	Unlikely to occur and probably absent.
Phoeniconaias minor (Lesser Flamingo)	Near-threatened	Near-threatened	Yes	No	Restricted to large alkaline pans and other inland water bodies.	Unlikely to occur.
Phoenicopterus ruber (Greater Flamingo)	-	Near-threatened	Yes	No	Restricted to large saline pans and other inland water bodies.	Unlikely to occur.
Polemaetus bellicosus (Martial Eagle)	Vulnerable	Endangered	Yes	No	Varied, from open karroid shrub to lowland savanna.	A fairly regular foraging visitor (not observed on the study area but from nearby Farms Droogeheuwel and Van Wyks Pan).
Sagittarius serpentarius (Secretarybird)	Vulnerable	Vulnerable	Yes	No	Prefers open grassland or lightly wooded habitat.	Regarded as a fairly common visitor to the open woodland areas and open broad-leaved woodland.

Table 38: Threatened and near threatened bird species that could utilise the proposed study area based on their known and historical distribution range and the presence of suitable habitat

Species	*Global Conservation Status**	*Regional Conservation Status***	*Recorded during SABAP1*	*Recorded during SABAP2*	*Referred Habitat*	*Occurrence Status*
Terathopius ecaudatus (Bateleur)	Near-threatened	Endangered	Yes	No	Lowveld and Kalahari savanna; mainly on game farms and reserves.	An uncommon foraging visitor - access to carcasses regarded as important (based on a single observation from Farm Appelvlakte).
Aegypius tracheliotos (Lapped-faced Vulture)	Endangered	Endangered	Yes	No	Lowveld and Kalahari savanna; mainly on game farms and reserves.	An irregular foraging visitor, often in company with other vulture species (known from a singe observation on the Farm Gelykebult, near the proposed powerline loop-in).

Conservation categories were used according to the IUCN (2016) and Taylor et al. (2015)**. Species highlighted in grey were confirmed during the respective surveys*

A brief account of important taxa is presented below (i.e. confirmed species and those regarded as regular foraging visitors).

26.6 Annotations on Conservation Important Species

26.6.1 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 (Taylor et al., 2015; BirdLife International, 2013a).

It is expected to be common on the study area (refer **Figure 28**), although it was not observed during the respective surveys), especially during the dry season when most of the broad-leaved woodland areas are accessible due to the sparse graminoid layer. It should be emphasised that collision of birds with the game fence pose and overhead power lines is a real risk to the long-term survival of this species. However, it also utilises old cultivated land, which allows for unrestricted movement during foraging bouts. Therefore, this species has undoubtedly benefited from selective clearing of woodland areas, which facilitate unhindered movement and foraging of such a large-bodied species.

Although it could occur on nearly any part of the study area (excluding the mine area), optimal foraging habitat was observed from the western parts of Farm Graaffwater and Goedehoop and the northern parts of Graaffwater. These areas correspond to open (historically cleared) woodland (refer **Figure 28**).

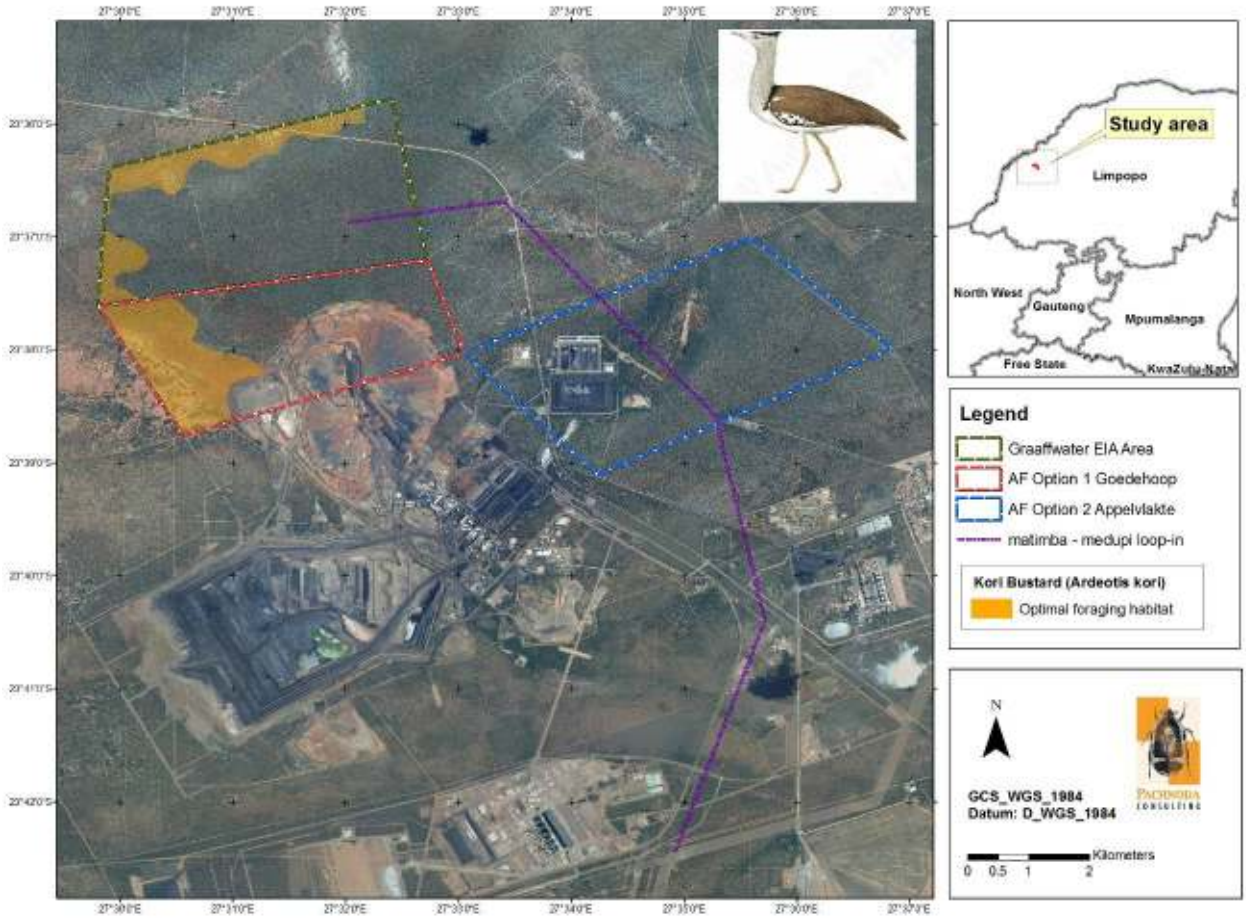


Figure 28: A satellite image illustrating the suitability of the study area for the occurrence of the regionally near threatened Kori Bustard (*Ardeotis kori*)

26.6.2 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). 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 a regular foraging visitor on the study area, which is believed to be part of an extensive home range used by at least one local breeding pair (*pers. obs.,* L. Niemand). However, during the survey an adult was observed foraging over the Farm Droogeheuwel and during 2013 on the nearby Farm Van Wyks Pan (refer **Figure 29**). 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.

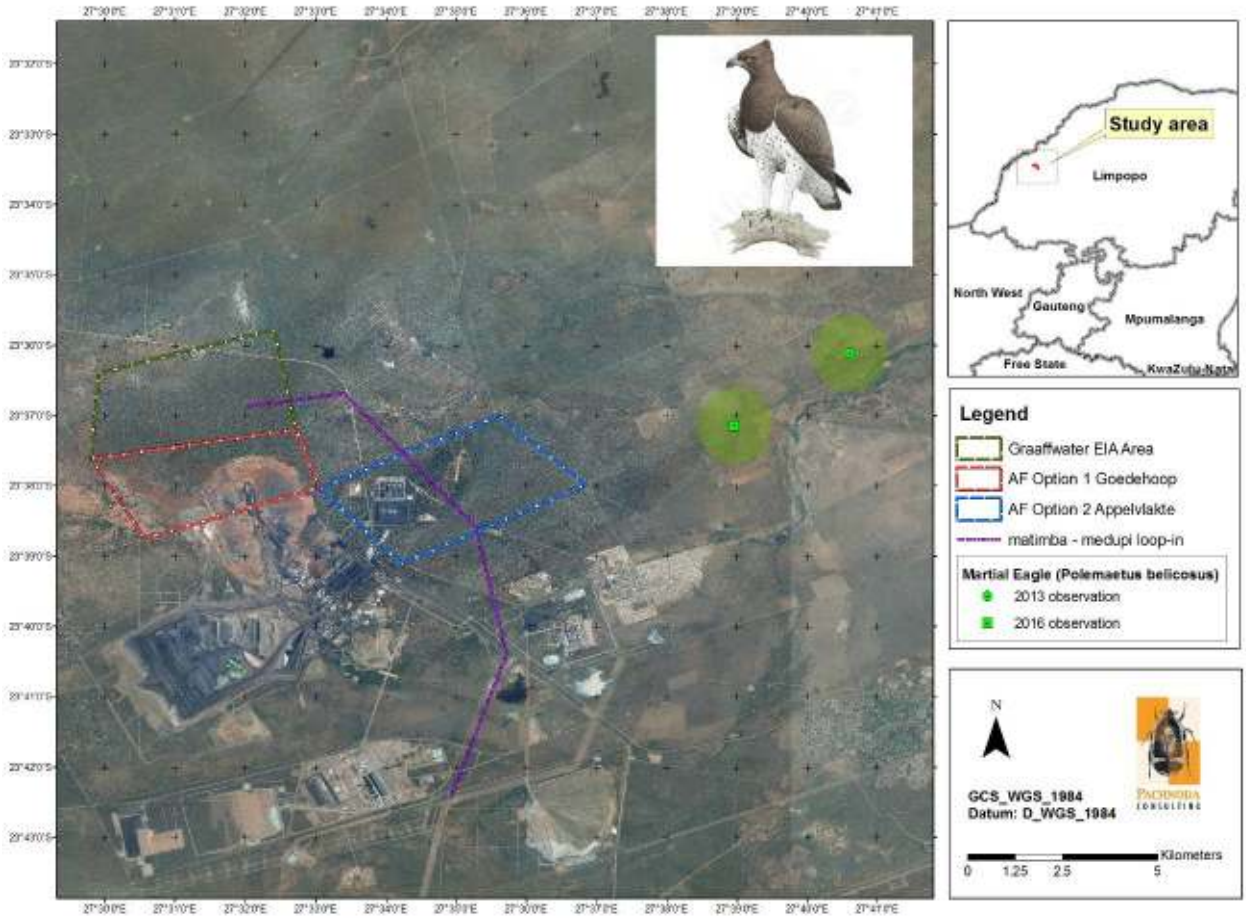


Figure 29: A satellite image illustrating observations of foraging Martial Eagle (*Polemaetus bellicosus)* within the larger study region

26.6.3 Scavenging Birds of Prey (genera Gyps, Torgos and Terathopius)

Four species of large-bodied scavenging raptors are expected to be present. These were formerly listed as vulnerable in South Africa (Barnes, 2000), although recent evidence based on declining trends has upgraded their status to endangered (Bateleur, Cape Vulture and Lapped-faced Vulture) and critically endangered (White-backed Vulture) (BirdLife International, 2012; 2015a, 2015b & 2015c). Of these, only the White-backed Vulture (*Gyps africanus*) is considered as a regular foraging visitor and is often utilising the large *Acacia erioloba, A. nigrescens* and *Combretum imberbe* trees for roosting habitat. The remaining species (*c*. Cape Vulture - *Gyps coprotheres*, Lappet-faced Vulture - *Torgos tracheliotos* and Bateleur - *Terathopius ecaudatus*) are irregular since their occurrences are best explained by the presence of carcasses. These species could utilise most of the study area, depending on the availability of food, but it was evident that certain areas experienced a higher frequency of foraging (sensu important foraging area(s); refer **Figure 30**).

The occurrence of these species on the study area is indicative of their ability to forage over large areas in search of food. However, their presence is a function of three important elements:

» Intentionally managed game farms with regular stocking of game. The presence of game ensures the availability of food, which is highly patchy in the present landscape;

» The presence of tall trees provides essential roosting habitat; and
» The spatial proximity of depressions facilitates hygiene and provides "bathing stations" during post-foraging excursions.

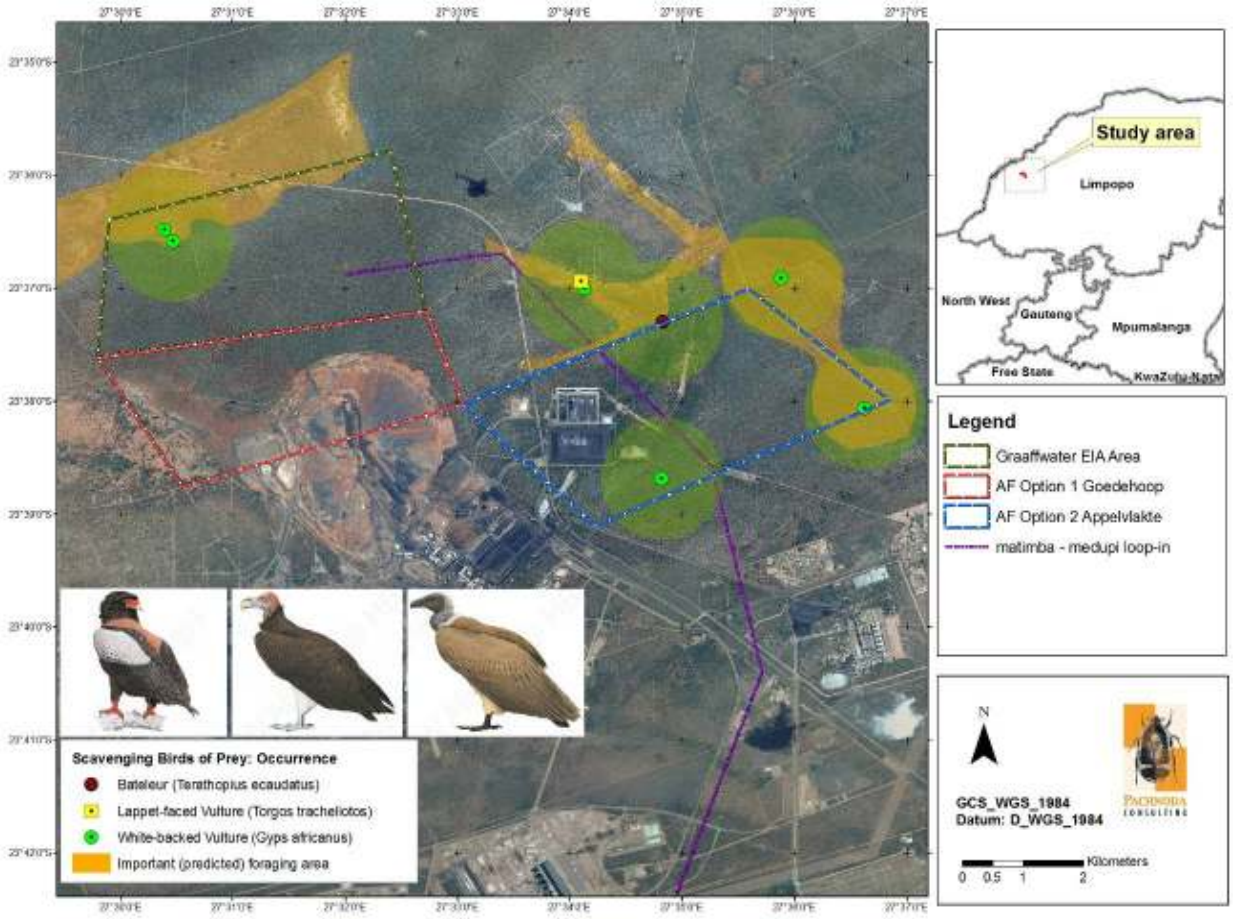


Figure 30: Satellite image illustrating the occurrence of foraging White-backed Vultures (*Gyps africanus)*, Lapped-faced Vultures (*Torgos tracheliotos)* and Bateleur (*Terathopius ecaudatus)* within the study area

26.6.4 Secretarybird (Sagittarius serpentarius)

This species was recently upgraded from near threatened to vulnerable (Taylor et al, 2015) 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 were included since it is considered as a fairly 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*) (refer **Figure 31**).

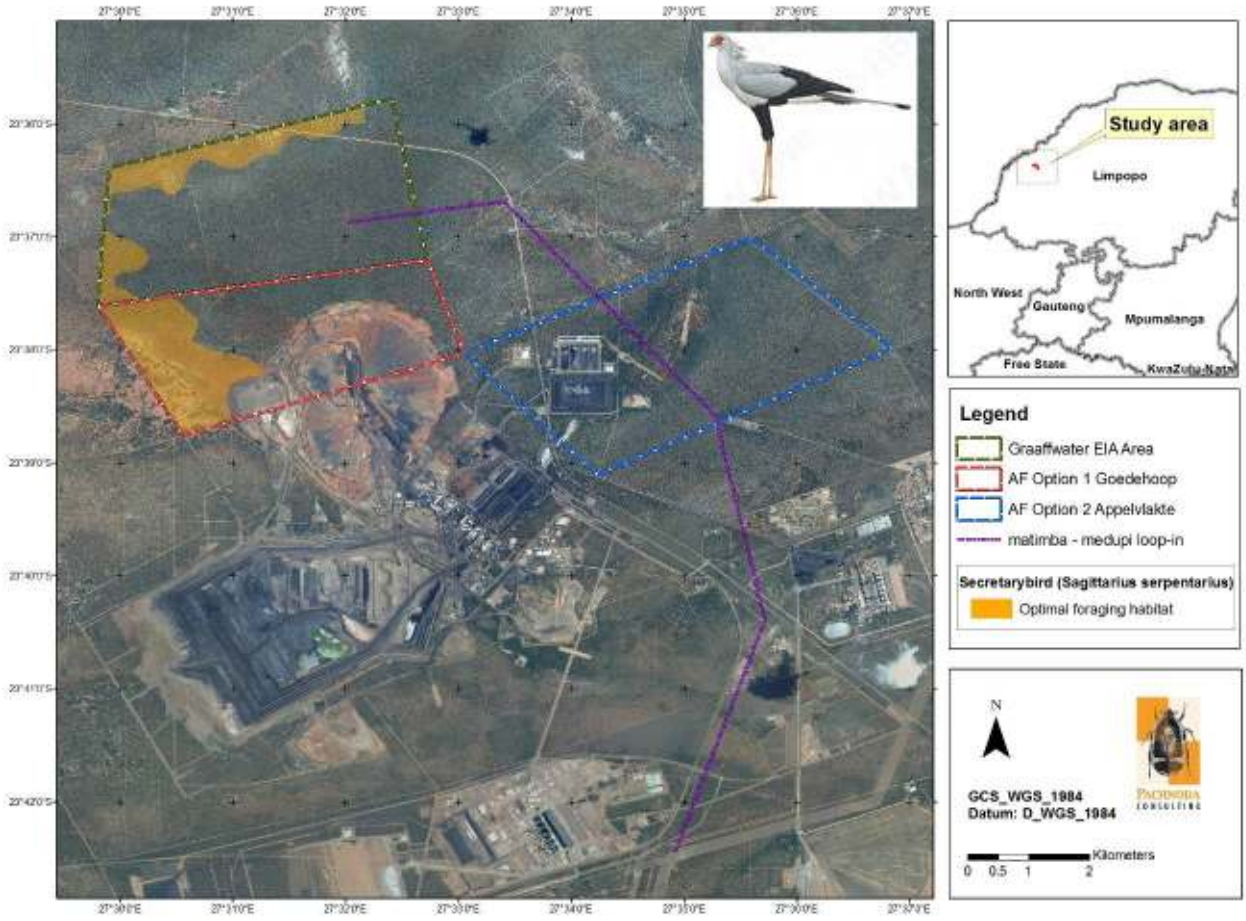


Figure 31: Satellite image illustrating the suitability of the study area for the occurrence of the regionally vulnerable Secretarybird (*Sagittarius serpentarius*)

26.6.5 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 (Taylor et al., 2015).

This species is often associated with ridges and mountain ranges where it prefers to nest on cliffs. It prefers to forage across 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/waterholes located within open woodland is preferred. Its occurrence on the study area is regarded as irregular and occasional (it was observed in 2013 from an artificial waterhole on the Farm Van Wyks Pan; refer **Figure 32**). However, based on its widespread distribution, it is predicted that foraging individuals could utilise the study area on occasion.

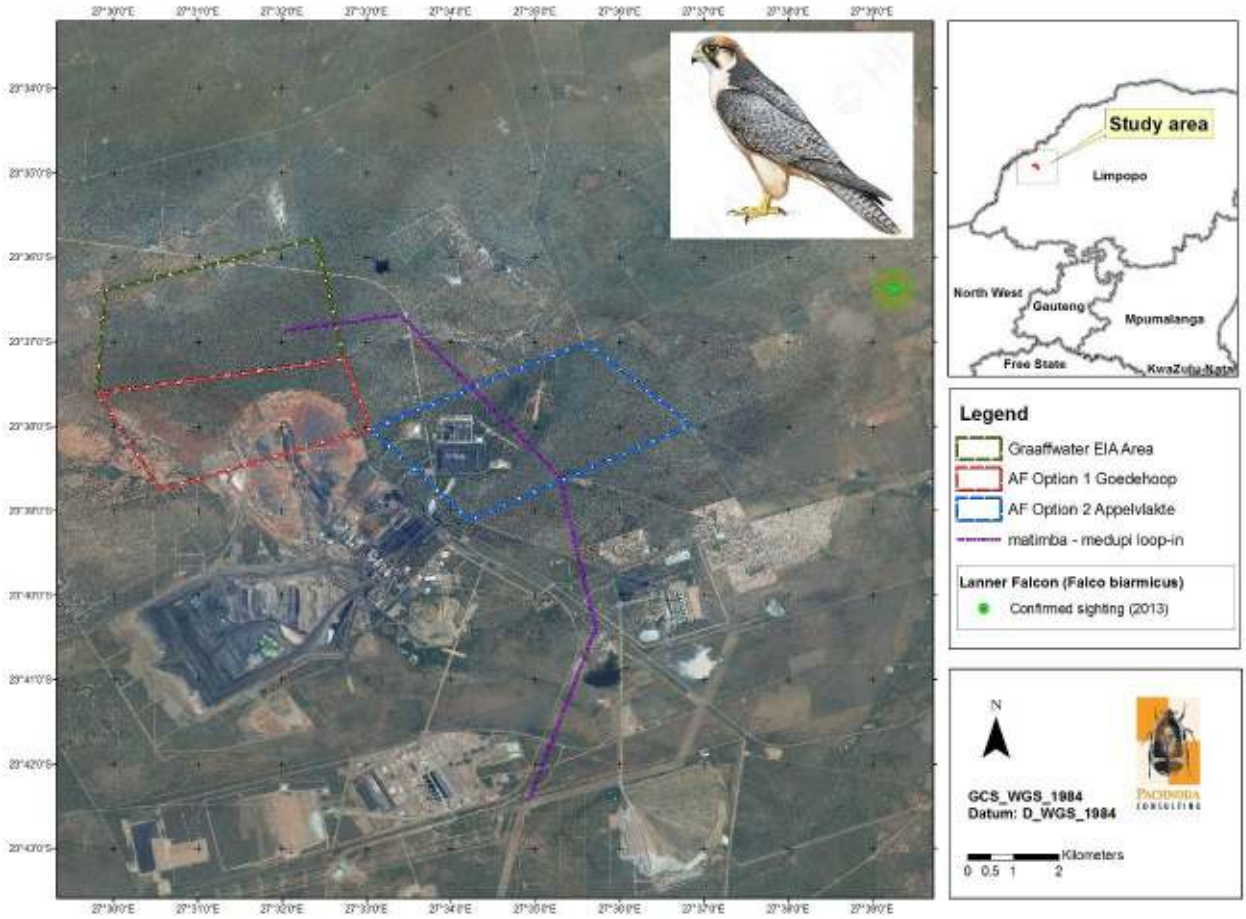


Figure 32: Satellite image illustrating an observation of Lanner Falcon (*Falco biarmicus)* on the Farm Van Wyks Pan during a 2013 survey

26.6.6 Storks (Ciconiidae)

Four (4) stork species of conservation concern are expected to be present on the study area, which include the regionally endangered Yellow-billed Stork (*Mycteria ibis*), 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 highly irregular, although supporting evidence suggests that many individuals are attracted to the nearby agricultural activities and inundated depressions (pans) (*pers. obs*., L. Niemand).

However, these species are only likely to be present on the depressions when inundated, although the Marabou Stork could utilise the large trees on the Farm Gelykebult (in close proximity to the proposed Matimba-Medupi Loop-in) for roosting purposes (refer **Figure 33**).

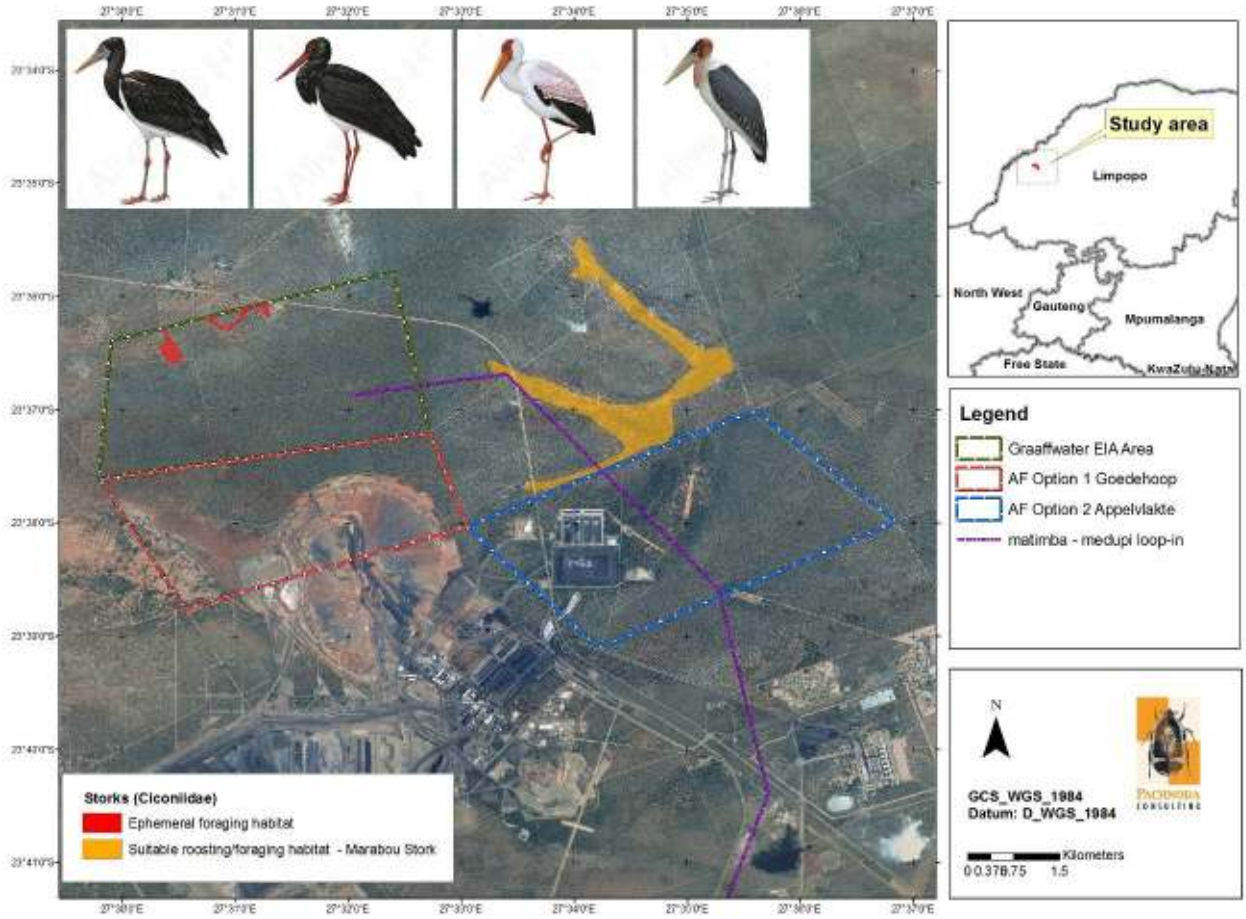


Figure 33: Satellite image illustrating the suitability of the study area for the occurrence of four regionally threatened and near threatened stork species (Ciconiidae).

26.7 Avifaunal Sensitivity

26.7.1 Areas with High Sensitivities

Areas with *High* sensitivities include all the depressions and pan features as well as focal roosting areas containing large trees (refer **Figure 34**):

» The depressions and pans in the study area provide ephemeral foraging habitat for wading bird species (including regionally threatened stork taxa) when inundated. These taxa are often absent from the surrounding dryland habitat types. They therefore contribute towards the regional avifaunal diversity;

» The depressions (when inundated) also provide essential breeding habitat for woodland waterfowl such as Knob-billed Duck (*Sarkidiornis melanotis*) which is dependent on these pans for reproduction;

» The tree layer surrounding many of the depressions and drainage lines provide roosting habitat for regionally threatened scavenging birds of prey, and when inundated provides "bathing" opportunities for scavenging bird species, and contributes toward avifaunal hygiene.

26.7.2 Areas with Medium-High Sensitivities

Areas with *Medium-high* sensitivities include all woodland units with an open canopy structure (refer **Figure 34**):

» The open woodland units provide essential foraging an breeding habitat for the regionally near threatened Kori Bustard (*Ardeotis kori*) and the vulnerable Secretarybird (*Sagittarius serpentarius*);
» These units support geographically isolated and often overlooked bird populations restricted to the Kalahari-Highveld biome. Noteworthy taxa include Tinkling Cisticola (*Cisticola rufilatus*), Namaqua Sandgrouse (*Pterocles namaqua*) and Burchell's Sandgrouse (*Pterocles burchellii*).

26.7.3 Areas with Medium Sensitivities

Areas with *medium* sensitivities include the microphyllous woodland units (refer **Figure 34**):

» This habitat is widespread in the region and supports high numbers of bird species restricted to the Kalahari-Highveld biome; and
» This habitat is ecological productive and has the inherent potential to sustain high richness values for bird taxa and high numbers of bird species.

26.7.4 Areas with Low-medium Sensitivities

Areas with *Low-medium* sensitivities include all the remaining woodland units including the broad-leaved woodland units on sandy soils (refer **Figure 34**):

» These habitat units are widespread in the region and sustain avifaunal species with widespread distribution ranges; and
» These habitat types maintain a high ecological connectivity with adjacent habitat types of similar floristic structure in the region.

26.7.5 Areas with Low Sensitivities

Areas with *Low* sensitivities include transformed habitat but with the ability to sustain avifaunal species (refer **Figure 34**):

» It includes the pollution control dam and degraded woodland habitat.

26.7.6 Areas with Very Low Sensitivities

Areas with *Very Low* sensitivities include all mining infrastructure (refer **Figure 34**).

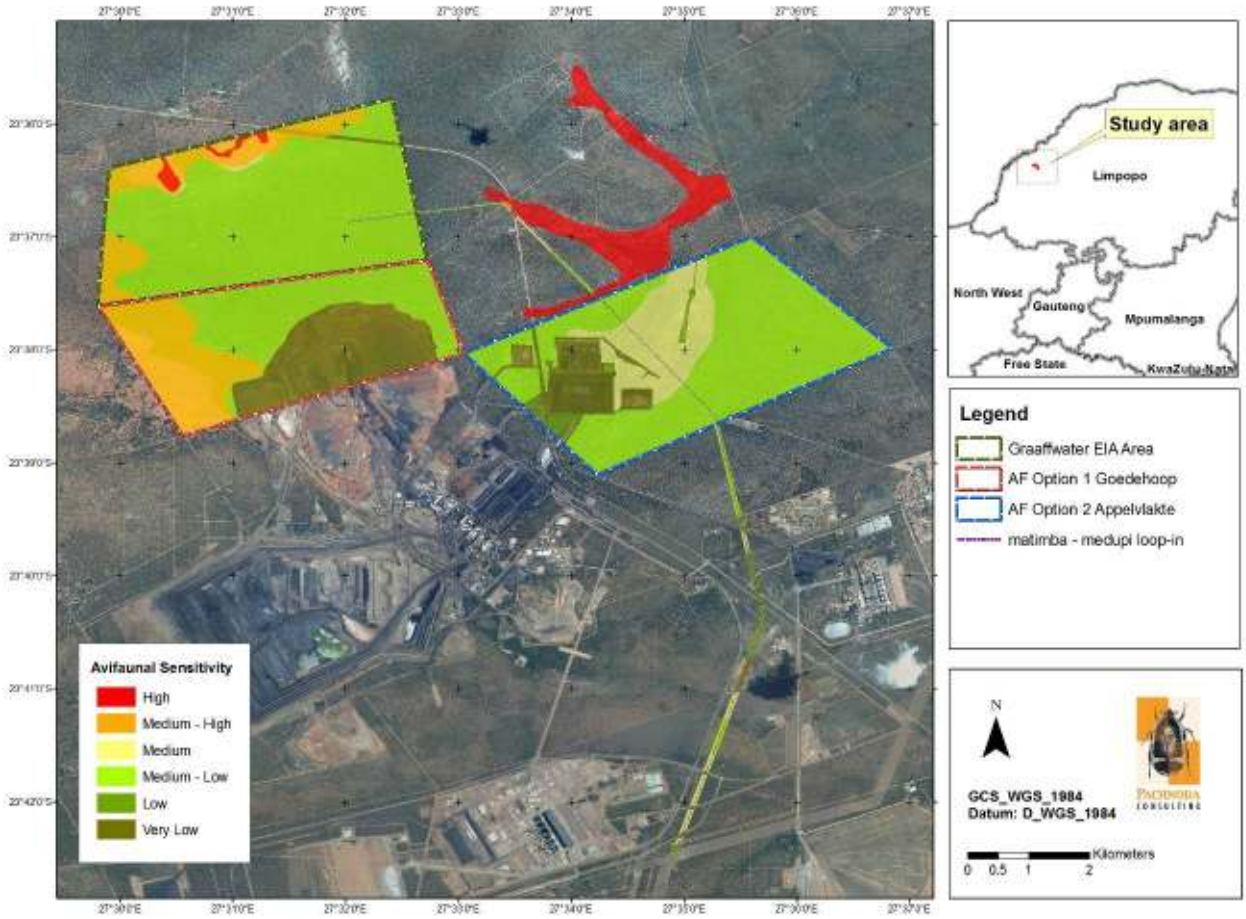


Figure 34: A sensitivity map illustrating the avifaunal importance and ecological function of the respective habitat units on the proposed study area.

26.8 Key Avifaunal Features & Synthesis

Based on the results, the avifauna 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 60 % of the regional richness (on a QDS level);

» This avifaunal community is not unique and poorly represented by South African endemics. The dominant composition is widespread in the region although it consists of many near-endemic species with high affinities to the Kalahari-Highveld biome;

» A high diversity of threatened species (mainly scavenging bird of prey species and Kori Bustard - *Ardeotis kori*) are expected to be present. Since the majority of these species requires large home range sizes, it could be argued that the frequency of occurrence and wide distribution of these species on the study area and on nearby farms are due to the uniformity of habitat types in the region. However, these species have a higher expected fidelity towards the study area based on (1) composition of open woodland interspersed by (2) depressions, (3) the presence of large roosting platforms (being tall trees) and (4) the occurrence of game;

» Part of the broad-leaved and microphyllous woodland habitat consists of an open canopy structure which provides foraging habitat for terrestrial large-bodied bird species (e.g.

the near-threatened Kori Bustard - *Ardeotis kori* and vulnerable Secretarybird *Sagittarius serpentarius*);

» Approximately 10 % of the expected bird composition consists of Palaearctic migratory species, including a prominent composition of *Sylvia* and *Hippolais* warbler taxa (*pers. obs*., L. Niemand);

» The study area is expected to support a high richness of apex predators pertaining to the Accipitriform and Falconiform (diurnal birds of prey) groupings, which are indicative of a "healthy" functional system. Twenty-five (25) diurnal birds of prey species are expected to be present. The study area also provides potential breeding habitat for the Intra-African migratory Wahlberg's Eagle (*Hieraaetus wahlbergi*); and

» The depressions and pan features 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 when inundated.

26.9 Impacts on the Avifaunal Environment

The construction and operation of the proposed coal-fired power plant and associated infrastructure is expected to have negative impacts 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.

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

a) Loss of important habitat containing high avifaunal diversity;
b) Loss of azonal and important avifaunal habitat types or ecosystems of restricted abundance containing unique bird compositions on a local scale;
c) Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.;
d) Displacement of bird species, especially large-bodied birds of prey and large terrestrial bird species;
e) Changes in the community structure due to habitat fragmentation (e.g. roads, loss of closed-canopy woodland) and altered habitat quality;
f) Loss of sensitive habitat and subsequent loss of threatened and near-threatened species;
g) Bird collisions with fence structures and proposed overhead power lines;
h) Electrocution of large-bodied birds due to the use of inappropriate tower design;
i) Loss of daily migration/foraging corridors (with reference to drainage lines).

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

a) Loss of ecological connectivity owing to habitat alteration;
b) Subsequent habitat change and changes to the local avifaunal community structure and composition (mainly generalists and secondary species);
c) Urban sprawl based on "job-seeking" opportunities leading to the localised depletion of natural resources and direct persecution of bird taxa;
d) Exacerbation of existing levels of habitat fragmentation and isolation; and

e) Cumulative impacts on local/ regional and national conservation targets and obligations.

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 community. Therefore, it is often witnessed that early successional habitat contributes to the establishment of a transient avifaunal community.

26.10 Quantification of Impacts on the Avifaunal Environment – Power Plant

Table 39: Quantification of impacts of the Power Plant on the avifaunal environment		
1. Nature of impact:	Direct impacts on/ losses and displacement of bird species of conservation importance and concern, and habitat associated with these species, with particular reference to large-bodied birds of prey and large terrestrial bird species. Impacts are unavoidable because of land clearing activities and the particular large home range size of focal bird species. This impact is restricted to the construction and operational phase, but is permanent	
	Without mitigation	***With mitigation***
Extent	**National (4)**	**National (4)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Definitive (5)**	**Definitive (5)**
Significance	***High (85)***	***High (75)***
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Unavoidable impacts on bird species will occur, irrespective of mitigation measures, albeit restricted to local footprint. Aim to avoid construction on important and sensitive bird habitat (e.g. habitat with high and medium-high avifaunal sensitivities)	
Mitigation Measures:	• Extent of impact likely to restricted to site only, restrict impacts to development footprint; • Avoid areas of high or medium-high avifaunal sensitivities by applying changes to the layout plan where necessary	
Cumulative Impacts:	• Continued loss/displacement of threatened and near threatened species on a local and regional scale; • Decrease in habitat available for species of conservation concern and importance, especially species requiring large home range sizes; • Potentially increase in threat level • Competition and intra-specific displacement elsewhere in the region	
Residual Impacts:	Sterilised landscapes with no propensity for species of conservation concern, decline in population sizes and numbers, continual decline in habitat availability	
2. Nature of impact:	Losses of natural habitat through physical transformation, modifications, removals and land clearance. Also includes the loss of habitat containing high avifaunal diversity on a local scale and reduction in species richness and diversity	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Definitive (5)**	**Definitive (5)**
Significance	***High (65)***	**Moderate (55)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, to some extent	
Can impacts be mitigated?	Yes, to a limited extent, representative habitat types (mainly microphyllous woodland) are widespread and cover large surface area of proposed site	
Mitigation Measures:	• Restrict losses of natural habitat to footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation and landscaping practices; • Ensure nodal/clustering of developments by grouping developments structures, avoid the uncontrolled spread of infrastructure;	

	• Allow infrastructure on areas of low sensitivity
Cumulative Impacts:	• Loss of natural habitat on a local and regional scale; • Cumulative developments lead to an increase in anthropogenic encroachment and resource demands, such as housing, water, etc., which places remaining natural resources under increased pressure
Residual Impacts:	Decreased species richness, low evenness values, subsequent loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat

3. Nature of impact:	Direct impacts on/ losses of azonal habitat types or ecosystems of particularly restricted occurrence containing unique avifaunal compositions on a local scale - many of these areas also provide habitat for threatened and near threatened bird species	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	***High* (60)**	**Moderate (39)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Restrict losses of natural habitat to footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation and landscaping practices; • Ensure nodal/clustering of developments by grouping developments structures, and avoid the uncontrolled spread of infrastructure; • Allow infrastructure on areas of low sensitivity; • Remove prominent large dead trees and re-instate during rehabilitation (where necessary); • Re-instate and re-locate artificial watering holes/points	
Cumulative Impacts:	Loss of natural habitat, with particular reference to restricted or azonal habitat receptors	
Residual Impacts:	Increase in habitat fragmentation and isolation, local decrease in bird richness, increased competition between bird species and individuals of the same species for natural resources, sterilised landscapes, increased fragmentation of habitat	

4. Nature of impact:	Impact on surrounding areas of natural habitat, such as habitat changes, surface water runoff, fragmentation and habitat isolation, etc. It is generally expected to be of moderate significance due to a moderate sensitivity of surrounding areas, although areas of high/medium-high sensitive occur nearby (drainage lines and open woodland)	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (56)**	**Moderate (33)**
Status (positive or negative)	Negative	
Reversibility	Moderately reversible, the nature of impacts are such that activities on the development site can be adapted to avoid impacts in surrounding areas	
Irreplaceable loss of resources?	Low	
Can impacts be mitigated?	Yes	
Mitigation Measures:	Implement generic monitoring programme and mitigation measures that are aimed at identifying and preventing the uncontrolled spread of impacts into adjacent areas of natural habitat	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation and subsequent displacement of bird taxa of conservation concern	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	

5. Nature of impact:	Impacts on ecological connectivity and ecosystem functioning. Although the site is regarded homogenous in nature, it does contribute towards local ecological functionality in providing in the life requirements for many bird species and bird associations

	Without mitigation	With mitigation
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Definitive (5)**	**Definitive (5)**
Significance	***High* (70)**	**Moderate (55)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Limit development to footprint area; • Avoid impacts in adjacent habitat; • Implement biodiversity monitoring programmes and maintain ecological connectivity with habitat of similar structure	
Cumulative Impacts:	Habitat loss, degradation, fragmentation & isolation of natural habitat	
Residual Impacts:	Fragmented, isolated portions of natural habitat, sterile landscapes, increased anthropogenic pressures on natural resources and reduced species richness relating to loss of specialised species and increased colonisation by unspecialised (generalist) species	
6. Nature of impact:	Increased exploitation of natural resources due to increased human presence and resource requirements	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Probable (3)**	**Probable (3)**
Significance	**Moderate (42)**	**Moderate (36)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Create public awareness programmes; • Implement biodiversity monitoring protocols; • Demarcate suitable areas for development (mainly on habitat with low sensitivity; • Cluster development and avoid "spread" of settlements across landscape	
Cumulative Impacts:	Loss of biodiversity on a local scale, continued/ exacerbated displacement of bird species	
Residual Impacts:	Low bird diversity, and continued displacement of bird species. Potential colonisation of feral (alien) species resulting in increased competition and localised displacement of native bird species	
7. Nature of impact:	Accelerated patterns in development on a local and regional level implies significant increases in local and regional habitat fragmentation and isolation levels	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Highly probable (4)**	**Highly probable (4)**
Significance	***High* (64)**	**Moderate (56)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	No	
Mitigation Measures:	• Implement generic mitigation measures; • Identify "hotspot' areas of local diversity; • Consider nodal development regions to avoid uncontrolled spread of developments	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, with particular	

	reference to residential demands and linear infrastructure
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat
8. Nature of impact:	Cumulative impacts on conservation obligations & targets. The conservation status of ecological habitat is regarded Least Concerned and is not part of an Important Bird and Biodiversity Area. The loss of the study area is not expected to result in an escalation of the threat level on a local or regional scale. Habitat loss is however permanent and local development patterns indicate accelerated losses of natural habitat and the displacement of large-bodied terrestrial and birds of prey species
	Without mitigation / **With mitigation**
Extent	**National (4)** / **Regional (3)**
Duration	**Permanent (5)** / **Permanent (5)**
Magnitude	**Low (4)** / **Minor (2)**
Probability	**Highly probable (4)** / **Probable (3)**
Significance	**Moderate (52)** / **Low (30)**
Status (positive or negative)	Negative
Reversibility	Irreversible
Irreplaceable loss of resources?	Yes, but only on a local scale
Can impacts be mitigated?	No
Mitigation Measures:	• Generic mitigation measures; • Contain, prevent the spread of cumulative impacts; • Consider an Offset Programme/ conservation programme (also with emphasis on large-scale migration/dispersal corridors)
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, loss of bird diversity
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat, sterile landscapes

26.11 Quantification of Impacts on the Avifaunal Environment – Ashing Facility - Appelvlakte

Table 40: Quantification of impacts of the Ashing Facility on the avifaunal environment	
1. Nature of impact:	Direct impacts on/ losses and displacement of bird species of conservation importance and concern, and habitat associated with these species, with particular reference to large-bodied birds of prey and large terrestrial bird species. Impacts are unavoidable because of land clearing activities and the particular large home range size of focal bird species. This impact is restricted to the construction and operational phase, and is permanent
	Without mitigation / ***With mitigation***
Extent	**National (4)** / **National (4)**
Duration	**Permanent (5)** / **Permanent (5)**
Magnitude	**Moderate (6)** / **Low (4)**
Probability	**Definitive (5)** / **Definitive (5)**
Significance	***High (75)*** / ***High (65)***
Status (positive or negative)	Negative
Reversibility	Irreversible
Irreplaceable loss of resources?	Yes
Can impacts be mitigated?	Unavoidable impacts on bird species will occur, irrespective of mitigation measures, albeit restricted to local footprint. Aim to avoid construction on important and sensitive bird habitat
Mitigation Measures:	Unavoidable impacts on bird species will occur, irrespective of mitigation measures, albeit restricted to local footprint. Aim to avoid construction on important and sensitive bird habitat (e.g. habitat with high and medium-high avifaunal sensitivities)
Cumulative Impacts:	• Extent of impact likely to restricted to site only, restrict impacts to development footprint; • Avoid areas of high or medium-high avifaunal sensitivities by applying changes to the layout plan where necessary
Residual Impacts:	• Continued loss/displacement of threatened and near threatened species on a local and regional scale; • Decrease in habitat available for species of conservation concern and

	importance, especially species requiring large home range sizes; • Potentially increase in threat level • Competition and intra-specific displacement elsewhere in the region
2. Nature of impact:	Losses of natural habitat through physical transformation, modifications, removals and damage. Also includes the loss of habitat containing high avifaunal diversity on a local scale and reduction in species richness and diversity

	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Definitive (5)**	**Definitive (5)**
Significance	***High* (65)**	**Moderate (55)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, to some extent	
Can impacts be mitigated?	No, especially since these habitat types (mainly microphyllous woodland) are widespread and cover large surface area of proposed site	
Mitigation Measures:	• Restrict losses of natural habitat to footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation and landscaping practices; • Ensure nodal/clustering of developments by grouping developments structures, avoid the uncontrolled spread of infrastructure; • Allow infrastructure on areas of low sensitivity	
Cumulative Impacts:	• Loss of natural habitat on a local and regional scale; • Cumulative developments lead to an increase in anthropogenic encroachment and resource demands, such as housing, water, etc., which places remaining natural resources under increased pressure	
Residual Impacts:	Decreased species richness, low evenness values, subsequent loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat	
3. Nature of impact:	Direct impacts on/ losses of azonal habitat types or ecosystems of particularly restricted occurrence containing unique avifaunal compositions on a local scale - many of these areas also provide habitat for threatened and near threatened bird species	

	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (52)**	**Moderate (33)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Restrict losses of natural habitat to footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation and landscaping practices; • Ensure nodal/clustering of developments by grouping developments structures, and avoid the uncontrolled spread of infrastructure; • Allow infrastructure on areas of low sensitivity; • Remove prominent large dead trees and re-instate during rehabilitation (where necessary); • Re-instate and re-locate artificial watering holes/points	
Cumulative Impacts:	Loss of natural habitat, with particular reference to restricted or azonal habitat receptors	
Residual Impacts:	Increase in habitat fragmentation and isolation, local decrease in bird richness, increased competition between bird species and individuals of the same species for natural resources, sterilised landscapes, increased fragmentation of habitat	
4. Nature of impact:	Impact on surrounding areas of natural habitat, such as habitat changes, surface water runoff, fragmentation and habitat isolation, etc. It is generally expected to be of low significance due to a moderate sensitivity of surrounding areas, although areas of high/medium-high sensitive occur nearby (drainage lines and	

	open woodland)

	Without mitigation	With mitigation
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (56)**	**Moderate (33)**
Status (positive or negative)	Negative	
Reversibility	Moderately reversible, the nature of impacts are such that activities on the development site can be adapted to avoid impacts in surrounding areas	
Irreplaceable loss of resources?	Low	
Can impacts be mitigated?	Yes	
Mitigation Measures:	Implement generic monitoring programme and mitigation measures that are aimed at identifying and preventing the uncontrolled spread of impacts into adjacent areas of natural habitat	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation and subsequent displacement of bird taxa of conservation concern	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	
5. Nature of impact:	Impacts on ecological connectivity and ecosystem functioning. Although the site is regarded homogenous in nature, it does contribute towards local ecological functionality in providing in the life requirements for many bird species and bird associations	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Definitive (5)**	**Definitive (5)**
Significance	***High (70)***	**Moderate (55)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Limit development to footprint area; • Avoid impacts in adjacent habitat; • Implement biodiversity monitoring programmes and maintain ecological connectivity with habitat of similar structure	
Cumulative Impacts:	Habitat loss, degradation, fragmentation & isolation of natural habitat	
Residual Impacts:	Fragmented, isolated portions of natural habitat, sterile landscapes, increased anthropogenic pressures on natural resources and reduced species richness relating to loss of specialised species and increased colonisation by unspecialised (generalist) species	
6. Nature of impact:	Increased exploitation of natural resources due to increased human presence and resource requirements	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Probable (3)**	**Probable (3)**
Significance	**Moderate (42)**	**Moderate (36)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Create public awareness programmes; • Implement biodiversity monitoring protocols; • Demarcate suitable areas for development (mainly on habitat with low sensitivity; • Cluster development and avoid "spread" of settlements across landscape	
Cumulative Impacts:	Loss of biodiversity on a local scale, continued/ exacerbated displacement of bird	

	species	
Residual Impacts:	Low bird diversity, and continued displacement of bird species. Potential colonisation of feral (alien) species resulting in increased competition and localised displacement of native bird species	
7. Nature of impact:	Accelerated patterns in development on a local and regional level implies significant increases in local and regional habitat fragmentation and isolation levels	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Highly probable (4)**	**Highly probable (4)**
Significance	***High* (64)**	**Moderate (56)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Implement generic mitigation measures; • Identify "hotspot' areas of local diversity; • Consider nodal development regions to avoid uncontrolled spread of developments	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, with particular reference to residential demands and linear infrastructure	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	
8. Nature of impact:	Cumulative impacts on conservation obligations & targets. The conservation status of ecological habitat is regarded Least Concerned and is not part of an Important Bird and Biodiversity Area. The loss of the study area is not expected to result in an escalation of the threat level on a local or regional scale. Habitat loss is however permanent and local development patterns indicate accelerated losses of natural habitat and the displacement of large-bodied terrestrial and birds of prey species	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (48)**	**Low (27)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	No	
Mitigation Measures:	• Generic mitigation measures; • Contain, prevent the spread of cumulative impacts; • Consider an Offset Programme/ conservation programme (also with emphasis on large-scale migration/dispersal corridors)	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, loss of bird diversity	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat, sterile landscapes	

26.12 Quantification of Impacts on the Avifaunal Environment – Ashing Facility - Graaffwater

Table 41: Quantification of impacts of the Ashing Facility on the avifaunal environment	
1. Nature of impact:	Direct impacts on/ losses and displacement of bird species of conservation importance and concern, and habitat associated with these species, with particular reference to large-bodied birds of prey and large terrestrial bird species. Impacts are unavoidable because of land clearing activities and the particular large home range size of focal bird species. This impact is restricted to the construction and operational phase, and is permanent

	Without mitigation	***With mitigation***
Extent	**National (4)**	**National (4)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Definitive (5)**	**Definitive (5)**
Significance	***High (85)***	***High (75)***
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Unavoidable impacts on bird species will occur, irrespective of mitigation measures, albeit restricted to local footprint. Aim to avoid construction on important and sensitive bird habitat	
Mitigation Measures:	Unavoidable impacts on bird species will occur, irrespective of mitigation measures, albeit restricted to local footprint. Aim to avoid construction on important and sensitive bird habitat (e.g. habitat with high and medium-high avifaunal sensitivities)	
Cumulative Impacts:	• Extent of impact likely to restricted to site only, restrict impacts to development footprint; • Avoid areas of high or medium-high avifaunal sensitivities by applying changes to the layout plan where necessary	
Residual Impacts:	• Continued loss/displacement of threatened and near threatened species on a local and regional scale; • Decrease in habitat available for species of conservation concern and importance, especially species requiring large home range sizes; • Potentially increase in threat level • Competition and intra-specific displacement elsewhere in the region	
2. Nature of impact:	Losses of natural habitat through physical transformation, modifications, removals and damage. Also includes the loss of habitat containing high avifaunal diversity on a local scale and reduction in species richness and diversity	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Definitive (5)**	**Definitive (5)**
Significance	***High (65)***	**Moderate (55)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, to some extent	
Can impacts be mitigated?	No, especially since these habitat types (mainly microphyllous woodland) are widespread and cover large surface area of proposed site	
Mitigation Measures:	• Restrict losses of natural habitat to footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation and landscaping practices; • Ensure nodal/clustering of developments by grouping developments structures, avoid the uncontrolled spread of infrastructure; • Allow infrastructure on areas of low sensitivity	
Cumulative Impacts:	• Loss of natural habitat on a local and regional scale; • Cumulative developments lead to an increase in anthropogenic encroachment and resource demands, such as housing, water, etc., which places remaining natural resources under increased pressure	
Residual Impacts:	Decreased species richness, low evenness values, subsequent loss of biodiversity on a local scale, increased pressure on natural resources, sterilised landscapes, increased fragmentation of habitat	
3. Nature of impact:	Direct impacts on/ losses of azonal habitat types or ecosystems of particularly restricted occurrence containing unique avifaunal compositions on a local scale - many of these areas also provide habitat for threatened and near threatened bird species	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Highly probable (4)**	**Probable (3)**

Significance	**Moderate (60)**	**Moderate (39)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Restrict losses of natural habitat to footprints; • Avoid peripheral or unnecessary losses of natural habitat; • Ensure proper rehabilitation and landscaping practices; • Ensure nodal/clustering of developments by grouping developments structures, and avoid the uncontrolled spread of infrastructure; • Allow infrastructure on areas of low sensitivity; • Remove prominent large dead trees and re-instate during rehabilitation (where necessary); • Re-instate and re-locate artificial watering holes/points	
Cumulative Impacts:	Loss of natural habitat, with particular reference to restricted or azonal habitat receptors	
Residual Impacts:	Increase in habitat fragmentation and isolation, local decrease in bird richness, increased competition between bird species and individuals of the same species for natural resources, sterilised landscapes, increased fragmentation of habitat	
4. Nature of impact:	Impact on surrounding areas of natural habitat, such as habitat changes, surface water runoff, fragmentation and habitat isolation, etc. It is generally expected to be of low significance due to a moderate sensitivity of surrounding areas, although areas of high/medium-high sensitive occur nearby (drainage lines and open woodland)	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (56)**	**Moderate (33)**
Status (positive or negative)	Negative	
Reversibility	Moderately reversible, the nature of impacts are such that activities on the development site can be adapted to avoid impacts in surrounding areas	
Irreplaceable loss of resources?	Low	
Can impacts be mitigated?	Yes	
Mitigation Measures:	Implement generic monitoring programme and mitigation measures that are aimed at identifying and preventing the uncontrolled spread of impacts into adjacent areas of natural habitat	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation and subsequent displacement of bird taxa of conservation concern	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	
5. Nature of impact:	Impacts on ecological connectivity and ecosystem functioning. Although the site is regarded homogenous in nature, it does contribute towards local ecological functionality in providing in the life requirements for many bird species and bird associations	
	Without mitigation	**With mitigation**
Extent	**National (4)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Definitive (5)**	**Definitive (5)**
Significance	***High* (75)**	**Moderate (60)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Limit development to footprint area; • Avoid impacts in adjacent habitat; • Implement biodiversity monitoring programmes and maintain ecological connectivity with habitat of similar structure	
Cumulative Impacts:	Habitat loss, degradation, fragmentation & isolation of natural habitat	
Residual Impacts:	Fragmented, isolated portions of natural habitat, sterile landscapes, increased	

	anthropogenic pressures on natural resources and reduced species richness relating to loss of specialised species and increased colonisation by unspecialised (generalist) species

6. Nature of impact:	Increased exploitation of natural resources due to increased human presence and resource requirements	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Probable (3)**	**Probable (3)**
Significance	**Moderate (42)**	**Moderate (36)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Create public awareness programmes; • Implement biodiversity monitoring protocols; • Demarcate suitable areas for development (mainly on habitat with low sensitivity; • Cluster development and avoid "spread" of settlements across landscape	
Cumulative Impacts:	Loss of biodiversity on a local scale, continued/ exacerbated displacement of bird species	
Residual Impacts:	Low bird diversity, and continued displacement of bird species. Potential colonisation of feral (alien) species resulting in increased competition and localised displacement of native bird species	

7. Nature of impact:	Accelerated patterns in development on a local and regional level implies significant increases in local and regional habitat fragmentation and isolation levels	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Highly probable (4)**	**Highly probable (4)**
Significance	***High* (64)**	**Moderate (56)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Implement generic mitigation measures; • Identify "hotspot' areas of local diversity; • Consider nodal development regions to avoid uncontrolled spread of developments	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, with particular reference to residential demands and linear infrastructure	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	

8. Nature of impact:	Cumulative impacts on conservation obligations & targets. The conservation status of ecological habitat is regarded Least Concerned and is not part of an Important Bird and Biodiversity Area. The loss of the study area is not expected to result in an escalation of the threat level on a local or regional scale. Habitat loss is however permanent and local development patterns indicate accelerated losses of natural habitat and the displacement of large-bodied terrestrial and birds of prey species	
	Without mitigation	**With mitigation**
Extent	**National (4)**	**Regional (3)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (52)**	**Low (30)**
Status (positive or negative)	Negative	

Reversibility	Irreversible
Irreplaceable loss of resources?	Yes, but only on a local scale
Can impacts be mitigated?	No
Mitigation Measures:	• Generic mitigation measures; • Contain, prevent the spread of cumulative impacts; • Consider an Offset Programme/ conservation programme (also with emphasis on large-scale migration/dispersal corridors)
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, loss of bird diversity
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat, sterile landscapes

26.13 Quantification of Impacts on the Avifaunal Environment – Power Lines

Table 42: Quantification of impacts of the Power Line on the avifaunal environment		
1. Nature of impact:	Direct impacts on/ losses and displacement of bird species of conservation importance and concern, and habitat associated with these species, with particular reference to large-bodied birds of prey and large terrestrial bird species. *This impact is restricted to the construction and is mainly of relevance to the large drainage line containing large trees (roosting habitat) on the Farm Gelykebult.*	
	Without mitigation	***With mitigation***
Extent	**National (4)**	**Regional (3)**
Duration	**Long term (4)**	**Long term (4)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Definitive (5)**	**Probable (3)**
Significance	***High (80)***	**Moderate (*39*)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes, on a local scale by means of re-alignment - especially moving the power line alignment (c. 500 m) away from habitat of high avifaunal sensitivity (e.g. drainage lines, including pans and dams)	
Mitigation Measures:	• Avoid areas of high or medium-high avifaunal sensitivities by applying changes to the alignment where necessary • Move power line alignment (c. 500 m) away from areas of high avifaunal sensitivity (e.g. drainage line on Gelykebult)	
Cumulative Impacts:	• Continued loss/displacement of threatened and near threatened species on a local and regional scale; • Decrease in habitat available for species of conservation concern and importance, especially species requiring large home range sizes	
Residual Impacts:	Sterilised landscapes with no propensity for species of conservation concern, decline in population sizes and numbers, continual decline in habitat availability	
2. Nature of impact:	Losses of natural habitat through physical transformation, modifications, removals and land clearance. Also includes the loss of habitat containing high avifaunal diversity on a local scale and reduction in species richness and diversity	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Probable (3)**	**Probable (3)**
Significance	**Moderate (39)**	**Moderate (33)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, to some extent	
Can impacts be mitigated?	Yes	
Mitigation Measures:	Re-alignment of power line alignment to avoid crossing areas of high avifaunal sensitivity	
Cumulative Impacts:	Loss of natural habitat on a local and regional scale.	
Residual Impacts:	• Decreased species richness; • Low evenness values;	

	• Subsequent loss of biodiversity on a local scale; • Increased pressure on natural resources; • Sterilised landscapes; • Increased fragmentation of habitat
3. Nature of impact:	Direct impacts on/ losses of azonal habitat types or ecosystems of particularly restricted occurrence containing unique avifaunal compositions on a local scale - many of these areas also provide habitat for threatened and near threatened bird species

	Without mitigation	**With mitigation**
Extent	**National (4)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	***High* (68)**	**Moderate (39)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• of high or medium-high avifaunal sensitivities by applying changes to the alignment where necessary • Move power line alignment (c. 500 m) away from areas of high avifaunal sensitivity (e.g.	
Cumulative Impacts:	Loss of natural habitat, with particular reference to restricted or azonal habitat receptors	
Residual Impacts:	• Increase in habitat fragmentation and isolation; • Local decrease in bird richness; • Increased competition between bird species and individuals of the same species for natural resources; • Sterilised landscapes; • Increased fragmentation of habitat	

4. Nature of impact:	Impact on surrounding areas of natural habitat, such as habitat changes, surface water runoff, fragmentation and habitat isolation, etc. It is generally expected to be of moderate significance due to a moderate sensitivity of surrounding areas, although areas of high/medium-high sensitive occur nearby (drainage lines and open woodland)

	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (56)**	**Moderate (30)**
Status (positive or negative)	Negative	
Reversibility	Moderately reversible, the nature of impacts are such that activities on the development site can be adapted to avoid impacts in surrounding areas	
Irreplaceable loss of resources?	Low	
Can impacts be mitigated?	Yes	
Mitigation Measures:	• Implement generic monitoring programme and mitigation measures that are aimed at identifying and preventing the uncontrolled spread of impacts into adjacent areas of natural habitat; • Avoid crossing/spanning of drainage lines or areas of high avifaunal sensitivity	
Cumulative Impacts:	• Loss of natural habitat; • Habitat fragmentation and degradation and subsequent displacement of bird taxa of conservation concern	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	

5. Nature of impact:	Impacts on ecological connectivity and ecosystem functioning. Although the area is regarded homogenous in nature, it does contribute towards local ecological functionality in providing in the life requirements for many bird species and bird associations

	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**

Duration	**Long term (4)**	**Long term (4)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (40)**	**Low (24)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	Avoid crossing/spanning of drainage lines or areas of high avifaunal sensitivity	
Cumulative Impacts:	• Habitat loss; • Degradation, fragmentation & isolation of natural habitat	
Residual Impacts:	• Fragmented, isolated portions of natural habitat, sterile landscapes; • Increased anthropogenic pressures on natural resources and reduced species richness relating to loss of specialised species and increased colonisation by unspecialised (generalist) species	
6. Nature of impact:	Increased exploitation of natural resources due to increased human presence and resource requirements	
	Without mitigation	**With mitigation**
Extent	**Local (2)**	**Local (2)**
Duration	**Long term (4)**	**Long term (4)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Probable (3)**	**Probable (3)**
Significance	**Moderate (30)**	**Low (24)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Create public awareness programmes; • Implement biodiversity monitoring protocols; • Demarcate suitable areas for development (mainly on habitat with low sensitivity; • Cluster developments and avoid "spread" of settlements across landscape	
Cumulative Impacts:	Loss of biodiversity on a local scale, continued/ exacerbated displacement of bird species	
Residual Impacts:	• Low bird diversity, and continued displacement of bird species; • Potential colonisation of feral (alien) species resulting in increased competition and localised displacement of native bird species	
7. Nature of impact:	Accelerated patterns in development on a local and regional level implies potential increases in local and regional habitat fragmentation and isolation levels	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Long term (4)**	**Long term (4)**
Magnitude	**Moderate (6)**	**Low (4)**
Probability	**Probable (3)**	**Probable (3)**
Significance	**Moderate (39)**	**Moderate (30)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	• Implement generic mitigation measures; • Consider nodal development regions to avoid uncontrolled spread of developments	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, with particular reference to residential demands and linear infrastructure	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	
8. Nature of impact:	Cumulative impacts on conservation obligations & targets. The conservation status of ecological habitat is regarded Least Concerned and is not part of an Important Bird and Biodiversity Area. The loss of the study area is not expected	

	to result in an escalation of the threat level on a local or regional scale. Habitat loss is however permanent and local development patterns indicate accelerated losses of natural habitat and the displacement of large-bodied terrestrial and birds of prey species

	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Long term (4)**	**Long term (4)**
Magnitude	**Low (4)**	**Minor (2)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	**Moderate (44)**	**Low (24)**
Status (positive or negative)	Negative	
Reversibility	Irreversible	
Irreplaceable loss of resources?	Yes, but only on a local scale	
Can impacts be mitigated?	No	
Mitigation Measures:	• Generic mitigation measures; • Contain and prevention of spread of cumulative impacts; • Consider an Offset Programme/ conservation programme (also with emphasis on large-scale migration/dispersal corridors)	
Cumulative Impacts:	Loss of natural habitat, habitat fragmentation and degradation, loss of bird diversity	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat, sterile landscapes	

9. Nature of impact:	Bird collisions with proposed overhead power lines	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Long term (4)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Definitive (5)**	**Probable (3)**
Significance	***High (*80)**	**Moderate (36)**
Status (positive or negative)	Negative	
Reversibility	Yes	
Irreplaceable loss of resources?	No	
Can impacts be mitigated?	Yes, to some extent	
Mitigation Measures:	1. Avoid spanning of drainage lines and open woodland habitat where a high incidence of large bodied terrestrial birds or birds of prey are evident. 2. Avoid spanning areas in close proximity to pans, dams or artificial watering holes or areas where game tend to congregate, or areas holding large trees that are used for roosting sites. 3. Fit "Double loop flight diverter (BFD) to earth wire at the following (refer **Figure 34**): (a) spanning drainage lines, dams or depressions, (b) when in close proximity (within 100 m of alignment) to dams, depressions or drainage lines, (c) Spanning arable lands, old cultivated land or open woodland. 4. Where possible, re-align alignment away from large drainage line on Gelykebult. 5. Where possible, placement of the power line alongside existing power lines will increase the visibility of the earth wires.	
Cumulative Impacts:	Increased bird mortality and displacement	
Residual Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat	

10. Nature of impact:	Electrocution of large-bodied birds due to the use of inappropriate tower design	
	Without mitigation	**With mitigation**
Extent	**Regional (3)**	**Local (2)**
Duration	**Permanent (5)**	**Permanent (5)**
Magnitude	**High (8)**	**Moderate (6)**
Probability	**Highly probable (4)**	**Probable (3)**
Significance	***High (*64)**	**Moderate (39)**
Status (positive or negative)	Yes	
Reversibility	No	

Irreplaceable loss of resources?	Yes, to some extent
Can impacts be mitigated?	1. For transmission lines (275 kV or more), use cross rope suspension tower (refer **Figure 35**). 2. For distribution lines (<275 kV, use a monopole design that allow for enough clearance between the live conductors (being positioned in an offset manner to each other) to eliminate the risk of electrocution. In addition, perching of large bird species should be discouraged by the addition of diagonal crossbars or by doing away with the crossbars, which holds the conductors in place. Bird "streamers" are also eliminated by fitting the poles with bird guards/spikes above the insulators. However, safe perching is facilitated by the fitment of a horizontal bar on top of the pole structure without the risk of electrocution (due to the perpendicular orientation of the bar relative to the conductors) (refer **Figure 36**). 3. Fit metal bird guards above the insulators of self-supporting towers. 4. The conductors at each tower shall be spaced more than 140 cm apart (this increases to the clearances between the live components). In case spacing of 140 cm is not possible, it is assumed that power lines shall be insulated with thick plastic/metal tubing at least 130 cm in length on both sides of the insulators. This will prevent birds with large wingspans (e.g. Martial eagles, vultures) from "bridging" the gap between the live components when flying off, or attempting to perch on the tower structure, thereby reducing the risk of electrocution. It is also advised to minimise potential bird "streamers" (e.g. when a perching bird is excreting) by discouraging birds from perching directly above the insulators. 5. Re-align alignment away from large drainage lines or areas where roosting is eminent.
Mitigation Measures:	Increased bird mortalities and displacement
Cumulative Impacts:	Increase in habitat fragmentation and isolation, loss of natural habitat, sterile landscapes
Residual Impacts:	Yes

Impact	*Power Station*		*Ashing Facility - Graaffwater*		*Ashing Facility - Appelvlakte*		*Power Lines*	
	Without Mitigation	Without Mitigation	With mitigation	With mitigation	Without Mitigation	With mitigation	Without Mitigation	With mitigation
1. Loss of sensitive/important bird habitat and subsequent displacement/loss of threatened and near threatened bird species	85	75	85	75	75	65	80	39
2. Loss of natural habitat (physical modifications, removal, damage) containing high avifaunal diversity	65	55	65	55	65	55	39	33
3. Loss of azonal, and important habitat types or ecosystems of restricted abundance containing unique bird compositions (on a local scale)	60	39	60	39	52	33	68	39
4. Decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc., also including Impacts on habitat types utilised by threatened or near-threatened bird species	56	33	56	33	56	33	56	30
5. Changes in the community structure due to habitat fragmentation (e.g. roads, loss of	70	55	75	60	70	55	40	24

Impact	*Power Station*		*Ashing Facility - Graaffwater*		*Ashing Facility - Appelvlakte*		*Power Lines*	
	Without Mitigation	Without Mitigation	With mitigation	With mitigation	Without Mitigation	With mitigation	Without Mitigation	With mitigation
closed-canopy woodland) and altered habitat quality								
6. Increased "urban sprawl" and exploitation of natural resources due to increased human presence and resource requirements	42	36	42	36	42	36	30	24
7. Exacerbation of existing levels of habitat fragmentation and isolation	64	56	64	56	64	56	39	30
8. Cumulative impacts on local/ regional and national conservation targets and obligations	52	30	52	30	48	27	44	24
9. Bird collisions with proposed overhead power line	n/a	n/a	n/a	n/a	n/a	n/a	80	36
10. Electrocution of large-bodied birds due to the use of inappropriate tower design	n/a	n/a	n/a	n/a	n/a	n/a	64	39

26.14 Concluding Impact Statement

26.14.1 Power Station (Farms Graaffwater & Goedehoop)

This regional habitat type supports a high richness of bird species. However, it is evident that a number of smaller habitat units (pan depressions and old cultivated land) are also prevalent and provide habitat for bird compositions that are different to the ecological types that dominate the region. From an avifaunal perspective, two dominant broad-scale habitat types are prominent in the area based on the dominant soil texture, which is a major driver of the observed vegetation composition. Apart from the aforementioned habitat types, four important azonal habitat types were also prevalent and scattered across the study area. The study area supports a high diversity of bird species representing approximately 60 % of the regional richness (on a QDS level), but the avifaunal community is not unique and is generally poorly represented by South African endemics.

It is therefore 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. Impacts associated with this development are generally accepted to be severe and permanent, but localised, not extending significantly beyond the boundaries of the site. No impacts of an unacceptable nature on habitat or singular species were recorded for the study area. The application of generic and site-specific mitigation measures are expected to ameliorate impacts to an acceptable significance on a larger scale.

26.14.2 Ashing Facility (Graaffwater vs. Appelvlakte)

Since both options are in close geographic proximity to each other, they tend to share similar broad-scale habitat units and are expected to experience similar impacts. Key considerations that were distilled from the avifaunal assessment include:

» The study area, in general supports a high diversity of bird species representing approximately 60 % of the regional richness (on a QDS level);
» The avifaunal community on the study area is not unique and poorly represented by South African endemics. The dominant composition is widespread in the region although it consists of many near-endemic species with high affinities to the Kalahari-Highveld biome;
» A high diversity of threatened species is expected to be present. Since the majority of these species requires large home range sizes, it could be argued that the frequency of occurrence and wide distribution of these species on the study area and on nearby farms are due to the high similarity of habitat types in the region;
» The study area is expected to support a high richness of apex predators pertaining to the Accipitriform and Falconiform (diurnal birds of prey) groupings, which are indicative of a "healthy" functional system. Twenty-five (25) diurnal birds of prey species are expected to be present. The study area also provides potential breeding habitat for the Intra-African migratory Wahlberg's Eagle (*Hieraaetus wahlbergi*); and
» Depressions and pan features 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 when inundated

Recommendation - The majority of impacts on the avifaunal discipline are therefore expected to be of high to moderate significance, but could be mitigated to moderate levels of significance. However, Graaffwater consists of a higher proportion of sensitive habitat (e.g. habitat with a high and medium-high avifaunal sensitivity) compared to Appelvlakte, which is also anticipated to accommodate a higher density of threatened and near threatened bird taxa. In addition, Appelvlakte has experienced a number of existing impacts and mining infrastructure, effectively compromising the ability of this area to some extent, to harbour ecologically important species and avifaunal assemblages. Therefore, it is the conclusion that the Farm Appelvlakte represents a "more feasible" placement option for the ashing facility.

26.14.3 Power Line

Habitat comprised in the proposed servitude represents typical woodland savanna of the region, albeit largely deteriorated because of existing developments. No particularly sensitive, atypical or unique avifaunal habitat is present within the servitude and the bird communities and assemblages therefore reflect the typical compositional characteristics on a larger scale. No red-flag impacts were identified on these sites, but care is advised to implement site-specific mitigation measures, with particular reference to impacts associated with bird collisions and electrocution due to inappropriate tower design.

26.14.4 Conclusion

It is the conclusion of the author that the loss of habitat associated with the proposed developments is unlikely to represent significant impacts on the bird communities and assemblages of the area on a local or regional scale. While losses of bird species and natural habitat within the development footprints are unavoidable, the use of recommended alternatives and the implementation of proposed mitigation hierarchy will, in all probability, ameliorate unavoidable, potential and likely impacts to an acceptable significance.

26.15 Mitigation

Three steps are of cardinal importance during the planning of infrastructure and activities (e.g. power stations and electricity generation), and should form an integral part of the decision-making process:

1 *Avoidance: avoid or prevent the ecological impact from happening.* Avoidance measures are the first prize during any ecological planning. Examples will include not to proceed with the proposed development at all or to avoid disturbing areas that are considered to be of high sensitivity.

3. *Mitigate: minimize the ecological impact.* Where avoidance is not possible, the impact on the ecological environment should be minimized by a suite of mitigation measures. These are not always practical and not often possible to implement due to the nature of the terrain.

4. *Compensate: provide an equivalent amount of ecological improvement in the region of the impact to balance the impact where it cannot be avoided or mitigated.* Compensation (synonymous to offsets) is a last resort and implies an improvement in the area that is normally larger than the affected or impacted area. In addition, compensation measures should be applied in close proximity to where the proposed impact is likely to occur. Improvement should only happen in areas where similar ecological conditions prevail as to the impacted area (e.g. "a like for like or better" scenario). Typical examples of compensation include: the proclamation of conservation areas larger than the impacted area, the restoration of altered habitat (through proper scientific conduct), the establishment of appropriate corridors and stepping stones to enhance animal movement and the enhancement of habitat that will facilitate the re-colonization of rare and threatened species that used to occur naturally in the impacted area.

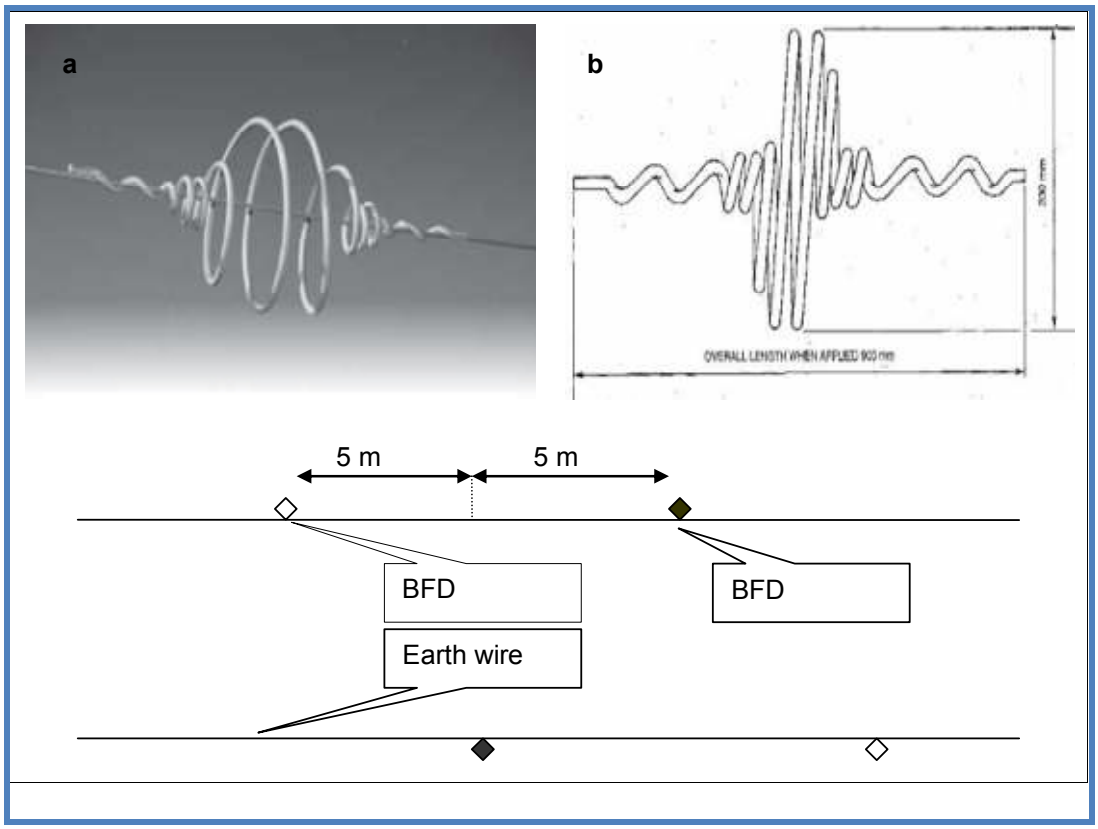


Figure 35: Mitigation design (1) - Double loop flight diverter (BFD)

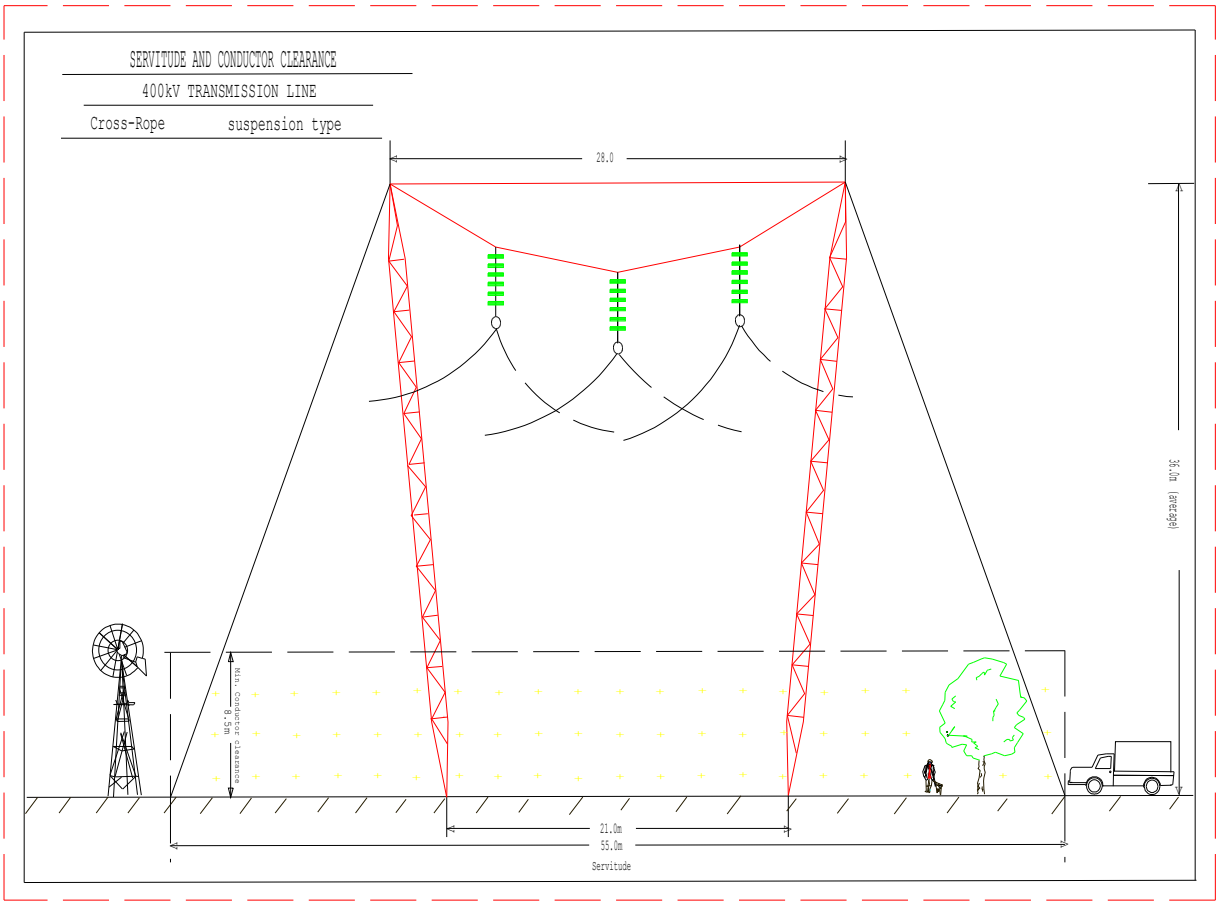


Figure 36: Mitigation design (3) - Cross Rope Suspension Tower

Section E

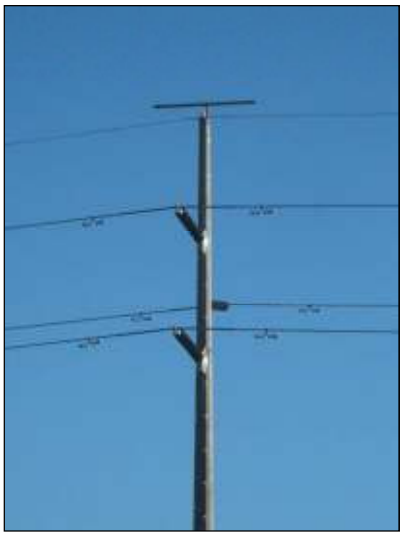


Figure 37: Mitigation design (3) - Fitment of a horizontal bar on top of pole structure

26.16 Avifaunal Management Action Plans

These Action Plans are by no means regarded as comprehensive and should be elaborated and detailed as needed during the various phases of the proposed development.

Loss of habitat associated with conservation important birds and important bird congregations		
Objective:	Ensure the preservation and enhancement of important bird habitat within remaining natural habitat that provide habitat for conservation important species and significant congregations of bird species	
Project Components	Any infrastructure development that will cause loss of natural habitat or deterioration of natural habitat where conservation important birds and bird congregations occur	
Potential Impacts	Loss of habitat associated with conservation important birds and important bird congregations	
Activity/ Risk Source	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective	Ensure the preservation and enhancement of important bird habitat within remaining natural habitat that provide habitat for conservation important species and significant congregations of bird species	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
1. Identify and delineate areas that are suitable for important birds and bird congregations and provide for the preservation and enhancement (management) of these areas	Environmental Team, Environmental Control Officer, Ecologists, Avifaunal specialists	Prior to site preparation activities
2. Ensure all activities that result in destruction of natural habitat are contained within the authorized footprint and do not spread beyond the boundaries of the site		Site preparation, Construction Phase
3. Identify habitat that can be retained within the development footprint in order to aid with preservation of diversity		Prior to site preparation activities
4. Identify individuals that would be suitable for rescue and relocation purposes to aid with landscaping and conservation		Prior to site preparation activities
Performance Indicator	Retain avifaunal diversity in remaining areas of natural habitat directly adjacent to development footprint, with specific reference to conservation important species	
	High avifaunal diversity, presence of diverse bird congregations	

Monitoring	Annual diversity assessments, presence/ absence monitoring	
Direct impacts on birds of conservation importance		
Objective:	Limit/ manage impacts on bird species of conservation importance	
Project Components	Any infrastructure development that will cause loss of natural habitat where conservation important species are likely to occur or activities that could cause the disturbance of populations or individuals of these species	
Potential Impacts	Loss of habitat suitable for populations of conservation important species or direct impacts and losses of populations or individuals of these species	
Activity/ Risk Source	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective	Limit the impact on conservation important birds, prevent impacts on birds in remaining areas of natural habitat	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
1. Compile a list of conservation important birds that are known to occur in the region	Construction Contractors, Environmental Team, Environmental Control Officer	Prior to site preparation activities
2. Implement awareness programmes for all contractors and workers on site		Site preparation, Construction Phase
3. Compile Standard Operational Procedures to deal with these birds, should they be threatened by construction/ operational activities and/or identification/marking and barricading of active nesting and roosting sites of iconic/charismatic bird species (e.g. raptors) storks or bustards when encountered		Prior to site preparation activities
4. Adapt operational activities to prevent direct impacts on these birds, including personnel presence in areas of natural habitat and vehicular movements/ speeds		Prior to site preparation activities
Performance Indicator	No significant loss of conservation important bird breeding/roosting sites (e.g. successful breeding and rearing of fledglings during breeding activities) as a result of construction or operational activities	
	The persistence of individuals and populations of protected or conservation important animals and birds in natural habitat surrounding the development	
Monitoring	Yearly monitoring of presence/ abundance of conservation important birds as part of bio monitoring programme	
Facilitating effective management of potential direct impacts on the avifaunal component of development areas		
Objective:	Facilitate effective displacement of birds from the development site, prevent continuous impacts on birds surrounding the development	
Project Components	All activities that will result in decimation of natural habitat occupied by animal species, activities that are likely to result in deaths of animals, activities that might attract animals to development/ construction sites	
Potential Impacts	Uncontrolled/ accidental death or displacement of birds that occupy natural habitat within the development site or temporarily occupy parts of the site/ infrastructures	
Activity/ Risk Source	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective	Limit the direct impacts on birds occupying natural habitat where development will take place, limit the presence/ occurrence of birds within construction/ operational areas, effect removal and relocation to suitable areas	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
1. Compile a list of conservation important animals and birds that are known to occur in the region	ECO, appointed specialist	Prior to site preparation activities

2. Compile and implement a capture and relocation programme prior to construction phase and/ or implement buffer areas to active nesting and roosting sites of storks, birds of prey (including vultures) and bustards		Prior to site preparation activities
3. Compile Standard Operating Procedures for the capture and relocation of animals during the construction phase and the implementation of buffer areas to ensure the preservation of active roosting and breeding sites of birds of prey/storks/bustards		Site preparation, construction and operational phases
Performance Indicator	No significant losses of bird diversity in areas surrounding the development footprint, successful relocation and release of animals captured on site and successful breeding and rearing of fledgling during breeding activities)	
	Continued presence of a high diversity of birds in immediate surrounds	
Monitoring	Development and implementation of bio monitoring programme	
Mitigating human – animal conflict situations		
Objective:	Minimize human-animal conflict situations	
Project Components	The presence of personnel within a development area that is occasionally occupied by opportunistic species, the presence of personnel remaining areas of natural habitat occupied by bird species, particularly ground dwelling species	
Potential Impacts	Uncontrolled/ accidental death of birds caused by uninformed and/or deliberate actions of personnel	
Activity/ Risk Source	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective	Limit adverse human-animal conflict opportunities, promote high awareness of personnel with accurate and constructive information	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**
1. Identify target species likely to result in conflict situations	ECO, appointed specialist	Prior to site preparation activities
2. Compile Standard Operating Procedures for the effective displacement and discouragement of birds during the construction phase		Prior to site preparation activities
3. Compile and implement awareness programmes to prevent accidental and/ uninformed killing of animals, with particular reference to snaring, traditional beliefs, capturing, introduction of pets, etc.		Site preparation, construction and operational phases
Performance Indicator	No significant losses of birds, successful displacement and discouragement of birds on site	
	Absence of snares from site fences and trapping of animals	
	Continued presence of a high diversity of birds in immediate surrounds	
Monitoring	Development and implementation of bio monitoring programme	
Minimize bird mortalities associated with power lines		
Objective:	Minimize bird mortalities caused by collision/electrocution by power line/electrical infrastructure	
Project Components	Power line infrastructure development that will cause potential bird mortalities	
Potential Impacts	Bird collision by earth wires and overhead cabling infrastructure and electrocution caused by bird strikes and streamers	
Activity/ Risk Source	Site preparation, construction activities, operational activities	
Mitigation: Target/ Objective	Minimize the impact on passing bird species prevent and mortalities to threatened and near threatened bird species	
Mitigation: Action/ Control	**Responsibility**	**Timeframe**

1. Ensure that a walkthrough of the proposed power line alignment conducted prior to commencement of activities in order to identify areas of high mortality/ electrocution risk	Environmental Control Officer, appointed specialist	Prior to site preparation activities
2. Ensure all activities that result in destruction of natural habitat are contained within the authorized footprint and do not spread beyond the boundaries of the site		Site preparation, Construction Phase
3. Identify areas along power line alignment in need of marking with BFD and/or re-alignment		Prior to site preparation activities
Performance Indicator	No evidence of bird mortalities	
	The presence of foraging/roosting and breeding threatened and near threatened bird species on the study site	
Monitoring	Regular (twice per year) monitoring of entire alignment for dead birds or evidence of bird mortalities	

27 APPENDIX 1 – RECORDED PHYTODIVERSITY OF THE SITE

Species Name	***Common Name***	***Family***	***Growth Form***	***Status/ Uses***
Abutilon species	--	Malvaceae	Forb	None
Acacia (Senegalia) burkei Benth.	Black monkey thorn (e), Swartapiesdoring (a)	Fabaceae	Tree	Medicinal uses
Acacia (Vachellia) erioloba	**Camel Thorn (e), Kameeldoring (a)**	**Fabaceae**	**Tree**	**Declining Status, Protected Tree (National Forest Act, 1998), edible parts, medicinal uses, firewood**
Acacia (Senegalia) erubescens Welw. ex Oliv.	Blue thorn (e), Blouhaak (a)	Fabaceae	Tree	Edible parts (gum)
Acacia (Vachellia) grandicornuta Gerstner	Horned thorn (e), Horingdoring (a)	Fabaceae	Tree	None
Acacia (Vachellia) karroo Hayne	Sweet Thorn (e), Soetdoring (a)	Fabaceae	Tree	Edible parts, dyes and tans, medicinal uses, firewood
Acacia (Vachellia) luederitzii	False umbrella thorn (e), Basterhaak-en-steek (a)	Fabaceae	Small tree	None
Acacia (Senegalia) mellifera	Black Thorn (e), Swarthaak (a)	Fabaceae	Small tree	Declared indicator of encroachment, medicinal uses, poison source
Acacia (Senegalia) nigrescens Oliv.	Knob thorn (e), Knoppiesdoring (a)	Fabaceae	Tree	Tannin rich bark
Acacia (Vachellia) nilotica	Scented thorn (e), Lekkerruikpeul (a)	Fabaceae	Tree	Dyes and tans
Acacia (Vachellia) robusta Burch. subsp. *robusta*	Broadpod robust thorn (e), Enkeldoring (a)	Fabaceae	Tree	None
Acacia (Senegalia) senegal var. *leiorachis*	Slender three-hook thorn (e), Slaploot (a)	Fabaceae	Tree	Traditional use of the gum, commercially exploited
Acacia (Vachellia) tortilis	Umbrella thorn (e), Hak-en-steek (a)	Fabaceae	Tree	Medicinal uses (bark)
Acanthopsis disperma	--	Acanthaceae	Forb	None
Acanthosicyos naudinianus	Gemsbok cucumber (e), Gemsbok komkommer (a)	Cucurbitaceae	Prostrate herb	Edible parts
Achyranthes aspera	Burrweed (e), Grootklitsbossie (a)	Amaranthaceae	Forb	Naturalised exotic
Albuca seineri (Engl. & K.Krause) J.C.Manning & Goldblatt	--	Hyacinthaceae	Geophyte	Indicator of overgrazing
Alternanthera pungens Humb.	Khaki Weed (e), Dubbeltjie (a)	Amaranthaceae	Prostrate herb	Weed, pioneer species
***Ammocharis coranica* (Ker Gawl.) Herb.**	**Sore eye lily (e), Seeroogblom (a)**	**Amaryllidaceae**	**Geophyte**	**Protected Plant, Schedule 11 (LEMA), poisonous alkaloids, medicinal uses**
Aptosimum species	--	Scrophulariaceae	Dwarf shrub	None
Aristida adscensionis L.	Annual Three-awn (e) Eenjarige Steekgras (a)	Poaceae	Grass	Poor grazing potential, Increaser IIC
Aristida canescens	Pale Three-awn (e), Vaalsteekgras (a)	Poaceae	Grass	Unpalatable, Increaser II
Aristida congesta subsp. *barbicollis*	Spreading Three-awn (e), Lossteekgras (a)	Poaceae	Grass	Poor grazing potential, Increaser IIC
Aristida congesta subsp. *congesta*	Tassel Three-awn (e), Katstertsteekgras (a)	Poaceae	Grass	Poor grazing potential, indicator of poor habitat, Increaser IIC
Aristida meridionalis Henrard	Giant three-awn (e), Langbeensteekgras (a)	Poaceae	Grass	Unpalatable, Increaser IIB
Aristida species	--	Poaceae	Grass	None
Aristida stipitata	Long-awned Three-awn (e), Langnaaldsteekgras (a)	Poaceae	Grass	Poor grazing potential, indicator of poor habitat, Increaser IIC

Species Name	Common Name	Family	Growth Form	Status/ Uses
Arundinella nepalensis Trin.	River grass (e), Riviergras (a)	Poaceae	Grass	Indicator of wet conditions, medicinal properties (Lesotho), palatable
Asparagus species	Wild Asparagus (e), Katbos (a)	Liliaceae	Shrub	None
Asparagus suaveolens Burch.	Bushveld Asparagus (e), Gewonekatbos (a)	Liliaceae	Shrub	None
Asparagus virgatus Baker	Katstert (a)	Liliaceae	Shrub	None
Barleria holubii C.B.Clarke	Small-leaved Barleria (e)	Acanthaceae	Dwarf shrub	None
Barleria lancifolia T.Anderson	Butterfly barleria (e), Skoenlapper-barleria (a)	Acanthaceae	Dwarf shrub	None
Bauhinia petersiana	Coffee neat's foot (e), Koffiebeesklou (a)	Fabaceae	Shrub	Medicinal uses, edible parts, substitute for coffee
Bidens pilosa L.	Black-jack (e), Knapsekêrel (a)	Asteraceae	Forb	Naturalised exotic, edible parts, Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)
Blepharis subvolubilis	Eyelash flower (e)	Acanthaceae	Dwarf shrub	None
Boscia albitrunca	**Sheperd's Tree (e), Witgat (a)**	**Capparaceae**	**Small tree**	**Protected Tree (National Forest Act, 1998)**
Boscia foetida	Stink Bush (e), Stinkwitgat (a)	Capparaceae	Small tree	Medicinal uses, browsing value
Bothriochloa bladhii (Retz.) S.T.Blake	Purple plume grass (e), Persklossiegras (a)	Poaceae	Grass	Strongly aromatic, generally avoided by grazers, contains essential oils
Bothriochloa insculpta (A.Rich.) A.Camus	Pinhole Grass (e), Stippelgras (a)	Poaceae	Grass	None
Bulbine narcissifolia	Wild Kopieva (e), Wildekopieva (a)	Liliaceae	Succulent	Medicinal uses
Bulbostylis hispidula (Vahl) R.W.Haines subsp. *pyriformis* (Lye) R.W.Haines	--	Cyperaceae	Sedge	None
Burkea africana Hook.	Wild seringa (e), Wildesering (a)	Caesalpiniaceae	Tree	Medicinal properties, edible worms feeding on the bark
Cadaba aphylla (Thunb.) Wild	Desert Spray (e), Bobbejaanarm (a)	Capparaceae	Shrub	Medicinal properties, potentially poisonous
Carex cernua Boott. var. *austro-africana* Kuekenth.	--	Cyperaceae	Sedge	None
Carissa bispinosa	Forest num-num (e), Bosnoemnoem (a)	Apocynaceae	Shrub	Edible parts, medicinal uses
Cenchrus ciliaris L.	Blue Buffalo Grass (e), Bloubuffelgras (a)	Poaceae	Grass	Palatable grazing species, Decreaser
Ceratotheca triloba (Bernh.) Hook.f.	Wild Foxglove (e), Vingerhoedblom (a)	Pedaliaceae	Forb	Medicinal properties
Cereus jamacuru (L.) Mill.	Queen of the night (e), Nagblom (a)	Cactaceae	Succulent	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)
Chamaecrista comosa	--	Caesalpiniaceae	Forb	None
Chascanum pinnatifidum var. *pinnatifidum*	Dainty trumpets (e)	Verbenaceae	Forb	Traditional medicinal uses
Chloris virgata Sw.	Feather-top Chloris (e), Witpluim-chloris (a)	Poaceae	Grass	None
Cleome angustifolia	Yellow mouse-whiskers (e), Peultjiesbos	Capparaceae	Forb	None
Cleome gynandra	African Cabbage (e), Oorpeultjie (a)	Capparaceae	Forb	Edible parts
Combretum apiculatum	Red bushwillow (e), Rooibos (a)	Combretaceae	Tree	Edible parts, firewood

Species Name	*Common Name*	*Family*	*Growth Form*	*Status/ Uses*
Combretum hereroense Schinz	Russet bushwillow (e), Kierieklapper (a)	Combretaceae	Small tree	Firewood
***Combretum imberbe* Wawra**	**Leadwood (e), Hardekool (a)**	**Combretaceae**	**Tree**	**Protected Tree (National Forest Act, 1998), firewood, medicinal uses**
Combretum molle R.Br. ex G.Don	Velvet bushwillow (e), Fluweelboswilg (a)	Combretaceae	Tree	Medicinal properties, traditional uses
Combretum zeyheri Sond.	Large-fruited bushwillow (e), Raasblaar (a)	Combretaceae	Tree	Edible parts, timber, weaving, medicinal uses
Commelina africana	Yellow Wandering Jew (e), Geeleendagsblom (a)	Commelinaceae	Forb	Medicinal properties
Commelina erecta L.	--	Commelinaceae	Forb	None
Commelina species	--	Commelinaceae	Forb	None
Commiphora africana (A.Rich.) Engl.	Hairy corkwood (e), Harige kanniedood (a)	Burseraceae	Small tree	Water source, medicinal uses
Commiphora pyracanthoides Engl.	Common corkwood (e), Gewone kanniedood (a)	Burseraceae	Small tree	Edible parts, traditional uses
Corchorus asplenifolius Burch.	Gusha (e), Geel varingblaartjie (a)	Tiliaceae	Forb	Traditional and medicinal uses, edible parts
***Crinum* species**	**Crinum (e), Crinum (a)**	**Amaryllidaceae**	**Geophyte**	**Protected Plant, Schedule 11 (Mpumalanga Nature Conservation Act 10 of 1998)**
Crotalaria sphaerocarpa Perr. Ex DC. subsp. *sphaerocarpa*	Mealie Crotalaria (e), Mielie-crotalaria	Fabaceae	Dwarf shrub	Sometimes a weed of cultivation
Cynodon dactylon (L.) Pers.	Common Couch Grass (e), Gewone kweekgras (a)	Poaceae	Grass	Indicator of disturbed areas, grazing potential
Cyperus esculentus	Yellow nutsedge (e), Geeluintjie (a)	Cyperaceae	Sedge	Weed, edible parts (tuber)
Cyperus obtusiflorus	White-flowered sedge (e), Geelbiesie (a)	Cyperaceae	Sedge	None
Cyperus species	--	Cyperaceae	Sedge	None
Cyperus species *1*	--	Cyperaceae	Sedge	None
Dactyloctenium giganteum Fisher & Schweick.	Giant Crowfoot (e), Reuse Hoenderspoor (a)	Poaceae	Grass	Palatable grazing
Dichanthium annulatum	Vlei Finger Grass (e), Vleivingergras (a)	Poaceae	Grass	Poor grazing value
Dicerocaryum eriocarpum (Decne.) Abels	Devil's Thorn (e), Elandsdoring (a)	Pedaliaceae	Prostrate herb	Medicinal uses, traditional uses
Dichrostachys cinerea	Sicklebush (e), Sekelbos (a)	Fabaceae	Small tree	Invader, medicinal properties, traditional uses, firewood, weaving
Dicoma capensis	Koorsbossie (a)	Asteraceae	Dwarf shrub	Medicinal uses
Dicoma species	--	Asteraceae	Dwarf shrub	None
Digitaria eriantha Steud.	Finger grass (e), Finger gras (a)	Poaceae	Grass	Weaving, palatable grazing grass, Decreaser
Dipcadi species	--	Liliaceae	Geophyte	None
Dodonaea angustifolia L.f.	Sand olive (e), Sandolien a)	Sapindaceae	Shrub	Medicinal properties
Echinochloa holubii (Stapf) Stapf	Holubic's panic grass (e), Watergras (a)	Poaceae	Grass	Indicator of moist conditions, moderately palatable
Ehretia rigida (Thunb.) Druce	Puzzle Bush (e), Deurmekaarbos (a)	Ehretiaceae	Small tree	None
***Elaeodendron transvaalensis* (Burtt Davy) Codd**	**Bushveld Saffron (e), Bosveld-saffraan (a)**	**Celastraceae**	**Tree**	**Near Threatened status, traditional and medicinal uses**
Elephantorrhiza obliqua var. *glabra*	Glabrous elephant's foot (e), Haarlose leebossie (a)	Fabaceae	Dwarf shrub	None
Enneapogon cenchroides (Roem. &	Nine-awned gras (e), Negenaaldgras (a)	Poaceae	Grass	Useful pioneer grass, moderately palatable

Species Name	Common Name	Family	Growth Form	Status/ Uses
Schult.) C.E.Hubb.				
Enteropogon macrostachyus (A.Rich.) Benth.	Hare grass (e), Haasgras (a)	Poaceae	Grass	Low grazing value, sometimes used in flower arrangements
Eragrostis curvula (Schrad.) Nees	Weeping love grass (e), Oulandsgras (a)	Poaceae	Grass	Edible parts, indicator of degraded areas
Eragrostis lehmanniana	Lehmanns' Love Grass (e), Knietjiesgras (a)	Poaceae	Grass	Weaving
Eragrostis pallens Hack.	Broom Love Grass (e), Besemgras (a)	Poaceae	Grass	Thatching & weaving
Eragrostis rigidior Pilg.	Broad curly leaf (e), Breë Krulblaar (a)	Poaceae	Grass	None
Eragrostis rotifer Rendle	Pearly love grass (e), Vleipluimgras (a)	Poaceae	Grass	Average palatability, important during winter in arid areas
Eragrostis species	--	Poaceae	Grass	None
Eriospermum species	--	Liliaceae	Geophyte	None
Euclea natalensis A.DC. subsp. *angustifolia* F.White	Bushveld hairy guarri (e), Bosveld harige guarrie (a)	Ebenaceae	Shrub	Traditional and medicinal uses, edible parts
Euclea undulata	Common Guarri (e), Gewone ghwarrie (a)	Ebenaceae	Small tree	Firewood
Euphorbia species	--	Euphorbiaceae	Succulent	None
Evolvulus alsinoides	Blue Haze (e)	Convolvulaceae	Forb	None
Flaveria bidentis (L.) Kuntze	Smelter's bush, Smelterbossie (a)	Asteraceae	Forb	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)
Gardenia volkensii	Savanna gardenia (e), Bosveldkatjiepiering (a)	Rubiaceae	Tree	Medicinal uses, carving, traditional uses
Geigeria burkei	Vermeerbos (a)	Asteraceae	Dwarf shrub	None
Gisekia africana var. *africana*	Rooi-rankopslag (a), Volstruisdruiwe (a)	Gisekiaceae	Prostrate herb	None
Gomphocarpus fruticosus (L.) Aiton f.	Milkweed (e), Melkbos (a)	Apocynaceae	Shrub	Medicinal uses
Gomphrena celosioides Mart.	Bachelor's button (e), Mierbossie (a)	Amaranthaceae	Prostrate herb	Weed, South America
Gossypium herbaceum subsp. *africanum*	Wild cotton (e), Wilde katoen (a)	Malvaceae	Forb	Traditional uses
Grewia bicolor Juss.	White Raisin (e), Witrosyntjie (a)	Tiliaceae	Shrub	Medicinal uses, edible parts
Grewia flava DC.	Velvet Raisin (e), Fluweelrosyntjiebos (a)	Tiliaceae	Shrub	Edible parts, weaving, traditional uses, declared indicator of encroachment
Grewia flavescens	Bushman Raisin (e), Kruisbessie (a)	Tiliaceae	Shrub	Edible parts, beer brewing
Grewia hexamita Burret	Giant donkeyberry (e), Reuserosyntjie (a)	Tiliaceae	Shrub	Edible parts
Grewia monticola Soind.	Silver raisin (e), Vaal rosyntjiebos (a)	Tiliaceae	Shrub	Edible parts, traditional uses, important browsing
Grewia occidentalis L.	Cross Berry (e), Kruisbessie (a)	Tiliaceae	Shrub	Medicinal uses, larval host for *Eagris nottoana, Netrobalane canopus*
Gymnosporia buxifolia	Common spike-thorn (e), Gewone pendoring (a)	Celastraceae	Small tree	Traditional uses
Gymnosporia senegalensis (Lam.) Exell	Red spike-thorn (e), Rooipendoring (a)	Celastraceae	Shrub	None
Harpagophytum zeyheri Decne. subsp. *zeyheri*	--	Pedaliaceae	Prostrate herb	None
Heliotropium ciliatum Kaplan	Vergeet-my-nietjie (a)	Boraginaceae	Forb	None
Hermannia species	--	Malvaceae	Dwarf shrub	None

Species Name	Common Name	Family	Growth Form	Status/ Uses
Hermannia tomentosa	Lusernbos (a)	Malvaceae	Dwarf shrub	None
Hermbstaedtia odorata	Rooiaarkatstert (a)	Amaranthaceae	Forb	None
Heteropogon contortus (L.) Roem. & Schult.	Spear grass (e), Assegaaigras (a)	Poaceae	Grass	Moderate grazing potential, irritant
Hibiscus engleri K.Schum.	Wild hibiscus (e), Wilde hibiskus (a)	Malvaceae	Forb	None
Hibiscus micranthus L.f.	--	Malvaceae	Forb	None
Hibiscus trionum L.	Bladderweed (e), Terblansbossie (a)	Malvaceae	Forb	None
Hilliardiella staehelinoides Harv.	Blouteebossie (a)	Asteraceae	Forb	None
Hirpicium bechuanense (S.Moore) Roessler	Botswana Marygold (e), Botswana-gousblom (a)	Asteraceae	Forb	Potentially poisonous
Indigofera daleoides	--	Fabaceae	Forb	None
Indigofera flavicans Baker	--	Fabaceae	Prostrate herb	None
Indigofera species	--	Fabaceae	Forb	None
Ipomoea magnusiana	Small Pink Ipomoea (e)	Convolvulaceae	Prostrate herb	None
Ipomoea obscura	Wild Petunia (e), Wildepatat (a)	Convolvulaceae	Prostrate herb	None
Ipomoea species	--	Convolvulaceae	Prostrate herb	None
Jatropha species	--	Euphorbiaceae	Forb	None
Justicia flava (Vahl) Vahl	--	Acanthaceae	Forb	None
Kalanchoe paniculata Harv.	Large Orange Kalanchoe (e), Hasieoor (a), Krimpsiektebossie (a)	Crassulaceae	Succulent	None
Kyphocarpa angustifolia (Moq.) Lopr.	Silky Burweed (e)	Amaranthaceae	Forb	None
Lantana rugosa Thunb.	Bird's Brandy (e), Voëlbrandewyn (a)	Verbenaceae	Dwarf shrub	None
Ledebouria species	--	Liliaceae	Geophyte	None
Leucas sexdentata	Bushveld Tumbleweed (e), Bosveld-waaibossie (a)	Lamiaceae	Forb	None
Limeum fenestratum	Lintblommetjie (a)	Aizoaceae	Forb	None
Litogyne gariepina	Dwarf Sage (e), Blougifbossie (a)	Asteraceae	Forb	Traditional uses
Lycium bosciifolium	Slapkriedoring (a)	Solanaceae	Shrub	None
Lycium cinereum	Kriedoring (a), Slangbessie (a)	Solanaceae	Shrub	Traditional uses
Marsdenia sylvestris (Retz.) P.I.Forst.	Miracle fruit (e)	Apocynaceae	Climber	None
Megaloprotrachne albecens	Kalahari Digitaria (e), Kalaharie Digitaria (a)	Poaceae	Grass	Kalahari Endemic
Melhania acuminata Mast. var. *acuminata*	Bushy honeycup (e)	Malvaceae	Forb	None
*Melinis repens (*Willd.) Zizka subp. *repens*	Natal Red Top (e), Natal-rooipluim (a)	Poaceae	Grass	Pioneer grass, relatively palatable, Increaser IIC
Melolobium species	--	Fabaceae	Dwarf shrub	None
Momordica balsamina L.	Balsam Pear (e), Laloentjie (a), Balsam Peer (a)	Cucurbitaceae	Climber	Edible parts, medicinal uses
Monechma divaricatum (Nees) C.B.Clarke	Wild lucern (e), Wilde Lusern (a)	Acanthaceae	Dwarf shrub	None
Neorautanenia mitis (A.Rich.) Verdc.	Gemsbokboontjie (a)	Fabaceae	Shrub	Potentially poisonous parts

Species Name	Common Name	Family	Growth Form	Status/ Uses
Ochna pulchra Hook.	Peeling plane (e), Lekkerbreek (a)	Ochnaceae	Tree	Traditional uses
Ocimum americanum	Wild Basil (e)	Lamiaceae	Dwarf shrub	none
Oldenlandia herbacea	False Spurry (e)	Rubiaceae	Forb	None
Opuntia stricta Haw.	Pest pear of Australia (e)	Cactaceae	Succulent	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Invader Species, Schedule 13 (Mpumalanga Nature Conservation Act 10 of 1998)
Oxygonum dregeanum	--	Polygonaceae	Dwarf shrub	None
Panicum maximum Jacq.	Buffalo Grass (e), Gewone Buffelsgras (a)	Poaceae	Grass	None
Panicum volutans	Tumble Grass (e), Rolgras (a)	Poaceae	Grass	None
Peltophorum africanum Sond.	Weeping wattle (e), Huilboom (a)	Caesalpiniaceae	Tree	Medicinal properties
Pentarrhinum insipidum E.Mey.	African Heartvine (e), Donkieperske (a)	Apocynaceae	Climber	Edible parts, Non endemic
Pergularia daemia	Bobbejaankambro (a), Kgaba	Apocynaceae	Climber	Medicinal uses
Perotis patens Gand.	Cat's Tail (e), Katstertgras (a)	Poaceae	Grass	Indicator of poor management, Decreaser IIC
Phyllanthus species	--	Euphorbiaceae	Shrub	None
Pogonarthria squarrosa (Roem. & Schult.) Pilg.	Herringbone Grass (e), Sekelgras (a)	Poaceae	Grass	Unpalatable, indicator of poor habitat conditions
Pollichia campestris Aiton	Waxberry (e), Teesuiker (a)	Illebracaceae	Dwarf shrub	Edible parts
Pomaria burchellii (DC.) B.B.Simpson & G.P.Lewis subsp. *burchellii*	--	Fabaceae	Prostrate herb	None
Portulaca kermesina N.E.Br.	Vygiebossie (a), Haaskos (a)	Portulacaceae	Succulent	None
Portulaca oleracea L.	Purslane (e), Varkkos (a)	Portulacaceae	Succulent	Edible parts
Pterocarpus rotundifolius (Sond.) Druce subsp. *rotundifolius*	Round-leaved bloodwood (e), Dopperkiaat (a)	Fabaceae	Small tree	Traditional uses, larval food for *Charaxes achaemenes achaemenes* and *Absantis venosa*
Pupalia lappacea	Burweed (e), Beesklits (a)	Amaranthaceae	Forb	Non endemic
Pycreus species	--	Cyperaceae	Sedge	None
Raphionacme species	--	Periplocaceae	Forb	None
Requienia sphaerosperma	--	Fabaceae	Forb	None
Rhigozum brevispinosum	Short-thorn pomegranate (e), Kortdoringgranaat (a)	Bignoniaceae	Shrub	None
Rhynchosia adenodes Eckl. & Zeyh.	--	Fabaceae	Prostrate herb	None
Rhynchosia species	--	Fabaceae	Prostrate herb	None
Rhynchosia totta	Yellow Carpet Bean (e)	Fabaceae	Forb	Edible parts
Ruellia patula Jacq.	White veld violet (e), Wit veldviooltjie (a)	Acanthaceae	Forb	None
Sansevieria aethiopica Thunb.	Bowstring hemp (e), Skoonma-se-tong (a)	Liliaceae	Geophyte	Medicinal properties, weaving, garden plants
Sarcostemma viminale (L.) R.Br.	Viny milkweed (e), Melktou (a)	Apocynaceae	Climber	Medicinal uses, potentially poisonous
Schkuhria pinnata (Lam.) Cabrera	Dwarf Marigold (e), Bitterbossie (a)	Asteraceae	Forb	Medicinal uses, weed (S. America)
Schmidtia pappophoroides Steud.	Sand Quick (e), Sandkweek (a)	Poaceae	Grass	Palatable grazing grass, Increaser

Species Name	Common Name	Family	Growth Form	Status/ Uses
Sclerocarya birrea (A.Rich.) Hochst. subsp. _caffra_ (Sond.) Kokwaro	**Marula (e), Maroela (a)**	**Anacardiaceae**	**Tree**	**Protected Tree (National Forest Act, 1998), edible parts, traditional uses**
Searsia lancea L.f.	Common Karree (e), Gewone Karree (a)	Anacardiaceae	Tree	Edible parts, tanning
Searsia tenuinervis	Kalahari Currant (e), Kalahari-taaibos (a)	Anacardiaceae	Shrub	Dyes & tanning
Securidaca longepedunculata var. longepedunculata	Violet tree (e), Krinkhout (a)	Polygalaceae	Tree	Medicinal uses, poisonous parts
Sericorema remotiflora (Hook.f.) Lopr.	Kwasbossie (a), Wolhaarbossie (a)	Amaranthaceae	Dwarf shrub	None
Setaria verticillata (L.) P.Beauv.	Bur Britle Grass (e), Klitsgras (a)	Poaceae	Grass	Edible parts, palatable grazing
Sida cordifolia L.	Flannel Weed (e), Hartblaartaaiman / Verdompsterk (a)	Malvaceae	Forb	None
Solanum elaeagnifolium Cav.	Silver-leaf bitter apple (e)	Solanaceae	Dwarf shrub	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)
Solanum lichtensteinii	Bitter apple (e), Bitter appel (a)	Solanaceae	Dwarf shrub	None
Solanum species	Tamato (e), Tamatie (a)	Solanaceae	Dwarf shrub	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014) (see act for details)
Sphenostylis angustifolia Sond.	Wild sweetpea (e), Wilde-ertjie (a)	Fabaceae	Prostrate herb	None
Spirostachys africana Sond.	**Tamboti (e), Tambotie (a)**	**Euphorbiaceae**	**Tree**	**Protected Plant, Schedule 11 (LEMA), timber, traditional uses, potentially poisonous**
Sporobolus ioclados (Trin.) Nees	Pan Dropseed (e), Panfynsaadgras (a)	Poaceae	Grass	Decreaser
Sporobolus nitens Stent	Curly-leaved dropseed (e), Krulblaar-fynsaadgras (a)	Poaceae	Grass	Useful for protection against erosion, low grazing potential
Stipagrostis ciliata	Tall Bushman Grass (e), Langbeenboesmangras (a)	Poaceae	Grass	Palatable grazing, Decreaser
Strychnos madagascariensis Poir.	Black monkey orange (e), Swartklapper (a)	Loganiaceae	Tree	Edible parts
Stylosanthes fruticosa (Retz.) Alston	Wild lucerne (e)	Fabaceae	Forb	None
Talinum crispalatum	Wildevygie (a)	Portulacaceae	Succulent	Edible parts, medicinal uses
Tapinanthus oleifolius	Mistletoe (e), Voëlent (a), Vuurhoutjies (a)	Loranthaceae	Parasite	None
Tapiphyllum parvifolium (Sond.) Robyns	Wild medlar (e), Mispel (a)	Rubiaceae	Small tree	Edible fruit
Tarchonanthus camphoratus L.	Wild Camphor Bush (e), Vaalbos (a)	Asteraceae	Shrub	Medicinal uses
Tephrosia lupinifolia	Vingerblaar-ertjie (a)	Fabaceae	Forb	None
Tephrosia species	--	Fabaceae	Forb	None
Terminalia sericea Burch. ex DC.	Silver cluster-leaf (e), Vaalboom (a)	Combretaceae	Tree	Medicinal properties, timber
Tragia dioica Sond.	--	Euphorbiaceae	Forb	None
Tragus racemosus	Large Carrot-seed grass (e), Grootwortelsaadgras (a)	Poaceae	Grass	Low grazing potential, Decreaser IIC
Tribulus terrestris L.	Common Dubbeltjie (e), Gewone Dubbeltjie (a)	Zygophyllaceae	Prostrate herb	Medicinal uses
Tricholaena monachne (Trin.) Stapf & C.E.Hubb.	Blue-seed grass (e), Blousaadgras	Poaceae	Grass	Moderate grazing potential, Increaser IIC
Tylosema fassoglense (Schweinf.) Torre & Hillc.	Creeping Bauhinia (e), Gemsbokboontjie (a)	Caesalpiniaceae	Prostrate herb	Medicinal uses, traditional uses

Species Name	***Common Name***	***Family***	***Growth Form***	***Status/ Uses***
Urochloa mosambicensis (Hack.) Dandy	Bushveld signal grass (e), Bosveldbeesgras (a)	Poaceae	Grass	Edible parts, palatable grazing grass
Vahlia capensis (L.f.) Thunb. subsp. *vulgaris* Bridson var. *vulgaris*	Toiingbossie (a)	Vulgariaceae	Forb	None
Waltheria indica L.	Meidebossie (a)	Sterculiaceae	Forb	None
Xenostegia tridentata	Miniature Morning Glory (e), Frankhout (a)	Convolvulaceae	Prostrate herb	Medicinal uses
Ximenia caffra	Sourplum (e), Suurpruim (a)	Olacaceae	Small tree	Edible parts
Ziziphus mucronata	Buffalo-thorn (e), Blinkblaar-wag-'n-bietjie (a)	Rhamnaceae	Small tree	Edible parts, medicinal uses
Zornia linearis E.Mey.	Narrow-leaved Catterpillar Bean (e)	Fabaceae	Prostrate herb	None

28 APPENDIX 2 – AVIFAUNAL DIVERSITY OF THE SITE

A list of bird species expected to occur on the study area (including those observed during the surveys). # refers to IOC numbers. Scientific names were used according to Gill & Donsker (2016) and colloquial names were used according to Hockey et al. (2005). The classification follows that of Hackett et al. (2008). Also provided are the global, regional and provincial conservation status of each species (IUCN, 2016; NEMBA, 2014; LEMA, 2003; Taylor et al., 2015). CR - Critically Endangered, EN - Endangered, VU - Vulnerable, NT - Near threatened, PROT - protected, SP PROT - specially protected and GAME - gamebirds. NEMBA - National Environmental Management: Biodiversity Act (Act No. 10 of 2004) and LEMA - Limpopo Environmental Management Act (No 7 of 2003).

Division/ Group	ORDER	Family	#	Scientific Name	Common Name	Afrikaans Name	Observed	Global Cons. Status (IUCN, 2016)	Regional Cons. Status (Taylor et al., 2015)	NEMBA TOPS (2015)	LEMA (2003)
Paleaognathes	STRUTHIONIFORMES	Struthionidae	1	*Struthio camelus*	Common Ostrich	Volstruis					
Galloanseres	GALLIFORMES	Phasianidae	3	*Peliperdix coqui*	Coqui Francolin	Swempie					PROT
			4	*Dendroperdix sephaena*	Crested Francolin	Bospatrys	1				GAME
			12	*Pternistis natalensis*	Natal Spurfowl	Natalse Fisant	1				GAME
			14	*Pternistis swainsonii*	Swainson's Spurfowl	Bosveldfisant	1				GAME
			16	*Coturnix delegorguei*	Harlequin Quail	Bontkwartel					PROT
		Numididae	20	*Numida meleagris*	Helmeted Guineafowl	Gewone Tarentaal	1				GAME
			21	*Dendrocygna bicolor*	Fulvous Duck	Fluiteend					PROT
	ANSERIFORMES	Anatidae	22	*Dendrocygna viduata*	White-faced Duck	Nonnetjie-eend					GAME
			23	*Thalassornis leuconotus*	White-backed Duck	Witrugeend					PROT
			25	*Alopochen aegyptiaca*	Egyptian Goose	Kolgans	1				GAME
			27	*Plectropterus gambensis*	Spur-winged Goose	Wildemakou					GAME
			28	*Sarkidiornis melanotos*	Knob-billed Duck	Knobbeleend					PROT
			30	*Anas capensis*	Cape Teal	Teeleend					PROT
			33	*Anas undulata*	Yellow-billed Duck	Geelbekeend	1				GAME
			34	*Anas smithii*	Cape Shoveler	Kaapse Slopeend					PROT
			36	*Anas erythrorhyncha*	Red-billed Teal	Rooibekeend					GAME
			39	*Anas hottentota*	Hottentot Teal	Gevlekte Eend					PROT
	PODICIPEDIFORMES	Podicipedidae	415	*Tachybaptus ruficollis*	Little Grebe	Kleindobbertjie	1				PROT
	COLUMBIFORMES	Columbidae	179	*Columba livia*	Rock Dove	Tuinduif					PROT
			180	*Columba guinea*	Speckled Pigeon	Kransduif	1				GAME
			185	*Spilopelia senegalensis*	Laughing Dove	Rooiborsduifie	1				
			187	*Streptopelia capicola*	Cape Turtle-Dove	Gewone Tortelduif	1				
			188	*Streptopelia semitorquata*	Red-eyed Dove	Grootringduif	1				
			189	*Turtur chalcospilos*	Emerald-spotted Wood-Dove	Groenvlekduifie	1				PROT
			192	*Oena capensis*	Namaqua Dove	Namakwaduifie	1				PROT
			193	*Treron calvus*	African Green-Pigeon	Papegaaiduif					PROT

Division/ Group	ORDER	Family	#	Scientific Name	Common Name	Afrikaans Name	Observed	Global Cons. Status (IUCN, 2016)	Regional Cons. Status (Taylor et al., 2015)	NEMBA TOPS (2015)	LEMA (2003)
	PTEROCLIFORMES	Pteroclidae	227	*Pterocles namaqua*	Namaqua Sandgrouse	Kelkiewyn					PROT
			229	*Pterocles bicinctus*	Double-banded Sandgrouse	Dubbelbandsandpatrys	1				PROT
			230	*Pterocles burchelli*	Burchell's Sandgrouse	Gevlekte Sandpatrys	1				PROT
	APODIFORMES	Apodidea	144	*Cypsiurus parvus*	African Palm-Swift	Palmwindswael	1				PROT
			147	*Apus apus*	Common Swift	Europese Windswael					PROT
			151	*Apus affinis*	Little Swift	Kleinwindswael	1				PROT
			153	*Apus caffer*	White-rumped Swift	Witkruiswindswael	1				PROT
	CAPRIMULGIFORMES	Caprimulgidae	172	*Caprimulgus pectoralis*	Fiery-necked Nightjar	Afrikaanse Naguil					PROT
			176	*Caprimulgus rufigena*	Rufous-cheeked Nightjar	Rooiwangnaguil	1				PROT
Shorebirds	CHARADRIIFORMES	Turnicidae	41	*Turnix sylvaticus*	Kurrichane Buttonquail	Bosveldkwarteltjie	1				PROT
		Scolopacidae	232	*Gallinago nigripennis*	African Snipe	Afrikaanse Snip					PROT
			240	*Tringa stagnatilis*	Marsh Sandpiper	Moerasruiter					PROT
			241	*Tringa nebularia*	Common Greenshank	Groenpootruiter					PROT
			245	*Tringa glareola*	Wood Sandpiper	Bosruiter					PROT
			247	*Actitis hypoleucos*	Common Sandpiper	Gewone Ruiter					PROT
			252	*Calidris minuta*	Little Stint	Kleinstrandloper					PROT
			263	*Philomachus pugnax*	Ruff	Kemphaan					PROT
		Jacanidae	268	*Actophilornis africanus*	African Jacana	Grootlangtoon					PROT
		Burhinidae	271	*Burhinus vermiculatus*	Water Thick-knee	Waterdikkop					PROT
			272	*Burhinus capensis*	Spotted Thick-knee	Gewone Dikkop	1				PROT
		Recurvirostridae	275	*Himantopus himantopus*	Black-winged Stilt	Rooipootelsie					PROT
		Charadriidae	282	*Charadrius pecuarius*	Kittlitz's Plover	Geelborsstrandkiewiet					PROT
			283	*Charadrius tricollaris*	Three-banded Plover	Driebandstrandkiewiet	1				PROT
			291	*Vanellus armatus*	Blacksmith Lapwing	Bontkiewiet	1				PROT
			294	*Vanellus senegallus*	African Wattled Lapwing	Lelkiewiet					PROT
			297	*Vanellus coronatus*	Crowned Lapwing	Kroonkiewiet	1				PROT
			300	*Rhinoptilus chalcopterus*	Bronze-winged Courser	Bronsvlerkdrawwertjie					PROT
			303	*Cursorius temminckii*	Temminck's Courser	Trekdrawwertjie					PROT
Ancestral landbirds	OTIDIFORMES	Oditidae	196	*Ardeotis kori*	Kori Bustard	Gompou		NT	NT	PROT	SP PROT
			197	*Lophotis ruficrista*	Red-crested Korhaan	Boskorhaan	1				PROT
	CUCULIFORMES	Cuculidae	112	*Clamator jacobinus*	Jacobin Cuckoo	Bontnuwejaarsvoël	1				PROT
			113	*Clamator levaillantii*	Levaillant's Cuckoo	Gestreepte Nuwejaarsvoël					PROT
			114	*Clamator glandarius*	Great Spotted Cuckoo	Gevlekte Koekoek					PROT
			116	*Cuculus solitarius*	Red-chested Cuckoo	Piet-my-vrou	1				PROT
			117	*Cuculus clamosus*	Black Cuckoo	Swartkoekoek	1				PROT
			119	*Cuculus gularis*	African Cuckoo	Afrikaanse Koekoek					PROT
			123	*Chrysococcyx klaas*	Klaas's Cuckoo	Meitjie					PROT

Division/ Group	ORDER	Family	#	Scientific Name	Common Name	Afrikaans Name	Observed	Global Cons. Status (IUCN, 2016)	Regional Cons. Status (Taylor et al., 2015)	NEMBA TOPS (2015)	LEMA (2003)
			125	*Chrysococcyx caprius*	Diderick Cuckoo	Diederikkie	1				PROT
		Centropodidae	131	*Centropus burchellii (=superciliosus)*	Burchell's Coucal	Gewone Vleiloerie	1				PROT
	MUSOPHAGIFORMES	Musophagidae	159	*Corythaixoides concolor*	Grey Go-away-bird	Kwêvoël	1				PROT
Core Gruiforms	GRUIFORMES	Rallidae	217	*Amaurornis flavirostris*	Black Crake	Swartriethaan					PROT
			224	*Gallinula chloropus*	Common Moorhen	Grootwaterhoender	1				PROT
			226	*Fulica cristata*	Red-knobbed Coot	Bleshoender					GAME
Waterbird radiation	SULIFORRMES	Anhingidae	425	*Anhinga rufa*	African Darter	Slanghalsvoël					PROT
			426	*Microcarbo africanus*	Reed Cormorant	Rietduiker					PROT
			428	*Phalacrocorax lucidus*	White-breasted Cormorant	Witborsduiker				PROT	PROT
	PELICANIFORMES	Ardeidae	433	*Egretta garzetta*	Little Egret	Kleinwitreier					PROT
			435	*Egretta brachyrhyncha*	Yellow-billed Egret	Geelbekwitreier					PROT
			436	*Ardea alba*	Great Egret	Grootwitreier					PROT
			439	*Ardea cinerea*	Grey Heron	Bloureier	1				PROT
			440	*Ardea melanocephala*	Black-headed Heron	Swartkopreier	1				PROT
			442	*Ardea purpurea*	Purple Heron	Rooireier					PROT
			443	*Bubulcus ibis*	Western Cattle Egret	Veereier (Bosluisvoël)	1				PROT
			444	*Ardeola ralloides*	Squacco Heron	Ralreier					PROT
			447	*Butorides striata*	Green-backed Heron	Groenrugreier					PROT
		Scopidae	453	*Scopus umbretta*	Hamerkop	Hamerkop	1				PROT
		Threskiornithidae	457	*Bostrychia hagedash*	Hadeda Ibis	Hadeda	1				PROT
			459	*Threskiornis aethiopicus*	African Sacred Ibis	Skoorsteenveër				PROT	PROT
			460	*Platalea alba*	African Spoonbill	Lepelaar					PROT
	CICONIIFORMES	Ciconiidae	463	*Mycteria ibis*	Yellow-billed Stork	Nimmersat			EN		PROT
			465	*Ciconia nigra*	Black Stork	Grootswartooievaar			VU		PROT
			466	*Ciconia abdimii*	Abdim's Stork	Kleinswartooievaar			NT		PROT
			468	*Ciconia ciconia*	White Stork	Witooievaar					PROT
			470	*Leptoptilos crumeniferus*	Marabou Stork	Maraboe			NT		PROT
Afroaves	STRIGIFORMES	Tytonidae	160	*Tyto alba*	Western Barn Owl	Nonnetjie-uil	1				PROT
		Strigidae	162	*Otus senegalensis*	African Scops-Owl	Skopsuil	1				PROT
			163	*Ptilopsus granti*	Southern White-faced Scops-Owl	Witwanguil					PROT
			165	*Bubo africanus*	Spotted Eagle-Owl	Gevlekte Ooruil	1				PROT
			166	*Bubo lacteus*	Verreaux's Eagle-Owl	Reuse-ooruil					PROT
			169	*Glaucidium perlatum*	Pearl-spotted Owlet	Witkoluil	1				PROT
	ACCIPITRIFORMES	Accipitridae	348	*Elanus caeruleus*	Black-shouldered Kite	Blouvalk	1				PROT
			350	*Milvus aegyptius*	Yellow-billed Kite	Geelbekwou	1				PROT
			351	*Haliaeetus vocifer*	African Fish-Eagle	Visarend					PROT
			356	*Gyps africanus*	African White-backed Vulture	Witrugaasvoël	1	CR	CR	EN	PROT

Division/ Group	ORDER	Family	#	Scientific Name	Common Name	Afrikaans Name	Observed	Global Cons. Status (IUCN, 2016)	Regional Cons. Status (Taylor et al., 2015)	NEMBA TOPS (2015)	LEMA (2003)
			358	*Gyps coprotheres*	Cape Vulture	Kransaasvoël		VU	EN		PROT
			359	*Aegypius tracheliotos*	Lappet-faced Vulture	Swartaasvoël	1	EN	EN	EN	PROT
			361	*Circaetus pectoralis*	Black-chested Snake-Eagle	Swartborsslangarend	1				PROT
			362	*Circaetus cinereus*	Brown Snake-Eagle	Bruinslangarend	1				PROT
			365	*Terathopius ecaudatus*	Bateleur	Berghaan	1	NT	EN	EN	SP PROT
			371	*Polyboroides typus*	African Harrier-Hawk	Kaalwangvalk	1				PROT
			372	*Kaupifalco monogrammicus*	Lizard Buzzard	Akkedisvalk					PROT
			374	*Melierax canorus*	Southern Pale Chanting Goshawk	Bleeksingvalk	1				PROT
			375	*Melierax gabar*	Gabar Goshawk	Witkruissperwer (Kleinsingvalk)	1				PROT
			377	*Accipiter badius*	Shikra	Gebande Sperwer	1				PROT
			378	*Accipiter minullus*	Little Sparrowhawk	Kleinsperwer					PROT
			379	*Accipiter ovampensis*	Ovambo Sparrowhawk	Ovambosperwer					PROT
			382	*Buteo vulpinus*	Steppe Buzzard	Bruinjakkalsvoël	1				PROT
			388	*Aquila rapax*	Tawny Eagle	Roofarend			EN	EN	PROT
			391	*Aquila spilogaster*	African Hawk-Eagle	Grootjagarend					PROT
			394	*Hieraaetus wahlbergi*	Wahlberg's Eagle	Bruinarend	1				PROT
			395	*Polemaetus bellicosus*	Martial Eagle	Breëkoparend	1	VU	EN	EN	SP PROT
		Sagittariidae	398	*Sagittarius serpentarius*	Secretarybird	Sekretarisvoël		VU	VU		PROT
	PICIFORMES	Indicatoridae	45	*Indicator indicator*	Greater Honeyguide	Grootheuningwyser	1				PROT
			46	*Indicator minor*	Lesser Honeyguide	Kleinheuningwyser	1				PROT
		Picidae	51	*Campethera bennettii*	Bennett's Woodpecker	Bennettse Speg	1				PROT
			53	*Campethera abingoni*	Golden-tailed Woodpecker	Goudstertspeg	1				PROT
			57	*Dendropicos fuscescens*	Cardinal Woodpecker	Kardinaalspeg	1				PROT
			58	*Dendropicos namaquus*	Bearded Woodpecker	Baardspeg	1				PROT
		Lybiidae	65	*Pogoniulus chrysoconus*	Yellow-fronted Tinkerbird	Geelblestinker	1				PROT
			67	*Tricholaema leucomelas*	Acacia Pied Barbet	Bonthoutkapper	1				PROT
			68	*Lybius torquatus*	Black-collared Barbet	Rooikophoutkapper	1				PROT
			69	*Trachyphonus vaillantii*	Crested Barbet	Kuifkophoutkapper	1				PROT
	BUCEROTIFORMES	Bucerotidae	71	*Tockus rufirostris*	Southern Red-billed Hornbill	Rooibekneushoringvoël	1				PROT
			73	*Tockus leucomelas*	Southern Yellow-billed Hornbill	Geelbekneushoringvoël	1				PROT
			76	*Tockus nasutus*	African Grey Hornbill	Grysneushoringvoël	1				PROT
			79	*Bucorvus leadbeateri*	Southern Ground-hornbill	Bromvoel		VU	EN		PROT
		Upupidae	80	*Upupa africana*	African Hoopoe	Hoephoep	1				PROT
		Phoeniculidae	81	*Phoeniculus purpureus*	Green Wood-Hoopoe	Rooibekkakelaar	1				PROT
			83	*Rhinopomastus cyanomelas*	Common Scimitarbill	Swartbekkakelaar	1				PROT
	CORACIIFORMES	Coraciidae	85	*Coracias garrulus*	European Roller	Europese Troupant	1				PROT

Division/ Group	ORDER	Family	#	Scientific Name	Common Name	Afrikaans Name	Observed	Global Cons. Status (IUCN, 2016)	Regional Cons. Status (Taylor et al., 2015)	NEMBA TOPS (2015)	LEMA (2003)
			86	*Coracias caudatus*	Lilac-breasted Roller	Gewone Troupant	1				PROT
			88	*Coracias naevius*	Purple Roller	Groottroupant	1				PROT
		Alcedinidae	91	*Alcedo cristata*	Malachite Kingfisher	Kuifkopvisvanger					PROT
			94	*Halcyon senegalensis*	Woodland Kingfisher	Bosveldvisvanger	1				PROT
			96	*Halcyon albiventris*	Brown-hooded Kingfisher	Bruinkopvisvanger	1				PROT
			97	*Halcyon chelicuti*	Striped Kingfisher	Gestreepte Visvanger	1				PROT
			99	*Ceryle rudis*	Pied Kingfisher	Bontvisvanger					PROT
		Meropidae	100	*Merops bullockoides*	White-fronted Bee-eater	Rooikeelbyvreter	1				PROT
			101	*Merops pusillus*	Little Bee-eater	Kleinbyvreter	1				PROT
			102	*Merops hirundineus*	Swallow-tailed Bee-eater	Swaelstertbyvreter	1				PROT
			105	*Merops persicus*	Blue-cheeked Bee-eater	Blouwangbyvreter					PROT
			107	*Merops apiaster*	European Bee-eater	Europese Byvreter	1				PROT
			108	*Merops nubicoides*	Southern Carmine Bee-eater	Rooiborsbyvreter					PROT
	COLIIFORMES	Coliidae	110	*Colius striatus*	Speckled Mousebird	Gevlekte Muisvoël	1				
			111	*Urocolius indicus*	Red-faced Mousebird	Rooiwangmuisvoël	1				
	PSITTACIFORMES	Psittacidae	134	*Poicephalus meyeri*	Meyer's Parrot	Bosveldpapegaai					PROT
	FALCONIFORMES	Falconidae	401	*Falco rupicolis*	Rock Kestrel	Kransvalk					PROT
			407	*Falco amurensis*	Amur Falcon	Oostelike Rooipootvalk					PROT
			412	*Falco biarmicus*	Lanner Falcon	Edelvalk			VU		PROT
	PASSERIFORMES:Corvoidea	Oriolidae	534	*Oriolus oriolus*	Eurasian Golden Oriole	Europese Wielewaal					PROT
			537	*Oriolus larvatus*	Black-headed Oriole	Swartkopwielewaal	1				PROT
		Dicruridae	539	*Dicrurus adsimilis*	Fork-tailed Drongo	Mikstertbyvanger	1				PROT
		Monarchidae	541	*Terpsiphone viridis*	African Paradise-Flycatcher	Paradysvlieëvanger	1				PROT
		Malaconotidae	543	*Nilaus afer*	Brubru	Bontroklaksman	1				PROT
			544	*Dryoscopus cubla*	Black-backed Puffback	Sneeubal	1				PROT
			546	*Tchagra senegalus*	Black-crowned Tchagra	Swartkroontjagra	1				PROT
			547	*Tchagra australis*	Brown-crowned Tchagra	Rooivlerktjagra	1				PROT
			551	*Laniarius ferrugineus*	Southern Boubou	Suidelike Waterfiskaal	1				PROT
			552	*Laniarius atrococcineus*	Crimson-breasted Shrike	Rooiborslaksman	1				PROT
			554	*Chlorophoneus sulfureopectus*	Orange-breasted Bush-Shrike	Oranjeborsboslaksman	1				PROT
			558	*Malaconotus blanchoti*	Grey-headed Bush-Shrike	Spookvoël	1				PROT
		Vangidae	559	*Prionops plumatus*	White-crested Helmet-Shrike	Withelmlaksman	1				PROT
		Platysteiridae	565	*Batis molitor*	Chinspot Batis	Witliesbosbontrokkie	1				PROT
		Corvidae	571	*Corvus albus*	Pied Crow	Witborskraai	1				
		Laniidae	573	*Lanius collurio*	Red-backed Shrike	Rooiruglaksman	1				PROT
			575	*Lanius minor*	Lesser Grey Shrike	Gryslaksman					PROT
			576	*Lanius collaris*	Common Fiscal	Fiskaallaksman	1				PROT
Australaves											

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			577	*Urolestes melanoleuca*	Magpie Shrike	Langstertlaksman	1				PROT
			578	*Eurocephalus anguitimens*	Southern White-crowned Shrike	Kremetartlaksman	1				PROT
		Camphephagidae	581	*Campephaga flava*	Black Cuckooshrike	Swartkatakoeroe	1				PROT
		Remizidae	584	*Anthoscopus minutus*	Cape Penduline-Tit	Gryskapokvoël					PROT
		Paridae	586	*Parus niger*	Southern Black Tit	Gewone Swartmees	1				PROT
			591	*Parus cinerascens*	Ashy Tit	Akasiagrysmees	1				PROT
	PASSERIFORMES:Sylvoidea	Hirundinidae	593	*Riparia riparia*	Sand Martin	Europese Oewerswael					PROT
			594	*Riparia paludicola*	Brown-throated Martin	Afrikaanse Oewerswael	1				PROT
			598	*Hirundo rustica*	Barn Swallow	Europese Swael	1				PROT
			600	*Hirundo albigularis*	White-throated Swallow	Witkeelswael					PROT
			601	*Hirundo smithii*	Wire-tailed Swallow	Draadstertswael	1				PROT
			603	*Hirundo dimidiata*	Pearl-breasted Swallow	Pêrelborsswael	1				PROT
			604	*Cecropis cucullata*	Greater Striped Swallow	Grootstreepswael	1				PROT
			605	*Cecropis abyssinica*	Lesser Striped Swallow	Kleinstreepswael					PROT
			606	*Cecropis semirufa*	Red-breasted Swallow	Rooiborsswael					PROT
			611	*Delichon urbicum*	Common House-Martin	Huisswael	1				PROT
		Pycnonotidae	615	*Pycnonotus tricolor*	Dark-capped Bulbul	Swartoogtiptol	1				
			616	*Pycnonotus nigricans*	African Red-eyed Bulbul	Rooioogtiptol	1				PROT
		Locustellidae	628	*Bradypterus baboecala*	Little Rush-Warbler	Kaapse Vleisanger					PROT
		Acrocephalidae	638	*Acrocephalus baeticatus*	African Reed-Warbler	Kleinrietsanger	1				PROT
			639	*Acrocephalus palustris*	Marsh Warbler	Europese Rietsanger	1				PROT
			643	*Acrocephalus gracilirostris*	Lesser Swamp-Warbler	Kaapse Rietsanger	1				PROT
		Cisticolidae (in part)	647	*Eremomela icteropygialis*	Yellow-bellied Eremomela	Geelpensbossanger	1				PROT
			650	*Eremomela usticollis*	Burnt-necked Eremomela	Bruinkeelbossanger	1				PROT
		Macrosphenidae	653	*Sylvietta rufescens*	Long-billed Crombec	Bosveldstompstert	1				PROT
		Sylviidae	666	*Sylvia subcaeruleum*	Chestnut-vented Tit-Babbler	Bosveldtjeriktik	1				PROT
			669	*Sylvia communis*	Common Whitethroat	Witkeelsanger					PROT
		Acrocephalidae (in part)	654	*Hippolais icterina*	Icterine Warbler	Spotsanger	1				PROT
			644	*Hippolais olivetorum*	Olive-tree Warbler	Olyfboomsanger					PROT
		Phylloscopidae	655	*Phylloscopus trochilus*	Willow Warbler	Hofsanger	1				PROT
		Leiothrichidae	661	*Turdoides bicolor*	Southern Pied Babbler	Witkatlagter	1				PROT
			662	*Turdoides jardineii*	Arrow-marked Babbler	Pylvlekkatlagter	1				PROT
		Zosteropidae	671	*Zosterops virens*	Cape White-eye	Kaapse Glasogie	1				PROT
		Cisticolidae	676	*Cisticola chiniana*	Rattling Cisticola	Bosveldtinktinkie	1				PROT
			677	*Cisticola rufilatus*	Tinkling Cisticola	Rooitinktinkie	1				PROT
			683	*Cisticola tinniens*	Levaillant's Cisticola	Vleitinktinkie					PROT
			685	*Cisticola fulvicapilla*	Neddicky	Neddikkie	1				PROT
			687	*Cisticola juncidis*	Zitting Cisticola	Landeryklopkloppie					PROT

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			688	*Cisticola aridulus*	Desert Cisticola	Woestynklopkloppie	1				PROT
			692	*Prinia subflava*	Tawny-flanked Prinia	Bruinsylangstertjie	1				PROT
			693	*Prinia flavicans*	Black-chested Prinia	Swartbandlangstertjie	1				PROT
			706	*Camaroptera brevicaudata*	Grey-backed Camaroptera	Grysrugkwêkwêvoël	1				PROT
			707	*Calamonastes fasciolatus*	Barred Wren-Warbler	Gebande Sanger	1				PROT
		Alaudidae	710	*Mirafra passerina*	Monotonous Lark	Bosveldlewerik					PROT
			712	*Mirafra africana*	Rufous-naped Lark	Rooineklewerik					PROT
			717	*Calendulauda sabota*	Sabota Lark	Sabotalewerik	1				PROT
			718	*Calendulauda africanoides*	Fawn-coloured Lark	Vaalbruinlewerik	1				PROT
			733	*Eremopterix leucotis*	Chestnut-backed Sparrowlark	Rooiruglewerik					PROT
			734	*Eremopterix verticalis*	Grey-backed Sparrowlark	Grysruglewerik					PROT
			735	*Calandrella cinerea*	Red-capped Lark	Rooikoplewerik					PROT
	PASSERIFORMES:Muscicapoidea	Turdidae	748	*Psophocichla litsipsirupa*	Groundscraper Thrush	Gevlekte Lyster	1				PROT
			749	*Turdus libonyanus*	Kurrichane Thrush	Rooibeklyster	1				PROT
		Muscicapidae	753	*Bradornis pallidus*	Pale Flycatcher	Muiskleurvlieëvanger	1				
			755	*Bradornis mariquensis*	Marico Flycatcher	Maricovlieëvanger	1				PROT
			756	*Melaenornis pammelaina*	Southern Black Flycatcher	Swartvlieëvanger	1				PROT
			757	*Sigelus silens*	Fiscal Flycatcher	Fiskaalvlieëvanger	1				PROT
			758	*Muscicapa striata*	Spotted Flycatcher	Europese Vlieëvanger	1				PROT
			761	*Myioparus plumbeus*	Grey Tit-Flycatcher	Waaierstertvlieëvanger	1				PROT
			767	*Cossypha caffra*	Cape Robin-Chat	Gewone Janfrederik					PROT
			768	*Cossypha humeralis*	White-throated Robin-Chat	Witkeeljanfrederik	1				PROT
			776	*Erythropygia leucophrys*	White-browed Scrub-Robin	Gestreepte Wipstert	1				PROT
			777	*Erythropygia paena*	Kalahari Scrub-Robin	Kalahariwipstert	1				PROT
			782	*Saxicola torquatus*	African Stonechat	Gewone Bontrokkie					PROT
			787	*Oenanthe pileata*	Capped Wheatear	Hoëveldskaapwagter					PROT
			792	*Oenanthe familiaris*	Familiar Chat	Gewone Spekvreter	1				PROT
			793	*Myrmecocichla formicivora*	Anteating Chat	Swartpiek					PROT
		Sturnidae	800	*Lamprotornis nitens*	Cape Glossy Starling	Kleinglansspreeu	1				PROT
			801	*Lamprotornis chalybaeus*	Greater Blue-eared Starling	Groot-blouoorglansspreeu	1				PROT
			804	*Lamprotornis australis*	Burchell's Starling	Grootglansspreeu	1				PROT
			806	*Cinnyricinclus leucogaster*	Violet-backed Starling	Witborsspreeu	1				PROT
			808	*Creatophora cinerea*	Wattled Starling	Lelspreeu					PROT
			810	*Acridotheres tristis*	Common Myna	Indiese Spreeu					PROT
		Buphagidae	812	*Buphagus erythrorynchus*	Red-billed Oxpecker	Rooibekrenostervoël	1				PROT
	PASSERIFORMES:Passeroidea	Nectariniidae	818	*Chalcomitra amethystina*	Amethyst Sunbird	Swartsuikerbekkie					PROT
			828	*Cinnyris talatala*	White-bellied Sunbird	Witpenssuikerbekkie	1				PROT

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			832	*Cinnyris mariquensis*	Marico Sunbird	Maricosuikerbekkie	1				PROT
		Ploceidae	836	*Bubalornis niger*	Red-billed Buffalo-Weaver	Buffelwewer	1				PROT
			837	*Sporopipes squamifrons*	Scaly-feathered Finch	Baardmannetjie	1				PROT
			838	*Plocepasser mahali*	White-browed Sparrow-Weaver	Koringvoël	1				PROT
			840	*Ploceus intermedius*	Lesser Masked-Weaver	Kleingeelvink					PROT
			846	*Ploceus velatus*	Southern Masked-Weaver	Swartkeelgeelvink	1				PROT
			847	*Ploceus cucullatus*	Village Weaver	Bontrugwewer	1				PROT
			851	*Anaplectes rubriceps*	Red-headed Weaver	Rooikopwewer	1				PROT
			854	*Quelea quelea*	Red-billed Quelea	Rooibekkwelea	1				PROT
			857	*Euplectes orix*	Southern Red Bishop	Rooivink	1				PROT
			861	*Euplectes albonotatus*	White-winged Widowbird	Witvlerkflap	1				PROT
		Estrildidae	867	*Amandava subflava*	Orange-breasted Waxbill	Rooiassie					PROT
			868	*Ortygospiza atricollis*	African Quailfinch	Gewone Kwartelvinkie					PROT
			869	*Amadina erythrocephala*	Red-headed Finch	Rooikopvink					PROT
			870	*Amadina fasciata*	Cut-throat Finch	Bandkeelvink					PROT
			875	*Estrilda erythronotos*	Black-faced Waxbill	Swartwangsysie	1				PROT
			878	*Estrilda astrild*	Common Waxbill	Rooibeksysie	1				PROT
			880	*Granatina granatina*	Violet-eared Waxbill	Koningblousysie	1				PROT
			881	*Uraeginthus angolensis*	Blue Waxbill	Gewone Blousysie	1				PROT
			884	*Pytilia melba*	Green-winged Pytilia	Gewone Melba	1				PROT
			886	*Lagonosticta senegala*	Red-billed Firefinch	Rooibekvuurvinkie	1				PROT
			889	*Lagonosticta rhodopareia*	Jameson's Firefinch	Jamesonse Vuurvinkie	1				PROT
			890	*Lonchura cucullatus*	Bronze Mannikin	Gewone Fret					PROT
		Viduidae	893	*Vidua chalybeata*	Village Indigobird	Staalblouvinkie	1				PROT
			897	*Vidua regia*	Shaft-tailed Whydah	Pylstertrooibekkie	1				PROT
			898	*Vidua macroura*	Pin-tailed Whydah	Koningrooibekkie	1				PROT
			899	*Vidua paradisaea*	Long-tailed Paradise-Whydah	Gewone Paradysvink	1				PROT
		Passeridae	901	*Passer domesticus*	House Sparrow	Huismossie	1				PROT
			902	*Passer motitensis*	Great Sparrow	Grootmossie	1				PROT
			903	*Passer melanurus*	Cape Sparrow	Gewone Mossie	1				PROT
			904	*Passer diffusus*	Southern Grey-headed Sparrow	Gryskopmossie	1				PROT
			906	*Gymnornis superciliaris*	Yellow-throated Petronia	Geelvlekmossie	1				PROT
		Motacillidae	907	*Motacilla aguimp*	African Pied Wagtail	Bontkwikkie	1				PROT
			908	*Motacilla capensis*	Cape Wagtail	Gewone Kwikkie	1				PROT
			920	*Anthus cinnamomeus*	African Pipit	Gewone Koester	1				PROT
			923	*Anthus vaalensis*	Buffy Pipit	Vaalkoester					PROT
			925	*Anthus similis*	Long-billed Pipit	Nicholsonse Koester					PROT
			929	*Anthus caffer*	Bushveld Pipit	Bosveldkoester					PROT

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		Fringillidae	935	*Crithagra atrogularis*	Black-throated Canary	Bergkanarie	1				PROT
			937	*Crithagra mozambica*	Yellow-fronted Canary	Geeloogkanarie	1				PROT
			938	*Crithagra flaviventris*	Yellow Canary	Geelkanarie	1				PROT
			941	*Crithagra gularis*	Streaky-headed Seedeater	Streepkopkanarie					PROT
		Emberizidae	947	*Emberiza impetuani*	Lark-like Bunting	Vaalstreepkoppie	1				PROT
			948	*Emberiza tahapisi*	Cinnamon-breasted Bunting	Klipstreepkoppie	1				PROT
			950	*Emberiza flaviventris*	Golden-breasted Bunting	Rooirugstreepkoppie	1				PROT

29 APPENDIX 3 - PERMIT APPLICATIONS

Protected Trees

Permit applications for the removal / relocation of protected trees must be directed to the Department of Fishery and Forestry (DAFF):

DWAF website: http://www.dwaf.gov.za/Forestry/PTlicence.asp

Protected Plants

The removal or relocation of protected plants is subjected to authorisation (permits) from the Limpopo Department of Economic Development, Environment and Tourism:

CITES and Permit Management
Department of Economic Development, Environment and Tourism
Limpopo
P.O. Box 55464
POLOKWANE
0700

Tel: 015 290 7000
Fax: (015) 295-5018

E-mail: Permits@Ledet.gov.za or
Rosa Moloto: MolotoMR@Ledet.gov.za

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