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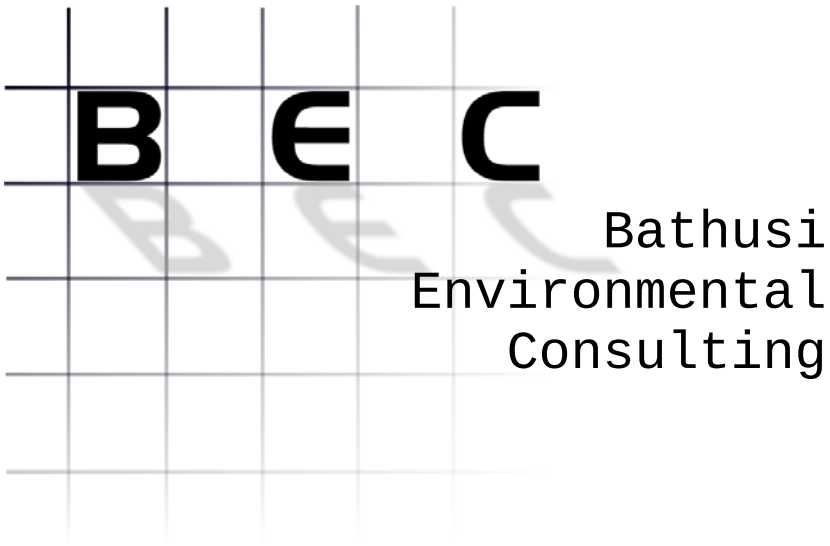
Red/ Orange Listed Flora Assessment for the proposed Tshwane Strengthening Project – Phase 1 - Apollo – Verwoerdburg 400kV Line

submitted by



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I Specialist Investigators

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).

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II Declaration of Independence

- All specialist investigators, project investigators and members of companies employed for conducting this particular investigation declare that:
- We act as independent specialists for this project.
- We consider ourselves bound to the rules and ethics of the South African Council for Natural Scientific Professions.
- At the time of completing this report, we did not have any interest, hidden or otherwise, in the proposed development as outlined in this document, except for financial compensation for work done in a professional capacity, in terms of the Environmental Impact Assessment Regulations, 2006.
- We will not be affected in any manner by the outcome of the environmental process of which this report forms part of, other than being part of the public.
- We do not have any influence over decisions made by the governing authorities.
- 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.
- Undertake to disclose to the National Department of Water and Environmental Affairs any material information that has or may have the potential to influence its decision or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2006;
- Will provide the National Department of Water and Environmental Affairs 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 formally register as an Interested and Affected Party.

III Glossary of Terms

A1 Taxa: Endemic to Gauteng.

A2 Taxa: Endemic to Gauteng and one other province.

A3 Taxa: Endemic to Gauteng and two or more other provinces.

Alternatives: A possible course of action that would meet the same purpose and need as another, but which would avoid/ minimize negative impacts. These can include alternative locations/sites, routes, layouts, processes, designs, schedules and/or inputs. The "no-go" alternative constitutes the 'without project' option and provides a benchmark against which to evaluate changes; development should result in net benefit to society and should avoid undesirable negative impacts.

B Taxa: Taxa that are not endemic to South Africa.

Buffer zone: A collar of land that filters edge effects.

Critically Endangered: A taxon is facing an extremely high risk of extinction in the wild, as indicated by the best available evidence.

Ecologically sensitive ecosystem: One where relatively even minor disturbances may result in substantial and significant changes.

Ecosystems: Include living (e.g. plants, animals) and non-living (e.g. minerals, soil, water) components, which can be defined in terms of distinguishing characteristics (e.g. a wetland ecosystem, a freshwater ecosystem, a terrestrial ecosystem, a forest ecosystem, etc.).

Endangered: A taxon is facing a very high risk of extinction in the wild, as indicated by the best available evidence.

Endemic or range-restricted species or ecosystem: One whose distribution is confined to a particular and often very limited geographical region.

Endemic: With reference to a taxon, that the taxon has its habitat in a specified district or area.

Environment: Broadly covers our surroundings and the characteristics of those surroundings that influence our health and wellbeing. That is, the environment includes all living organisms (plants, animals and other life), the physical environment (land, water and air), as well as social, economic and cultural conditions. Sometimes we speak of 'the natural environment' and 'the built environment', to differentiate between natural and man-made systems.

***Ex situ* conservation:** Conservation outside a taxon's wild/ natural habitat, usually involving propagation or seed banking.

Habitat: The place or type of site where an organism or population naturally occurs.

***In situ* conservation:** Conservation within a taxon's wild habitat where the populations occur naturally.

Indirect impacts: Occur later in time or at a different place from the activity, e.g. extraction of groundwater for irrigation leads to changes in the water table and affects distant water users.

Irreplaceable loss: When it results in the loss of a resource without substitute, and which cannot be replaced. An impact leading to irreplaceable loss of biodiversity is, by definition, irreversible.

Irreversible impact: One that arguably cannot be reversed in time (e.g. decrease in area of a specific vegetation type, loss of genetic diversity through reduction in size of populations of a particular species). Some, but not all, irreversible impacts will lead to irreplaceable loss of biodiversity. They may, or may not, be acceptable to society or stakeholders in terms of their current values.

Metapopulation: A group of interconnected subpopulations, usually of subequal size; features of individuals now found in one subpopulation might have been determined by conditions affecting them when they were located in another subpopulation.

Near Threatened Status: A taxon that is not Critically Endangered, Endangered or Vulnerable currently, but is close to qualifying for, or is likely to qualify for, one of these categories in the near future.

Population: A group of individuals of one species in an area.

Precautionary Principle: States that "where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Protected area: As defined by National Environmental Management: Protected Areas Act, 2003 (No. 57 of 2003).

Protected species or ecosystem: One that is protected by law from particular activities and land uses.

Red Data Book' or 'Red List': Provides information on threatened species.

Species: A group of plants, animals, micro-organisms or other living organisms that are morphologically similar; that share inheritance from common ancestry; or whose genes are so similar that they can breed together and produce fertile offspring.

Threatened species or ecosystem: Species/ Ecosystems that are at risk of going extinct in its natural range. It may be 'critically endangered' at extremely high risk, 'endangered' at very high risk, or 'vulnerable' at high risk. Species or ecosystems at low or no risk are not 'threatened', and fall into the 'near threatened' or 'least concern' categories.

Urban areas: All built up areas in Gauteng, including residential, commercial, retail, institutional, educational, industrial and mixed use developments, where proposed developments are 50 percent abutted by urban development and which can be readily connected to municipal bulk infrastructure services.

Vulnerable Status: A taxon is facing a high risk of extinction in the wild, as indicated by the best available evidence.

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1 Executive Summary

The aim of this report is to provide the reader with an overview of the presence and extent of Red/Orange Listed flora species and communities occurring within the general region of the proposed Apollo–Verwoerdburg 400kV corridors, making pertinent recommendations in order to avoid adverse impacts on Red/Orange Listed plant communities and the habitat that these species occur in. Results of the site investigations and results presented in this report will ultimately be included in the Biodiversity EIA report for this project in order to highlight specific areas or aspects that are likely to be affected adversely by the proposed development.

The GDARD database indicates the presence of 21 Red/Orange Data flora species within the 2528CC ¼-degree grid in which the study area is situated, including:

- *Brachycorythis conica* subsp. *transvaalensis* (Vulnerable);
- ***Cheilanthes deltoidea* subsp. nov. Gauteng form (Vulnerable) (confirmed presence);**
- ***Cleome conrathii* (Near Threatened) (confirmed presence);**
- ***Habenaria barbertoni* (Near Threatened) (confirmed presence);**
- *Habenaria kraenzliniana* (Near Threatened);
- ***Habenaria mossii* (Endangered) (confirmed presence);**
- *Holothrix randii* (Near Threatened);
- ***Lithops lesliei* subsp. *lesliei* (Near Threatened) (confirmed presence);**
- ***Melolobium subspicatum* (Vulnerable) (confirmed presence); and**
- *Trachyandra erythrorrhiza* (Near Threatened).

Six species are known to occur in the study area, four of which occur within the proposed corridors (AV_Routes 1 and 2). These two routes are therefore considered fatally flawed in terms of the proposed development as a result of the confirmed presence of Red and Orange Data plant species. The biodiversity sensitivity of these two options, not taking any other sensitivity into consideration, is regarded as high. It is therefore recommended that none of these options be used for the proposed development.

AV_Route 3 is characterised by Red List Metapopulation as well as Red List Historic Location, most probably as a result of the presence of pristine rocky grassland that is representative of the regional vegetation. Because no Red or Orange Listed plant species are known to occur within this particular corridor, the sensitivity of this proposed corridor, compared to the other options, is regarded as the lowest. This statement is made purely on the basis of Red/ Orange Listed data, not considering other biological attributes which will be considered in the main biodiversity EIA report. An additional aspect that renders this option more suitable for the proposed development is the presence of existing power lines.

2 Project Background

Tshwane has applied for new supply points and a step load increase to Eskom Transmission and Distribution. A number of options were analysed based on technical and economical benefits to all parties involved and the proposed solution, which is known as the City of Tshwane Electricity Supply Plan Scheme proposed to build four new substations in the Tshwane area. Three will be built by Eskom and one will be built by Tshwane. These four substations are Phoebus, Verwoerdburg, Anderson and Wildebeest Substations. The proposed solution will meet the Tshwane electricity requirement, representing the less costly option in addition to de-loading the heavily loaded Minerva and Apollo Substations.

Subsequent to a preliminary site investigation, a community of Red Listed plant species was identified within the proposed corridor between the Apollo and Verwoerdburg Substations. Additional surveys were conducted in order to determine the extent and presence of Red/ Orange Listed flora species within the general area.

3 Scope of Work

- Obtain all relevant Red/ Orange Listed flora information;
- Survey the area for Red/ Orange Listed flora species and communities during the current flowering period;
- Present the status of Red/ Orange Listed flora species that are known to occur in the region;
- Describe the presence, status and associated habitat attributes of any other Red Data species within the general area;
- Map all relevant aspects;
- Identify any areas that may be considered ‘no-go’ areas from a biodiversity perspective; and
- Make pertinent recommendations in terms of the proposed corridors.

4 Limitations of this Investigation

- This report is based on a strategic investigation and selective sampling of some parts of the general region.
- No detailed or long-term investigation of biological attributes and biological diversity that may be present in the study area was conducted. No definite conclusions may therefore be drawn with regards to biological diversity or conservation strategies as far as this report or the study area is concerned.
- This company, the consultants and/or specialist investigators do not accept any responsibility for conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from these strategic assessments or requests made to them for the purpose of this report.
-
- Additional information may come to light during a later stage of the process for which no allowance could have been made at the time of this report.
- BEC withholds the right to amend this report, recommendations and/ or conclusions at any stage of the project should significant or additional information come to light.
- Information contained in this report cannot be applied to any other area, however similar in appearance or any other aspect, without proper investigation.

5 Approach to the Study

While a proper knowledge of the biodiversity of the region is not negotiable for the ultimate success of this assessment, an attempt was made to remove subjective opinions that might be held on any part of the study area as far as possible. Inherent characteristics of a project of this nature implies that no method will be foolproof in all instances as a result of the shortcomings in available databases and lack of site specific detail that could be obtained from detailed site investigations in a short period of time. This is a shortcoming of every scientific study that has ever been conducted; it simply is not humanly possible to know everything or to consider aspects to a level of molecular detail. However, the approach followed in this study is considered effective in presenting objective comments on the comparison of biodiversity sensitivity of parts in the study area that are frequently separated by vast distances.

6 Location

The proposed 400kV line will be located between the existing Kwagga Substation (S25.75751° & E2810442°) and the proposed Phoebus Substation (S25.56360° & E28.09583°) in the City of Tshwane Metropolitan Municipality (CTMM), Gauteng Province, covering a distance of approximately 30km (Figure 1). A Google earth image of the region is presented in Figure 2. In addition to the original corridor alternatives, an additional corridor was identified during the scoping phase of the project. This corridor was also included in the investigation.

For technical specifications pertaining to the proposed lines, the reader is referred to the main EIA document.

7 Flora Species of Conservation Importance

The GDARD database indicates the presence of the following Red Data flora species within the 2528CC ¼-degree grid in which the study area is situated:

- *Andromischus umbraticola* subsp. *umbraticola* (Near Threatened);
- *Boophane disticha* (Declining);
- *Bowiea volubilis* subsp. *volubilis* (Vulnerable);
- ***Brachycorythis conica* subsp. *transvaalensis*** (Vulnerable);
- *Callilepis leptophylla* (Declining);
- *Ceropegia decidua* subsp. *pretoriensis* (Vulnerable);
- ***Cheilanthes deltoidea* subsp. nov. Gauteng form** (Vulnerable);
- ***Cleome conrathii*** (Near Threatened);
- *Crinum macowanii* (Declining);
- *Drimia sanguinea* (Near Threatened);
- *Eucomis autumnalis* (Declining);
- *Gunnera perpensa* (Declining);
- ***Habenaria barbertoni*** (Near Threatened);
- ***Habenaria kraenzliniana*** (Near Threatened);
- ***Habenaria mossii*** (Endangered);
- ***Holothrix randii*** (Near Threatened);
- *Hypoxis hemerocallidea* (Declining);
- *Ilex mitis* var. *mitis* (Declining);
- ***Lithops lesliei* subsp. *lesliei*** (Near Threatened);
- ***Melolobium subspicatum*** (Vulnerable); and
- ***Trachyandra erythrorrhiza*** (Near Threatened).

Only species that are indicated by GDARD database as occurring within the immediate vicinity of any of the proposed corridors will be dealt with in this report (indicated in **bold**).

Figure 1: Location of the study area

Figure 2: Google image of the general region

7.1 Brachycorythis conica subsp. transvaalensis

Conservation Status:	Vulnerable (A3)
Habitat:	Short grasslands, hillsides, on sandy gravel overlying dolomite, sometimes also on quartzites; occasionally open woodland; 1000 - 1705m.
Flowering Season:	January to March.
Occurrence:	Historic presence in proposed corridors, study area.

The historic extent of the community comprises extensive parts of the proposed corridors, particularly the northern parts (Figure 3). This species is indicated to flower between January and March and the surveys that were conducted in November and December are therefore not effective in assessing the presence/ extent of this species within the proposed corridors. However, because the presence of this species is indicated as 'Historic Location' and since the area is known quite adequately, the absence of this species from the region could be accepted with a relative high degree of certainty.

The potential presence of this species within the proposed corridors does therefore not influence the selection process.

7.2 Cheilanthes deltoidea subsp. nov. Gauteng form

Conservation Status:	Vulnerable (A2)
Habitat:	Southwest facing soil pockets and rock crevices in chert rock.
Flowering Season:	November – June.
Occurrence:	**Confirmed presence in proposed corridors**, historic presence in study area.

The presence of this species was confirmed in the study area by means of available data and results of the site investigation. The confirmed presence of stands of this species within two of the proposed corridors (AV_Route 1 and AV_Route 2) (Figure 4) renders these corridors unsuitable for the proposed project as a result of potential impacts on stands of this Red Data species. GDARD information is used to indicate the extent of stands/ community.

The historic extent of this species furthermore comprises extensive parts of the proposed corridors. This species is indicated to flower between November and June and the surveys that were conducted in November and December were effective in assessing the extent of this species within the proposed corridors. The historic location of this species becomes important since remaining stands still occur in the region. There is therefore a high likelihood that suitable habitat might become repopulated by this species. This species is strongly associated with rocky outcrops and ridges and all suitable habitat should therefore be regarded important/ highly sensitive.

Figure 3: Extent of *Brachycorythis conica subsp. transvaalensis* within the study area

Figure 4: Extent of *Cheilanthes deltoidea* in the study area

7.3 Cleome conrathii

Conservation Status:	Near Threatened (A3)
Habitat:	Stony quartzite slopes, usually in red sandy soil, grassland or open to closed deciduous woodland, all aspects.
Flowering Season:	March to May, December to January.
Occurrence:	**Confirmed presence in proposed corridors**

The presence of this species is confirmed in the study area by means of available data. The timing of the site investigations was too early to make actual observations of the extent of the community/ stands and information from GDARD is used in this regard. The confirmed presence of stands of this species within two of the proposed corridors (AV_Route 1 and AV_Route 2) (Figure 5) renders the use of these corridors unsuitable for the proposed project as a result of potential impacts on the stands of this Red Data species.

In communication with a representative of GDARD, it was indicated that this species might be more widely spread than indicated by available data. Suitable habitat should therefore be regarded as important/ highly sensitive.

7.4 Habenaria barbertoni

Conservation Status:	Near Threatened (A2)
Habitat:	Grassland, on rocky hillsides.
Flowering Season:	February to March.
Occurrence:	Historic presence in proposed corridors.

The historic extent of the community comprises extensive parts of the proposed corridors (Figure 6). This species is indicated to flower between February and March and the surveys that were conducted in November and December are therefore not effective in assessing the presence/ extent of this species within the proposed corridors. However, because the presence of this species is indicated as 'Historic Location' and since the area is well known, the absence of this species from the region could be accepted with a relative high degree of certainty.

The potential presence of this species within the proposed corridors does therefore not influence the selection process.

Figure 5: Extent of *Cleome conrathii* within the study area

Figure 6: Extent of *Habenaria barbertoni* in the study area

7.5 Habenaria kraenzliniana

Conservation Status:	Near Threatened (A3)
Habitat:	Terrestrial in stony, grassy hillsides, recorded from 1,000 to 1,400m.
Flowering Season:	February to April.
Occurrence:	**Confirmed presence in proposed corridors, study area**

The presence of this species was confirmed in the northern part of the study area by means of available data, rendering AV_Route 1 (Figure 7) unsuitable for the proposed project as a result of potential impacts on the stands of this Near Threatened species.

This species is indicated to flower between February and April and the surveys that were conducted in November and December were not effective in assessing the extent of this species within the proposed corridors and GDARD information is used to indicate the extent of stands/ community. This species is strongly associated with rocky outcrops and ridges and all suitable habitat should therefore be regarded important/ highly sensitive.

7.6 Habenaria mossii

Conservation Status:	Endangered (A1)
Habitat:	Open grassland on dolomite or in black sandy soil.
Flowering Season:	March to April.
Occurrence:	**Confirmed presence in study area**, historic presence in study area, metapopulation in study area

The presence of this species was confirmed in the study area by means of available data, but the population is indicated outside the proposed corridors (northwest of AV Route 1), thereby not affecting the selection process (Figure 8). The historic extent of this species comprises small parts of the general region to the northeast of the proposed corridors. This species is indicated to flower between March and April and the surveys that were conducted in November and December were not effective in assessing the presence/ extent of this species within the proposed corridors. GDARD information is therefore used to indicate the extent of stands/ communities.

Figure 7: Extent of *Habenaria kraenzliniana* within the study area

Figure 8: Extent of *Habenaria mossii* in the study area

7.7 Holothrix randii

Conservation Status:	Near Threatened (B)
Habitat:	Grassy slopes and rock ledges, usually southern aspects.
Flowering Season:	September to January.
Occurrence:	Metapopulation present in study area

Figure 9 illustrates the presence of the metapopulation of this Orange Listed species in the study area, with a small portion captured within AV_Route 1. This species is indicated to flower between September and January, but surveys conducted did not reveal any individuals within the proposed corridors. The potential presence of this species within the proposed corridors does therefore not influence the selection process.

7.8 Lithops lesliei subsp. lesliei

Conservation Status:	Near Threatened (B)
Habitat:	Primary habitat appears to be the arid grasslands in the interior of South Africa where it usually occurs in rocky places, growing under the protection of surrounding forbs and grasses.
Flowering Season:	March to June.
Occurrence:	**Confirmed presence in study area**

The presence of this species is confirmed in the study area by means of available data. The timing of the site investigations was too early to make actual observations of the extent of the community/ stands and information from GDARD is used in this regard. The confirmed presence of stands of this species is indicated to the south of the proposed corridors (Figure 10). The proposed corridors are not expected to affect this particular community/ stand of Orange Listed species adversely.

Suitable habitat should however be regarded important/ highly sensitive.

Figure 9: Extent of *Holothrix randii* within the study area

Figure 10: Extent of *Lithops lesliei* subsp. *lesliei* in the study area

7.9 Melolobium subspicatum

Conservation Status:	Vulnerable (A1)
Habitat:	Grassland
Flowering Season:	September to May.
Occurrence:	**Confirmed presence within proposed corridors**

The presence of this species is confirmed in the study area by means of available data and results of the site investigation, during which numerous individuals were located. This species was originally thought to be located much more to the east, but subsequent identification of individuals revealed many to be a closely resembling *Dichilus* species. The timing of the site investigations was adequate to make observations of the extent of the community/ stands and, but information from GDARD is used to indicate the extent of the community. The confirmed presence of stands of this species within the proposed corridors AV_Route (Figure 11) renders the use of these corridors unsuitable for the proposed project as a result of potential impacts on the stands of this Red Data species.

Suitable habitat occurs extensively in the study area, particularly to the south of the ridge area; all suitable habitat should therefore be regarded as highly sensitive and important.

7.10 Trachyandra erythrorrhiza

Conservation Status:	Near Threatened (A3)
Habitat:	Marshy areas, grassland, usually in back turf marshes.
Flowering Season:	September to November.
Occurrence:	Metapopulation present in proposed corridors

Figure 12 illustrates the presence of the metapopulation of this Orange Listed species in the study area, with a portion captured within AV_Route 1. This species is indicated to flower between September and November, but surveys conducted did not reveal any individuals within the proposed corridors. The potential presence of this species within the proposed corridors does therefore not influence the selection process.

Figure 11: Extent of *Melolobium subspicatum* within the study area

Figure 12: Extent of *Trachyandra erythrorrhiza* in the study area

8 Discussion & Integration of Results

Figure 13 illustrates the combined location of Red/ Orange Listed plant species within the study area, ranked in importance as follows:

- Red List Confirmed;
- Orange List Confirmed;
- Red List Metapopulation;
- Orange List Metapopulation;
- Red List Historic Location; and
- Orange List Historic Location.

It is evident that AV_Routes 1 and 2 could be considered fatally flawed in terms of the confirmed presence of Red and Orange Data plant species within the proposed corridors. The biodiversity sensitivity of these two options, not taking any other sensitivity into consideration, is regarded as high. It is therefore recommended that none of these options be used for the proposed development.

AV_Route 3 is characterised by Red List Metapopulation as well as Red List Historic Location, most probably as a result of the presence of pristine rocky grassland that is representative of the regional vegetation. Because no Red or Orange Listed plant species are known to occur within this particular corridor, the sensitivity of this proposed corridor, compared to the other options is regarded as the highest. This statement is made purely on the basis of Red/ Orange Listed data, not considering other biological attributes which will be considered in the main biodiversity EIA report. An additional aspect that renders this option more suitable for the proposed development is the presence of existing power lines.

Figure 13: Distribution of Red/ Orange Listed plant species within the study area

9 GDARD Red List Plant Species Guidelines

9.1 Introduction

These Guidelines aim to facilitate the conservation of the Red List Plant Species of Gauteng and are to be used by the Department, applicants and any other person or organisation that are responsible for managing, or whose actions affect, areas in Gauteng where populations of Red List Plant Species grow. The purpose of these guidelines is to promote the conservation of Red List Plant Species in Gauteng, which are species of flora that face risk of extinction in the wild. By protecting Red List Plant Species, conservation of diverse landscapes is promoted which forms part of the overall environmental preservation of diverse ecosystems, habitats, communities, populations, species and genes in Gauteng.

The Guidelines are intended to provide a decision-making support tool to any person or organisation that is responsible for managing, or whose actions affect, areas in Gauteng where populations of Red List Plant Species grow, whether such person or organisation be an organ of state or private entity or individual; thereby enabling the conservation of the Red List Plant Species that occur in Gauteng

9.2 Guiding Principles

The principles that inform these Guidelines are as set out hereunder.

- In accordance with the objectives of the Convention on Biological Diversity (1992), the Department must ensure that the diversity of landscapes, ecosystems, habitats, communities, populations, species and genes in Gauteng is conserved.
- As Red List Plant Species face an extremely high, very high or high risk of extinction in the wild, or are close to facing a risk of extinction in the wild, the Department must ensure that these species are afforded special conservation attention.
- Species endemic to Gauteng must be afforded the maximum protection as they occur nowhere else in the world.
- Conservation of only a single population of a Red List Plant Species will intensify the taxon's extinction risk and also neglects the lowest level of biodiversity, which is genetic diversity; consequently all populations of Red List Plant Species must be conserved.
- *In situ* conservation of Red List Plant Species is preferable to *ex situ* conservation: removing a population from its natural habitat and placing it under artificial conditions will result in the erosion of the inherent genetic diversity and characteristics of that species.
- In order to ensure the persistence of a population of a Red List Plant Species, it is imperative that the ecological processes maintaining that population persist.

- In order to ensure the persistence of a population of a Red List Plant Species, pollinators must be conserved in accordance with the following measures
  - the habitat must be managed to provide appropriate nest sites for pollinators and a seasonal succession of suitable forage and host plants;
  - pollinators must be protected from herbicide and pesticide application and soil disturbance must be prevented; and
  - habitat fragmentation must be avoided and connectivity promoted.
- Translocation of Red List Plant Species is an unacceptable conservation measure because –
  - the translocated species may harm other species;
  - the translocated species may transmit pathogens and/ or parasites;
  - translocation may result in rapid changes in the species itself;
  - translocations are expensive; and
  - translocations are rarely successful; in order to be successful, the translocated individuals must survive and result in the establishment of a self-sustaining, viable population able to reproduce and adapt to changing environmental conditions.
- Rural parts of Gauteng should be protected from insensitive development and
  - urban sprawl/encroachment should be avoided;
  - policy guiding developers should be more strictly applied in rural areas.
- A species can only be assumed to be locally extinct when surveys over a time frame appropriate to the taxon's life cycle and growth form have failed to record an individual; surveys should:
  - only be undertaken within the taxon's flowering season
  - discount the possibility that the population is dormant due to unfavourable environmental conditions.
- Suitable habitat adjacent to known populations of Red List Plant Species has a high probability of being colonised by new individuals of that Red List Plant Species and might ultimately result in a new population.
- In order to protect a plant population from detrimental edge effects associated with a fragmented landscape, it is necessary to protect it with a buffer zone.

9.3 Guidelines

9.3.1 Red List Plant Species Conservation

Three basic rules of conservation apply to populations of Red List Plant Species, as set out hereunder.

- All populations of Near Threatened and Threatened plant taxa must be conserved *in situ*;
- All populations of Near Threatened and Threatened plant taxa must be protected with a buffer zone in accordance with guidelines as set out below; and

- An Ecological Management Plan must be compiled in respect of all actions that affect populations of Red List Plant Species, and such Ecological Management Plans must conform to Guidelines set out below.

9.3.2 Setting of buffer zone widths

- In urban areas, a minimum buffer zone of 200 (two hundred) meters is required from the edge of a Red List Plant Species population;
- In rural areas, a larger buffer zone width is required to protect populations of Red List Plant Species from detrimental edge effects that are active over distances greater than 200 metres, in accordance with their priority grouping:
  - A1 priority grouping - a buffer zone of at least 600 (six hundred) meters from the edge of the Red List Plant Species population must be allowed;
  - A2 priority grouping - a buffer zone of at least 500 (five hundred) meters from the edge of the Red List Plant Species population must be allowed;
  - A3 priority grouping - a buffer zone of at least 400 (four hundred) meters from the edge of the Red List Plant Species population must be allowed; and
  - B priority grouping -a buffer zone of at least 300 (three hundred) meters from the edge of the Red List Plant Species population must be allowed.

9.3.3 Ecological Management Plans

A person/organisation/applicant wishing to undertake any action that affects a population of a Red List Plant Species must prepare an Ecological Management Plan:

- An Ecological Management Plan must be compiled by a suitably qualified ecologist (at least a BSc (Hons) in Plant Ecology or equivalent) as approved by the Department;
- The implementation of the Ecological Management Plan is the responsibility of an appropriate management authority, such as a body corporate or section 21 company, vested with the authority to ensure the correct ecological management of the area where the Red List Plant Species population is growing;
- The Ecological Management Plan must:
  - Ensure the persistence of the Red List Plant Species population;
  - Include a monitoring programme that monitors the size, stage structure and vigour of the Red List Plant Species population as well as threats to the population;
  - Facilitate/augment natural ecological processes such as fire and herbivory;
  - Provide for the habitat and life history needs of important pollinators;
  - Minimise artificial edge effects (e.g. water runoff from developed areas and application of chemicals);
  - Include an ongoing monitoring and eradication programme for non-indigenous species with specific emphasis on invasive and weedy species; and
  - Result in a report back to the Department on an annual basis;

- Mitigatory measures are required to protect the Red List Plant Species population during construction;
- Only species indigenous to South Africa may be used for landscaping, with plant species locally indigenous to the region or found naturally growing in areas authorized for development being preferred;
- Landscaping must include forage and host plants required by pollinators; and
- Before construction is initiated, all areas earmarked for an authorized development must be fenced off from those areas to be retained as an open space system, and all construction-related impacts (including service roads) must be contained within the fenced-off development areas.

10 Photographic Records

Photo 1: Example of pristine ridge habitat

Photo 2: Example of Red Data habitat (*Cheilanthes deltoidea*)

Photo 3: Example of *Cheilanthes deltoidea*

Photo 4: Example of *Melolobium subspicatum*

Photo 5: Example of existing lines in AV_Route 3

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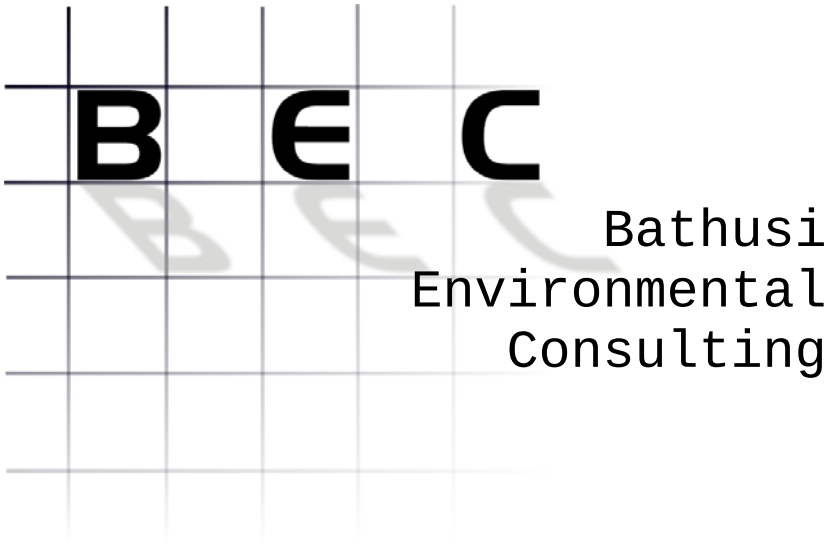
DEA Ref: 12/12/20/1470

Terrestrial Biodiversity EIA Report for the proposed Tshwane Strengthening Project – Phase 1 - Apollo-Verwoerdburg 400kV Line

submitted by



January 2010

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I Specialist Investigators

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).

Investigator: Riaan Robbeson (Pr.Sci.Nat.) (BEC)
Qualification: M.Sc. (Plant Ecology, UP)
Affiliation: South African Council for Natural Scientific Professions
Registration number: 400005/03
Fields of expertise: Botanical Scientist & Ecological Scientist.
Affiliation: Grassland Society of Southern Africa
Status: Professional Member

Investigator: Dewald Kamffer (Pr.Sci.Nat.)
Capacity: Faunal Investigator
Qualification: M.Sc. (Conservation Biology)
Affiliation: South African Council for Natural Scientific Professions
Registration number: 400204/05
Fields of expertise: Ecological Scientist & Zoological Scientist.

II Declaration of Independence

- All specialist investigators, project investigators and members of companies employed for conducting this particular investigation declare that:
- We act as independent specialists for this project.
- We consider ourselves bound to the rules and ethics of the South African Council for Natural Scientific Professions.
- At the time of completing this report, we did not have any interest, hidden or otherwise, in the proposed development as outlined in this document, except for financial compensation for work done in a professional capacity, in terms of the Environmental Impact Assessment Regulations, 2006.
- We will not be affected in any manner by the outcome of the environmental process of which this report forms part of, other than being part of the public.
- We do not have any influence over decisions made by the governing authorities.
- 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.
- Undertake to disclose to the National Department of Environmental Affairs and Tourism, any material information that have or may have the potential to influence its decision or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2006;

- Will provide the National Department of Environmental Affairs and Tourism 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 formally register as an Interested and Affected Party.

III Glossary of Terms

Alternatives: A possible course of action, in place of another, that would meet the same purpose and need but which would avoid or minimize negative impacts or enhance project benefits. These can include alternative locations/sites, routes, layouts, processes, designs, schedules and/or inputs. The "no-go" alternative constitutes the 'without project' option and provides a benchmark against which to evaluate changes; development should result in net benefit to society and should avoid undesirable negative impacts.

Biome: Any major ecological community of organisms, usually characterized by a dominant vegetation type.

Bryophyte: include all embryophytes ('land plants') that are non-vascular, having tissues and enclosed reproductive systems, but lacking vascular tissue that circulates liquids. They neither have flowers nor produce seeds, reproducing via spores.

Cumulative impacts: The combined or additive effects on biodiversity or ecosystem services over time or in space. They may seem to be insignificant when seen in isolation, but collectively they have a significant effect

Direct impacts: Those that take place at the same time and in the same space as the activity, e.g. clearing of natural vegetation for agriculture.

Direct, indirect and cumulative impacts: Decision makers need to know the direct, indirect and cumulative impacts of a proposed activity on the environment, if they are to take informed decisions in line with sustainable development.

Ecologically sensitive ecosystem: One where relatively even minor disturbances may result in substantial and significant changes.

Ecosystems: Include living (e.g. plants, animals) and non-living (e.g. minerals, soil, water) components, which can be defined in terms of distinguishing characteristics (e.g. a wetland ecosystem, a freshwater ecosystem, a terrestrial ecosystem, a forest ecosystem, etc.).

Endemic or range-restricted species or ecosystem: One whose distribution is confined to a particular and often very limited geographical region.

Environment: Broadly covers our surroundings and the characteristics of those surroundings that influence our health and wellbeing. That is, the environment includes all living organisms (plants, animals and other life), the physical environment (land, water and air), as well as social, economic and cultural conditions. Sometimes we speak of 'the natural environment' and 'the built environment', to differentiate between natural and man-made systems.

Epihydate: A plant that grows on another plant but without deriving nourishment from it and not parasitic, as some ferns and orchids growing on trees.

Habitat: The place or type of site where an organism or population naturally occurs.

Helophyte: A biennial or herbaceous plant of which only the buds survive a harsh period, such as winter.

Hydrophyte: A plant that only grows wholly or partly submerged in water.

Indigenous: Native to a particular area.

Impact Assessment (IA): A process that is used to identify, predict and assess the potential positive and negative impacts of a proposed project (including reasonable alternatives) on the environment and to propose appropriate management actions and monitoring programmes. IAs are used to inform decision-making by the project proponent, relevant authorities and financing institutions. The process includes some or all of the following components: screening, scoping, impact assessment and decision-making.

Indirect impacts: Occur later in time or at a different place from the activity, e.g. extraction of groundwater for irrigation leads to changes in the water table and affects distant water users.

Irreplaceable loss: When it results in the loss of a resource without substitute, and which cannot be replaced. An impact leading to irreplaceable loss of biodiversity is, by definition, irreversible

Irreversible impact: One that arguably cannot be reversed in time (e.g. decrease in area of a specific vegetation type, loss of genetic diversity through reduction in size of populations of a particular species). Some, but not all, irreversible impacts will lead to irreplaceable loss of biodiversity. They may, or may not, be acceptable to society or stakeholders in terms of their current values

Issue: A context-specific question that asks “what, or how severe, will the impact of some activity/aspect of the development be on some element of the environment?”

Lichen: A lichen is a symbiosis; two or more organisms living together such that both are more successful within the partnership than they would have been if they were living on their own. With lichens the basic components of this partnership are a fungus (mycobiont) and one or more algae and/or cyanobacteria (photobiont).

Natural resources: Include living and non-living materials that can be exploited or used by people. Natural resources form part of ecosystems, and our living natural resources contribute to biodiversity. Some people use ‘natural resources’ to mean the same thing as biodiversity or ecosystem services.

Precautionary Principle: States that “where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation.

Protected area: As defined by National Environmental Management: Protected Areas Act, 2003 (No. 57 of 2003).

Protected species or ecosystem: One that is protected by law from particular activities and land uses.

Red Data Book' or 'Red List': Provides information on threatened species.

Significance: A term used to evaluate how severe an impact would be, taking into account objective or scientific data as well as human values. A specific significance rating should not be confused with the acceptability of the impact (i.e. an impact of low significance is not automatically "acceptable").

Species: A group of plants, animals, micro-organisms or other living organisms that are morphologically similar; that share inheritance from common ancestry; or whose genes are so similar that they can breed together and produce fertile offspring.

Suffrutex: A low-growing woody shrub or perennial with woody base.

Sustainable development: Development that meets the needs of the current generation without compromising the ability of future generations to meet their own needs and aspirations, or improving the quality of human life while living within the carrying capacity of supporting ecosystems".

Threatened species or ecosystem: Species/ ecosystems that are at risk of going extinct in its natural range. It may be 'critically endangered' at extremely high risk, 'endangered' at very high risk, or 'vulnerable' at high risk. Species or ecosystems at low or no risk are not 'threatened', and fall into the 'near threatened' or 'least concern' categories.

IV Legislation

Compliance with provincial, national and international legislative aspects is strongly advised in the planning, assessment, authorisation and execution of this particular project. In the compilation of this report, the following legislative aspects were taken into consideration, but were not necessarily limited to:

- Biodiversity Act (No. 10 of 2004);
- Conservation of Agricultural Resources Act 43 of 1983;
- Constitution of the Republic of South Africa (Act 108 of 1996);
- Convention on Biological Diversity, 1995;
- Convention on International Trade in Endangered Species of Wild Life and Fauna;
- Environmental Conservation Act (No. 73 of 1989);
- National Environmental Management Act (No. 107 of 1998);
- National Forests Act, 1998 (No 84 of 1998);
- Protected Areas Act (No. 57 of 2003); and
- White Paper on the conservation and sustainable use of South Africa's biological diversity.

V Table of Contents

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1 Executive Summary

The aim of this report is to provide the reader with an overview of biodiversity attributes and the inherent biodiversity sensitivity of the respective corridor options, extension of the existing Verwoerdburg Substation and surrounding areas. Results of site investigations are encapsulated in this EIA in order to highlight specific areas or sensitive aspects that are likely to be affected adversely by the proposed development.

1.1 Biophysical Attributes

Only biophysical attributes that have a direct bearing on the current status of the ecology/ biodiversity of a region are discussed and assessed in this document. The proposed corridor options comprise significant areas of importance in terms of C-PLAN. Attributes that will potentially be affected include the following:

- ridges;
- perennial rivers;
- non-perennial rivers;
- primary vegetation;
- RD Mammal;
- RED Invertebrate historic location;
- Red Data plant confirmed location;
- Red Data plant historic location;
- Red Data plant metapopulation;
- Orange Data plant confirmed location;
- Orange Data plant historic location; and
- Orange Data plant metapopulation.

Areas of surface water that will potentially be affected by the corridor options include a perennial river and non-perennial stream. A Class 3 ridge will potentially be affected by some of the corridor options, particularly in the middle sections of AV_Routes 1 and 2. The current status of the region is relatively transformed, with some areas of remaining natural habitat remaining in the region. Urbanisation, stands of exotic trees and agriculture represents the major land transformation effects within the region. Road infrastructure has caused a relative high degree of habitat fragmentation and isolation. The three corridor options are situated within the Carletonville Dolomite Grassland vegetation type. This vegetation type is regarded as Vulnerable.

The biophysical sensitivity of the corridor options is largely determined by the transformation status of the area. Natural habitat associated with ridges and wetlands are regarded highly sensitive and existing information indicates a high biophysical sensitivity within the northern part of the corridor options. AV_Route 1 and AV_Route 2 comprise the highest total of Medium-high and High biophysical sensitivities when added together, although AV_Routes 3 and 3a comprise some areas of High biophysical sensitivity. The

biophysical assessment indicates a high sensitivity associated with AV_Routes 1 and 2 in terms of biophysical attributes. Although certain biophysical attributes within AV_Routes 3 and 3a are regarded sensitive, mitigation against significant impacts is regarded possible.

1.2 Floristic Attributes

The aim of this section is to provide the reader with an overview of floristic attributes of the corridor options.

Available data on the SANBI database indicates the presence of approximately 906 species within the ¼-degree grid (2528CC) in which the study area is situated. The prominence of herbs, shrubs, grasses and geophytes indicates a high diversity of habitat types, dominated by a grassland physiognomy. The high floristic diversity provides indication that extensive parts of the study area comprises pristine habitat. Numerous invasive and exotic species are however present throughout the region. A total of 133 plant families are represented in the study area, including Poaceae, Fabaceae, Asteraceae and Cyperaceae.

An analysis of aerial photographs and results of the field surveys revealed the following floristic habitat types within the corridor options:

- Degraded Grassland Habitat Medium-low Floristic Sensitivity;
- Natural Grassland Habitat Medium-high Floristic Sensitivity;
- Ridge Habitat Type High Floristic Sensitivity;
- Stands of Exotic Trees Low Floristic Sensitivity;
- Transformed Areas Low Floristic Sensitivity; and
- Wetland Habitat Types Medium-high Floristic Sensitivity.

A separate report was compiled to indicate the presence and extent of Red/ Orange Listed plant species within the general area. These sensitivities were incorporated into the integrated floristic sensitivity map that considered the sensitivity of the corridor options as it relates to the presence of Red and Orange Listed plant species as well as results obtained from the floristic sensitivity analysis.

The presence of extensive High sensitivity areas within AV_Routes 1 and 2 renders these options effectively unsuitable for the proposed development. The High floristic sensitivity within these options is ascribed on the basis of the presence of Red Data flora species, sensitive ridges and pristine vegetation. While extensive Medium-high sensitivity areas are present within AV_Routes 3 and 3a, mitigation of potential impacts on pristine vegetation is regarded possible.

1.3 Faunal Attributes

The aim of this section is to provide the reader with an overview of faunal attributes and inherent faunal sensitivity of the study area. The main focus of this assessment is on endangered or sensitive animal species that could be expected to be found in the region of the study area. The likelihood of these animals being present within the region is estimated by using known geographic distributions of these species and comparing these species' usually very specific habitat requirements with those present in the study area.

Naming precedence of faunal habitat types are in accordance with the floristic habitat types identified previous sections, including:

- Grassland Habitat (Natural and Degraded) Medium-high Faunal Sensitivity
- Ridge Habitat Type High Faunal Sensitivity
- Stands of Exotic Trees Low Faunal Sensitivity
- Transformed Areas Low Faunal Sensitivity
- Wetland Habitat Types Medium-high Faunal Sensitivity

AV_Route 3 comprises no high sensitivity areas, rendering this option more suitable for the proposed development than either of the other two options, which comprises relative large areas of high faunal sensitivities. The current status of grassland habitat within existing servitudes (AV_Routes 3 and 3a) indicates that it is possible to mitigate expected impacts within a grassland habitat.

- A total of 58 butterfly species are listed for the Q-grid 2528CC, including one Red Data species, namely the Marsh Sylph (*Metisella meninx*).
- A total of 12 frog species are listed for the Q-grid 2528CC, including one Red Data species, namely the Giant Bullfrog (*Pyxicephalus adspersus*).
- A total of 45 reptile species are listed for the Q-grid 2528CC. No Red Data reptile species are regarded likely to occur in the study area.
- A total of 80 mammal species are listed for the region of the study area, including 19 Red Data species.

AV_Route 1 is regarded the most diverse in terms of available faunal habitat and is expected to exhibit the highest faunal diversity. However, none of the Red Data species listed for the general area are highly likely to be found in the study area. One species of concern is however considered a likely inhabitant, namely *Ichnestoma stobbiai*.

AV_Route 2 is regarded the second-most diverse in terms of available faunal habitat of the three corridor options. It is likely to host all of the terrestrial species found in the study area of AV_Route 1, but lack the aquatic and amphibian species limited to the wetland habitat found within AV_Route 1. It is also considered a likely host of *Ichnestoma stobbiai*.

AV_Routes 3 and 3a are the least diverse in terms of faunal habitat. It is likely to host all of the terrestrial grassland species found in the general study, but will lack the aquatic and amphibian species limited to the wetland habitat as well as the ridge specialist species found on the dolomite Ridge Habitat of AV_Routes 1 and 2.

1.4 Ecological Interpretation

Results of the respective floristic and faunal sensitivity analysis are combined to present an overview of the ecological sensitivity of the habitat types identified in the assessment. The following ecological sensitivities are ascribed to habitat types:

- Degraded Grassland Habitat — Medium-high Ecological Sensitivity;
- Natural Grassland Habitat — Medium-high Floristic Sensitivity;
- Ridge Habitat Type — High Floristic Sensitivity;
- Stands of Exotic Trees — Low Floristic Sensitivity;
- Transformed Areas — Low Floristic Sensitivity; and
- Wetland Habitat Types — Medium-high Floristic Sensitivity.

The integrated floristic sensitivity map is regarded representative of the biodiversity sensitivity of the area, indicating that AV_Routes 1 and 2 are not regarded suitable for the proposed development as a result of the presence of various Red/ Orange Data flora species and communities within these two corridor options. Either of AV_Routes 3 or 3a is therefore recommended for the proposed development, although fairly extensive Medium-high ecological sensitivity areas are present within this option. Evidence along existing servitudes bears sufficient evidence to the potential to mitigate expected impacts. AV_Route 3a is regarded slightly more preferable as it is slightly shorter in distance.

1.5 Impact Assessment

Rating of impacts is based on the estimated effect that construction and operation of powerlines will have on terrestrial biodiversity and ecological attributes of the study area. No impacts were identified that could lead to a beneficial impact on the identified habitat type within the study area since the proposed development is largely destructive. Potential impacts include the following, but are not necessarily limited to:

- Direct impacts:
  - Destruction of threatened flora & fauna species & associated habitat;
  - Direct impacts on common fauna species;
  - Destruction of sensitive/ pristine regional habitat types;
- Indirect Impacts:
  - Impacts on surrounding habitat/ species;
- Cumulative Impacts:
  - Impacts on local and national conservation obligations & targets;
  - Increase in local and regional fragmentation/ isolation of habitat; and
  - Increase in environmental degradation.

Expected impacts are mostly as a result of the physical disturbance of surface areas and clearance of servitudes during the construction period. Impacts within the Ridge Habitat are regarded to be highly significant and expected impacts are regarded unacceptable, particularly since various Red/ Orange Data plant species are known to occur within this environment. Corridor options that comprise highly sensitive habitat types are therefore regarded unsuitable for the proposed development and the 'No Go' option is therefore recommended for AV_Routes 1 and 2.

Impacts within the remainder of the area (AV_Routes 3 and 3a) are regarded to be of moderate nature and the implementation of generic mitigation measures is expected to minimize likely impacts within these environments.

Impacts during the operational phase of the project are mostly restricted to the maintenance procedures within the servitudes as well as latent effects of habitat alteration. Impacts are generally regarded to be of a moderate nature and the implementation of generic mitigation measures are expected to decrease the significance of impacts to an acceptable level within AV_Routes 3 and 3a. AV_Route 3a is regarded slightly more preferable as it comprises a slightly shorter distance.

2 Project Background

The current Eskom transmission network supplies Tshwane Municipality via three points, namely Kwagga, Njala and Verwoerdburg. The contracted reserve capacity at each point is reviewed annually and the latest information indicates that Kwagga's reserve capacity is 840MVA, Njala is 650MVA and Verwoerdburg is 200MVA. Meter measurements at the respective points indicate that the maximum loading has reached 920MVA at Kwagga (2007), 700MVA at Njala (2007) and 208MVA at Verwoerdburg (2007).

Tshwane has subsequently applied for new supply points and a step load increase to Eskom Transmission and Distribution. A number of options were analyzed based on technical and economical benefits to all parties involved and the proposed solution, which is known as the City of Tshwane Electricity Supply Plan Scheme proposed to build four new substations in the Tshwane area. Three will be built by ESKOM and one will be built by Tshwane. These four substations are ESKOM Phoebus 400/275/132kV Substation; ESKOM Verwoerdburg 400/132kV Substation; ESKOM Anderson 400/132kV Substation and Tshwane 400/132kV Wildebees Substation. The proposed solution will meet the Tshwane electricity requirement, representing the less costly option in addition to de-loading the heavily loaded Minerva and Apollo Substations. Phase 1 of this scheme entails the following:

- Construction of 275kV line from Phoebus to Kwagga Substation (30km); and
- Establishment of Phoebus Substation; and
- Extension of the existing Kwagga Substation.

This report deals specifically with the last aspect of Phase 1.

3 Introduction

When natural systems are rezoned for development, indigenous flora are replaced by exotic species and converted to sterile landscapes with no dynamic propensity or ecological value. Additionally, development rarely focus on decisive planning to conserve natural environments, while little thought is normally given to the consequences on the ecological processes of development in highly sensitive areas.

Transformation and fragmentation of natural habitat are not the only results of unplanned or intended developments; loss of ecosystem functioning and ultimately the local extinction of species can also result. Careful planning will therefore not only preserve rare and endemic species and communities, but also conserve the ecological integrity of ecosystems of the landscape level which is imperative for the continuation of natural resources, such as fossil fuels, water and soils with agricultural potential.

In 1992, the Convention of Biological Diversity, a landmark convention, was signed by more than 90% of all members of the United Nations. The enactment of the National

Environmental Management Biodiversity Act, 2004 (Act No. 10 of 2004), together with the abovementioned treaty, focuses on the preservation of all biological diversity in its totality, including genetic variability, natural populations, communities, ecosystems up to the scale of landscapes. Hence, the local and global focus changed to the sustainable utilisation of biological diversity.

4 Scope of Work

- Compile a report on the regional biodiversity sensitivities of the region, specifically the three corridor options;
- Assess the status of biophysical attributes within the corridor options and extension of the existing Verwoerdburg Substation that have a bearing on biodiversity of the study area;
- Obtain relevant Red Data flora information and evaluate Red Data taxa probabilities;
- Obtain PRECIS data in order to highlight existing knowledge of the species richness of the region;
- Compile biophysical, floristic, faunal and an integrated ecological sensitivity map that will highlight areas of importance as it relates to the construction and operation of power lines within the natural environment;
- Assess the status of biodiversity attributes in areas identified as sensitive to the construction and operation of power lines;
- Identify any areas that may be considered 'no-go' areas from a biodiversity perspective;
- Provide a description of the general ecological status of corridor options and evaluate the status of Red Data flora and fauna habitat and probabilities of occurrence for Red Data species;
- Assess the ecological sensitivity of corridor options to the construction and operation of power lines subsequent to the implementation of suitable mitigation measures; and
- Assess the nature and extent of the potential impacts that are likely to result from the construction and operation of power lines on the ecological integrity of corridor options during the construction and operational phases;
- Assess and propose potential mitigation measures that can be applied during the construction and operational phases that will minimize impacts on the biodiversity of the corridor options.

5 Limitations of this Investigation

- This report is based on a strategic investigation and selective sampling of some parts of the study area.
- No detailed or long-term investigation of biological attributes and biological diversity that may be present in the study area was conducted.
- This company, the consultants and/or specialist investigators do not accept any responsibility for conclusions, suggestions, limitations and recommendations made in good faith, based on the information presented to them, obtained from these strategic assessments or requests made to them for the purpose of this report.
- No definite conclusions may therefore be drawn with regards to biological diversity or conservation strategies as far as this report or the study area is concerned.
- Additional information may come to light during a later stage of the process for which no allowance could have been made at the time of this report.
- BEC withholds the right to amend this report, recommendations and/ or conclusions at any stage of the project should significant or additional information comes to light.
- Information contained in this report cannot be applied to any other area, however similar in appearance or any other aspect, without proper investigation.

6 Approach to the Study

While a proper knowledge of the biodiversity of the region is not negotiable to the ultimate success of this project, an attempt was made to remove any subjective opinions that might be held on any part of the study area as far as possible. Inherent characteristics of a project of this nature implies that no method will be foolproof, mainly as a result of shortcomings in available databases and lack of site specific detail that could be obtained from detailed site investigations conducted over a short period of time. It is an unfortunate fact that inherent sensitivities within certain areas are likely to exist that could not be captured or illustrated during the process. This is a shortcoming of every scientific study that has ever been conducted; it simply is not possible to know everything or to consider aspects to a level of molecular detail. However, the approach followed in this study is considered effective in presenting objective comments on the comparison of biodiversity sensitivity of parts in the study area.

In order to present an objective opinion of the biodiversity sensitivity of the corridor options and how this relates to the suitability/ unsuitability of any option in terms of the proposed development, all opinions and statements presented in this document are based on three aspects, namely:

- Specialist interpretation of available data, or known sensitivities of certain aspects;
- Augmentation of existing knowledge by means of field surveys and site specific information; and
- An objective mathematical calculation of results obtained from the process.

6.1 Background Information

All species have certain habitat preferences and specific requirements in terms of nutrient/ food requirements, shelter, moisture, etc. in order to successfully live and propagate. For most species on earth, these specific requirements are not known. The ability to withstand changes to the environment in which a species occur is generally known as the tolerance level of that species. These tolerance levels have plastic and elastic characteristics which complicate the process of impact assessments as the immediate and long-term reaction of species to forced changes is mostly not known.

Common species are generally characterised by high tolerance levels and these species are able to adapt to changing and varying habitat types. In contrast, most threatened and conservation important species have extremely low tolerance levels to habitat changes and other impacts, which is a main reason for their threatened status. Slight changes to the environment in which these species occur might result in catastrophic impacts on the community. The identification of areas in which these species occurs represent a major objective of this study.

The overall goal of this particular investigation is to therefore to assess the biodiversity sensitivities of the local region by means of the Ecosystem Approach or Landscape Ecology. The Ecosystem Approach is advocated by the Convention on Biological Diversity. It recognizes that people and biodiversity are part of the broader ecosystems on which they depend, and that it should thus be assessed in an integrated way is the study of spatial variation in landscapes at a variety of scales. Principles of the Ecosystem Approach include the following:

- The objectives of ecosystem management are a matter of societal choice.
- Ecosystem managers should consider the effects of their activities on adjacent and other systems.
- Conservation of ecosystem structure and functioning, to maintain ecosystem services, should be a priority target.
- Ecosystems must be managed within the limits of their functioning.
- The approach must be undertaken at appropriate spatial and temporal scales.
- Objectives for ecosystem management should be set for the long-term.
- Management must recognise that change is inevitable.
- The approach should seek an appropriate balance between, and integration of, conservation and use of biodiversity.
- All forms of relevant information should be considered.
- All relevant sectors of society and scientific disciplines should be involved

For the purpose of this particular study a local scale was selected as suitable in terms of the size of the study area. The approach of Landscape Ecology includes the assessment of biophysical and societal causes, consequences of landscape heterogeneity and factors that causes disturbance to these attributes. In laymen's terms it implies that if sensitive

habitat types/ ecosystems (frequently associated with biodiversity elements of high sensitivity or conservation importance) are protected, species that are highly sensitive to changes in the environment will ultimately be protected. Species conservation is therefore replaced by the concept of habitat conservation. This approach is regarded effective since the protection of sensitive ecosystems will ultimately filter down to species level.

It is inevitable that the Landscape Ecology Approach will not function effectively in all instances since extremely localised and small areas of sensitivity do occur scattered in the study area, which are not always captured on available databases or might have been missed during the site investigations. A safeguard in this regard is also represented by the final phase of the project that will involve a detailed walkthrough of the selected routes. During this phase these small and localised areas can be avoided by means of localised deviations of sections of the line or moving tower structures to areas of lower sensitivity.

The compilation of exhaustive species lists and the identification and description of localised ecological habitat types did not represent objectives of this study. It was regarded important to identify areas of sensitivity on a local scale and, where possible, communities or species that are considered sensitive in terms of impacts that are likely to result from the proposed development.

This ecological investigation therefore aims to:

- Determine the sensitivity of the receiving natural environment as it relates to the construction and operation of powerlines in a natural environment;
- Highlight the known level of biodiversity;
- Highlight flora and fauna species of conservation importance that are likely to occur within the study area;
- Estimate the level of potential impacts of the construction and operation of proposed power lines on the biological resources of the study area;
- Make contributions in the route selection in order to prevent unacceptable adverse impacts in the biological environment; and
- Apply the Precautionary Principal throughout the assessment[1].

6.2 Assessment of Biophysical Attributes

6.2.1 Data Selection Process

Available databases of biophysical attributes are implemented to identify regional areas of importance as it relates to biodiversity. Biophysical attributes that are known to be associated with biodiversity aspects of importance, conservation potential or natural status of the environment were implemented to compile the ecological sensitivity analysis of the study area. These attributes include the following:

[1] (www.pprinciple.net/the_precautionary_principle.html).

- Areas of known floristic or faunal importance (C-Plan Version 2);
- Areas of surface water;
- Degradation classes (ENPAT Land Cover Classes);
- Regional vegetation types (VEGMAP);
- Land cover categories; and
- Ridges (as classified by GIS analysis, slopes exceeding 5° or 8.8%).

The first step in assessing the biophysical aspects of importance is the delineation of natural habitat, or the exclusion of transformed or degraded habitat. Areas that are transformed as a result of human activities, including agriculture, mining, urban development, etc, constitute parts of the study area where no natural habitat remains and where natural biodiversity is entirely compromised, to the extent that any recovery to a previous, pristine status is regarded impossible. These areas are generally suitable for the purpose of construction and operation of power lines since impacts on important biological resources are regarded unlikely. Ultimately, areas that are characterised by high levels of transformation or degradation or which are characterised by low occurrences of biophysical aspects or biodiversity importance, will be considered more suitable for the proposed development, compared to areas constituting large tracts of untransformed and sensitive habitat types.

Secondly, sensitivity values are ascribed to biophysical attributes based on how these contribute to biological diversity or sensitivity. Ultimately all the information is compiled to present a holistic picture of the areas where biophysical aspects of importance occur, presenting a map that depicts regional biodiversity sensitivities based on biophysical attributes.

6.2.2 Biophysical Sensitivities - GIS Analysis

The method that is described below is believed to present a holistic view of the biodiversity sensitivity of an area, based on available data as well as the specialist's interpretation of the sensitivity of aspects that are contained in the databases. In specific cases an adjustment of sensitivity of certain areas were made based on information that was obtained from field surveys as well as information that was presented from landowners and interested parties.

The GIS analysis of data was compiled in following stages, namely:

- As a first approximation an assessment was compiled during which available databases were assessed for suitability of use in this particular project. Every attempt was made to utilise the most recent available data; databases were replaced as newer information became available even during late stages of the assessment. Each database was separated into different aspects in terms of how it affects biodiversity sensitivity on a local and regional scale:

- A certain biodiversity sensitivity was ascribed to respective attributes of each database, for example, the 'Land Cover' database was separated into respective classes in the manner in which it affects the local and regional biodiversity sensitivity, i.e. classes such as 'Agricultural', 'Urban Developments' and 'Degradation' was grouped and ascribed a LOW value;
- Care was taken to avoid duplicity between the various databases, for instance, aspects such as 'Woodland' and 'Grassland' was omitted from the 'Land Cover' database as these classes are adequately represented by the VEGMAP database;
- Care was also taken of existing gaps of information in available databases, for example; while the ENPAT database of rivers does reflect larger rivers on a national scale, additional data is available in other databases that are not necessarily captured in the ENPAT database;
- Where a single database contains different classes of sensitivity, these databases were split in the respective classes for layering;
- Available databases were subsequently integrated in order to determine the maximum sensitivity of a particular parcel of land;
- The resultant map provided a basic assessment of the potential sensitivity on a local and regional scale;

- The last step in the analysis represents the calculation of sensitivity classes within the proposed corridors. The compiled image of the biodiversity sensitivity map was 'clipped' with each of the corridors and the extent (in hectares) of each sensitivity class (0 – 5) was calculated and subjected to further analysis (please refer Section 15 of this document, for calculation procedures).

6.3 Assessment of Floristic Attributes

6.3.1 Floristic Patterns & Regional Diversity

In order to obtain an overview of the status of the vegetation within the study area, a selection of sample plots was investigated throughout the study area. Strategic investigation into the status of the vegetation included the following:

- Comments pertaining to general floristic diversity;
- General status of vegetation;
- Presence and status of primary vegetation;
- General land transformation and degradation status;
- Habitat suitability for Red Data flora species;
- General sensitivity pertaining to the construction and operation of power lines;
- Baseline PRECIS data obtained from SANBI was obtained to present an overview of the regional diversity of plants; and
- Data and information obtained from landowners during interviews as well as information presented during the public participation process.

6.3.2 Floristic Sensitivity

The floristic sensitivity of the respective corridors is a subjective assessment of habitat types, implementing the regional vegetation types, as described in the VEGMAP database. Sensitivities are based on the following criteria:

- Delineation of all remaining natural vegetation (exclusion of all transformed and degraded habitat);
- A subjective assessment of the primary status of the vegetation during the field surveys;
- The likelihood of an area occupying a community of Red Data or protected flora species based on habitat attributes, also considering the list of Red Data species known to occur in the area; and
- General physiognomic attributes.

The total area of remaining natural vegetation occupied within the respective corridors was calculated by GIS analysis and estimated floristic sensitivities ascribed to each vegetation type, as follows:

No/ Zero Floristic Sensitivity	0
Low Floristic Sensitivity	1
Medium Floristic Sensitivity	3
Medium-High Floristic Sensitivity	4
High Floristic Sensitivity	5

6.3.3 Red Data Flora Assessment

A list of Red Data flora species that occur within the study area was obtained from GDACE. In most cases very little information is available about the habitat preferences of these species. However, habitat types in which these species normally occur are highlighted in the sensitivity analysis of the study area.

6.4 Assessment of Faunal Attributes

The association of faunal assemblages and vegetation communities is well known and the regional vegetation types are therefore used as an indication of the potential distribution of fauna species, taking the habitat preference and general requirements of fauna species into consideration.

6.4.1 General Faunal Diversity

Available databases are used in order to obtain an overview of the distribution patterns of fauna species in the study area. It should be noted that, because extremely limited information is available in terms of the true faunal composition of extensive parts of the study area, the species composition is by no means considered to be comprehensive. It is

however presented in order to indicate the variety of fauna species that could be encountered in the range of habitat types in the study area. Information supplied by land owners in this regard is regarded important and all information that was obtained during the environmental process is captured in the database.

Furthermore, the association of fauna species of conservation importance with certain regional habitat types will provide a good indication of the sensitivity of specific regions, highlighting areas of concern.

It should also be noted that specific disciplines, particularly invertebrates, are generally poorly sampled and little information is available on the diversity of species in most regions.

6.4.2 Red Data Fauna Probabilities

Three parameters were used to assess the Probability of Occurrence for Red Data species:

- Habitat requirements (HR) - Most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics in the study area is evaluated.
- Habitat status (HS) - The status or ecological condition of available habitat in the study area is assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Data species (especially wetland-related habitats where water quality plays a major role); and
- Habitat linkage (HL) - Movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to surrounding habitats and adequacy of these linkages are evaluated for the ecological functioning of Red Data species within the study area.

The estimated Probability of Occurrence is presented in five categories, namely:

- very low;
- low;
- moderate;
- high; and
- very high.

6.5 Impact Evaluation

Direct, indirect and cumulative impacts of issues will be assessed in terms of the following criteria.

6.5.1 Nature of the Impact

A description of what causes the effect, what will be affected and how it will be affected.

6.5.2 Spatial Extent of the Impact

Quantifying the spatial effect of impacts; whether the impact will be local (limited to the immediate area) or regional (having a far-ranging effect).

1 Limited to the site and its immediate surroundings;
2 Local/ Municipal extending only as far as the local community or urban area;
3 Provincial/Regional;
4 National i.e. South Africa; or
5 Across International borders.

6.5.3 Duration of the Impact

Determines the expected duration of the impact in terms of years.

1 Immediate (less than 1 year);
2 Short term (1-5 years);
3 Medium term (5-15 years);
4 Long term (the impact will cease after the operational life span of the project); or
5 Permanent (no mitigation measures of natural process will reduce the impact after construction).

6.5.4 Magnitude of the Impact

Quantified between the scales of small (will have not effect on the environment) and very high (will result in complete destruction of patterns and permanent cessation of processes).

0 None (where the aspect will have no impact on the environment);
1 Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected);
2 Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected);

3 Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way);
4 High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
5 Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).

6.5.5 Reversibility of the Impact

1 Reversible (regenerates naturally);
3 Recoverable (requires human input); or
5 Irreversible

6.5.6 Consequence of the Impact

Derived from the following formula:
Consequence = Severity + Reversibility + Duration + Spatial Scale

6.5.7 Probability of Occurrence

Describes the likelihood of the impact actually occurring.

0 None (impact will not occur);
1 Improbable (the possibility of the impact materialising is very low as a result of design, historic experience or implementation of adequate mitigation measures);
2 Low probability (there is a possibility that the impact will occur);
3 Medium probability (the impact may occur);
4 High probability (it is most likely that the impact will occur); or
5 Definite / do not know (the impact will occur regardless of the implementation of any prevention or corrective actions or it the specialist does not know what the probability will be based on too little published information).

6.5.8 Significance of the Impact

Based on a synthesis of the information contained in the points above and can be described as low, medium or high. Significance is determined using the following formula:
Significance of environmental impact = Consequence X Probability

- More than 60 significance points indicate HIGH environmental significance;
- Between 30 and 60 significance points indicate MODERATE environmental significance; and
- Less than 30 points indicate LOW environmental significance.

Relevant mitigation measures will be considered and impacts will then be ranked again according to the significance results after mitigation.

6.5.9 Status of the Impact

- Negative effect (i.e. at a cost to the environment);
- Positive effect (i.e. at a benefit to the environment); or
- Neutral effect on the environment.

6.5.10 Mitigation of the Impact

The degree to which the impact can be mitigated.

7 Location

The corridor options are located in the Kungwini Municipality, Gauteng Province, between Christine de Wit Road (west) and the R21 (east) (Figure 1). The proposed lines will link into an existing servitude leading to Apollo Substation. Three alternatives are being considered for this project, namely AV_Route 1, AV_Route 2, AV_Routes 3 (recommended in the avifaunal scoping report) and 3a (recommended subsequent to EIA integration meeting). A Google Earth image is presented in Figure 2.

For technical specifications pertaining to the proposed lines, the reader is referred to the main EIA document. Only aspects that could potentially affect the terrestrial biodiversity and ecology of the area will be included in this document.

8 Biophysical Habitat Attributes

While many biophysical aspects, such as geology, soils and climate, have an influence on the development of the ecology of a region, it is beyond the scope of this report to present a detailed description of every biophysical attribute and how these relate to potential impacts resulting from the construction and operation of power lines in a grassland environment. Only aspects that have a direct bearing on the current status of the ecology of a region are therefore discussed and evaluated in this document.

8.1 Gauteng Conservation Plan (C-PLAN) Sensitivities)

C-PLAN sensitivities are illustrated in Figure 3. The proposed line variants comprise significant areas of importance and sensitivity in terms of C-PLAN. Environmental aspects that will potentially be affected include the following:

- ridges;
- perennial rivers;
- non-perennial rivers;
- primary vegetation;
- RD Mammal;
- RED Invertebrate historic location;
- Red Data plant confirmed location;
- Red Data plant historic location;
- Red Data plant metapopulation;
- Orange Data plant confirmed location;
- Orange Data plant historic location; and
- Orange Data plant metapopulation.

All of these aspects were ascribed a High or Medium-high biophysical sensitivity value as part of the biophysical sensitivity analysis.

Figure 1: Location of the study area

Figure 2: Google Earth image of the general region

Figure 3: C-Plan sensitivities of the general region

8.2 Areas of Surface Water

Areas of surface water that will potentially be affected by the proposed line variants include perennial and non-perennial rivers. A perennial river and non-perennial stream is present within the corridor options (Figure 3), but were found to be relatively degraded and compromised by litter, dumping, infestation by exotic species, poor water quality and erosion. A high biophysical sensitivity was nonetheless ascribed to all wetland habitat types as part of the biophysical sensitivity analysis. These streams are present in the western part of the study area, while no areas of surface water are present in the eastern part.

Wetland habitat types contribute significantly towards the local and regional biodiversity of an area due to the atypical habitat that is present within the interface of terrestrial and aquatic habitat types. These ecotones (areas or zones of transition between different habitat types) are frequently occupied by species that occur in both the bordering habitat types, and is therefore generally rich in species. In addition, many flora and fauna species is specifically adapted to exploit the temporal or seasonal fluctuation in moisture levels in these areas and exhibits extremely narrow habitat variation tolerance levels. In addition, these areas are also visited on a frequent basis by terrestrial animals that utilise water sources on a frequent basis. Ecotonal interface areas form extremely 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. This method of seed distribution is extremely evident in the case of invasive alien tree species that occur extensively in many of the rivers and streams. The morphology of a region can also be loosely associated with the presence and diversity of aquatic habitat types. Topographically heterogeneous regions are usually associated with the presence of numerous smaller rivers and streams caused by increased run-off and slopes. Plains and areas where low slopes prevail are usually characterised by the presence of few, but large, rivers and pans, comprising extensive surface areas.

8.3 Ridges & Slopes

The corridor options will potentially affect a Class 3 ridge. Significant ridge areas are present in the middle sections of AV_Routes 1 and 2 (Figure 3).

Varied topography is recognised as one of the most powerful influences contributing to the high biodiversity of southern Africa. The interplay between topography and climate over a long period has led to the evolution of a rich biodiversity. Landscapes composed of spatially heterogeneous abiotic conditions provide a greater diversity of potential niches for plants and animals than do homogeneous landscapes. The richness and diversity of flora are found to be significantly higher in sites with high geomorphological heterogeneity and it can reasonably be assumed that associated faunal communities will also be significantly more diverse in spatially heterogeneous environments.

Ridges are characterised by high spatial heterogeneity due to the range of differing aspects (north, south, east, west and variations thereof), slopes and altitudes, all resulting in differing soil (e.g. depth, moisture, temperature, drainage, nutrient content), light and hydrological conditions. The 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. Many Red Data/ threatened species of plants and animals inhabit ridges. Due to their threatened status, Red Data species require priority conservation efforts in order to ensure their future survival. It follows that ridges will be characterized by a particularly high biodiversity; as such their protection will contribute significantly to the conservation of biodiversity in Gauteng.

At least three threatened mammal species that occur within Gauteng utilise habitat provided by ridges environment including Juliana's Golden mole (*Amblysomus julianae*), which is perhaps the most threatened small mammal in Africa. Several bird species occurring in Gauteng that are on the South African or international Red Data lists or are considered to be of conservation concern are dependent on ridges, koppies and hills. Similarly, three rare reptile species that occur in Gauteng utilise rocky habitats such as those provided by ridges. The Northern Pygmy Toad (*Bufo fenoulheti*) and the Common River Frog (*Rana angolensis*) are found in kloofs. Many Red Data butterflies (especially those belonging to the lycaenid group) occur on the southern slopes of ridges, e.g. the Heidelberg copper butterfly (*Chrysoritis aureus*) is restricted to the rocky southern slopes of the Alice Glockner Nature Reserve. *Metisella meninx* is a Vulnerable butterfly species that occurs at altitudes above 1,600m and as such, these butterflies are often present on ridge systems. Invertebrates are reliant on hilltops as thermal refugia from winter cold air drainage.

Natural corridors, which are present in unfragmented landscapes, such as rivers, riparian zones and topographic features should be retained following fragmentation. Such corridors may remain relatively self-sustaining after fragmentation as they continue to be essentially isolated in a larger matrix, unlike remnant corridors that require substantial management to counteract the external effects of the surrounding matrix. Remnant corridors only become corridors when the surrounding landscape is fragmented and until that time had been part of the overall matrix.

Ridges may have a direct effect on temperature/radiation, surface airflow/wind, humidity and soil types. Ridges also influence fire in the landscape, offering protection for those species that can be described as "fire-avoiders". Because of the influence of topography on rainfall, many streams in Gauteng originate on ridges and control water inputs into wetlands. The protection of the ridges in Gauteng in a natural state will thus ensure the normal functioning of ecosystem processes. In contrast, development of a ridge will alter these major landscape processes. For example, water runoff into streams and wetlands will increase.

8.3.1 Class 3 Ridges

Figure 4 provides an example of a Class 3 ridge, with BLACK indication the transformed areas and GREEN indicating the untransformed parts. A Class 3 ridge is classified as any ridge on which 35% to 65% of the ridge is transformed. Ridges in this class are to be designated as low impact development areas (A) and high impact development areas (B). Development should be contained within areas that are already transformed (B).

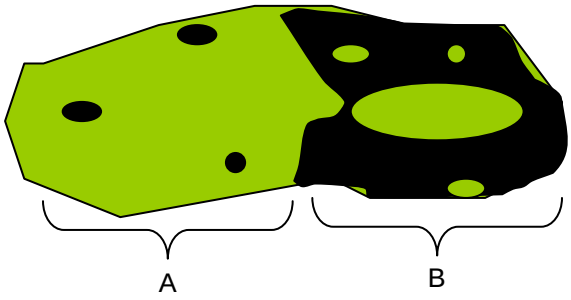

Figure 4: Example of Class 3 ridge

- **Untransformed areas:**

No further subdivisions will be allowed and consolidation of subdivisions will be encouraged. Low impact developments will be considered requiring full EIA with full set of specialist reports including, but not limited to the following:

- An ecological study, including both functional and compositional aspects;
- A Red Data study for both fauna and flora;
- An invertebrate study;
- All specialist studies to examine cumulative impacts.
- Ecological footprint of low impact developments to cover no more than 5% of a property;
- All impacts for these developments must be sufficiently mitigated;
- A management plan to maintain the ecological integrity of remaining property is required and implementation is the responsibility of the developer; and
- A 200m buffer zone of low impact development is required around class 3(A) ridges.

- **Transformed areas**

Exempt from EIA process unless:

- A Red Data species is recorded for the ridge – implementation of Red Data policy is required.

- The open space is 4ha or larger. EIA with all specialist reports (see above) is required. All policy guidelines as listed for (Untransformed areas) above are applicable.
- Surrounding community / landowners object. A scoping report is then required with specialist reports identified in accordance with public objections but should at least include a social study, including cultural, historical and open space value aspects

8.4 Land Cover & Land Use

Land cover categories are presented in Figure 5. The corridor options are located in areas that comprise extensive areas of 'Untransformed Grassland', but parts of the corridor option comprise stands of exotic trees and cultivated lands. Land transformation in the general surrounds is mostly the result of urban development, agriculture and plantations.

For the purpose of this biodiversity assessment, land cover are categorised into classes that represent natural habitat or areas that contribute to habitat degradation and transformation on a local or regional scale. The assumption is made that landscapes exhibiting high levels of transformation are normally occupied by plant communities and faunal assemblages that does not reflect the original or pristine status of an area or region.

Three important aspects are associated with habitat changes that accompany certain land uses. Transformation of natural habitat by land uses such as agriculture, mining and urbanisation results in the decimation of habitat for flora and fauna species as these areas will not return to the original pristine status. It also affects species directly; changes in species composition results from the exodus of species that are no longer able to exist in changed habitat conditions, a decrease in abundance of other species or an influx of invasive species not normally associated with the original habitat. While some, or most, of the species that occupy these changed habitat conditions might be indigenous to a region, they are not endemic to an area. Lastly a larger threat to the natural biodiversity of a region is represented by the influx of invasive exotic species and weeds that can effectively sterilise large tracts of remaining natural habitat.

Figure 5: Land cover categories of the study area

8.5 Land Transformation Effects

Figure 6 provides an indication of the remaining untransformed areas within the general surrounds. It is evident that the region is relatively transformed, with only some areas of remaining natural habitat remaining in the region. Urbanisation, stands of exotic trees and agriculture represents the major land transformation effects within the region. Road infrastructure has caused a relative high degree of habitat fragmentation and isolation.

8.5.1 Habitat Fragmentation

Habitat fragmentation is the emergence of discontinuities (fragmentation) in an organism's preferred environment/ habitat and can be caused by geological processes that slowly alter the layout of the physical environment or by human activity such as land conversion, which can alter the environment on a much faster time scale. The former is thought to be one of the major causes of speciation, while the latter is causative in extinctions of many species.

Habitat fragmentation caused by humans occurs when native vegetation is cleared for human activities such as agriculture, rural development or urbanization. Remaining habitat fragments are therefore rarely representative samples of the initial landscape. Habitats which were once continuous become divided into separate fragments. After intensive clearing, the remaining fragments tend to be small islands isolated from each other by crop land, pasture, roads, pavement or even barren land. The term habitat fragmentation includes six discrete phenomena:

- Reduction in the total area of the habitat;
- Increase in the amount of edge;
- Decrease in the amount of interior habitat;
- Isolation of one habitat fragment from other areas of habitat;
- Breaking up of one patch of habitat into several smaller patches; and
- Decrease in the average size of each patch of habitat.

One of the major ways that habitat fragmentation affects biodiversity is by reduction in the amount of available habitat for plants and animals. Plants and other sessile organisms in these areas are usually directly destroyed while mobile animals (especially birds and mammals) retreat into remnant patches of habitat, leading to crowding effects and increased competition.

Figure 6: Isolation & fragmentation of untransformed habitat in the region

Species that can move between fragments may use more than one fragment while others must make do with what is available in the single fragment in which they ended up. Area is the primary determinant of the number of species in a fragment. The size of the fragment will influence the number of species which are present when the fragment was initially created, and will influence the ability of these species to persist in the fragment. Small fragments of habitat can only support small populations of plants and animals and small populations are more vulnerable to extinction. Minor fluctuations in climate, resources or other factors, that would be unremarkable and quickly corrected in large populations can be catastrophic in small, isolated populations. Fragmentation of habitat is therefore an important cause of species extinction.

Population dynamics of subdivided populations tend to vary asynchronously. In an unfragmented landscape a declining population can be "rescued" by immigration from a nearby expanding population, but in fragmented landscapes the distance between fragments may prevent this from happening. Additionally, unoccupied fragments of habitat that are separated from a source of colonists by some barrier are less likely to be repopulated than adjoining fragments.

Additionally, habitat fragmentation leads to edge effects. Microclimatic changes in light, temperature, and wind can alter the ecology around the fragment, and in the interior and exterior portions of the fragment. Fires become more likely in the area as humidity drops and temperature and wind levels rise. Exotic and pest species may establish themselves easily in such disturbed environments, and the proximity of domestic animals often upsets the natural ecology. Also, habitat along the edge of a fragment has a different climate and favours different species from the interior habitat.

The existence of viable habitat is critical to the survival of any species, and in many cases the fragmentation of any remaining habitat can lead to difficult decisions for conservation biologists. Given a limited amount of resources available for conservation is it preferable to protect the existing isolated patches of habitat or to buy back land to get the largest possible continuous piece of land. It is however an ongoing debate and is often referred to as SLOSS (Single Large or Several Small).

8.5.2 Habitat Isolation

Habitat isolation is defined as the extent to which a parcel of land or habitat of a certain species, or community of species, is separated from other similar habitat, species or communities, where the distance of separation might be larger than what is acceptable for species that occupy an area in order to successfully navigate in order to feed, propagate or inhabit.

The degree of habitat isolation experienced by individuals of a given species depends on many factors. For example, above a particular level of habitat loss the physical distances

between habitats patches increase exponentially. For many species, rate of movement between patches of suitable habitat can be reduced as a result. Spatial scale, mobility and mode of movement (e.g. flying versus crawling) are key issues associated with considerations of the impacts of habitat subdivision and habitat isolation. The spatial scales of which a species moves and over which it perceives its environment will strongly influence the extent to which a given modified landscape is, or is not, negatively subdivided or isolated for that taxon. For example, for some small mammal and flightless insect species, a road may effectively subdivide and isolate the populations on either side of it, whereas such a road would have very limited or no impact on more mobile species.

Many of the warnings associated with the themes of habitat loss and habitat degradation are also relevant to considerations of habitat subdivision and habitat isolation. This is because, like habitat loss, what constitutes habitat subdivision and habitat isolation will be species specific. For example, the isolation of vegetation patches defined from a human perspective may not lead to habitat isolation from the perspective of some species. Even in a landscape that is extensively modified by humans, the matrix may be highly permeable for some species. Hence, actual levels of habitat isolation might therefore actually be relatively low for these taxa and recolonization rates of patches can be high. For other species, the same matrix may be 'hostile', meaning that neighbouring patches, although being located relatively close together, are actually very isolated for the specific species.

The spatial isolation of habitat can impair dispersal movements between the natural territory and suitable habitat patches, which are typically made by juvenile or sub-adult animals attempting to establish new territories. This interruption to dispersal can reduce the genetic size of populations through impaired patterns of gene flow. Importantly, effective dispersal involves not only the movement of an individual, but also its successful reproduction in the receiving population. In some cases, males and females of a given species do not respond in the same way to habitat isolation. In addition, the recolonization of vacant territories in some habitat patches by individuals originating from other habitat patches is critical for maintaining the overall demographic size of a given species population. By affecting patterns of dispersal between patches, habitat isolation can have significant effects on the occupancy of otherwise suitable habitat patches, including protected areas like nature reserves. For example, population recovery after disturbance may be imparts by habitat isolation.

Habitat isolation may shift a formerly contiguous and interacting population into a series of loosely connected subpopulations (i.e. metapopulation). A metapopulation is defined as a set of local populations which interact via individuals moving between local populations. However, patchily distribution of populations of a species does not always conform to a true metapopulation structure.

8.5.3 Transformation Sensitivities

In order to compile a map of transformation sensitivities the assumption is made that areas of transformation no longer contain any natural habitat and are therefore placed in a low biophysical sensitivity category. These areas are regarded suitable for development purposes and the assumption is also made that expected impacts within these areas will be of a less significant nature than in areas where natural habitat are still present.

Extensive areas within the study area are transformed and some parts of remaining natural habitat is highly fragmented and isolated. However, the largest extent of the study area comprises natural habitat that is characterised by high continuity, i.e., much of the transformation is nodal in nature and while high levels of transformation is present, a high level of continuity is also noted, implying that organisms are able to migrate extensive distances without having to cross any unnatural borders (moderate habitat isolation). The proposed development is not expected to contribute towards local and regional levels of fragmentation and isolation.

8.6 Regional Vegetation - VEGMAP

The three corridor options are situated within the Carletonville Dolomite Grassland vegetation type.

This vegetation type is present on slightly undulating plains dissected by prominent rocky chert ridges. Species-rich grasslands form a complex mosaic pattern dominated by many species. It is regarded as Vulnerable; small extents are conserved in statutory reserves, including Sterkfontein Caves, Oog van Malmanie, Abe Bailey, Boskop Dam Schoonspruit, Krugersdorp, Olifantsvlei and Groenkloof. Almost a quarter is already transformed by cultivation, urban sprawl or by mining activity as well as the building of the Boskop and Klerkskraal Dams. The endemic species *Delosperma davyi* occurs in this vegetation type. The following species are regarded representative of the Carletonville Dolomite Grassland vegetation type.

- **Graminoids**

Aristida congesta, Brachiaria serrata, Cynodon dactylon, Digitaria tricholaenoides, Diheteropogon amplectens, Eragrostis chloromelas, E. racemosa, Heteropogon contortus, Loudetia simplex, Schizachyrium sanguineum, Setaria sphacelata, Themeda triandra, Alloteropsis semialata, Andropogon schirensis, Aristida canescens, A. diffusa, Bewsia biflora, Bulbostylis burchellii, Cymbopogon caesius, C. pospischilii, Elionurus muticus, Eragrostis curvula, E. gummiflua, E. plana, Eustachys paspaloides, Hyparrhenia hirta, Melinis nerviglumis, M. repens, Monocymbium cerisiiforme, Panicum coloratum, Pogonarthria squarrosa, Trichoneura grandiglumis, Triraphis andropogonoides, Tristachya leucothrix and *T. rehmannii.*

- **Herbs**

Acalypha angustata, Barleria macrostegia, Chamaecrista mimosoides, Chamaesyce inaequilatera, Crabbea angustifolia, Dianthus mooiensis, Dicoma anomala, Helichrysum caespititium, H. miconiifolium, H. nudifolium, Ipomoea ommaneyi, Justicia anagalloides, Kohautia amatymbica, Kyphocarpa angustifolia, Ophrestia oblongifolia, Pollichia campestris, Senecio coronatus and *Vernonia oligocephala.*

- **Geophytic Herbs**

Boophane disticha and *Habenaria mossii.*

- **Low Shrubs**

Anthospermum rigidum, Indigofera comosa, Pygmaeothamnus zeyheri, Searsia magalismontana, Tylosema esculentum and *Ziziphus zeyheriana.*

- **Geoxylic Suffrutices**

Elephantorrhiza elephantina and *Parinari capensis* subsp. *capensis.*

This vegetation type is regarded as Vulnerable, with a conservation target of 24%. Small extents are conserved in statutory (Sterkfontein Caves – part of the Cradle of Humankind World Heritage Site, Oog van Malmanie, Abe Bailey, Boskop Dam, Schoonspruit, Krugersdorp, Olifantsvlei, Groenkloof) and in at least six private conservation areas. Almost a quarter is already transformed for cultivation, by urban sprawl or by mining activity as well as the building of the Boskop and Klerkskraal Dams.

8.7 Biophysical Sensitivities - Analysis

Ascribed biophysical sensitivities are based on a combination of the likelihood of a specific biophysical attribute being important in terms of biodiversity attributes and the expected reaction of the particular attribute to impacts associated with the construction and operation of powerlines as perceived relevant to this particular project. Sensitivities are ultimately collated and a biophysical sensitivity map is produced that presents an overview of the biophysical sensitivity of the study area on a local and regional scale.

Shortcomings of this approach are that localised and small areas of importance that are not captured in existing databases or that were not observed during the extensive field survey will not be reflected on the sensitivity map. It should be noted that areas of a small extent will be identified and appropriately avoided during the final walk-through of the project.

It is evident that the biophysical sensitivity of the corridor options is largely determined by the transformation status of the area. Natural habitat associated with ridges and wetlands are regarded highly sensitive and existing information indicate a high biophysical sensitivity within the northern part of the corridor options (Figure 7).

Figure 7: Biophysical sensitivities of the region

The extent of biophysical sensitivities within the respective corridor options are calculated in Table 2, indicating that AV_Route 1 and AV_Route 2 comprises the highest total of High and Medium-high biophysical sensitivities when added together (25.8 ha and 23.2 ha respectively); although AV_Route 3 comprises the second highest extent of High sensitivity areas (7.6 ha).

Table 1: Extent of habitat sensitivities within respective sections

Section	Low / No Sensitivity	Medium Sensitivity	Medium-high Sensitivity	High Sensitivity
AV_Route 1	17.8 ha	10.3 ha	10.7 ha	15.1 ha
AV_Route 2	16.3 ha	5.4 ha	20.2 ha	3.1 ha
AV_Route 3	1.9 ha	40.4 ha	0.0 ha	7.6 ha
AV_Route 3a	40.8 ha	34.2 ha	0.1 ha	7.2 ha

This assessment indicates the high sensitivity of AV_Route 1 and AV_Route 2 in terms of biophysical attributes. Certain biophysical attributes within AV_Routes 3 and 3a are regarded highly sensitive, but mitigation against significant impacts is regarded possible and either of these routes is regarded suitable in terms of biophysical habitat sensitivities.

Extension of the existing Verwoerdburg Substation is not expected to result in adverse impacts within high biophysical sensitivity areas. The area immediately adjacent to the existing Verwoerdburg Substation is regarded transformed and degraded.

9 Floristic Attributes of the Study Area

9.1 Regional Diversity

The compilation of detailed species lists for specific regions was not perceived as part of the scope of this environmental impact assessment and only general observations of the floristic diversity was made during the field surveys. Available data on the SANBI database indicates the presence of approximately 906 species within the ¼-degree grid (2528CC) in which the study area is situated. This high floristic diversity is the result of highly diverse biophysical attributes, including soils, geology, micro-climatic conditions, moisture regimes, slopes, aspect, rockiness, soil depth, etc. A dissemination of the growth forms that occur in the region is presented in Table 3. The prominence of herbs (344 species, 38.0%), shrubs (113 species, 12.5%), grasses (128 species, 14.1%) and geophytes (105 species, 11.6%) indicates a high diversity of habitat types. The high diversity of species also provides indication that extensive parts of the study area comprises habitat of a pristine nature in which the natural diversity of the region is reflected. The contribution of weeds and invasive species is also noted and numerous invasive and exotic species are present throughout the region.

Table 2: Growth forms in the general region

Growth Form	Number	Percentage
Bryophytes	14	1.5%
Carnivores	1	0.1%
Climbers	46	5.1%
Creepers	2	0.2%
Cyperoids	48	5.3%
Epihydates	1	0.1%
Epiphytes	2	0.2%
Geophytes	105	11.6%
Graminoids	128	14.1%
Helophytes	9	1.0%
Herbs	344	38.0%
Hydrophytes	1	0.1%
Lichens	2	0.2%
Parasites	13	1.4%
Scramblers	1	0.1%
Shrubs	113	12.5%
Suffrutex	2	0.2%
Trees	74	8.2%
Total	**906**	

A total of 133 plant families are represented in the study area. Prominent families include Poaceae (128 species, 14.1%), Fabaceae (93 species, 10.3%), Asteraceae (89 species, 9.8%) and Cyperaceae (48 species, 5.3%).

9.2 Floristic Habitat Types of the Study Area

An analysis of aerial photographs and results of the field surveys revealed the following communities and variations within the proposed corridors (Figure 8):

- Degraded Grassland Habitat;
- Natural Grassland Habitat;
- Ridge Habitat Type;
- Stands of Exotic Trees;
- Transformed Areas; and
- Wetland Habitat Types.

The extent of habitat types within the corridor options is presented in Table 4.

Table 3: Extent of habitat types within corridor sections

Habitat Type	AV_Route 1	AV_Route 2	AV_Route 3	AV_Route 3a
Degraded Grassland Habitat	12.3 ha	2.8 ha	7.0 ha	3.7 ha
Natural Grassland Habitat	17.5 ha	5.8 ha	41.0 ha	36.4 ha
Ridge Habitat Type	12.0 ha	20.2 ha	0.0 ha	0.1 ha
Stands of Exotic Trees	6.4 ha	13.6 ha	9.3 ha	5.2 ha
Transformed Areas	2.5 ha	2.6 ha	4.7 ha	0.9 ha
Wetland Habitat Types	3.2 ha	0.0 ha	0.0 ha	0.0 ha
Total	**53.9 ha**	**45.0 ha**	**62.0 ha**	**42.6 ha**

9.2.1 Degraded Grassland Habitat

This habitat type comprises grassland areas where surface disturbances led to species changes in the herbaceous layer (succession). Although the physiognomy is still grassland, the current species composition indicates irreversible changes to a sub-climax or secondary climax status. Species that dominate the composition include the grasses *Hyparrhenia hirta, H. tamba, Aristida congesta* subsp. *congesta, Eragrostis plana, E. chloromelas, E. racemosa* and *E. curvula*.

The forb layer is characteristically poor in species diversity and contains mostly species that is indicative of the disturbed nature of the vegetation, which is also reflected in the absence of dicotyledonous forbs and geophytes that frequent areas of relative pristine vegetation. Forb species that are present in this vegetation unit include *Richardia brasiliensis, Pseudognaphalium luteo-album, Helichrysum* spp, *H. nudifolium, Anthospermum rigidum, Chaetacanthus costatus, Anthospermum rigidum, H. rugulosum, Conyza podocephala, Berkheya setifera, Stoebe vulgaris, Commelina africana, Gomphocarpus fruticosus, Solanum elaeagnifolium* and *Senecio inornatus.*

The process of succession is described as directional, cumulative changes in the species that occupy an area, through time. Vegetation units where weed species (mostly annual grasses and forbs) predominate represent the pioneer communities and the initial stages of succession and are usually found immediately after the impact/disturbance. If

significant changes in species composition for an area do not occur within a period, the community is said to be a mature or climax community.

A medium-low floristic status is ascribed to these areas and the likelihood of encountering Red Data flora species within these areas are regarded low.

9.2.2 Natural Grassland Habitat

This habitat type is representative of the regional vegetation type (Carletonville Dolomite Grassland) and is regarded to be in a pristine status. The grassland physiognomy is dominant and low rocky outcrops occur scattered throughout the area. The species composition is highly diverse, comprising numerous herbs and grasses. Woody and shrub species are generally absent, or occur scattered as low bushes or clumps. A characteristic of the pristine nature of the vegetation in these parts are the fact that no particular species is found to be dominant (monospecific stands); numerous co-dominant species are encountered throughout the habitat. Also, a high diversity of herbs and forb species are present, including a high diversity of geophytes, while weedy species, although occurring, is present at low intervals.

Prominent species within these areas include the grasses *Elionurus muticus, Digitaria monodactyla, Brachiaria serrata, Themeda triandra, Tristachya rehmannii, Panicum natalense, Diheteropogon amplectens, Hyparrhenia hirta, Eragrostis* species, *Trachypogon spicatus, Urelytrum agropyroides, Heteropogon contortus, Eragrostis capensis, Setaria sphacelata, Cymbopogon plurinodis, Eustachys paspaloides, Aristida diffusa, Eragrostis racemosa* and *Pogonarthria squarrosa.* The herb layer comprise the following co-dominant species *Helichrysum* species, *Hypoxis iridifolia, Polygala hottentotta, Chaetacanthus costatus, Ledebouria ovalifolia, Sphenostylis angustifolia, Hypoxis rigidula, Indigofera* species, *Striga asiatica, Dipcadi* species, *Geigeria burkei, Scabiosa columbaria, Hermannia transvaalensis, Helichrysum callicomum, Gnidia capitata, Jamesbrittenia aurantiaca, Anthospermum rigidum, Elephantorrhiza elephantina, Aloe greatheadii, Pentanisia angustifolia, Conyza podocephala, Helichrysum nudifolium, Acalypha angustata, Boophane disticha, Becium obovatum, Dianthus mooiensis, Eriosema salignum, Raphionachme hirsuta, Helichrysum rugulosum, Commelina africana* and *Vernonia natalensis.*

The floristic status of this habitat is regarded high. Various Red and Orange Data flora species occur within this habitat type, particularly in areas that are located in close vicinity to ridges.

9.2.3 Ridge Habitat Type

This habitat type is associated with the ridges, exhibiting a high degree of rockiness and severe slopes. Soils within these parts are generally shallow and relative poor.

The species composition of these areas is, to a large extent, similar to the Natural Grassland Habitat. Variations include the presence of wooded clumps that include the species *Celtis africana, Searsia pyroides, Grewia flava, Zanthoxylon capense, Euclea crispa, Searsia discolor, Maytenus heterophylla, Diospyros lycioides, Ficus* species, *Searsia* species, *Dombeya rotundifolia, Tapiphyllum parvifolium, Acacia caffra* and *Protea welwitchii.* While the composition of the grass sward is similar to that of the Natural Grassland Habitat, some species are largely restricted to the rocky outcrops of this habitat type, including *Schizachyrium sanguineum* and *Loudetia simplex.* Forb species that are restricted to this habitat type include *Plexipus hederaceus, Schistostephium crataegifolium, Macledium macrocephalum, Xysmalobium undulatum, Tephrosia capensis, Pygmaeothamnus chamaedendrum, Rhynchosia caribaea, Crassula capitella, Senecio oxyriifolius, Parinari capensis, Cordylogyne globosa, Leonurus ocymifolia, Clematis brachiata, Pellaea calomelanos, Eulophia* species and *Xerophyta retinervis.*

Ridges in the study area is regarded pristine and of high floristic status, comprising a high diversity of plants, including various Red and Orange Data flora species.

9.2.4 Stands of Exotic Trees

Stands of *Eucalyptus* trees are present in the study area. The species composition and physiognomy is dominated by the exotic trees and a poorly developed herbaceous layer is noted in most cases. In stands where the density of trees is not particularly high, a well developed grass layer may be present, consisting almost exclusively of *Hyparrhenia hirta, Eragrostis chloromelas, E. curvula* and *E. gummiflua*.

The significance of floristic attributes of this vegetation unit is considered low. Attributes that contribute to this status include:

- being infested with declared exotic tree species;
- low species diversity; and
- low coverage of species generally associated with pristine grassland.

The removal and control of alien and exotic species is recommended and should be included in the EMP for the proposed development. The likelihood of encountering Red Data flora species within these parts are regarded low and a low floristic status is ascribed to this habitat type.

9.2.5 Transformed Areas

Transformed areas represent parts where historical or recent human activities led to the total transformation of the natural vegetation. No natural vegetation remains in these areas and the floristic status of these areas is therefore regarded low because of the presence of secondary vegetation or the entire absence of any vegetation. The likelihood of encountering Red Data flora species within these areas are regarded low and a low floristic status is ascribed to this habitat type.

9.2.6 Wetland Habitat Types

Wetland habitat types within the study area comprise a perennial river and non-perennial drainage line. Vegetation within both these areas were found to be relative degraded, but is consistent with the moist regimes, consisting of a dominant grass layer (*Imperata cylindrica, Eragrostis plana, Setaria nigrirostris, Themeda triandra* and *Hyparrhenia* spp) and a relative low diversity of sedges and forbs such as *Cyperus* spp, *Typha capensis, Verbena brasiliensis* and *Schoenoplectus corymbosus*. *Phragmites australis* dominates large parts of the perennial river and exotic trees, such as *Morus alba, Acacia mearnsii, Eucalyptus* spp. *Salix babylonica,* etc. occur extensively with some indigenous trees such as *Acacia karroo* and *Combretum erythrophyllum.* General conditions of the perennial river were also found to be severely degraded as extensive litter and obviously poor water quality is present.

A medium-low floristic status is estimated for this habitat type, mainly as a result of the degraded status of the vegetation. A medium-low likelihood of encountering Red Data flora species in this habitat type is estimated. The relative narrow ecotonal areas that are created by variance in soil moisture are rich in species.

9.3 Flora Species of Conservation Importance

The reader is referred to the additional document compiled specifically for Red Data occurring within the corridor options (Report Code SVE – ARD – 2010/17). These sensitivities will be incorporated into the integrated floristic sensitivity map.

9.4 Floristic Sensitivity Analysis

Floristic sensitivity is based on an analysis of floristic attributes, taking existing impacts and conservation potential into consideration, but also considering the potential significance of impacts resulting from the proposed development. Floristic sensitivities are calculated in Table 4 and illustrated in Figure 9.

Figure 8: Floristic habitat types within the corridor options

Table 4: Floristic sensitivity of habitat types								
Criteria	**RD species**	**Landscape sensitivity**	**Status / Ecological quality**	**Species composition**	**Functionality / fragmentation**	**TOTAL**	**SENSITIVITY INDEX**	**SENSITIVITY CLASS**
Community	**Criteria Ranking**							
Degraded Grassland Habitat	3	3	4	5	2	100	34%	**Medium-low**
Natural Grassland Habitat	8	8	8	9	7	235	76%	**Medium-high**
Ridge Habitat Type	10	10	10	9	9	285	92%	**High**
Stands of Exotic Trees	2	2	2	1	1	53	17%	**Low**
Transformed Areas	1	1	1	2	3	35	11%	**Low**
Wetland Habitat Types	6	10	5	6	8	202	65%	**Medium-high**

Figure 9: Floristic habitat sensitivity within respective corridor options

9.5 Integrated Floristic Sensitivity Analysis

The sensitivity of the corridor options as it relates to the presence of Red and Orange Listed plant species and the floristic habitat sensitivity analysis are integrated to present the final floristic sensitivity of the corridor options, as illustrated in Figure 10. An analysis of the extent of integrated floristic sensitivities within the respective corridor options is presented in Table 5.

Table 5: Extent of floristic habitat sensitivities in respective corridor options

Corridor Option	Low	Medium-Low	Medium	Medium-high	High
AV_Route 1	12.6 ha	7.4 ha	4.9 ha	38.7 ha	71.4 ha
AV_Route 2	21.3 ha	0.0 ha	2.8 ha	8.2 ha	51.7 ha
AV_Route 3	15.0 ha	2.7 ha	4.4 ha	60.1 ha	0.0 ha
AV_Route 3a	6.1 ha	0.0 ha	3.7 ha	36.4 ha	0.1 ha

The presence of extensive High sensitivity areas (associated with the confirmed presence of various Red Data flora species) within AV_Routes 1 and 2 renders these options effectively unsuitable for the proposed development. The High floristic sensitivity within these options is ascribed based on the presence of Red Data flora species, sensitive ridges and pristine vegetation.

While extensive Medium-high sensitivity areas are present within AV_Routes 3 and 3a, mitigation of potential impacts on pristine vegetation is regarded possible. This can be observed in the existing servitude alongside the proposed AV_Routes 3 and 3a corridor options.

Extension of the existing Verwoerdburg Substation is not expected to affect highly sensitive floristic habitat. The area adjacent to the existing Verwoerdburg Substation does not exhibit any floristic attributes of importance.

Figure 10: Integrated Floristic Sensitivity Analysis of the corridor options

10 Faunal Attributes of the Study Area

10.1 Faunal Habitat Types

Naming precedence of faunal habitat types are in accordance with the floristic habitat types identified previous sections, including:

- Grassland Habitat (Natural and Degraded);
- Ridge Habitat Type;
- Stands of Exotic Trees;
- Transformed Areas; and
- Wetland Habitat Types.

The distribution of the faunal habitat types are illustrated in Figure 11.

10.1.1 Grassland Habitat (Natural & Degraded)

Grassland Habitat of the study area represents the dominant original faunal habitat type of the region. Natural Grassland Habitat Type of the study area is regarded pristine and closely represents original grasslands of the study area region. Although the Degraded Grassland differs significantly from the original/ pristine grasslands, elements of the Carletonville Dolomite Grassland are also found in this habitat type. Variation in grassland physiognomy, including density, height and distribution, contribute towards total faunal habitat diversity. Additionally, attributes such as moribund termitaria, surface rock, etc. that are frequently associated with grassland habitat, also create micro-habitat that enable additional species to utilize such these areas as breeding and feeding habitat.

For instance, reptile species such as *Hemachatus haemachatus, Causus rhombeatus, Leptotyphlops scutifrons* and *Rhinotyphlops lalandei* are less likely to be found in grasslands without moribund termitaria than in grassland littered with these shelters. Red Data species listed for the area, such as *Pyxicephalus adspersus, Atelerix frontalis* and *Suncus infinitesimus,* are known to be found in grasslands (although not exclusively).

Grasslands of the study area are furthermore important corridors for the movement of species between other faunal habitat types such as ridges and wetlands. A high faunal status is ascribed to this habitat type as a result of the relative pristine status of much of the habitat, particularly the Natural Grassland areas.

10.1.2 Ridge Habitat Type

Ridge Habitat of the study area represents a unique and very important faunal habitat type. Elements that characterise this habitat are limited by nature and create unique habitat features that support small and specialized faunal communities and –assemblages. The high degree of rockiness and steeper slopes found within ridge habitats, combined

with the likelihood of cave-like structures and surface fissures commonly associated with dolomite areas, combine to create an area with unique and diverse faunal habitat qualities.

Species that rely on these habitat characteristics include bats, scorpions, geckos, skinks, smaller snakes, blue and – copper butterflies and some of the rock specialist rodents and insectivores. Red Data species listed for the general region that is likely to utilise this particular habitat type include most ridge-dependant species include *Miniopterus schreibersii, Rhinolophus clivosus* and *Rhinolophus darlingi.*

A high faunal habitat status is ascribed to this habitat type as it was found to be in a pristine status. Extremely few surface disturbances are noted and the vegetation of these areas appears to be representative of the original/ pristine regional vegetation type (Carletonville Dolomite Grassland).

10.1.3 Stands of Exotic Trees

Stands of exotic trees found in the study area represent an unnatural faunal habitat not originally found in the region of the study area. Although these areas include faunal habitat elements and additional vertical levels (arboreal) that are not found in any of the other faunal habitat types found in the study area, these elements are alien to the Grassland Biome in general and therefore also the study area. Although it is highly likely that these habitat attributes will increase the overall faunal diversity of the area (especially faunal richness) by providing nesting sites for birds, shelter for a variety of animals and feeding sites for different invertebrate assemblages, this artificial increase in faunal diversity is not regarded relevant and were therefore omitted during the sensitivity analyses; resultant high faunal diversity is not a realistic representation of the true ecological potential of this specific habitat type and the general faunal habitat diversity of the study area (similar to a zoo with a very high faunal richness but very low ecological value).

None of the Red Data species listed for the general area are likely to be found within the stands of exotic trees, except perhaps for migratory purpose, in which the case the stands of exotic trees are a hindrance rather than being an attribute.

10.1.4 Transformed Areas

Transformed areas found within the study area have little to offer in terms of faunal habitat or ecological value. These areas are likely to host only very generalist species that are likely present in all suburban gardens of the region, which are generally highly adaptable and not under any threat; this holds true on species-, assemblage- and community levels. None of the Red Data species listed for the study area are likely to be found in the transformed areas of the study area corridors. The transformed areas are

therefore regarded to exhibit low faunal status and contribute little towards the general faunal richness and –diversity of the study area and surrounding regions.

10.1.5 Wetland Habitat Types

Wetland habitat found in the study area represents unique and very important faunal habitat type. Elements and attributes that characterise this habitat are limited by nature and create unique habitat features that support small and specialized faunal communities and –assemblages. Although the wetlands of the study area are not regarded pristine in terms of current conditions (the urban nature of the surrounding regions has ensured that the wetlands have subjected to severe long-term transformation pressures) it still include wetland elements that ensure the continued residence of wetland specialist species not likely to be found elsewhere in the study area. Wetland species listed for the study area include *Lycodonomorphus rufulus, Amietia angolensis, Amietia fuscigula, Xenopus laevis* and *Melanitis leda*. Most of the Red Data species listed for the general area that are estimated to have at least a moderate probability of occurrence for the study area, can be considered wetland specialist (if not totally restricted to wetlands at least partially dependant on wetlands for breeding and/or feeding purposes). These species include *Metisella meninx, Pyxicephalus adspersus, Myosorex varius* and *Crocidura hirta*.

The wetland habitat of the study area significantly contributes towards the general faunal diversity of the study area and is of high faunal significance.

Figure 11: Faunal habitat types of the study area

10.2 Red Data & Common Faunal Probability Assessment

As a result of restrictions with regards to database availability specific faunal groups are used during the species-specific element of this faunal assessment. Data on the Q-degree level is available for the following faunal groups:

Invertebrates: Butterflies (South African Butterfly Conservation Assessment – http://sabca.adu.org.za);

Amphibians: Frogs (Atlas and Red Data Book of the South Africa, Lesotho and Swaziland);

Reptiles: Snakes and other Reptiles (South African Reptile Conservation Assessment - http://sarca.adu.org.za); and

Mammals: Terrestrial Mammals (Red Data Book of the Mammals of South Africa: A Conservation Assessment.)

Animals found to be present in the Q-grid 2528CC in the above-mentioned databases were considered potential inhabitants of the study area. Species observed in the study sites during the field investigation were added to the list of species considered relevant to the study area. The likelihood of each species' presence in the study areas were estimated based on known ecological requirements of species; these requirements were compared to the ecological conditions found in the study areas and surrounding faunal habitat.

Please note that the avifaunal component is addressed in a separate document and are therefore not included in this assessment. The known diversity of the general region is presented in the following sections. Red Data species are indicated in red.

10.2.1 Invertebrates

A total of 58 butterfly species are listed for the Q-grid 2528CC, including one Red Data species, namely the Marsh Sylph (*Metisella meninx*).

AV_Route 1: one species is estimated to have a moderate-low probability of occurrence, 3 a moderate, 20 a moderate-high and 34 a high probability of occurrence;

AV_Route 2: one species is estimated to have a low probability of occurrence; 15 a moderate, 21 a moderate-high and 32 a high probability of occurrence; and

AV_Route 3 and 3a: one species is estimated to have a low probability of occurrence; 8 a moderate-low, 15 a moderate, 2 a moderate-high and 31 a high probability of occurrence.

Table 6: Invertebrate probabilities for Apollo-Verwoerdburg

Species Details			Assessment		
Biological Name	**English Name**	**Status**	**Route 1**	**Route 2**	**Route 3 & 3a**
Acraea horta	Garden Acraea	LT	high	high	high
Acraea neobule	Wandering Donkey Acraea	LT	high	high	high
Actizera lucida	Rayed Blue	LT	high	high	high
Aloeides henningi	Henning's Copper	LT	moderate-high	moderate-high	moderate-low
Aloeides molomo	Molomo Copper	LT	moderate-high	moderate-high	moderate

Table 6: Invertebrate probabilities for Apollo-Verwoerdburg					
Species Details			**Assessment**		
Biological Name	**English Name**	**Status**	**Route 1**	**Route 2**	**Route 3 & 3a**
Aloeides taikosama	Dusky Copper	LT	moderate-high	moderate-high	moderate
Anthene amarah	Black-striped Hairtail	LT	moderate-high	moderate-high	moderate
Axiocerses tjoane	Common Scarlet	LT	moderate-high	moderate-high	moderate-low
Belenois aurota	Brown-veined White	LT	high	high	high
Byblia ilithyia	Spotted Joker	LT	high	high	high
Cacyreus marshalli	Common Geranium Bronze	LT	high	high	high
Catacroptera cloanthe	Pirate	LT	high	high	high
Catopsilla florella	African Migrant	LT	high	high	high
Charaxes jahlusa	Pearl-spotted Charaxes	LT	moderate-high	moderate-high	moderate-high
Charaxes jasius	Foxy Charaxes	LT	moderate-high	moderate-high	moderate-high
Chilades trochylus	Grass Jewel Blue	LT	high	high	high
Colias electo	Lucerne Butterfly	LT	high	high	high
Colotis evenina	Common Orange Tip	LT	moderate-high	moderate-high	moderate
Cupidopsis jobates	Tailed Meadow Blue	LT	high	moderate-high	moderate
Danaus chrysippus	African Monarch	LT	high	high	high
Deudorix antalus	Brown Playboy	LT	high	high	high
Eicochrysops messapus	Cupreous Blue	LT	moderate-high	moderate-high	moderate
Eretis umbra	Small Marbled Elf	LT	moderate-high	moderate-high	moderate
Euchrysops malathana	Common Smoky Blue	LT	moderate-high	moderate-high	moderate
Eurema brigitta	Broad-bordered Grass Yellow	LT	high	high	high
Gegenes niso	Common Hottentot Skipper	LT	high	high	high
Gegenes pumilio	Dark Hottentot Skipper	LT	high	moderate-high	moderate
Hypolimnas misippus	Common Diadem	LT	high	high	high
Junonia hierta	Yellow Pansy	LT	high	high	high
Junonia oenone	Blue Pansy	LT	high	high	high
Junonia orithya	Eyed Pansy	LT	high	high	high
Lampides boeticus	Long-tailed Blue	LT	high	high	high
Lepidochrysops letsea	Free State Blue	LT	moderate	moderate	moderate
Lepidochrysops patricia	Patricia Blue	LT	moderate-high	moderate-high	moderate
Lepidochrysops procera	Potchefstroom Blue	LT	moderate-high	moderate-high	moderate
Leptomyrina henningi	Henning's Black-eye	LT	high	high	moderate
Leptotes pirithous	Common Blue	LT	high	high	high
Melanitis leda	Common Evening Brown	LT	moderate-high	low	low
Metisella meninx	Marsh Sylph	VU	moderate-low	low	low
Metisella willemi	Netted Sylph	LT	moderate	moderate	moderate-low
Mylothris agathina	Common Dotted Border	LT	high	high	high
Papilio demodocus	Citrus Swallowtail	LT	high	high	high
Papilio nireus	Green-banded Swallowtail	LT	high	high	high
Paternympha narycia	Spotted-eye Brown	LT	moderate-high	moderate-high	moderate-low
Pinacopteryx eriphia	Zebra White	LT	high	high	high
Platylesches ayresii	Peppered Hopper	LT	moderate-high	moderate-high	moderate
Platylesches neba	Flower-girl Hopper	LT	moderate	moderate	moderate-low
Pontia helice	Meadow White	LT	high	high	high
Precis archesia	Garden Commodore	LT	high	high	high
Spialia diomus	Common Sandman	LT	high	high	high
Spialia mafa	Mafa Sandman	LT	moderate-high	moderate-high	moderate
Stygionympha wichgrafi	Wichgraf's Hillside Brown	LT	moderate-high	moderate-high	moderate-low

Table 6: Invertebrate probabilities for Apollo-Verwoerdburg					
Species Details			**Assessment**		
Biological Name	**English Name**	**Status**	**Route 1**	**Route 2**	**Route 3 & 3a**
Tarucus sybaris	Dotted Blue	LT	high	high	high
Tsitana tsita	Dismal Sylph	LT	moderate-high	moderate-high	moderate-low
Uranothauma nubifer	Black Heart	LT	moderate-high	moderate-high	moderate-low
Vanessa cardui	Painted Lady	LT	high	high	high
Zizeeria knysna	Sooty Blue	LT	high	high	high
Zizula hylax	Gaika Blue	LT	high	high	high

10.2.2 Amphibians

A total of 12 frog species are listed for the Q-grid 2528CC, including one Red Data species, namely the Giant Bullfrog (*Pyxicephalus adspersus*).

AV_Route 1: three species are estimated to have a moderate and 9 species a high probability of occurrence;

AV_Route 2: five species are estimated to have a low, 2 a moderate and 5 species a high probability of occurrence; and

AV_Route 3 and 3a: five species are estimated to have a low, 2 a moderate and 5 species a high probability of occurrence.

Table 7: Amphibian probabilities for Apollo-Verwoerdburg					
Species Details			**Assessment**		
Biological Name	**English Name**	**Status**	**Route 1**	**Route 2**	**Route 3 & 3a**
Amietia angolensis	Common River Frog	LT	high	low	low
Amietia fuscigula	Cape River Frog	LT	high	low	low
Amietophrynus gutturalis	Gutttural Toad	LT	high	high	high
Amietophrynus rangeri	Raucous Toad	LT	high	high	high
Cacosternum boettgeri	Boettger's Caco	LT	high	high	high
Kassina senegalensis	Bubbling Kassina	LT	high	high	high
Phrynobatrachus natalensis	Snoring Puddle Frog	LT	high	low	low
Pyxicephalus adspersus	Giant Bullfrog	NT	moderate	low	low
Schismaderma carens	Red Toad	LT	high	high	high
Tomopterna cryptotis	Tremelo Sand Frog	LT	moderate	moderate	moderate
Tomopterna natalensis	Natal Sand Frog	LT	moderate	moderate	moderate
Xenopus laevis	Common Platanna	LT	high	low	low

10.2.3 Reptiles

A total of 45 reptile species are listed for the Q-grid 2528CC. No Red Data reptile species are regarded likely to occur in the study area.

AV_Route 1: twelve species are estimated to have a low probability of occurrence; 8 a moderate-low, 10 a moderate, 2 a moderate-high and 13 a high probability of occurrence;

AV_Route 2: fifteen species are estimated to have a low probability of occurrence; 7 a moderate-low, 10 a moderate, 1 a moderate-high and 12 a high probability of occurrence; and

AV_Route 3 and 3a: fifteen species are estimated to have a low probability of occurrence; 7 a moderate-low, 11 a moderate and 12 a high probability of occurrence.

Table 8: Reptile probabilities for Apollo-Verwoerdburg

Species Details			Assessment		
Biological Name	**English Name**	**Status**	**Route 1**	**Route 2**	**Route 3 & 3a**
Agama aculeata	Distant's Ground Agama	LT	moderate-low	moderate-low	moderate-low
Agama atra	Southern Rock Agama	LT	moderate-low	moderate-low	moderate-low
Agama hispida	Southern Spiny Agama	LT	low	low	low
Amblyodipsas polylepis	Common Purple-glossed Snake	LT	low	low	low
Amplorhinus multimaculatus	Many-spotted Snake	LT	low	low	low
Aparallactus capensis	Black-headed Centipede-eater	LT	high	high	high
Atractaspis bibronii	Bibron's Stiletto Snake	LT	moderate	moderate	moderate
Bitis arietans	Puff Adder	LT	moderate-low	moderate-low	moderate-low
Causus rhombeatus	Rhombic Night Adder	LT	high	high	high
Chamaeleo dilepis	Common Flap-neck Chameleon	LT	low	low	low
Cordylus jonesii	Jones' Girdled Lizard	LT	moderate-high	moderate-high	moderate
Crotaphopeltis hotamboeia	Red-lipped Snake	LT	moderate-low	low	low
Dasypeltis scabra	Rhombic Egg-eater	LT	high	high	high
Duberria lutrix	Common Slug-eater	LT	low	low	low
Elapsoidea sundevallii	Highveld Garter Snake	LT	moderate	moderate	moderate
Gerrhosaurus flavigularis	Yellow-throated Plate Lizard	LT	high	high	high
Hemachatus haemachatus	Rinkhals	LT	high	high	high
Hemidactylus mabouia	Moreau's Tropical House Gecko	LT	moderate	moderate	moderate
Kinixys lobatsiana	Lobatse Hinged Tortoise	LT	moderate-low	moderate-low	moderate-low
Lamprophis aurora	Aurora House Snake	LT	moderate-low	moderate-low	moderate-low
Lamprophis capensis	Brown House Snake	LT	high	high	high
Lamprophis inornatus	Olive House Snake	LT	moderate-low	moderate-low	moderate-low
Leptotyphlops distanti	Distant's Thread Snake	LT	moderate	moderate	moderate
Leptotyphlops scutifrons	Peters' Thread Snake	LT	high	high	high
Lycodonomorphus rufulus	Common Brown Water Snake	LT	high	low	low
Lycophidion capense	Cape Wolf Snake	LT	moderate-low	moderate-low	moderate-low
Lygodactylus capensis	Cape Dwarf Gecko	LT	low	low	low
Naja annulifera	Snouted Cobra	LT	low	low	low
Naja mossambica	M'Fezi	LT	low	low	low
Pachydactylus affinis	Transvaal Thick-toed Gecko	LT	high	high	high
Panaspis wahlbergii	Wahlberg's Snake-eyed Skink	LT	low	low	low
Pedioplanis lineoocellata	Spotted Sand Lizard	LT	moderate	moderate	moderate
Philothamnus hoplogaster	Green Water Snake	LT	moderate	low	low
Prosymna sundevallii	Sundevall's Shovel-snout	LT	moderate	moderate	moderate
Psammophis brevirostris	Short-snouted Grass Snake	LT	moderate	moderate	moderate
Psammophis crucifer	Montane Grass Snake	LT	moderate	moderate	moderate
Psammophis mossambicus	Olive Grass Snake	LT	low	low	low
Psammophis trinasalis	Kalahari Sand Snake	LT	low	low	low
Psammophylax rhombeatus	Rhombic Skaapsteker	LT	moderate-high	moderate	moderate
Pseudaspis cana	Mole Snake	LT	high	high	high
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake	LT	high	high	high
Telescopus semiannulatus	Eastern Tiger Snake	LT	low	low	low
Trachylepis capensis	Cape Skink	LT	high	high	high
Trachylepis punctatissima	Montane Speckled Skink	LT	moderate	moderate	moderate
Typhlops bibronii	Bibron's Blind Snake	LT	high	high	high

10.2.4 Mammals

A total of 80 mammal species are listed for the region of the study area, including 19 Red Data species.

AV_Route 1: forty-four species are estimated to have a low probability of occurrence; 12 a moderate-low, 18 a moderate and 6 a high probability of occurrence;

AV_Route 2: fifty-one species are estimated to have a low probability of occurrence; 13 a moderate-low, 11 a moderate and 5 a high probability of occurrence; and

AV_Route 3 and 3a: fifty-three species are estimated to have a low probability of occurrence; 11 a moderate-low, 11 a moderate and 5 a high probability of occurrence.

Table 9: Mammal probabilities for Apollo-Verwoerdburg

Species Details			Assessment		
Biological Name	**English Name**	**Status**	**Route 1**	**Route 2**	**Route 3 & 3a**
Acomys spinosissimus	Spiny Mouse	LC	low	low	low
Aethomys ineptus	Tete Veld Rat	LC	high	high	high
Aethomys namaquensis	Namaqua Rock Mouse	LC	high	high	high
Aonyx capensis	Cape Clawless Otter	LC	moderate	low	low
Atelerix frontalis	South African Hedgehog	NT	moderate	moderate	moderate
Atilax paludinosus	Water Mongoose	LC	moderate	low	low
Canis mesomelas	Black-backed Jackal	LC	moderate-low	moderate-low	moderate-low
Caracal caracal	Caracal	LC	low	low	low
Cercopithecus aethiops	Vervet Monkey	LC	low	low	low
Crocidura cyanea	Reddish-grey Musk Shrew	DD	moderate	low	low
Crocidura hirta	Lesser Red Musk Shrew	DD	moderate	low	low
Crocidura mariquensis	Swamp Musk Shrew	DD	moderate-low	low	low
Crocidura silacea	Lesser Grey-brown Musk Shrew	DD	low	low	low
Cryptomys hottentotus	Common Mole-rat	LC	high	high	high
Cynictis penicillata	Yellow Mongoose	LC	high	high	high
Dendromus melanotis	Grey Climbing Mouse	LC	low	low	low
Dendromus mystacalis	Chestnut Climbing Mouse	LC	low	low	low
Elephantulus brachyrhynchus	Short-snouted Elephant-shrew	DD	low	low	low
Elephantulus myurus	Rock Elephant-shrew	LC	moderate-low	moderate-low	low
Epomophorus wahlbergi	Wahlberg's Epauletted Fruit Bat	LC	low	low	low
Felis nigripes	Black-footed Cat	LC	low	low	low
Felis silvestris	African Wild Cat	LC	low	low	low
Galago moholi	Southern Lesser Galago	LC	low	low	low
Galerella sanguinea	Slender Mongoose	LC	moderate	moderate	moderate
Genetta genetta	Small-spotted Genet	LC	low	low	low
Genetta tigrina	Large-spotted Genet	LC	low	low	low
Graphiurus murinus	Woodland Dormouse	LC	low	low	low
Helogale parvula	Dwarf Mongoose	LC	low	low	low
Hyaena brunnea	Brown Hyaena	NT	low	low	low
Hystrix africaeaustralis	Porcupine	LC	moderate-low	moderate-low	moderate-low
Ichneumia albicauda	White-tailed Mongoose	LC	low	low	low
Ictonyx striatus	Striped Polecat	LC	moderate-low	moderate-low	moderate-low
Lemniscomys rosalia	Single-striped Mouse	DD	moderate-low	moderate-low	moderate-low
Lepus saxatilis	Scrub Hare	LC	high	high	high
Lutra maculicollis	Spotted-necked Otter	NT	low	low	low
Mastomys coucha	Multimammate Mouse	LC	moderate	moderate	moderate
Mastomys natalensis	Natal Multimammate	LC	moderate	moderate	moderate

	Mouse				
Miniopterus schreibersii	Schreiber's Long-fingered Bat	NT	moderate	moderate	moderate
Mungos mungo	Banded Mongoose	LC	low	low	low
Mus indutus	Desert Pygmy Mouse	LC	low	low	low
Myosorex varius	Forest Shrew	DD	moderate	low	low
Myotis tricolor	Temminck's Hairy Bat	NT	moderate-low	moderate-low	moderate-low
Mystromys albicaudatus	White-tailed Rat	EN	low	low	low
Neoromicia capensis	Cape Serotine Bat	LC	moderate	moderate	moderate
Nycteris thebaica	Egyptian Slit-faced Bat	LC	moderate	moderate	moderate
Oreotragus oreotragus	Klipspringer	LC	low	low	low
Orycteropus afer	Aardvark	LC	low	low	low
Otomys angoniensis	Angoni Vlei Rat	LC	moderate	moderate-low	moderate-low
Otomys irroratus	Vlei Rat	LC	moderate	moderate-low	moderate-low
Papio ursinus	Chacma Baboon	LC	low	low	low
Pedetes capensis	Springhare	LC	low	low	low
Phacochoerus africanus	Warthog	LC	low	low	low
Pipistrellus rusticus	Rusty Bat	NT	moderate-low	moderate-low	moderate-low
Poecilogale albinucha	African Weasel	DD	moderate-low	moderate-low	moderate-low
Potamochoerus porcus	Bushpig	LC	low	low	low
Procavia capensis	Rock Hyrax	LC	low	low	low
Pronolagus randensis	Jameson's Red Rock Rabbit	LC	moderate-low	moderate-low	low
Proteles cristatus	Aardwolf	LC	low	low	low
Raphicerus campestris	Steenbok	LC	low	low	low
Rhabdomys pumilio	Striped Mouse	LC	high	moderate-low	moderate-low
Rhinolophus blasii	Peak-saddle Horseshoe Bat	VU	moderate-low	moderate-low	moderate-low
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	NT	moderate	moderate	moderate
Rhinolophus darlingi	Darling's Horseshoe Bat	NT	moderate	moderate	moderate
Rhinolophus simulator	Bushveld Horseshoe Bat	LC	low	low	low
Saccostomys campestris	Pouched Mouse	LC	low	low	low
Sauromys petrophilus	Flat-headed Free-tailed Bat	LC	low	low	low
Scotophilus dinganii	Yellow House Bat	LC	low	low	low
Scotophilus viridis	Lesser Yellow House Bat	LC	low	low	low
Steatomys krebsii	Krebs' Fat Mouse	LC	low	low	low
Steatomys pratensis	Fat Mouse	LC	low	low	low
Suncus infinitesimus	Least Dwarf Shrew	DD	moderate	moderate	moderate
Suricata suricatta	Suricate	LC	low	low	low
Sylvicapra grimmia	Common Duiker	LC	low	low	low
Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC	moderate	moderate	moderate
Taphozous mauritianus	Mauritian Tomb Bat	LC	low	low	low
Tatera brantsii	Highveld Gerbil	LC	low	low	low
Thallomys paedulcus	Tree Rat	LC	low	low	low
Thryonomys swinderianus	Greater Cane Rat	LC	moderate-low	low	low
Vulpes chama	Cape Fox	LC	low	low	low
Xerus inauris	Cape Ground Squirrel	LC	low	low	low

10.3 Corridor Option Descriptions

10.3.1 AV_Route 1

This option is regarded the most diverse in terms of available faunal habitat. It not only comprises mainly Carletonville Dolomite Grassland (Natural 32%, Degraded 23%) and dolomite Ridge Habitat (22%), but also the only significant Wetland Habitat of the three corridor options (6%). Transformed Habitat (5%) and Exotic Trees (12%) complete the faunal habitats of AV_Route 1.

This option is expected to exhibit the highest faunal diversity as a result of high habitat diversity. However, none of the Red Data species listed for the general area are highly likely to be found in the study area. One species of concern is however considered a likely inhabitant, namely *Ichnestoma stobbiai*. This fruit chafer is known from nearby locations with similar habitat and considered to be a species of concern within Gauteng.

10.3.2 AV_Route2

AV_Route 2 is regarded the second-most diverse in terms of available faunal habitat of the three corridor options. Similar to route 1, it comprises Carletonville Dolomite Grassland (Natural 13%, Degraded 6%) and dolomite Ridge Habitat (45%). No significant wetland habitat is present in this option. Transformed Habitat (6%) and Exotic Trees (30%) complete the faunal habitats of this option. AV_Route 2 is expected to exhibit the second highest faunal diversity of the three options. It is likely to host all of the terrestrial species found in the study area of AV_Route 1, but lack the aquatic and amphibian species limited to the wetland habitat found within route 1's corridor. It is also considered a likely host of *Ichnestoma stobbiai*.

10.3.3 AV_Route3 & 3a

AV_Routes 3 and 3a are the least diverse in terms of faunal habitat of the three corridor options. Similar to other options, it is dominated by Carletonville Dolomite Grassland (Natural 66%, Degraded 11%). These options do not include any significant wetland habitat or ridge habitat. Transformed Habitat (8%) and Exotic Trees (15%) complete the faunal habitats of this option. Routes 3 and 3a are expected to exhibit the lowest faunal diversity of the three options. It is likely to host all of the terrestrial grassland species found in the general study, but will lack the aquatic and amphibian species limited to the wetland habitat as well as the ridge specialist species found on the dolomite Ridge Habitat of AV_Routes 1 and 2. It is not considered a likely host of *Ichnestoma stobbiai*.

10.4 Faunal Habitat Sensitivities

Faunal sensitivities are based on the assessment of the following habitat attributes:

- Current biophysical habitat status;
- Ecological linkages to other areas of suitable faunal habitat (migration potential);
- Red Data probabilities.

The calculation of faunal sensitivities are presented in Table 10 and visually presented in Figure 12.

Table 10: Faunal Habitat Sensitivities for the study area

Community	Status	Linkage	RD Likelihood	Average	Sensitivity Class
Grassland Habitat	8	6	8	73%	**Medium-High**
Ridge Habitat Type	9	8	10	90%	**High**
Stands of Exotic Trees	2	2	1	17%	**Low**
Transformed Areas	1	1	0	7%	**Low**
Wetland Habitat Types	4	9	9	73%	**Medium-High**

Habitat types that are pristine are regarded as high quality faunal habitat and the likelihood of Red Data species occurring within these areas is generally high. These habitat types are often associated with environmental features that are also regarded as sensitive, such as riparian zones, aquatic habitat and rocky outcrops (ridges). The extent of habitat sensitivities within the respective corridor options is indicated in Table 11. It is evident that AV_Routes 3 and 3a comprise extremely little high sensitivity areas, rendering these options more suitable for the proposed development than either of the other two options, which comprises relative large areas that are regarded high in faunal sensitivities. The status of grassland within existing servitudes indicates that it is regarded possible to mitigate expected impacts within a grassland habitat.

Table 11: Extent of faunal habitat sensitivities within corridor options

Corridor Option	Low	Medium-high	High
AV_Route 1	8.9 ha	33.0 ha	12.0 ha
AV_Route 2	16.2 ha	8.6 ha	20.2 ha
AV_Route 3	14.0 ha	48.0 ha	0.0 ha
AV_Route 3a	6.1 ha	40.1 ha	0.1 ha

Extension of the existing Verwoerdburg Substation is not expected to affect highly sensitive faunal habitat. The area adjacent to the existing Verwoerdburg Substation does not exhibit any faunal attributes of importance.

Figure 12: Faunal habitat sensitivities of the proposed servitudes

11 Integrated Biodiversity Sensitivity

Results of the respective floristic and faunal sensitivity analysis are combined to present an overview of the ecological sensitivity of the habitat types identified in the assessment. In order to obtain the ecological sensitivity of the respective communities, the highest sensitivity for each ecological unit is selected as being representative of the ecological sensitivity of the specific ecological unit. Results are determined in Table 12.

Table 12: Ecological Sensitivity of respective habitat types

Corridor Section	Floristic Sensitivity	Faunal Sensitivity	Ecological Sensitivity
Degraded Grassland Habitat	Medium-low	Medium-high	**Medium-high**
Natural Grassland Habitat	Medium-high	Medium-high	**Medium-high**
Ridge Habitat Type	High	High	**High**
Stands of Exotic Trees	Low	Low	**Low**
Transformed Areas	Low	Low	**Low**
Wetland Habitat Types	Medium-high	Medium-high	**Medium-high**

Assessment of biodiversity sensitivity considered the integrated floristic sensitivities that are based on the location and extent of Red Data flora species and communities as well as floristic and faunal habitat sensitivities. The integrated floristic sensitivity is regarded representative of the biodiversity sensitivity of the area (Figure 10), indicating that AV_Routes 1 and 2 are not regarded suitable for the proposed development as a result of the presence of various Red/ Orange Data flora species and communities within these corridor options. AV_Routes 3 and 3a are therefore recommended for the proposed development, although fairly extensive Medium-high ecological sensitivity areas are present within these options. Evidence within existing servitudes along the AV_Routes 3 and 3a options bears sufficient evidence to the potential to mitigate expected impacts.

Extension of the existing Verwoerdburg Substation is not expected to affect highly sensitive ecological habitat. The area adjacent to the existing Verwoerdburg Substation does not exhibit any ecological (biophysical, floristic, faunal) attributes of importance.

12 Impact Assessment

Rating of impacts is based on the estimated effect that construction and operation of powerlines will have on terrestrial biodiversity and ecological attributes of the study area. Impacts identified in this section are partly based on the Guidance Document on Biodiversity, Impact Assessment and Decision Making in Southern Africa (2006). Impacts are assessed as it relates to the construction and operation of powerlines within a specific habitat type.

12.1 Anticipated Impacts

No impacts were identified that could lead to a beneficial impact on the identified habitat type within the study area since the proposed development is largely destructive.

Impacts resulting from the construction and operation of powerlines on ecological attributes of the study area are largely restricted to the physical impacts on biota or the habitat in which they occur. Direct impacts, such as habitat destruction and modifications, are usually regarded immediate, long-term and of high significance, particularly in high sensitivity areas. These impacts are mostly measurable and fairly easy to assess as the effects thereof is immediately visible and can be determined to an acceptable level of certainty. In contrast, effects of indirect impacts are not immediately evident and can consequently not be measured to an acceptable level of certainty. A measure of subjective estimation is therefore necessary in order to evaluate this type of impact. Lastly, impacts of a cumulative nature places direct and indirect impacts of this projects into a regional and national context, particularly in view of similar or resultant developments and activities. Because cumulative impacts are not always measurable, a certain level of estimation is necessary to ascribe significance levels to these types of impacts

Impacts are rated upon the background of biodiversity sensitivities as determined in previous chapters. Potential impacts include the following, but are not necessarily limited to:

- Direct impacts:
  - Destruction of threatened flora & fauna species & associated habitat;
  - Direct impacts on common fauna species;
  - Destruction of sensitive/ pristine regional habitat types;
- Indirect Impacts:
  - Impacts on surrounding habitat/ species;
- Cumulative Impacts:
  - Impacts on local and national conservation obligations & targets;
  - Increase in local and regional fragmentation/ isolation of habitat; and
  - Increase in environmental degradation.

Other, more subtle impacts on biological components, such as changes in local, regional and global climate, effects of noise pollution on fauna species, increase in acid rain, ground water deterioration, the effect of EMF on fauna species, etc. are impacts that cannot be quantified to an acceptable level of certainty and is mostly subjective in nature as either little literature is available on the topic or contradictory information exist.

12.2 Nature of Impacts

12.2.1 Destruction of Threatened Flora & Fauna Species & Associated Habitat

The loss of Red Data or Threatened species or areas that are suitable for these species is a significant impact on the biodiversity of a region. Threatened species, in most cases, do not contribute significantly to the biodiversity of an area in terms of sheer numbers as there are generally few of them, but a high ecological value is placed on the presence of such species in an area as they are frequently an indication of pristine habitat conditions. Conversely, the presence of pristine habitat conditions can frequently be accepted as an indication of the potential presence of species of conservation importance.

Red Data species are particularly sensitive to changes in their environment, having adapted to a narrow range of specific habitat requirements. Habitat changes, mostly a result of human interferences and activities, are one of the greatest reasons for these species having a threatened status. Surface transformation activities within habitat types that are occupied by flora species of conservation importance will definitely result in significant and permanent impacts on these species and their population dynamics. Effects of this particular impact are usually permanent and recovery or mitigation is generally not perceived as possible.

One of the greatest drawbacks in terms of limiting this particular impact is that extremely little information is generally available in terms of the presence, distribution patterns, population dynamics and habitat requirements of Red Data flora species. However, in this particular instance, a Red/ Orange Data investigation revealed the presence and extent of various important species within some of the corridor options. Eliminating these options as viable corridors for the proposed project, as a result of significant impacts on conservation important species, therefore becomes possible. Furthermore, by applying ecosystem conservation principles to this impact assessment and subsequent planning and development phases, resultant impacts will be limited to a large extent.

Direct threats to threatened fauna species is regarded low in probability, mainly as a result of the ability of fauna species to migrate away from areas where impacts occur. Probably the only exception to this statement will be in the event where extremely localised habitat that are occupied by threatened fauna species are impacted by construction and operational activities to the extent that the habitat no longer satisfy the habitat requirements of the particular species.

This impact is highly likely to occur as a result of the known presence of Red/ Orange Data flora species within the corridor options. It is highly likely to result in significant and severe impacts and is therefore likely to result in the recommendation of 'No Go' options for some of the corridor options.

12.2.2 Direct Impacts on Common Flora & Fauna Species

The likelihood of this impact affecting common fauna species is relatively low as a result of the ability of animal species to migrate away from direct impacts. The tolerance levels of common animal species occurring in the study area and impacts resulting from the proposed development is of such a nature that surrounding areas will suffice in habitat requirements of species forced to move from areas of pact during periods of impacts, while affected areas are likely to become repopulated subsequent to high impact periods.

Likely, common flora species are widespread and occur fairly abundantly in adjacent habitat. The possibility of this proposed powerlines affecting common flora species, to the extent that their conservation status might change, is regarded highly unlikely.

This impact, although highly likely to occur, is likely to result in fairly low significance.

12.2.3 Destruction of Sensitive / Pristine Regional Habitat Types

The loss of pristine natural regional habitat represents loss of habitat and biodiversity on a regional scale. Sensitive habitat types include ridges, koppies, wetlands, rivers, streams and localised habitat types of significant physiognomic variation and unique species composition. These areas represent centres of atypical habitat and contain biological attributes that are not frequently encountered in the greater surrounds. A high conservation value is usually ascribed to floristic communities and faunal assemblages of these areas as they contribute significantly to the biodiversity of a region. Furthermore, these habitat types are generally isolated and are frequently linear in nature, such as rivers and ridges. Any impact that disrupts this continuous linear nature will risk fragmentation and isolation of existing ecological units, affecting the migration potential of some fauna species adversely, pollinator species in particular.

Considering the relative high fragmentation and isolation factors in the general surrounds, the presence of sensitive and pristine habitat types, a high conservation value is ascribed to these areas. The pristine status of natural grassland habitat within the study area is an important factor that will likely result in strong recommendations pertaining to the suitability of certain corridor options. Impacts within these areas are most likely to result in severe and significant impacts.

12.2.4 Impacts on Local and National Conservation Obligations & Targets

This impact is regarded a cumulative impact since it affects the status of conservation strategies and targets on a local as well as national level and is viewed in conjunction with other types of local and regional impacts that affects areas of conservation importance. Impacts that could potentially affect the status of protected areas are regarded unacceptable and should be avoided at all costs. Natural habitat in the general surrounds of areas of conservation importance act as a buffer for these areas and is also as a potential source of genetic variability, particularly in the case of relative small conservation areas.

The importance of extensive parts of the study area has been confirmed in the Red/ Orange Data flora assessment as well as in this biodiversity assessment and potential impacts on these areas of conservation importance is likely to result in severe and significant impacts.

12.2.5 Increase in Local & Regional Fragmentation / Isolation of Habitat

Uninterrupted habitat is a precious commodity for biological attributes in modern times, particularly in areas that are characterised by moderate and high levels of transformation. The loss of natural habitat, even small areas, implies that biological attributes have permanently lost that ability of occupying that space, effectively meaning that a higher premium is placed on available food, water and habitat resources in the immediate surrounds. This, in some instances might mean that the viable population of plants or animals in a region will decrease proportionally with the loss of habitat, eventually decreasing beyond a viable population size. The danger in this type of cumulative impact is that effects are not known, or is not visible; with immediate effect and normally when these effects become visible they are beyond repair. Linear types of developments affect the migratory success of animals in particular.

An important mitigation measure in this regard is to utilise existing corridors of habitat fragmentation. By aligning new servitudes with existing ones or with roads, current levels of habitat fragmentation will not be increased significantly. In contrast, constructing new powerlines through areas of unfragmented habitat, the adverse effects of habitat fragmentation and isolation will be maximised. Therefore, where potential servitudes are presented with similar sensitivities, a potential alignment with an existing servitude might result in one being more suitable for the proposed development than an option affecting an area of largely untransformed habitat. Unfortunately this is not always a clear-cut case as it is heavily dependent on the local and regional sensitivity of the existing line, which might be located in areas of high sensitivity, while a line going through untransformed habitat might represent impacts of lower significance in terms of other types of impacts.

12.2.6 Increase in Environmental Degradation

Impacts associated with this particular type of development that will lead to initial, incremental or augmentation of existing types of environmental degradation include impacts on the air, soil and water present within available habitat. Pollution of these elements might not always be immediately visible or readily quantifiable, but incremental or fractional increases might rise to levels where biological attributes could be affected adversely on a local or regional scale. In most cases are these effects are not bound and is dispersed, or diluted over an area that is much larger than the actual footprint of the causal factor. Similarly, developments in untransformed and pristine areas are usually not characterised by visibly significant environmental degradation and these impacts are usually most prevalent in areas where continuous and long-term impacts have been experienced.

12.3 Construction Phase

12.3.1 Rating of Impacts

Impacts are assessed prior to the implementation of any mitigation measures as well as subsequent to the implementation of all required and recommended mitigation measures in order to indicate the expected efficiency of proposed measures. Significance of impacts is rated as **high**, **medium**, or **low**.

Nature	**Impacts of powerlines within Corridor Option AV_Route 1**	
	Before Mitigation	**After Mitigation**
Extent	4	4
Duration	5	5
Magnitude	5	4
Reversibility	5	5
Consequence	19	18
Probability	5	5
Significance	**95**	**90**
Status	Negative	Negative
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated	No	
Mitigation	Not possible	
Cumulative Impacts	Habitat degradation, loss of conservation areas, increase in conservation status of species	
Residual Impacts	Degradation of pristine habitat, infestation by weeds and alien species, erosion, species loss.	

Nature	Impacts of powerlines within Corridor Option AV_Route 2	
	Before Mitigation	**After Mitigation**
Extent	4	4
Duration	5	5
Magnitude	5	4
Reversibility	5	5
Consequence	19	18
Probability	5	5
Significance	**95**	**90**
Status	Negative	Negative
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated	No	
Mitigation	Not possible	
Cumulative Impacts	Habitat degradation, loss of conservation areas, increase in conservation status of species	
Residual Impacts	Degradation of pristine habitat, infestation by weeds and alien species, erosion, species loss.	

Nature	Impacts of powerlines within Corridor Option AV_Route 3	
	Before Mitigation	**After Mitigation**
Extent	3	1
Duration	3	2
Magnitude	3	2
Reversibility	3	3
Consequence	12	8
Probability	3	2
Significance	**36**	**16**
Status	Negative	Negative
Irreplaceable loss of resources?	No	
Can impacts be mitigated	Yes	
Mitigation	Proper tower placement, limited vegetation maintenance underneath powerlines, generic mitigation	
Cumulative Impacts	Infestation by weeds and alien vegetation	
Residual Impacts	Erosion, changes in surface conditions	

Nature	Impacts of powerlines within Corridor Option AV_Route 3a	
	Before Mitigation	**After Mitigation**
Extent	3	1
Duration	3	2
Magnitude	3	2
Reversibility	3	3
Consequence	12	8
Probability	3	2
Significance	**36**	**16**
Status	Negative	Negative
Irreplaceable loss of resources?	No	
Can impacts be mitigated	Yes	
Mitigation	Proper tower placement, limited vegetation maintenance underneath powerlines, generic mitigation	
Cumulative Impacts	Infestation by weeds and alien vegetation	
Residual Impacts	Erosion, changes in surface conditions	

12.4 Impact Assessment Rating – Operational Phase

Significance of impacts is rated as **high**, **medium**, or **low**.

12.4.1 Rating

Nature	Impacts of powerlines within Corridor Option AV_Route 1	
	Before Mitigation	**After Mitigation**
Extent	4	4
Duration	5	5
Magnitude	4	4
Reversibility	5	5
Consequence	18	18
Probability	5	5
Significance	**90**	**90**
Status	Negative	Negative
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated	No	
Mitigation	Not possible	
Cumulative Impacts	Habitat degradation, loss of conservation areas, increase in conservation status of species	
Residual Impacts	Degradation of pristine habitat, infestation by weeds and alien species, erosion, species loss.	

Nature	Impacts of powerlines within Corridor Option AV_Route 2	
	Before Mitigation	**After Mitigation**
Extent	4	4
Duration	5	5
Magnitude	4	4
Reversibility	5	5
Consequence	18	18
Probability	5	5
Significance	**90**	**90**
Status	Negative	Negative
Irreplaceable loss of resources?	Yes	
Can impacts be mitigated	No	
Mitigation	Not possible	
Cumulative Impacts	Habitat degradation, loss of conservation areas, increase in conservation status of species	
Residual Impacts	Degradation of pristine habitat, infestation by weeds and alien species, erosion, species loss.	

Nature	Impacts of powerlines within Corridor Option AV_Route 3	
	Before Mitigation	**After Mitigation**
Extent	2	1
Duration	4	3
Magnitude	4	3
Reversibility	3	3
Consequence	13	10
Probability	3	3
Significance	**39**	**30**
Status	Negative	Negative
Irreplaceable loss of resources?	No	
Can impacts be mitigated	Yes	
Mitigation	Proper tower placement, limited vegetation maintenance underneath powerlines, generic mitigation	
Cumulative Impacts	Infestation by weeds and alien vegetation	
Residual Impacts	Erosion, changes in surface conditions	

Nature	Impacts of powerlines within Corridor Option AV_Route 3	
	Before Mitigation	**After Mitigation**
Extent	2	1
Duration	4	3
Magnitude	4	3
Reversibility	3	3
Consequence	13	10
Probability	3	3
Significance	**39**	**30**
Status	Negative	Negative
Irreplaceable loss of resources?	No	
Can impacts be mitigated	Yes	
Mitigation	Proper tower placement, limited vegetation maintenance underneath powerlines, generic mitigation	
Cumulative Impacts	Infestation by weeds and alien vegetation	
Residual Impacts	Erosion, changes in surface conditions	

12.5 Discussion

Expected impacts are mostly as a result of the physical disturbance of surface areas and clearance of servitudes during the construction period. Impacts within the ridge habitat type are regarded to be highly significant and expected impacts are regarded unacceptable, particularly since various Red/ Orange Data plant species are known to occur within this environment. Corridor options that comprise highly sensitive habitat types are therefore regarded unsuitable for the proposed development and the impacts of an unacceptable nature and significance is expected for these options.

Expected impacts resulting from the construction phase within AV_Routes 3 and 3a are regarded to be of moderate nature and the implementation of generic mitigation measures is expected to minimize likely impacts within these environments. AV_Route 3a is regarded slightly more preferable as it comprises a slightly shorter distance.

Impacts during the operational phase of the project are mostly restricted to the maintenance procedures within the servitudes as well as latent effects of habitat alteration. Expected impacts resulting from the operational phase within AV_Routes 3 and 3a are regarded to be of moderate nature and the implementation of generic mitigation measures is expected to minimize likely impacts within these environments.

Extension of the existing Verwoerdburg Substation is not expected to result in significant impacts on the ecological environment as this area was indicated to exhibit low ecological sensitivity.

Table 13: Summary of Impact Assessment		
Corridor Option	**Pre Mitigation**	**Post Mitigation**
Construction Period		
AV_Route 1	95	90
AV_Route 2	95	90
AV_Route 3	36	16
AV_Route 3a	36	16
Operational Period		
AV_Route 1	90	90
AV_Route 2	90	90
AV_Route 3	39	30
AV_Route 3a	39	30

13 Activities Resulting in Impacts

A summation/ elaboration of expected activities are presented, based on generic procedures followed. Activities that will result in adverse impacts on the natural environment will include the following, but are not necessarily limited to:

Activity 1 - construction and use of access roads;
Activity 2 - clearing of vegetation for construction and access purposes where required;
Activity 3 - surface disturbances surrounding footprint areas;
Activity 4 - surface disturbances in areas used for storage space;
Activity 5 - excavation of footprints;
Activity 6 - human movement and use of surrounding areas;
Activity 7 - health and sanitation issues;
Activity 8 - occurrence of open and accidental fires;
Activity 9 - refuelling and vehicle maintenance (spillages and pollution);
Activity 10 - poaching/trapping/ illegal hunting;
Activity 11 - storage and use of chemicals; and
Activity 12 - clearing of vegetation for servitude maintenance (removing, cutting, trimming of trees), including physical clearance and use of chemicals.

13.1 Access Roads - Construction & Use

For much of the grassland areas, this activity does not constitute a significant impact and the loss of biodiversity attributes are not expected to affect the status or sensitivity of habitat or species on a local or regional scale. However, sensitive areas, including rivers, streams and mountainous parts in particular, are regarded extremely vulnerable for related impacts and significant impacts is expected to occur as a result of the construction and use of access roads. Adverse effects of this activity include increased erosion, destabilisation of the substrate, prevalence of weeds and invasive species, damage to pristine and sensitive environments.

The rehabilitation and use of existing roads is recommended for the proposed operations. Construction of new access roads in the mountainous areas is regarded a prohibited activity and should be considered only when all other alternatives have been exhausted. The construction process should be undertaken with extreme care and under the implementation of all necessary mitigation measures.

13.2 Surface Disturbances Surrounding Footprint Areas

Importing materials, vehicles, personnel, storage of materials, infrastructure, removal of existing structures, excavation, construction activities include actions that will result in the degradation of the immediate surrounds of pole locations. These effects are usually associated with the decimation of herbaceous and scrubby layers, open soils, erosion and infestation by weeds and pioneer species. Clear and proper demarcation of construction areas should be maintained in order to limit the effect of these activities to a minimum.

Proper cleanup and rehabilitation should suffice in limiting impacts associated with this activity. This activity is not expected to result in significant impacts in low sensitivity areas, but high sensitivity areas will be affected adversely.

13.3 Surface Disturbances in Areas used for Storage Space

Extensive storage areas lead to surface disturbances that contribute to environmental degradation. Accessibility and future rehabilitation need to be considered in the selection of storage areas. Sensitive areas need to be avoided at all costs. Provisions must be made for waste management, temporary ablution facilities, vehicle maintenance areas, erosion control, proper fencing, etc.

13.4 Excavation of Footprints

Areas need to be excavated in order for the substrate anchoring of pole structures. Fortunately these areas are small in size and associated activities and movement of vehicles and personnel is regarded to represent a more severe risk to the environment than the actual footprint excavation. It is cautioned that the loss of topsoil, infestation with weeds and pioneer species, increased erosion and localised impacts on flora are some of the impacts associated with this activity that need to be monitored.

This activity is not expected to result in significant impacts in low sensitivity areas, but high sensitivity areas will be affected adversely.

13.5 Human Movement & Use of Surrounding Areas

The presence of personnel and the activities in a natural environment will result in localised surface disturbances in and around the construction sites. All vehicle and human movement must be restricted to the servitude area and access roads. Clear demarcation of construction areas must be provided. This is regarded particularly important in order to avoid any contact with animals within conservation areas and game farms. Speed limits must be sufficiently low in order to prevent accidents while periods of vehicular movement should be restricted to periods of light, i.e. no travelling during the night.

Noise levels should be controlled. It is unavoidable that periods of high noise will be experienced, every attempt should be made to limit these periods as far as possible. It is envisaged that this will form part of the responsibilities of the ECO.

Animals usually have a relative high tolerance for noise and disturbances. Most species, when being disturbed, will temporarily evacuate the area and seek suitable shelter, to return at a later stage. However, some animals might be affected to the state where nests or cover is permanently abandoned. The identification of these sites and location of infrastructure and construction facilities as far away as possible should form part of the

responsibilities of the ECO. Any unnecessary disturbances, particularly from vehicles and helicopters, should be avoided as far as possible.

13.6 Health, Sanitation and Litter Issues

Drinking of water from streams should not be allowed, drinking water should be provided for on site workers from a trusted source. Temporary sanitation facilities need to be available to site workers at all times. The use thereof should furthermore be advocated.

Aspects pertaining to snakes, scorpions and similar dangerous impacts need to be taken into consideration during the period of maintenance and construction. All health and safety related issues need to be addressed prior to any personnel going on site.

All litter should be contained in suitable storage areas and immediately removed to a suitable disposal facility. Plastic bags, containers, wrapping and insulation material will pose a threat to animals of the area.

13.7 Occurrence of Open & Accidental Fires

The use of fires for cooking purposes or any other purpose may result in accidental spread to adjacent areas. All areas, as a result of high biomass and flammability are regarded prone to the development and spread of accidental fires. Although fire is a natural occurrence, any accidental occurrence should be prevented. Other causes include smoking, discarded cigarettes and matches, overheating vehicles or equipment or faulty electrical equipment or wiring, welding and cutting operations. No firewood may be collected.

13.8 Refuelling & Vehicle Maintenance (spillages and pollution)

Refuelling should be restricted to areas dedicated for this activity, preferably at an existing off-site refuelling facility. On-site refuelling should be done with extreme care, taking all preventative measures against spillages.

Similarly, emergency vehicle maintenance/ repairs should be done in a suitably manner to avoid any spillages or pollution of the environment. Spillages of any nature should be cleaned and rehabilitated by means of appropriate measures.

13.9 Poaching/ Trapping/ Illegal Hunting

Any interaction with wild animals should be prevented and all wild animals should be treated as dangerous, particularly snakes, scorpions, large mammals and predators. The trapping, poaching or capturing of any animal is regarded an illegal activity. Any contact with wild animals should be avoided as far as possible. Should the presence of wild animals happen to interfere with construction, safety or operational procedures a responsible person should be contacted to deal with the problem or remove the animals. It is strongly advised that a herpetologist/ snake capturer be on permanent stand-by for the specialised capturing, removing and relocating of reptiles. Proper medical procedures/ treatment should also be available on-site in the event of injuries or incidents, particularly for snake-bites.

13.10 Clearing of Vegetation for Construction & Access Purposes

Clearance of vegetation should be done in accordance to standards as available in Eskom documentation.

13.11 Storage & Use of Hazardous Materials & Chemicals

Hazardous materials and chemicals should be stored and use in a manner not to affect the natural environment negatively. Storage should be off site and only be transported to a site when required and then only in an acceptable and safe manner. Mixing of chemicals should be conducted as per manufacturer's label, taking cognisance of all specifications. Appropriate safety measures should implemented by users of all chemicals. By no means should any water be extracted from streams and rivers for the purpose of mixing chemicals. In the event of pollution it must be dealt with in the prescribed manner so that the environment is not damaged.

Chemicals used in the immediate vicinity of rivers, streams and dams should be applied in a manner not to pollute the water. This would probably exclude spraying methods. Pollution of any surface of ground water must be reported to the Department of Water Affairs.

13.12 Clearing of Vegetation for Servitude Maintenance

Clearance levels between the conductor and vegetation need to be maintained in the interest of effective line performance and for safety purposes. Pruning of indigenous trees is preferred to complete removal. Pruning must be according to set standards as available in Eskom documentation.

Alien vegetation is mostly associated with the rivers and old agricultural fields. All alien vegetation should be removed from the servitude area. Accepted removal and treatment

methods should be implemented with extreme caution not to contaminate aquatic systems. Herbicide application to be conducted according to manufacturer's label. Clearance of vegetation should be done in accordance to standards as available in Eskom documentation.

Grass build-up around structures should be hoed/ slashed to required levels. The implementation of a fire management strategy is recommended to prevent grass build-up within the servitude areas. This is preferred to large scale mowing.

14 Recommended Mitigation Measures

The single most important mitigation measure in the case of line variants that were identified as being unsuitable for the proposed development, in terms of biodiversity and ecological aspects, is the preferred use of an alternative line variant that will result in less significant impacts.

Mitigation measures are divided into two groups, namely:

- generic mitigation measures (measures that is required/ recommended for the entire line and during the maintenance/ construction process); and
- site/ action specific mitigation measures (measures that is required/ recommended for specific sites, or in the event of specific activities or impacts).

14.1 Generic Mitigation Measures

Mitigation Measure 1 - Appoint Environmental Control/ Site Officer. Appointment prior to start of construction, responsibilities should include, but not limited to ensuring adherence to EMP guidelines, guidance of activities, planning, reporting;

Mitigation Measure 2 - Compile and implement environmental monitoring programme, the aim of which should be ensuring long-term success of rehabilitation and prevention of environmental degradation;

Mitigation Measure 3 - Conduct a final walkthrough prior to commencement of construction activities. This should be the responsibility of ECO/ ecologist. Responsibilities should be ensuring absence of Red Data species from construction sites, identification of localised areas of significance;

Mitigation Measure 4 - Identify areas of high ecological sensitivity during final walk-through and recommend localised deviations in the alignment;

Mitigation Measure 5 - Identify areas that will be suitable for access roads, ensuring proper upgrade/ construction/ maintenance in order to limit erosion, proliferation of weeds, etc.;

Mitigation Measure 6 - Limit construction, maintenance and inspection activities to dry periods in order to curb occurrence/ augmentation of erosion in

areas of existing erosion, destabilizing of substrate in areas of high slopes, riparian zones, etc;

Mitigation Measure 7 - Demarcate construction areas in order to control movement of personnel, vehicles, providing boundaries for construction sites in order to limit dilution or spread of peripheral impacts;

Mitigation Measure 8 - 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;

Mitigation Measure 9 - Compile an education programme for all contractors and subcontractors/ workers to ensure compliance to all aspects of EMP as well as educating personnel in the safe and proper conduct within areas of natural habitat;

Mitigation Measure 10 - Prevent open fires, provide demarcated fire-safe zones, facilities and fire control measures;

Mitigation Measure 11 - Limit damage/ pruning/ cutting of indigenous trees to a minimum in accordance to Eskom guidelines;

Mitigation Measure 12 - The pruning of the woody layer is recommended instead of complete removal of all woody plants. Leaving a significant portion of the woody structure intact will prevent the establishment of an atypical habitat, limiting adverse impacts to a large extent;

Mitigation Measure 13 - Ensure off site storage of hazardous materials, chemicals, fuels, oils, etc. in order to prevent accidental spillage, contamination or pollution;

Mitigation Measure 14 - Develop emergency maintenance operational plan to deal with any event of contamination, pollution or spillages, particularly in sensitive areas;

Mitigation Measure 15 - Provide temporary on-site sanitation, litter and waste management and hazardous materials management facilities;

Mitigation Measure 16 - Ensuring surface restoration and resloping in order to prevent erosion, taking cognisance of local contours and landscaping;

Mitigation Measure 17 - Rehabilitation of disturbed areas subsequent to construction activities, taking cognisance of factors such as topsoil replacement, removal of introduced materials, local environmental factors;

Mitigation Measure 18 - Removal of dismantled structures, rubble, litter, refuse, temporary infrastructures, sanitation equipment, etc. subsequent to construction and rehabilitation; and

Mitigation Measure 19 - Final inspection in order to ensure adherence to EMP guidelines, completion of localised/ remaining areas of impact, monitoring of rehabilitation success, etc.

14.2 Site Specific Mitigation Measures

Some of the site specific mitigation measures are indicated in Figure 16. These site specific mitigation measures are in addition to the recommended realignments presented in Section 12.5.

The following site/ action specific mitigation measures are recommended:

Mitigation Measure 20 - Conduct on-foot inspections in areas where access for vehicles are not possible/ feasible;

Mitigation Measure 21 - Prohibit construction of new access roads in areas of high environmental sensitivity. Use should be made of existing roads, ensuring proper maintenance/ upgrade. Alternative methods of construction/ access to sensitive areas is recommended;

Mitigation Measure 22 - Construction of new/ temporary bridges as part of access roads across non-perennial streams and larger rivers is regarded a prohibited activity, use should be made of existing crossings, ensuring proper maintenance/ upgrade;

Mitigation Measure 23 - Ensure proper substrate anchorage, provide 'dummy pole' in order to prevent damage/ injury of mammals as a result of direct contact with pole structures;

Mitigation Measure 24 - Ensure that riparian areas are spanned/ pole structures are not placed within proximity to rivers, streams. Ensure placement of footprints outside 1:100 year floodlines. Crossing of riparian systems is only permitted at existing/ approved crossing points, taking due care to prevent additional/ new impacts;

Mitigation Measure 25 - Prevent impacts on any surface water as a result of hazardous materials, contamination, unnecessary crossing by vehicles or personnel, extraction, drinking or other human uses, construction and maintenance activities; and

Mitigation Measure 26 - Remove invasive and alien vegetation, particularly in vicinity of riparian zones where alien and invasive trees are known to occur. The implementation of a monitoring programme in this regard is recommended, being the responsibility of the ECO/ ecologist.

15 Photographic Records

Photo 1: Example of stands of exotic trees

Photo 2: Example of pristine grassland in close vicinity of ridge habitat

Photo 3: Example of ridge habitat

Photo 4: Existing impact within ridge environment (quad bike tracts)

Photo 5: Example of wooded clumps within ridge habitat

Photo 6: Example of wetland habitat

Photo 7: Existing servitude within grassland habitat