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Biodiversity Basic Impact Assessment Report for the Proposed Etna - Trade Route 88 kV Power Line and Switching Station within the City of Johannesburg Metropolitan Municipality, Gauteng Province©

this report was produced by

Bathusi Environmental Consulting

Ecological Specialist Investigations

prepared for

Nsovo Environmental Consulting

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1 PROJECT & REPORT DETAILS

Report Name:	Biodiversity Basic Impact Assessment Report for the Proposed Etna - Trade Route 88 kV Power Line and Switching Station within the City of Johannesburg Metropolitan Municipality, Gauteng Province
Client:	Nsovo Environmental Consulting
Report Type:	Biodiversity Basic Impact Assessment Report
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Report Author:	Riaan A. J. Robbeson (Pr.Sci.Nat.) (Bathusi Environmental Consulting)

2 REPORT REFERENCE & CITATION

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

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

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

Furthermore, in terms of Section 113(j) of the Environment Act, 2008 (Lesotho), the Minister may make regulations to *"provide for the conduct and certification of environmental practitioners."*

Table 1: Biodiversity specialists contributing to the project	
Botanical Investigator:	**Riaan Robbeson (Pr.Sci.Nat.)**
Qualification:	M.Sc. (Botany), UP
Affiliation:	South African Council for Natural Scientific Professions
Fields of Expertise:	Botanical Scientist & Ecological Scientist
Registration Number:	*400005/03*
Affiliation:	Grassland Society of Southern Africa
Membership Status:	Professional Member
Membership Number:	*667.08/08*
Faunal Investigator:	**Dewald Kamffer (Pr.Sci.Nat.)**
Qualification:	M.Sc. (Conservation Biology), UP
Affiliation:	South African Council for Natural Scientific Professions
Fields of expertise:	Ecological Scientist & Zoological Scientist
Registration number:	*400204/05*

REPORT NAVIGATION

4 LIST OF TABLES

5 LIST OF FIGURES

6 EXECUTIVE SUMMARY

The existing 88 kV power line represents old infrastructure and is unable to meet the electricity distribution demands, requiring an upgrade to meet the needs of the surrounding communities and Eskom (The Client) is therefore proposing the following activities:

- The decommissioning of the existing 88 kV Etna - Trade Route power line; and
- The construction of an 88 kV power line within the same servitude built at 132 kV specifications.

This power line will connect the existing Etna and Lehae substations and the Trade Route Switching Station, which is currently under construction. The power line will be an 88 kV double circuit twin turn and all activities will be undertaken within the existing servitude.

The proposed development triggers activities under Government Notice R983 (Listing Notice 1) Activity 11(i) and 31(i) of the 2014 EIA Regulations. In accordance with the requirements of the NEMA, Eskom Holdings SOC Limited requires approval from the Competent Authority, i.e. Department of Environmental Affairs, to undertake the proposed project. Eskom has therefore appointed Nsovo Environmental Consulting as the Environmental Assessment Practitioner (EAP) to conduct this Basic Assessment Process. Bathusi Environmental Consulting has been appointed to evaluate the terrestrial biological environment, providing insight into the sensitivities, liabilities and opportunities that the ecological environment exhibit, ultimately making recommendations in terms of mitigative actions that will ensure a minimal impact of the proposed activity on the biological environment.

GDARD requires the following aspects to be investigated (as per email communiqué received per email, dd. 2016/10/26):

- Plants, with specific reference to *Cineraria austrotransvaalensis;*
- Invertebrates, with specific reference to *Lepidochrysops praeterita* (Highveld Blue Butterfly);
- Vegetation;
- Wetlands;
- Ridges; and
- Dolomite.

This biodiversity report addresses the first three aspects; it is strongly recommended that specialist input into the latter three aspects also be acquired to present a comprehensive assessment of the biological environment as per GDARD requirements.

6.1 BIOPHYSICAL ENVIRONMENT

The existing Etna – Trade Route line is situated within a largely urbanised environment and is exhibit thy typical responses of the natural environment to the pressures of urbanisation. High levels of habitat fragmentation and isolation is noted across the region, although a moderate level of connectivity is noted for the remaining areas of natural habitat that are crossed by the line. Limited agriculture and extensive urbanisation has played a major role in transforming the landscape of the immediate region, while remnants of mining infrastructure, secondary anthropogenic activities, and mine dumps are prevalent in the immediate surrounds, particularly to the south of the line. The status of remaining natural grasslands exhibits a typical degradation gradient, varying between pristine and deteriorated and is also a reflection of the size of remnant area; smaller portions are frequently more deteriorated, while edge effects and secondary impacts have less of an impact on larger areas.

A Class 2 ridge is crossed by the existing line and impacts associated with the construction activities of new lines is regarded a significant threat to the continued conservation of this area, particularly in view of the presence of pristine grasslands that buffer the ridge from nearby development and anthropogenic activities. Class 2 ridges constitute approximately 40 % of the ridges of Gauteng and is categorised as based on approximately 5-35 % transformation. Development guidelines presented by the Directorate of Nature Conservation (Development guidelines for Class 2 ridges, 2001) include (*inter alia*)*:*

- No further subdivisions will be allowed and consolidation of subdivisions will be encouraged;
- 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 200 m buffer zone of low impact development is required around Class 2 ridges.

The Class 2 ridge that is situated within the proposed corridor was found to exhibit a high proportion of natural, climax grassland that is representative of the regional ecological types, and is therefore regarded a highly sensitive environment. The proposed activity is expected to result in limited, but manageable impacts on the status of these areas.

Several large wetland systems and rivers are situated in spatial proximity to the proposed route. These drainage systems form part of the Vaal Catchment area, none of which are likely to be affected adversely by the proposed activity. The status of these areas is generally found to be severely degraded due to current land use, existing agricultural activities, trampling, overgrazing, erosion and poor water quality from historic mining activities.

The BGIS (2015) dataset for protected areas in southern Africa indicates the presence of the Olifantsvlei Municipal Nature Reserve immediately to the east of the existing line (SAPAD, 2015 Quarter 1, version 2). No buffer zone is indicated for this dataset. The Johanna Jacobs Private Nature Reserve is situated approximately 9 km to the south of the Etna Substation. It is regarded unlikely that the proposed activity will exacerbate existing impacts on these conservation areas. No buffer zones for these conservation areas are indicated on the information database.

C-Plan (v 3.3) information indicates that the proposed line partially comprises the following C-Plan conservation categories:

- Primary vegetation;
- Red List invertebrate habitat; and
- Ecological Support Areas (ESAs).

Other C-Plan conservation categories are furthermore spatially situated in proximity to the existing line, but are unlikely to be affected directly by the proposed activity. All areas of untransformed habitat therefore need to be scrutinised to assess the ecological integrity and status pertaining to the mentioned biodiversity attributes, particularly in view of the presence of riparian/ wetland habitat in close proximity to the proposed site. Additional categories that are spatially situated in proximity to the line include:

- Red List bird habitat;
- Red List mammal habitat; and
- Red List plant habitat.

6.2 BOTANICAL ATTRIBUTES

The study area is geographically situated within the Mesic Highveld Grassland Bioregion, more specifically within the following ecological types (as defined by Mucina and Rutherford, 2006):

- Carletonville Dolomite Grassland (Vulnerable);
- Eastern Temperate Freshwater Wetlands (Vulnerable);
- Gauteng Shale Mountain Bushveld (Vulnerable); and
- Soweto Highveld Grassland (Endangered).

Grassland defines itself: landscapes dominated by grass. However, although grasses are the most visible plants, grasslands have an exceptional diversity of herbaceous species, particularly those with belowground storage organs such as bulbs or tubers. These plants produce many of our spectacular wild flowers and contribute to biodiversity that is second only to the Cape Fynbos in species richness. Grassland species are particularly well adapted to being defoliated, whether by grazing, fire or frost. Repeated defoliation, within reason, does no real harm to such plants nor does it reduce productivity.

Information obtained from the SANBI database (POSA, 2009) indicates the known presence of only 85 plant species within the ¼-degree grid that is spatially represented in the study area (2627BD). This low diversity reflects of a poor floristic knowledge of the region and a severe under representation of the floristic diversity of the larger region due to poor sampling efforts within these parts. Some of the surrounding ¼-degree grids do however reflect the regional diversity context of the Grassland Biome,

An alpha diversity of 122 plant species was recorded during the brief survey period. It should be noted that the timing of the survey (October 2016) was not conducive for the collation of a comprehensive floristic inventory as extremely little raining advents have occurred prior to the site investigation. The recorded diversity is nonetheless regarded diverse, despite significant anthropogenic influences and impacts and provides a good reflection of the regional floristic diversity as well as in the context of the Grassland Biome. Despite adverse sampling conditions, the recorded diversity corresponds with other surveys concluded in the immediate region of the study sites. It is recommended that a detailed floristic inventory be compiled as part of the '**walkdown phase**' for the project during the vegetative and reproductive season of the region. Red Data assessments that should ideally also form part of the walkdown phase for the project, could be utilised as ideal opportunities to compile comprehensive inventories for the study area.

Despite the moderate recorded floristic diversity, an appraisal of the growth forms reflects the grassland physiognomy with a high percentage of the species comprising forbs (43 species, 35.2 %) grasses (24 species, 19.7 %), dwarf shrubs (10 species, 8.2 %). The grassland physiognomy is further highlighted by the absence of trees and shrubs, the only notable trees presence being exotic species and localised stands on rocky ridges. The recorded diversity is also represented by 38 plant families, typically dominated by Asteraceae (28 species, 23.0 %), Poaceae (26 species, 21.3 %) and Fabaceae (10 species, 8.2 %). No other plant families have been found to attain any specific dominance.

A preliminary list of conservation important plants that are known to occur in the general region indicates the known presence of 12 conservation important plant species in the immediate region. The following species are regarded likely to persist in the area, based on the habitat variability and status:

- *Adromischus umbraticola* subsp. *umbraticola;*
- *Boophone disticha;*
- *Cineraria austrotransvaalensis;*
- *Cineraria longipes;*
- *Khadia beswickii;*
- *Lithops lesliei subsp. lesliei;* and

- *Myrothamnus flabellifolius*

To establish/ refute the presence of these plants within the servitude it is strongly recommended that suitable Red Data assessment surveys be conducted during the reproductive periods of these plants **as part of the walkdown phase of the project**. The following timeframes are recommended:

- January; and
- March/ April.

Specifically, the need to assess the potential presence of *Cineraria austrotransvaalensis* was requested by GDARD as a requirement of these biodiversity studies. Based on the variability and status of habitat within the servitude, it is regarded highly likely that this species could persist in this area. The reproductive period (which is typically the most optimal period for identification purposes) is between March and June. This field investigation could therefore not establish the presence/ absence of this species from the servitude as it was conducted outside the reproductive period of the species. To confirm the presence/ absence of this species from the proposed servitude, it is therefore strongly recommended that a **walkdown assessment be conducted between March and June**. The presence of this species within the servitude will require detailed and site-specific mitigation measures as the conservation of individuals of conservation important plants with status higher than 'Rare' status, requires *in situ* protective actions.

A basic site investigation revealed the following micro habitat types (and inherent floristic sensitivity):

- Deteriorated Grassland (Medium-low Floristic Sensitivity);
- Natural/ Rocky Grassland Matrix (High Floristic Sensitivity);
- Ridges/ Rocky Grassland Matrix (High Floristic Sensitivity);
- Transformed Areas (Low Floristic Sensitivity); and
- Wetland Habitat (Medium-high Floristic Sensitivity).

High floristic sensitivity habitat comprises approximately 29.4 % of the existing line, emphasising likely and significant impacts within the floristic environment, if not mitigated properly. Botanical attributes that are regarded important in this regard include the potential/ likely presence of conservation important plant species and extremely sensitive grassland and ridge habitat that comprises vegetation that exhibits pristine attributes and are also representative of the regional ecological types.

6.3 FAUNAL ATTRIBUTES

The faunal assessment for the proposed upgrade of the Etna – Trade Route line was conducted in October 2016. The study approach implemented for this study is based on a qualitative and quantitative habitat assessment and collection of data based on ecological indicators such as tracks, dung, diggings, etc. of mammals present in the study area. This qualitative and quantitative habitat assessment approach is typically applied in smaller studies and is regarded sufficient to identify and estimate the variety, status and inherent sensitivity of the receiving environment for this impact evaluation assessment.

A total of 44 animal species were recorded in the study area during this brief survey. This diversity includes:

- 6 insect species;
- 36 bird species; and
- 2 mammal species.

The alien and invasive Common Myna, *Acridotheres tristis* (Linnaeus, 1766) was recorded. No Red Data species was recorded during the brief survey period.

A brief appraisal of revealed that 15 fauna species of conservation concern are listed for the Gauteng Province, including:

- 4 invertebrates;
- 1 reptile; and
- 10 mammals.

A basic assessment of the Probability of Occurrence (PoO) for these species revealed that:

- 5 species have a low PoO in the study area;
- 7 species have a moderate-low PoO in the study area;
- 2 species a moderate PoO in the study area; and
- 1 species (Highveld Blue) is estimated to have a moderate-high PoO in the study area.

The diversity of animals recorded in the study area during the field investigation represent species that are commonly encountered in areas where some natural ecological processes within the rocky and wetland habitats of the area have been retained. Although no evidence of species of conservation concern (red data or otherwise) were recorded during the field investigation, habitat diversity and status of the study area and surrounds are such that the potential presence of some species of conservation concern cannot be discounted. Consequently, it is estimated that the Southern African Hedgehog and the African White-tailed Rat, exhibit at least a medium PoO for the study area while the Highveld Blue are estimated to exhibit a highly likely presence in the area because of suitable habitat.

Animals of terrestrial as well as aquatic ecosystems are closely linked to and significantly influenced by plant community structures and species diversities. Faunal community structure and ecological diversity cannot be evaluated without considering vegetation patterns. Plant communities or micro habitat types described in this document are therefore considered representative of the main faunal habitats within the study area for the purposes of this assessment, including the following:

- Deteriorated Grassland (Medium-low Faunal Sensitivity);
- Natural/ Rocky Grassland Matrix (Medium-high Faunal Sensitivity);
- Ridges/ Rocky Grassland Matrix (High Faunal Sensitivity);
- Transformed Areas (Low Faunal Sensitivity); and
- Wetland Habitat (Medium-high Faunal Sensitivity).

An assessment (as per GDARD requirements) of the presence of *Lepidochrysops praeterita* as part of the terrestrial biodiversity assessments revealed that Ridges/rocky grassland matrix habitat fragments found in the study area are considered suitable habitat for this species. The presence of the Endangered Highveld Blue, *Lepidochrysops praeterita* Swanepoel, 1962, therefore cannot be discounted at this stage of the process and it is strongly recommended that all potential habitat of the species be investigated during a walkdown survey to establish the habitat extent and quality of the species within the study area prior to the commencement of construction.

The ecological connectivity of the study area is regarded moderately poor and most of the untransformed faunal habitat fragments of the study area have been degraded to some extent. Anthropogenic disturbance factors such as noise, dust, physical presence of movement, snares and traps, etc. further accounts for the low faunal species richness of the study area (particularly for small and medium-sized mammals). The wetland systems that are partly found within the study area, has been severely degraded for most its extent; rehabilitation of the entire systems will be costly and challenging. Impacts resulting from the proposed development on the fauna of the study area region will most likely be limited to loss and degradation of habitat, but are likely to be of low significance if properly mitigated.

6.4 IMPACT ASSESSMENT & SITE SENSITIVITY

The proposed activity is likely to result in the loss of natural habitat and no impacts of a beneficial nature on the biological/ ecological environment are likely to result. Based on a generic list of impacts associated with this type of development, the following impacts are regarded likely to occur:

1) Loss and/ or displacement of plant and animal taxa of conservation importance concern;
2) Loss of habitat associated with taxa of conservation importance;
3) Local depletion/ displacement of plant and animal individuals, species, assemblages and reduction of local biodiversity;
4) Loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance, sensitive animal refugia, etc.; and
5) Loss and alteration of ecological processes and ecosystem services on a local scale.
6) Impacts on habitat types that are associated with plants and animals of conservation importance (decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.);
7) Altered quality and ecological functionality (including fire, erosion) of surrounding areas and natural habitat, increased human-animal conflict situations; and
8) Exacerbated encroachment of invasive, exotic and encroacher species, increased utilisation and anthropogenic utilisation factors resulting in exacerbated deterioration.
9) Increased plundering of natural resources due to increased human encroachment;
10) Exacerbation of existing levels of habitat fragmentation and isolation; and
11) Cumulative impacts on local/ regional and national conservation targets and obligations (loss of natural grassland habitat).

Direct Impacts		
Nature	1. Direct loss and or displacement of plant and animal taxa of conservation importance concern	
	Before Mitigation	After Mitigation
Significance	70	20
Nature	2. Direct loss of habitat associated with plant and animal taxa of conservation importance	
	Before Mitigation	After Mitigation
Significance	70	22
Nature	3. Local depletion of plant and animal taxa and reduction of local biodiversity	
	Before Mitigation	After Mitigation
Significance	36	28
Nature	4. Loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance, sensitive animal refugia, etc	
	Before Mitigation	After Mitigation
Significance	65	18
Nature	5. Loss and alteration of ecological processes and ecosystem services on a local scale	
	Before Mitigation	After Mitigation
Significance	40	24
Indirect Impacts		
Nature	6. Indirect impacts on habitat types that are associated with plants and animals of conservation importance (locally)	
	Before Mitigation	After Mitigation
Significance	75	24
Nature	7. Indirect deterioration of habitat quality and ecological functionality (including fire, erosion) of surrounding natural areas	
	Before Mitigation	After Mitigation
Significance	60	21
Nature	8. Exacerbated encroachment of invasive, exotic and encroacher plant species	
	Before Mitigation	After Mitigation
Significance	56	16
Cumulative Impacts		

Nature	**9. Increased plundering of natural resources due to increased human encroachment**	
	Before Mitigation	**After Mitigation**
Significance	**40**	**12**
Nature	**10. Exacerbation of existing levels of habitat fragmentation and isolation**	
	Before Mitigation	**After Mitigation**
Significance	**40**	**12**
Nature	**11. Cumulative impacts on local/ regional and national conservation targets and obligations**	
	Before Mitigation	**After Mitigation**
Significance	**44**	**14**

An evaluation of impacts on the biological environment revealed the potential for significant adverse impacts on sensitive biodiversity receptors, if left unmitigated and uncontrolled. Impacts of a significant nature are more likely to occur in the southern part of the line, between the Lehae and Etna substations, where natural grassland and ridge habitat abound. Sensitive biodiversity receptors include plants and animal species of conservation concern as well as sensitive and pristine grassland and ridge habitat types that are currently in a pristine condition and included in the Vulnerable and Endangered conservation categories. However, the implementation of site-specific as well as generic mitigation measures is likely to reduce the occurrence or level of significance to an acceptable level, minimising the effects of the activity to acceptable levels. A detailed walkdown, which will inform final mitigation strategies in terms of conservation important plants and animals, is regarded a crucial and important part of activities prior to the commencement of construction. Results of this walkdown will inform the final Construction EMP for the activity.

Most impacts of a direct nature are expected to be of relative small extent, possibly extending somewhat beyond the actual footprint of the development, and of relative short duration. Current conditions underneath the exiting lines indicated that, should actual habitat deterioration be controlled to acceptable levels, the subsequent recovery of habitat should be to the extent that normal habitat conditions could be expected to recur after an estimated period of approximately 5 seasons.

It is ultimately the considered opinion of the specialists that impacts of the proposed activity on the biological environment, with suitable mitigation intervention, can be managed and controlled to prevent any significant and permanent damage and losses to the sensitive biodiversity receptors of the receiving environment.

7 INTRODUCTION

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

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

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

Energy is essential for sustainable development. In many countries, including South Africa, economic growth and social needs are resulting in substantially greater energy demands, even considering continuing and accelerated energy efficiency improvements. The need for a stable supply of energy across South Africa is one of the most hotly debated topics; from governmental institutions, industries and developers, down to the common household. It is common knowledge that the demand for electricity in South Africa is rapidly growing and that South Africa needs to expand its electricity generating capacity; frequent interruptions and increasing electricity prices underline shortages currently experienced in the country.

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

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

8 PROJECT SYNOPSIS

The existing 88 kV power line represents old infrastructure and is unable to meet the electricity distribution demands, requiring an upgrade to meet the needs of the surrounding communities and Eskom (The Client) is therefore proposing the following activities:

- The decommissioning of the existing 88 kV Etna - Trade Route power line; and
- The construction of an 88 kV power line within the same servitude built at 132 kV specifications.

This power line will connect existing Etna and Lehae substations and the Trade Route Switching Station, which is currently under construction. The power line will be an 88 kV double circuit twin turn and all activities will be undertaken within the existing servitude.

The proposed development triggers activities under Government Notice R983 (Listing Notice 1) Activity 11(i) and 31(i) of the 2014 EIA Regulations. In accordance with the requirements of the NEMA, Eskom Holdings SOC Limited requires approval from the Competent Authority, i.e. Department of Environmental Affairs, to undertake the proposed project. Eskom has therefore appointed Nsovo Environmental Consulting as the Environmental Assessment Practitioner (EAP) to conduct this Basic Assessment Process. Bathusi Environmental Consulting has been appointed to evaluate the terrestrial biological environment, providing insight into the sensitivities, liabilities and opportunities that the ecological environment exhibit, ultimately making recommendations in terms of mitigative actions that will ensure a minimal impact of the proposed activity on the biological environment.

The proposed project will be located on Farms Rietfontein 301, Portions 45, 15, 43, 48, 46, 47, 104, 103, 18, 19 & 129 and Vlakfontein 303, Portions 27, 23, 5, 22, 17, 16, 10, 57, 12, & 6 within the jurisdiction of City of Johannesburg Metropolitan Municipality, Ward 122 in the Gauteng Province, South Africa.

9 TERMS OF REFERENCE FOR THE BIODIVERSITY ASSESSMENTS

9.1 AIMS FOR THE BOTANICAL BASIC IMPACT ASSESSMENT

A botanical assessment will be done, focussing on:

- Assimilating and appraise records, data and reports available for the project area;
- Providing a brief biophysical description of the region that is spatially sympatric to the study area;
- Compiling a catalogue of plant species persisting within the study area, including abundance and status;
- Identifying ecologically valuable (threatened, protected and Red Data) taxa based on available regional information;
- Identifying ethno-botanical species;
- Identification of weedy/ alien plants with a view to managing these plants;
- Defining and mapping the different micro habitat types based on an evaluation of available aerial imagery;
- Assessing direct and indirect impacts of the proposed development on the botanical communities;
- Assessing cumulative impacts in terms of this environment within the wider area as well as in terms of cumulatively in terms of the infrastructure requirements;
- Compiling management and mitigating measures for identified impacts; and
- Compiling a botanical management plan for the construction and operational phases, with specific reference to rehabilitation guidelines.
- Make recommendations pertaining to the implementation of a botanical monitoring protocol that have objectives of preservation and conservation of botanical attributes of the study area and surrounds.

9.2 AIMS FOR THE FAUNAL BASIC IMPACT ASSESSMENT

A general faunal (inclusive of invertebrate, mammalian herpetofauna and avifaunal aspects) assessment will be done, focussing on:

- Assimilating and appraise available desktop and regional based information pertaining to the study area;
- Formulating a generic list of animal species of the area, with specific reference to conservation important taxa that are likely to persist in the region;
- Determining if/ what threatened animal species are present within the area which may be impacted on, based on available data and historic surveys;
- Mapping of habitats of identified threatened species;
- Identifying species that will be sensitive to relevant impacts;
- Assessing the potential impact of loss of habitat on animals, with reference to direct and indirect impacts;
- Assessing cumulative impacts in terms of this environment within the wider area as well as in terms of cumulatively in terms of the infrastructure requirements;
- Identifying means of avoiding, reducing or managing the impacts on fauna.
- Make recommendations pertaining to the implementation of a faunal monitoring protocol in order to provide temporal recommendations for the conservation of sensitive and critical faunal attributes of the area and limiting the impacts of development operations onto these attributes

10 GDARD SPECIALIST BIODIVERSITY REQUIREMENTS

GDARD requires the following aspects to be investigated (as per email communiqué received per email, dd 2016/10/26):

- Plants, with specific reference to *Cineraria austro-transvaalensis;*
- Invertebrates, with specific reference to *Lepidochrysops praeterita* (Highveld Blue Butterfly);
- Vegetation;
- Wetlands;
- Ridges; and
- Dolomite.

This biodiversity report addresses the assessment of the first three aspects; it is strongly recommended that specialist input into the latter aspects also be acquired to present a comprehensive assessment of the biological environment as per GDARD requirements. The compilation of a detailed GIS model should be compiled to delineate the exact boundaries of the ridges contained within the existing servitude. This GIS model should be based on a contour height interval of 1 m or less and should take cognizance of details contained within the GDARD Ridges Policy.

11 LOCATION AND PROJECT LAYOUT

The proposed upgrade of the existing Etna – Trade Route 88 kV line will comprise an approximate distance of 9.1 km between the new Trade Route Switching Station (currently under construction) in the north and the existing Etna Substation in the south. A collage of georeferenced Google Earth imagery is presented in **Figure 1**, illustrating the physical attributes of the immediate region. The proposed project will be located on Farms Rietfontein 301, Portions 45, 15, 43, 48, 46, 47, 104, 103, 18, 19 & 129 and Vlakfontein 303, Portions 27, 23, 5, 22, 17, 16, 10, 57, 12, & 6 within the jurisdiction of City of Johannesburg Metropolitan Municipality, Ward 122 in the Gauteng Province, South Africa.

12 BIOPHYSICAL ENVIRONMENT

12.1 LAND COVER & LAND USE OF THE REGION

The Grassland Biome of South Africa, because of its development potential, is under severe threat from anthropogenic-induced habitat transformation. Highly developed urban areas, such as the Johannesburg-Midrand-Pretoria urban complex, exemplifies these threats (and pressure responses) of habitat loss and associated impacts. Other than being unquestionably deleterious, there is generally a lack of understanding of the exact effect of land changes on remaining portions of natural habitat within urban environments. Neke & du Plessis (2004) equated threat with any land-use resulting in land-cover conversion from grassland to any other land-cover class and concluded that at least 44.7 % of the grasslands had been transformed and the remaining semi-pristine areas are highly fragmented.

When viewed in isolation, changes may be small and have little effect on the natural environment; however, it is hypothesized that over longer periods, these impacts significantly alter the natural environment and negatively affect the environmental quality and conservation potential. It is also evident that land transformation (degradation) is generally tolerated by natural habitat and faunal assemblages (plastic and elastic attributes), but beyond a certain cut-off point, a severe, usually permanent, decline occurs. Critical determining factors in this process include land use activity, connectivity, fragmentation, and isolation factors, etc. It is also critical to note that various ecological types (woodland, grassland, wetland, ridges, etc.) may react vastly different to a certain impact as they exhibit different plastic and elastic characteristics.

From available information, it is evident that the proposed route is situated within a largely urbanised environment and is characterised by typical degradation and habitat transformation associated with urbanisation (refer **Figures 1 & 2**). High levels of habitat fragmentation and isolation is noted across the region; although a moderate level of connectivity is noted for the remaining areas of natural habitat that are crossed by the line. Limited agriculture and extensive urbanisation has played a major role in transforming the landscape of the immediate region, while remnants of mining infrastructure, secondary anthropogenic activities, and mine dumps are prevalent in the immediate surrounds, particularly to the south of the line. However, expansive areas of remaining natural grassland are noted within the proposed route (southern part). The status of these grasslands exhibits a typical degradation gradient, varying between pristine and deteriorated. Pressures from anthropogenic activities not only transforms natural habitat, but also leads to degradation of remaining surrounding, natural habitat. The present status of grassland portions is mostly also a reflection of the size of area; smaller remnant portions are frequently more deteriorated, while edge effects and secondary impacts have less of an impact on larger areas.

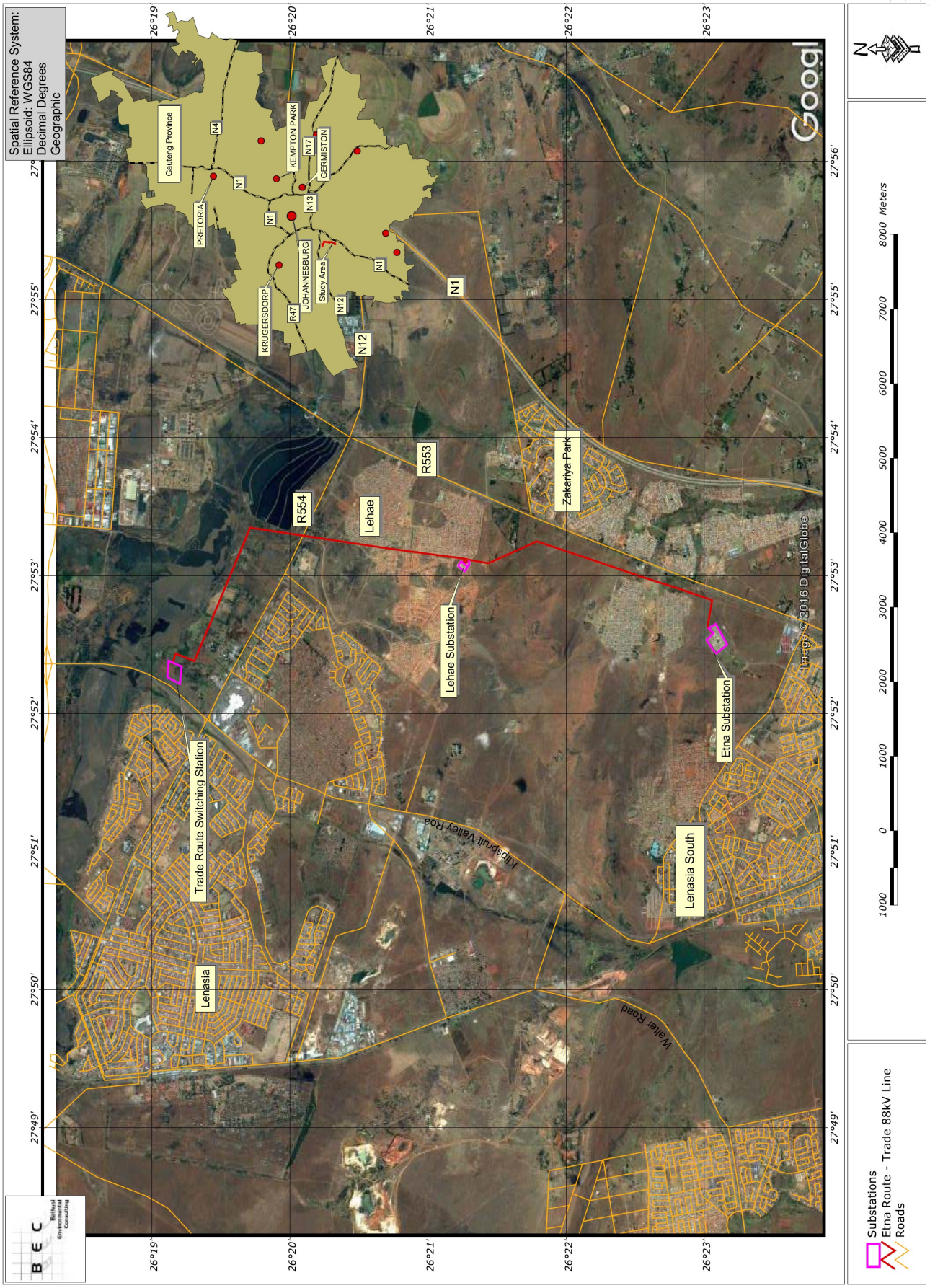


Figure 1: Regional location of the Etna – Trade Route 88 kV line

Image courtesy of GoogleEarth.com

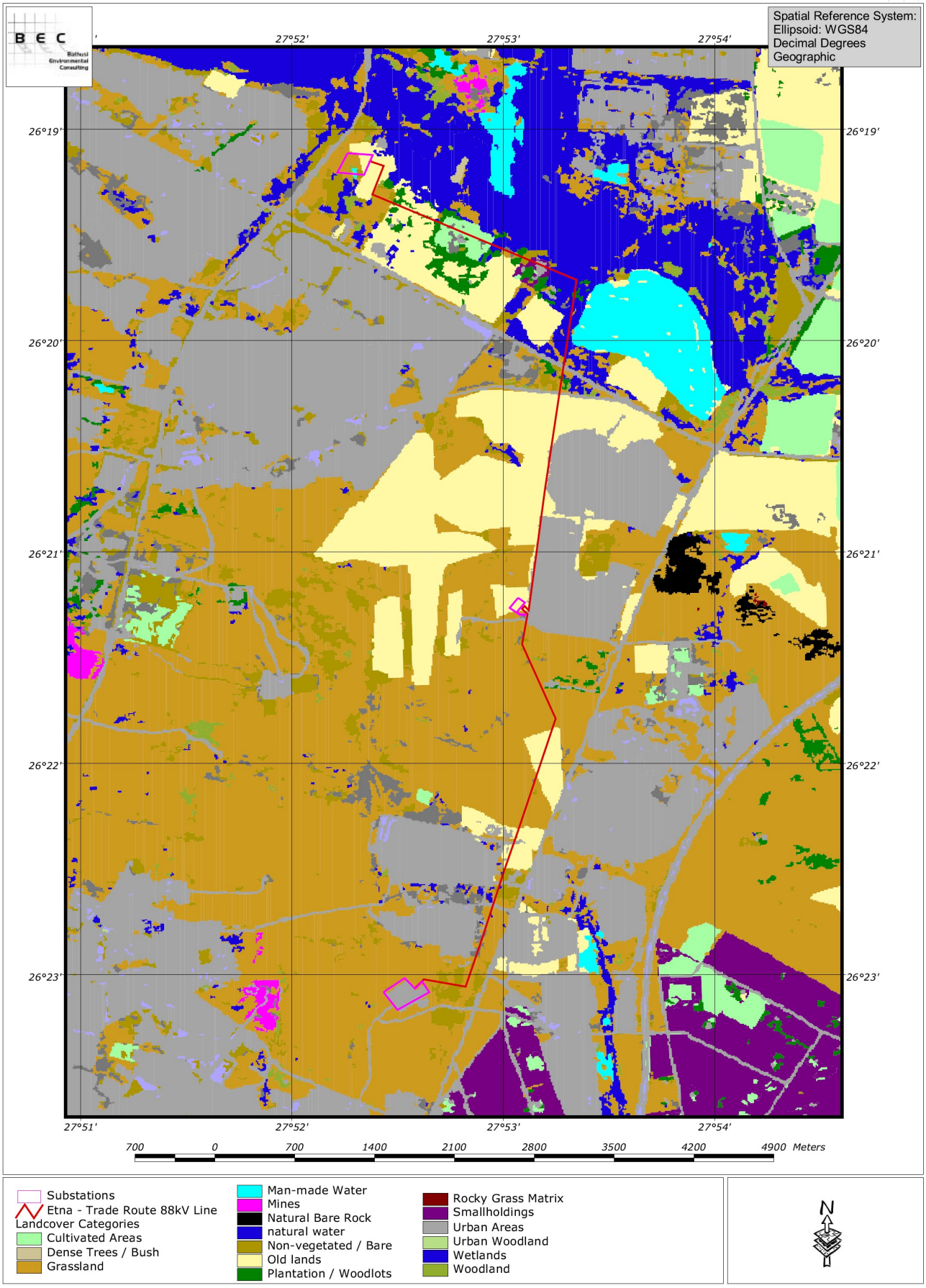


Figure 2: Land cover categories of the immediate region

12.2 TOPOGRAPHY, RELIEF & SLOPES

Areas with topographical variation, particularly a with a high incidence of hills and ridges, are important as they provide for high spatial heterogeneities, thereby likely to sustain populations of conservation important species. From a functional point of view, these hills and ridges are important landscape features assisting winged invertebrates in locating potential mating partners. On a landscape scale, ridges facilitate animal dispersal to other nearby rocky outcrops and ridges (so-called "stepping stones") and thereby function as important ecological linkages. In addition, the faunal populations colonising these patches of outcrops provide a balance through recruitment of individuals (*e.g.* immigration-emigration) among these patches, thereby maintaining meta-populations dynamics. A slope of 9 % (5°) or more is considered significant since the association between increasing slopes and conservation important species is positively related.

A Class 2 ridge is crossed by the existing line and impacts associated with the construction activities of new lines is regarded a significant threat to the continued conservation of this area, particularly in view of the presence of pristine grasslands that buffer the ridge from nearby development and anthropogenic activities (refer **Figure 4**).

12.2.1 Ridges of Gauteng

Quartzite ridges of Gauteng are characterized by a unique plant species composition. As the Witwatersrand is considered transitional between the grassland and savanna biome, floristic elements from both these biomes contribute to the floristic richness of Gauteng ridges. Contributing to this richness is a third Drakensberg element in the flora. The Gauteng ridges, together with the Drakensberg Escarpment, should be regarded as one of the most important natural assets in the entire region of the northern provinces of South Africa (Bredenkamp & Brown, 1998).

The term 'ridge' loosely refers to hills, koppies, mountains, kloofs, gorges, etc.; this is a result of similar biodiversity, ecological and aesthetic values. The essential characteristic defining these topographic features is the slope of the site, whereby any topographic feature in the landscape that is characterized by slopes of 5° or more (i.e. $\geq$8.8 % or $\geq$1 in 11 gradient), as determined by means of a GIS digital elevation model, is defined as a ridge. Please note that although rocky outcrops are not covered by the policy (since their small area coverage does not allow the classification of these features as ridges) they are regarded as sensitive areas characterized by high biodiversity and as such, a no-go development policy should be applied.

Ridges represent vital natural corridors as they function both as wildlife habitat, providing resources needed for survival, reproduction and movement. Furthermore, it also serves as biological corridors, providing for movement between habitat patches. Both functions are potentially critical to conservation of biological diversity as the landscape becomes increasingly fragmented into smaller, more isolated patches (Rosenberg *et al.*, 1997). Natural corridors, which are present in unfragmented landscapes, such as rivers, riparian zones and topographic features, should be retained following fragmentation (Loney & Hobbs, 1991). Urbanisation represents the major threat to the biodiversity of ridges of Gauteng, while encroaching alien vegetation, agriculture and mines/quarries are responsible for the permanent transformation of ridge habitat in the province.

All ridges in Gauteng have been classified into four classes based on the percentage of the ridge that has been transformed (mainly through urbanization) using the 1994 CSIR/ARC Landcover data.

12.2.2 Class 2 Ridge

Class 2 ridges constitute approximately 40 % of the ridges of Gauteng and is categorised as based on approximately 5-35 % transformation (refer **Figure 3**). Development guidelines presented by the Directorate of Nature Conservation (Development guidelines for Class 2 ridges, 2001) include, *inter alia:*

- No further subdivisions will be allowed and consolidation of subdivisions will be encouraged;
- No-go development policy; low impact (e.g. tourism developments) will be considered requiring full EIA (including public participation exercise) with full set of specialist reports including (but not limited to):
  - An ecological study, including both functional (ecological processes including connectivity function of ridge at a landscape level perspective) and compositional (biodiversity) aspects;
  - A Red Data study for both fauna and flora;
  - An invertebrate study;
  - A hydrological / geohydrological study;
  - A geotechnical study;
  - A pollution study, including both air and water pollution;
  - A social study, including cultural, historical and open space value aspects;
  - A visual study; and
  - A study of service provision and access;
- 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 200 m buffer zone of low impact development is required around Class 2 ridges.**

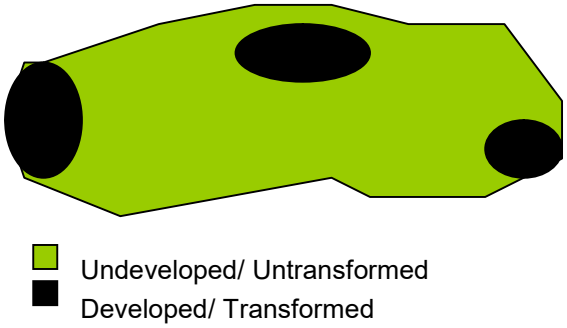


Figure 3: Representation of a Class 2 ridge, according to the extent of transformation

The Class 2 ridge that is situated within the proposed corridor was found to exhibit a high proportion of natural, climax grassland that is representative of the regional ecological types, and is therefore regarded a highly sensitive environment. Limiting construction activities within these areas will be critical towards the minimisation of impacts associated with the activity. While a certain measure of construction activity is unavoidable, the footprint of affected areas should be kept to an absolute minimum. No impacts outside the approved servitude should be allowed, with specific reference to activities such as movement of personnel and vehicles, laydown areas, clearance of vegetation, etc.

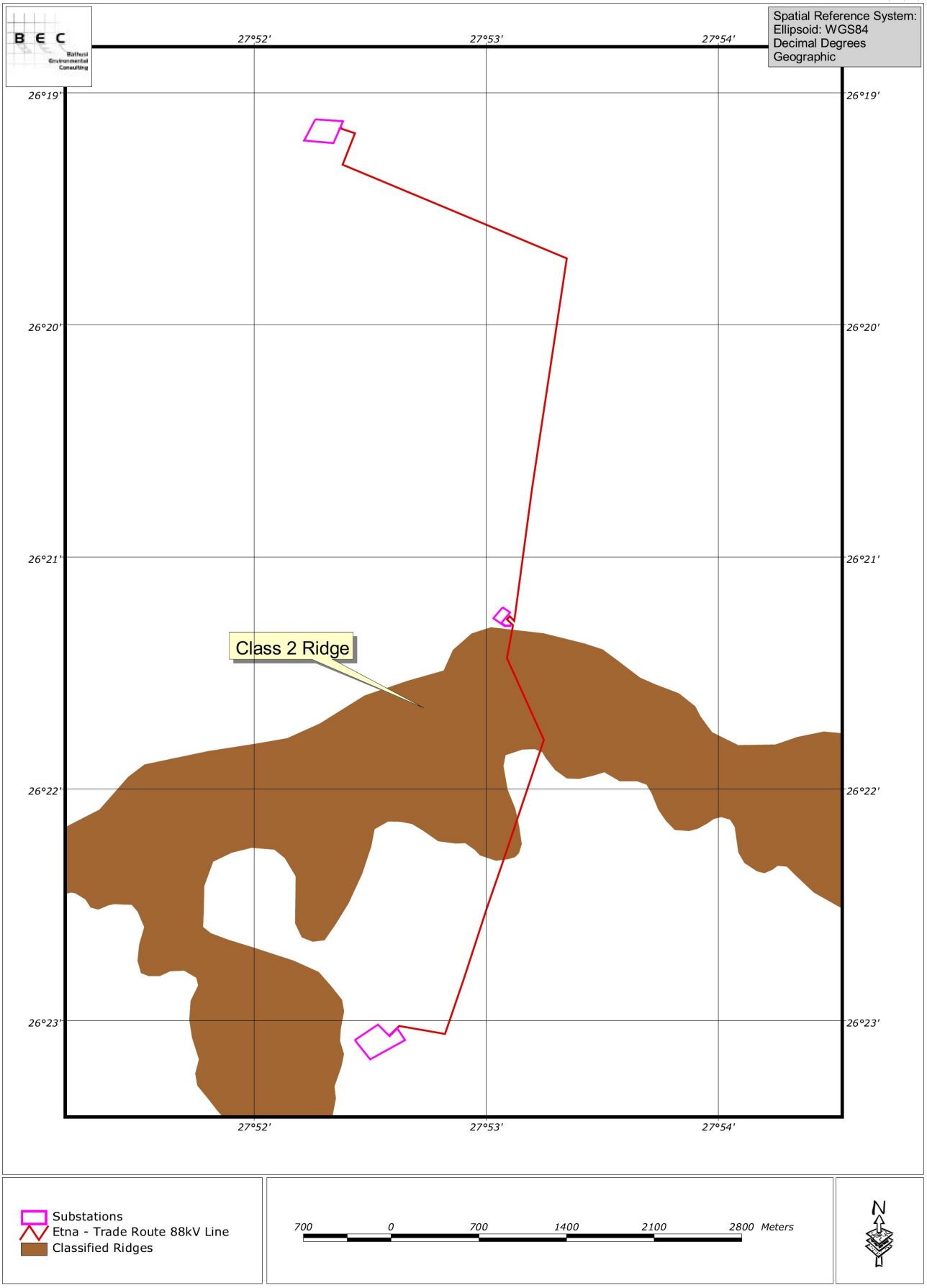


Figure 4: Spatial presence of categorised ridges within the servitude and surrounds

12.3 SURFACE WATER AND WETLANDS

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

Several large wetland systems and rivers are situated near the proposed route. These drainage systems form part of the Vaal Catchment area. A basic illustration of the spatial distribution of wetland types within the immediate surrounds of the proposed route variants are presented in **Figure 5**, but for a detailed discussion of wetlands and the specific impacts thereon, the reader is referred to the specialist report dealing with the impact on wetland habitat types.

Due to topographically varied habitat, the general region in which the line is situated, exhibits various wetland types. For a detailed explanation of these wetland types, the reader is referred to the wetland ecology report. The status of these areas is generally found to be severely degraded due to current land use, existing agricultural activities, trampling, overgrazing, erosion and poor water quality from historic mining activities.

12.4 REGIONAL CONSERVATION IMPORTANCE

The BGIS (2015) dataset for protected areas in southern Africa indicates the presence of the Olifantsvlei Municipal Nature Reserve immediately to the east of the existing line (SAPAD, 2015 Quarter 1, version 2) and the Johanna Jacobs Private Nature Reserve approximately 9 km to the south of the Etna Substation (refer **Figure 6**). Neither of these areas is currently afforded a buffer zone in the 'Protected area buffers South Africa 2015 Quarter 1' database, as such the proposed activity is not situated within a zone of a protected area. It is regarded unlikely that the proposed activity will exacerbate existing impacts on these conservation areas.

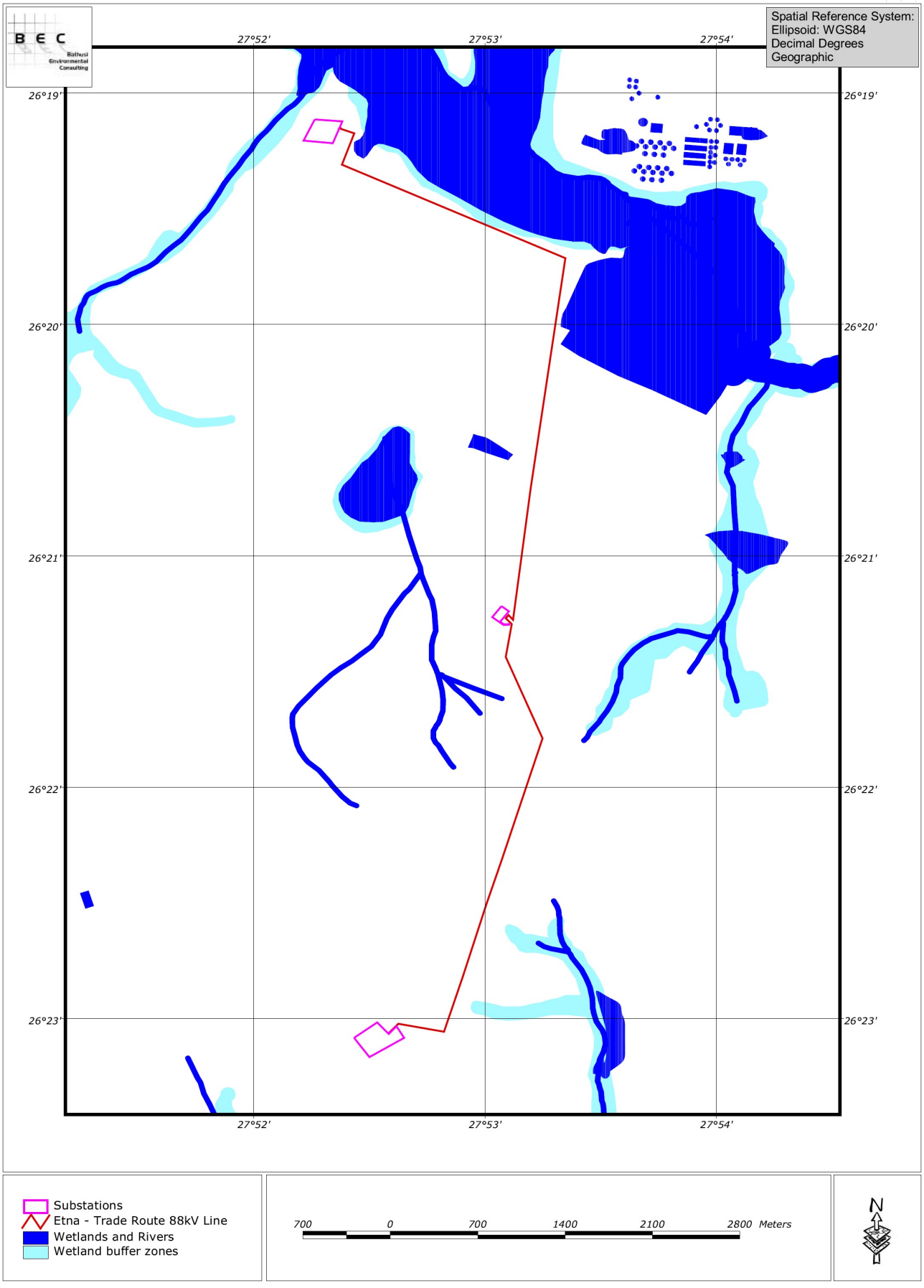


Figure 5: Wetlands and areas of surface water in proximity to the line

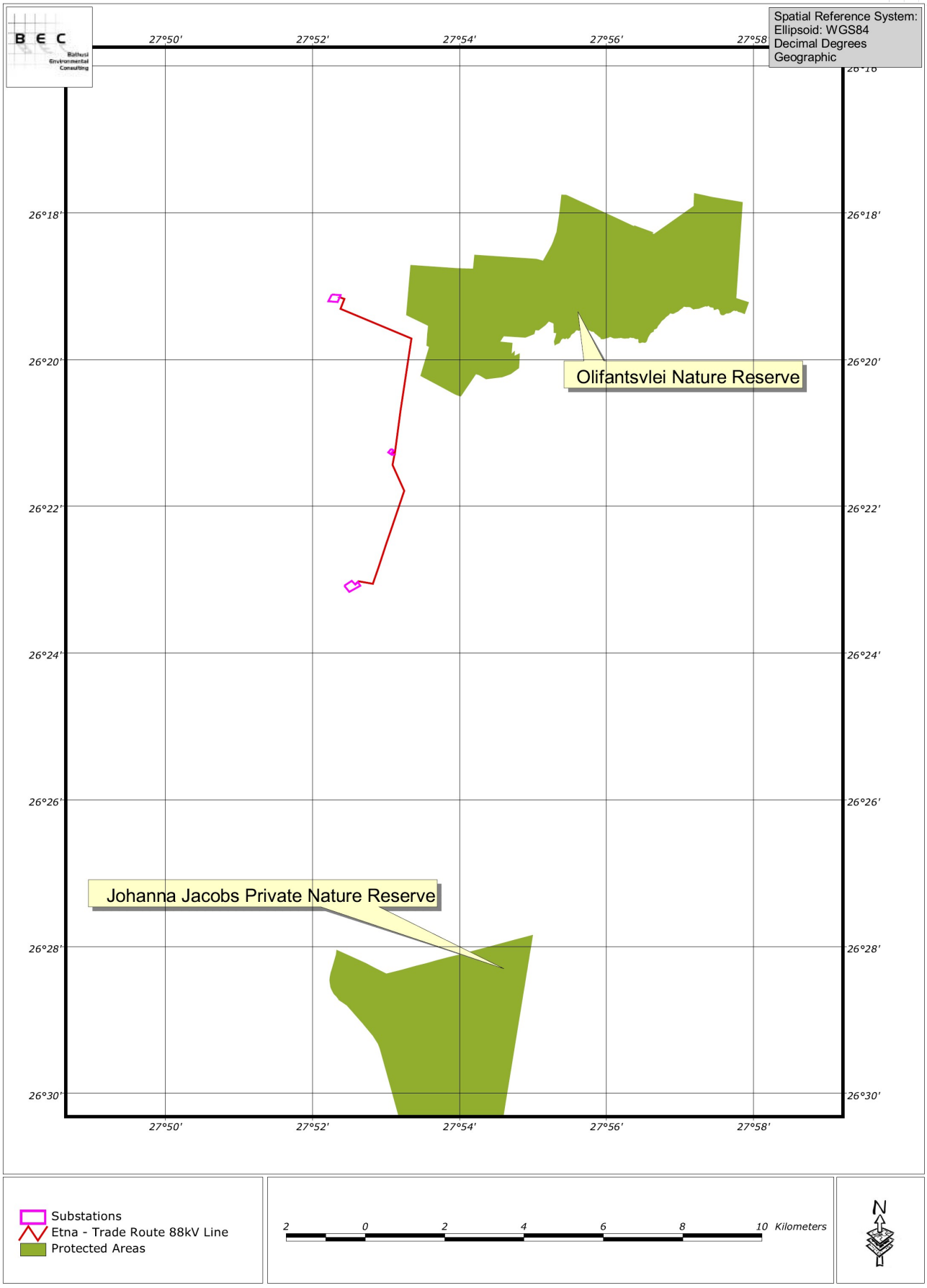


Figure 6: Conservation areas in the proximity of the line

12.5 GDARD C-PLAN CONSERVATION CATEGORIES

C-Plan (v 3.3) information indicates that the proposed line traverses the following C-Plan conservation categories (refer **Figure 7**):

- Primary vegetation;
- Red List invertebrate habitat; and
- Ecological Support Areas (ESAs).

Other conservation categories are furthermore spatially situated in proximity to the existing line, but are unlikely to be affected directly by the proposed activity. All areas of untransformed habitat therefore need to be scrutinised to assess the ecological integrity and status pertaining to the mentioned biodiversity attributes, particularly in view of the presence of riparian/ wetland habitat in proximity to the proposed site.

Additional categories that are spatially situated in proximity to the line include:

- Red List bird habitat;
- Red List mammal habitat; and
- Red List plant habitat.

12.5.1 Ecological Support Areas

ESAs are areas that are not essential for meeting biodiversity representation targets/thresholds, but nonetheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, flood mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for Critical Biodiversity Areas (CBAs).

ESA's are an imperative part of C-Plan 3 to ensure sustainability in the long term (persistence principle, Margules and Pressey, 2000, Cowling, et al., 2003). According to these authors, a conservation plan that does not include ESA's would not be sustainable, as it would assume a static (as opposed to a dynamic) environment. ESAs are part of the entire hierarchy of biodiversity, but it is not possible to include all biodiversity features. Landscape features associated with ESAs (termed spatial surrogates for ESAs) include dolomite, rivers, wetlands, pans, corridors for climate change and species migration, ridges and low-cost areas.

To establish the Present Ecological Status (PES) of these areas, GDARD has requested specific aspects to be included as part of this report, as per **Section 10**.

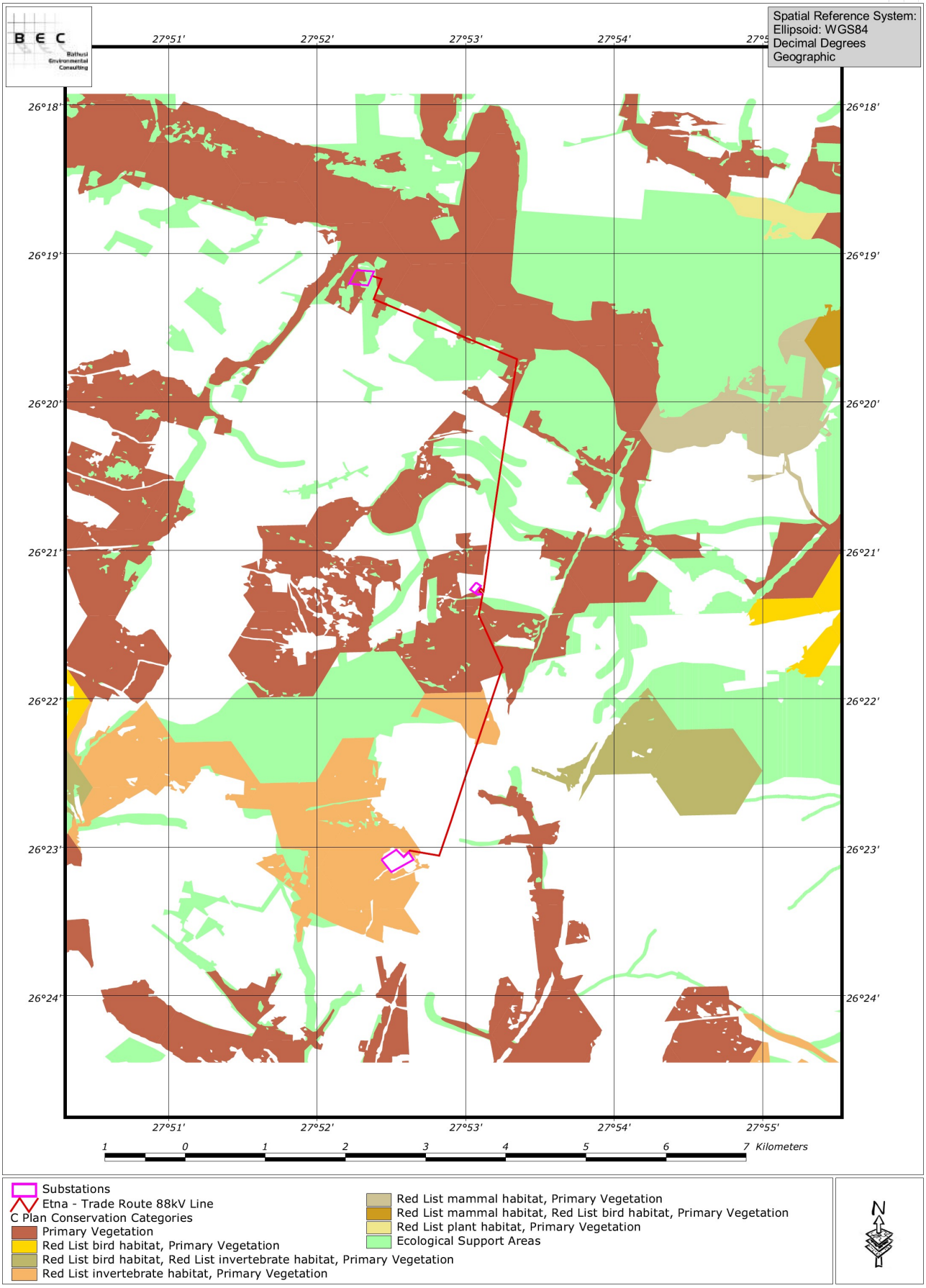


Figure 7: C-Plan conservation categories of the immediate surrounds

13 BOTANICAL ATTRIBUTES OF THE RECEIVING ENVIRONMENT

13.1 BACKGROUND TO THE GRASSLAND ECOLOGY

Grassland defines itself: landscapes dominated by grass. However, although grasses are the most visible plants, grasslands have an exceptional diversity of herbaceous species, particularly those with belowground storage organs such as bulbs or tubers. These plants produce many of our spectacular wild flowers and contribute to biodiversity that is second only to the Cape Fynbos in species richness. Grassland species are particularly well adapted to being defoliated, whether by grazing, fire or frost. Repeated defoliation, within reason, does no real harm to such plants nor does it reduce productivity.

African grasslands are particularly old, stable and resilient ecosystems. Most plants are perennials and surprisingly long lived, with very few annual species, which are the pioneer plants needed to repair disturbances. This renders grasslands vulnerable to destruction by cultivation; once ploughed it is invaded by weedy pioneer plants that are mostly alien. Although many grassland plants do produce seed, very little germinates, most being used as vital food for their rich rodent, insect and bird fauna. Gauteng grasslands are mainly found in the highveld around 1 400 m. These are cool, dry open landscapes, with rainfall exceeding 500 $mm.yr^{-1}$. Frost, hailstorms and lightning strikes are common during periodic raining events. The natural occurrence of fire and other defoliating events favour grassland plants over woody species, helping to maintain the open treeless character of grasslands. Grasslands have shallow-rooted vegetation with a growing season limited to about six months of the year. The non-growing seasons are characterised by cool and dry conditions, during which time most foliage is removed or killed by frost and dies back to ground level.

Grasslands covers most of Gauteng Province, but much of this has been transformed by urban landscapes and agriculture as large parts of these grasslands occur on deep fertile soils of high agricultural value. The unproductive winter and spring seasons in grassland require agricultural strategies for livestock and cultivation that bridge this gap in economic productivity. This substantial and irreversible reduction of the biome is due however mainly attributed to cultivation, especially industrial scale agriculture and timber growing. While these land uses destroy biodiversity, extensive livestock grazing can be reasonably biodiversity-friendly, provided good management and safe stocking rates are applied.

The palatability of grass and its value as food for livestock increases with decreasing rainfall, which is also correlated with altitude, also extending from grassland into savannas. Although sweetveld grasses produce less biomass than sourveld grasses, they have higher food value and lower fibre. This means the plant nutrients are more available in lower rainfall areas due to less leaching of the soil by high rainfall. The 650 mm rainfall isoline approximately separates these two livestock zones. Fire is a characteristic feature of grassland (and savannas) and is a necessary component of good land management. Grassland plants depend on fire, they resprout annually from their rootstocks.

Without frequent fire, grasslands eventually become invaded with woody species and some herbaceous plants die. Regular burning to complement good grazing management helps to prevent the increase of species unpalatable to livestock, including woody species that result in bush encroachment. The large number of conservation important species in grasslands is a problem for environmental impact assessments. They are mostly small, very localised and visible for only a few weeks in the year when they flower. Most surveys will not pick them up and special skills are required to locate and identify them reliably.

13.2 REGIONAL FLORISTIC CONTEXT

The study area is geographically located in the Mesic Highveld Grassland Bioregion, more specifically spatially represented within the following ecological types (as defined by Mucina and Rutherford, 2006) (refer **Figure 8**):

- Carletonville Dolomite Grassland (Vulnerable);
- Eastern Temperate Freshwater Wetlands (Vulnerable);
- Gauteng Shale Mountain Bushveld (Vulnerable); and
- Soweto Highveld Grassland (Endangered).

13.2.1 Carletonville Dolomite Grassland

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. This vegetation type is regarded as **Vulnerable**, with a conservation target of 24 %. Only small portions 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. The endemic species *Delosperma davyi* persists 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 ommanneyi, Justicia anagalloides, Kohautia amatymbica, Kyphocarpa angustifolia, Ophrestia oblongifolia, Pollichia campestris, Senecio coronatus* and *Hilliardiella oligocephala.*

Geophytic Herbs: *Boophone 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.*

13.2.2 Eastern Temperate Freshwater Wetlands

This vegetation type occurs around water bodies with stagnant water (lakes, pans, periodically flooded vleis, and edges of calmly flowing rivers) and is embedded within the Grassland Biome.

The landscape is generally flat, or shallow depressions filled with (temporary) water bodies supporting zoned systems of aquatic and hygrophilous vegetation of temporarily flooded grasslands and ephemeral herblands. The vleis from where flow of water is impeded by impermeable soils and/ or by erosion resistant features, such as dolerite intrusions. Many vleis and pans of this type of wetlands are inundated and/ or saturated only during the summer rainfall season and for some months after this into the middle of the dry winter season, but the may remain saturated all year round. Surface water inundation may be present at any point while the wetland is saturated, and some plan species will be present only under inundated condition, or under permanently saturated conditions. The presence of standing water should not be takes as a sign of permanent wetness.

The highveld endemic species *Rorippa fluviatilis* var. *caledonica* and the endemic taxa *Disa zuluensis, Kniphofia flammula, Nerine platypetala* and the succulent herb *Crassula tuberella* occur in this vegetation type.

A **Vulnerable** conservation status is attributed to this ecological type. About 5% is statutorily conserved in the **Blesbokspruit**, Hogsback, Marievale, Olifantsvlei, Seekoeivlei, Wakkerstroom Wetland, Umgeni Vlei and Pamula Park Nature Reserves. It is also protected in private nature reserves such as the Korsman Bird Sanctuary and Langfontein. Some 15% has been transformed to cultivated land, urban areas or plantations. In places, intensive grazing and use of lakes and freshwater pans as drinking pools for cattle or sheep cause major damage to the wetland vegetation. Alien species that are encountered in this type of wetland include *Bidens bidentata, Cirsium vulgare, Conyza bonariensis, Oenothera rosea, Physalis viscosa, Plantago lanceolata, Rumex crispus, Sesbania punicea, Schkuhria pinnata, Stenotaphrum secundatum, Trifolium pratense, Verbena bonariensis, V. brasiliensis* and *Xanthium strumarium.*

Vegetation patterning in rings in concentric rings is often found in pans. Pan size and depth may be a factor limiting vegetation, as large water bodies with shallow water may experience wave action. This limits the presence of species with floating leaves as well as some submerged and marginal macrophytes. The situation is more complex in vleis as these often have variable microtopography and soil types within as single wetland. It is possible for seasonally inundated zones to occur embedded inside the permanently inundated zone of a vlei, if this zone is present.

13.2.3 Gauteng Shale Mountain Bushveld

This vegetation type occurs mainly on the ridge of the Gatsrand south of Carletonville – Westonaria – Lenasia. It also occurs as a narrow band along the ridge that runs from a point between Tarlton and Magaliesberg in the west, through Sterkfontein, Pelindaba, Atteridgeville to Klapperkop and Southeastern Pretoria in the east. Altitude varies between 1 300 and 1 750 m.

The landscape is low, broken ridges varying in steepness and with high surface rock cover. Vegetation is a short, semi-open thicket dominated by a variety of woody species including *Senegalia caffra, Searsia leptodictya, S. magalismontana, Cussonia spicata, Ehretia rigida, Maytenus heterophylla, Euclea crispa, Zanthoxylum capense, Dombeya rotundifolia, Protea caffra, Celtis africana, Ziziphus mucronata, Vangueria infausta, Canthium gilfillanii, Englerophytum magalismontanum, Combretum molle, Ancylobotrys capensis,*

Olea europaea subsp. *europaea* and *Grewia occidentalis.* The understory is dominated by a variety of grasses. Some of the ridges form plateaus above the northern slopes that carry scrubby grassland with high surface rock cover.

This unit is ascribed a **Vulnerable** conservation status. Less than 1 % is statutorily conserved in, for example the Skanskop and Hartbeesthoek Nature Reserves, Magaliesberg Nature Area and Groenkloof National Park. Additionally, over 1 % conserved in other reserves, including the John Nash Nature Reserve, Cheetah Park and Hartbeesthoek Radio Astronomy Observatory. About 21 % is transformed mainly by urban and built-up areas, mines and quarries, cultivation and plantations. Wattle is a common invader in places.

This unit represents the arid western part of the ridges of Rocky Highveld Grassland (Low % Rebelo 1996) or Bankenveld (Acocks 1988). In species composition and vegetation structure, it is similar to and positioned adjacent to Andesite Mountain Bushveld. This unit occurs more frequently on warmer north-facing slopes and is underlain by rocks of sedimentary origin, whereas Andesite Mountain Bushveld occurs more frequently on cooler south-facing slopes and underlain by rocks of volcanic origin.

Typical species recorded in this unit include the following:

Small Trees: *Senegalia caffra, Dombeya rotundifolia, Vachellia karroo, Celtis africana, Combretum molle, Cussonia spicata, Englerophytum magalismontanum, Protea caffra, Searsia leptodictya, Vangueria infausta, Zanthoxylum capense,* and *Ziziphus mucronata.*

Tall Shrubs: *Asparagus laricinus Canthium gilfillanii, Chrysanthemoides monilifera, Dichrostachys cinerea, Diospyros austro-africana, Diospyros lycioides* subsp. *lycioides, Ehretia rigida,* subsp. *rigida Euclea crispa* subsp. *crispa, Grewia occidentalis, Gymnosporia polyacantha, Olea europaea* subsp. *africana, Tephrosia capensis,* and *T. longipes.*

Low Shrubs: *Acalypha angustata, Asparagus suaveolens, Athrixia elata, Felicia muricata, Indigofera comosa,* and *Searsia magalismontana* subsp. *magalismontana.*

Geoxylic Suffrutex: *Elephantorrhiza elephantina*

Succulent Shrub: *Kalanchoe rotundifolia*

Woody Climber: *Ancylobotrys capensis*

Graminoids: *Hyparrhenia dregeana, Cymbopogon caesius, C. pospischilii, Digitaria eriantha* subsp. *eriantha,* and *Eragrostis curvula.*

Herbs: *Dicoma zeyheri, Helichrysum nudifolium, H. rugulosum, Hermannia lancifolia, Hibiscus pusillus, Selaginella dregei, Senecio venosus, Hilliardiella natalensis,* and *H. oligocephala.*

Geophytic Herbs: *Cheilanthes hirta, Pellaea calomelanos* and *Scadoxus puniceus.*

13.2.4 Soweto Highveld Grassland

The Soweto Highveld Grassland comprises a gently to moderately undulating landscape on the Highveld plateau supporting short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra* and accompanied by a variety of other grasses such as *Elionurus muticus, Eragrostis racemosa, Heteropogon contortus* and *Tristachya leucothrix*. In undisturbed parts, only scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover.

This vegetation type is regarded **Endangered** with a target of 24 %. Only a handful of patches are statutorily conserved, including Wadrift, Krugersdorp, Leeuwkuil, Suikerboschrand and Rolfe's Pan Nature Reserve. A few areas are privately conserved, including Johanna Jacobs, Tweefontein, Gert Jacobs, Nikolaas and Avalon Nature Reserves and Heidelberg Natural Heritage Site. Almost half of the area already transformed by cultivation, urban sprawl, mining and building of road infrastructure. Some areas have been flooded by dams (Grootdraai, Leeukuil, Trichardtsfontein, Vaal, and Willem Brummer).

The typical species composition of these grasslands comprises of the following taxa:

Graminoids: *Andropogon appendiculatus*, *Brachiaria serrata*, *Cymbopogon pospischilii*, *Cynodon dactylon*, *Elionurus muticus*, *Eragrostis capensis*, *E. chloromelas*, *E. curvula*, *E. plana*, *E. planiculmis*, *E. racemosa*, *Heteropogon contortus*, *Hyparrhenia hirta*, *Setaria nigrirostris*, *S. sphacelata*, *Themeda triandra*, *Tristachya leucothrix*, *Andropogon schirensis, Aristida adscensionis, A. bipartita, A. congesta, A. junciformis* subsp. *galpinii, Cymbopogon caesius, Digitaria diagonalis, Diheteropogon amplectens, Eragrostis micrantha, E. superba, Harpochloa falx, Microchloa caffra,* and *Paspalum dilatatum.*

Herbs: *Hermannia depressa*, *Acalypha angustata, Berkheya setifera, Dicoma anomala, Euryops gilfillanii, Geigeria aspera* var. *aspera, Graderia subintegra, Haplocarpha scaposa, Helichrysum miconiifolium, H. nudifolium* var. *nudifolium, H. rugulosum, Hibiscus pusillus, Justicia anagalloides, Lippia scaberrima, Rhynchosia effusa, Schistostephium crataegifolium, Selago densiflora, Senecio coronatus, Hilliardiella oligocephala,* and *Wahlenbergia undulata.*

Geophytic Herbs: *Haemanthus humilis* subsp. *hirsutus* and *H. montanus.*

Herbaceous Climber *Rhynchosia totta*

Low Shrubs *Anthospermum hispidulum, A. rigidum* subsp. *pumilum, Berkheya annectens, Felicia muricata* and *Ziziphus zeyheriana.*

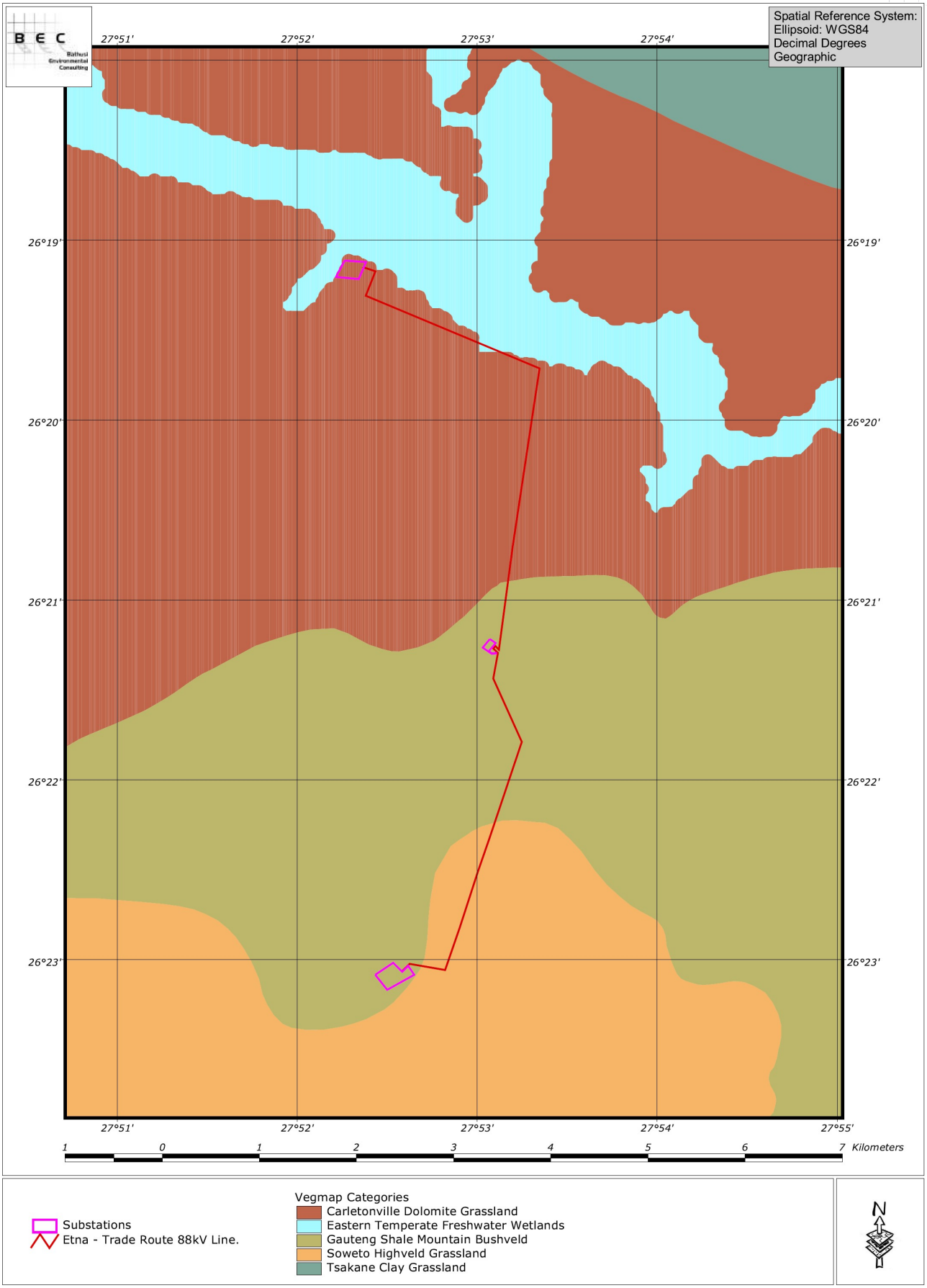


Figure 8: Vegmap categories of the region

13.3 REGIONAL PHYTODIVERSITY

Information obtained from the SANBI database (POSA, 2009) indicates the known presence of only 85 plant species within the ¼-degree grid that is spatially represented in the study area[1] (2627BD). This low diversity reflects of a poor floristic knowledge of the region and a severe underrepresentation of the floristic diversity of the larger region due to poor sampling efforts within these parts. Some of the surrounding ¼-degree grids do however reflect the regional diversity context of the Grassland Biome, for example:

- 2627BA 249 species;
- 2627BB 908 species;
- 2628AA 1,040 species;
- 2628AC 259 species;
- 2627DB 331 species; and
- 2628CA 472 species.

13.4 SAMPLING DIVERSITY

An alpha diversity of 122 plant species was recorded during the brief survey period. It should be noted that the timing of the survey (October 2016) was not conducive for the collation of a comprehensive floristic inventory as extremely little raining advents have occurred prior to the site investigation. The recorded diversity is nonetheless regarded diverse, despite significant anthropogenic influences and impacts and provides a good reflection of the regional floristic diversity as well as in the context of the Grassland Biome. Despite adverse sampling conditions, the recorded diversity corresponds with other surveys concluded in the immediate region of the study sites. It is strongly recommended that a detailed floristic inventory be compiled during the vegetative and reproductive season of the region. Red Data assessments could be utilised as ideal opportunities to compile comprehensive inventories for the study area.

Despite the moderate recorded floristic diversity, an appraisal of the growth forms (refer **Table 2**) reflects the grassland physiognomy with a high percentage of the species comprising forbs (43 species, 35.2 %) grasses (24 species, 19.7 %), dwarf shrubs (10 species, 8.2 %). The grassland physiognomy is further highlighted by the absence of trees and shrubs, the only notable trees presence being exotic species and localised stands on rocky ridges.

Table 2: Recorded growth forms for the study area

Growth Form	*Number*	*Percentage*
Climbers	1	0.8 %
Dwarf shrubs	10	8.2 %
Ferns	1	0.8 %
Forbs	43	35.2 %
Geophytes	6	4.9 %
Grasses	24	19.7 %
Hydrophilics	2	1.6 %
Perennial herbs	6	4.9 %
Prostrate herbs	8	6.6 %
Sedges	1	0.8 %
Shrubs	8	6.6 %
Small trees	2	1.6 %
Succulents	2	1.6 %
Trees	8	6.6 %
Total	**122**	

[1] This list is not included in the report, but can be presented separately on request.

The recorded diversity is also represented by 38 plant families, typically dominated by Asteraceae (28 species, 23.0 %), Poaceae (26 species, 21.3 %) and Fabaceae (10 species, 8.2 %). No other plant families have been found to attain any specific dominance.

13.5 PLANTS OF CONSERVATION IMPORTANCE

13.5.1 Background

The internationally endorsed IUCN Red List Categories and Criteria was employed for the assessment of the conservation status of plants. This system is designed to measure species' risk of extinction. The purpose of this system is to highlight those species that are most urgently in need of conservation action. Due to its strong focus on determining risk of extinction, the IUCN system does not highlight species that are at low risk of extinction, but may nonetheless be of high conservation importance. Because the Red List of South African plants is used widely in southern African conservation practices such as systematic conservation planning or protected area expansion, an amended system of categories designed to highlight those species that are at low risk of extinction but of conservation concern are used. Species that are at risk of extinction, also known as threatened or endangered species are those that are classified in the categories Critically Endangered (CR), Endangered (EN) and Vulnerable (VU) (refer **Figure 9**).

Guidelines for the assessment of Red List species include (but are not necessarily limited to):

- A botanical specialist with local botanical and ecological knowledge and experience should undertake the survey;
- A suitable survey should be undertaken; in the summer-rainfall areas of the country, botanical surveys should take place between October and April while in the winter-rainfall areas they should take place between August and October;
- Prior to visiting the site, the specialist consultant should download a list of species that could potentially occur at the site from POSA;
- It is important that specimens are collected as part of the botanical survey, especially for taxonomic groups likely to be of conservation concern;
- Plants should be identified to species level wherever possible, not genus level;
- Species that may be dormant should also be reported;
- Once specimens are collected, they should be identified at an herbarium. Potential species of conservation concern sampled should be identified by a taxonomist specializing in the plant group in question;
- Specialist botanists should also include in their reports a list of species of conservation concern that may occur at a site but may be dormant because of unfavourable environmental conditions, for example species that were not seen because the vegetation at a site has not been burnt for many years.

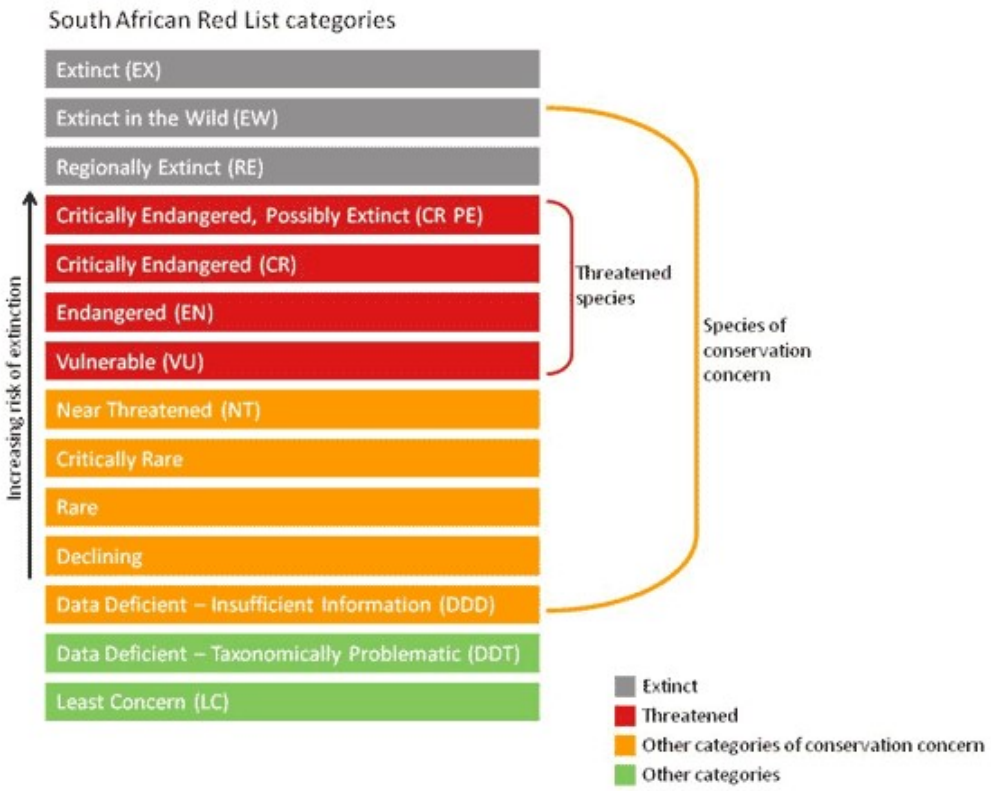


Figure 9: South African Red List Categories (courtesy of SANBI)

A preliminary list of conservation important plants that are known to occur in the general region is presented in **Table 3**. This list was compiled from the POSA sampling records, GDARD sampling records as well as visual observations made during the brief survey period.

Table 3: Conservation important plants recorded for the region

Species	*Flowering Season*	*Suitable Habitat*	*Conservation Status (1-global status; 2-national status)*
Adromischus umbraticola* subsp. *umbraticola	**September-January**	**Rock crevices on rocky ridges, usually south-facing, or in shallow gravel on top of rocks, but often in shade of other vegetation.**	**Near Threatened[1]**
Boophone disticha*	**October-January**	**Dry grassland and rocky areas.**	**Declining[2]**
Cineraria austrotransvaalensis	**March-June**	**Amongst rocks on steep slopes of hills and ridges, as well as at the edge of thick bush or under trees; on all aspects and on a range of rock types: quartzite, dolomite and shale; 1400 – 1700 m.**	**Near Threatened[1]**
Cineraria longipes	**March-May**	**Grassland, on koppies, amongst rocks and along seepage lines, exclusively on basalt on south-facing slopes.**	**Vulnerable[1]**
Gunnera perpensa	October-March	In cold or cool, continually moist localities, mainly along upland streambanks.	Declining[2]
Ilex mitis var. *mitis*	October-December	Riverbanks, streambeds, evergreen forests.	Declining[2]
Khadia beswickii	**July-April**	**Open areas on shallow surfaces over rocks in grassland.**	**Vulnerable[1]**
Kniphofia typhoides	February-March	Low-lying wetlands and seasonally wet areas in climax Themeda triandra grasslands on heavy black clay soils, tends to disappear from degraded grasslands.	Near Threatened[1]
Lepidium mossii	Unknown	Unknown.	Data Deficient[1]
Lessertia mossii	Unknown	Unknown.	Data Deficient[1]

Table 3: Conservation important plants recorded for the region			
Species	*Flowering Season*	*Suitable Habitat*	*Conservation Status (1-global status; 2-national status)*
Lithops lesliei subsp. lesliei	**March-June**	**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.**	**Near Threatened[2]**
Myrothamnus flabellifolius	**Unknown**	**Rocky places**	**Data Deficient[1]**

- Species annotated with * were recorded during the survey period; and
- Species indicated as bold are considered likely inhabitants of the study area, considering the status and diversity of habitat present within the servitude.

Considering the status and types of habitat present, it is evident that areas of natural grassland, with specific reference to the rocky ridges, are regarded highly suitable habitat for several conservation important plant taxa. To establish/ refute the presence of these plants within the servitude it is strongly recommended that suitable Red Data assessment surveys be conducted as part of the walkdown assessment during the reproductive periods of these plants. The following timeframes are recommended:

- January; and
- March/ April.

Specifically, the need to assess the presence of *Cineraria austro-transvaalensis* was requested by GDARD as a requirement of these biodiversity studies. Based on the variability and status of habitat within the servitude, it is regarded highly likely that this species could persist in this area. The reproductive period (which is typically the most optimal period for identification purposes) is between March and June. This specific field investigation could therefore not establish the presence/ absence of this species from the servitude. To confirm the presence/ absence of this species from the servitude, it is therefore strongly recommended to conduct a walkdown survey between the months of March and June. The presence of this species within the servitude will require detailed and site-specific mitigation measures as the conservation of individuals of conservation important plants with status higher than Rare status, requires *in situ* protective actions.

Unavoidable impacts are likely to occur along the existing servitude. Where the presence of any conservation important plant species has been identified within an area of unavoidable impact, the removal and/ or relocation of the individual plants is advised. Removal of plants should take cognisance of the GDARD Plant Rescue Scheme (2008) for the removal of plants of horticultural and medicinal value from development sites;

13.6 MICRO HABITAT TYPIFICATION

A basic site investigation revealed the following micro habitat types (refer **Figure 10**)[2]:

- Deteriorated Grassland;
- Natural/ Rocky Grassland Matrix;
- Ridges/ Rocky Grassland Matrix;
- Transformed Areas; and
- Wetland Habitat.

[2] Please note a servitude width of approximately 100 m was used for mapping purposes. This does not necessarily relate to the actual servitude width of the existing line, but is used as an indication of the potential impact on the terrestrial biodiversity environment.

13.6.1 Deteriorated Grassland

Parts of the proposed route exhibit characteristics of compromised grassland areas where recent and historic surface disturbances resulted in severe deterioration, or complete decimation, of the original herbaceous layer. Subsequent revegetation has taken place in some parts and are characterised by the colonisation by numerous weeds, invasive and pioneer species and absence of most of the original grassland elements. The level of disturbance determines the divergence from the natural (original) species composition, but the dominance of weeds and exotic and secondary climax species is generally accepted as an indication of the deteriorated status of these parts. Visually, and by implication therefore also structurally, these areas appear dissimilar to areas of natural grassland.

Localised excavation and construction activities and the indirect impacts associated within these activities have contributed significantly to the severe deterioration of grasslands in the immediate area. Similarly, indirect impacts associated with the establishment and growth of residential areas and townships have resulted in deterioration of remaining portions of natural grasslands adjacent to these parts where dumping, littering and localised surface disturbances occurred.

The likelihood of encountering any Red Data flora species within these parts is regarded medium-low and a medium-low floristic status and sensitivity is generally ascribed to these parts; the construction of linear infrastructure within these parts are not expected to result in significant impacts on the status of surrounding natural (sensitive) grassland types.

A total of 57 species were recorded within these parts; typical species are presented in **Table 4**.

Table 4: Typical species composition of the Deteriorated Grassland Habitat

Species Name	*Family*	*Growth Form*
Acacia mearnsii De Wild.	Fabaceae	Tree
Acacia podalyriifolia A. Cunn. Ex G. Don	Fabaceae	Tree
Argemone ochroleuca	Papaveraceae	Perennial herb
Arundo donax	Poaceae	Shrub
Berkheya species	Asteraceae	Forb
Bidens pilosa L.	Asteraceae	Forb
Bromus catharticus Vahl	Poaceae	Grass
Canna indica	Cannaceae	Perennial herb
Chenopodium album L.	Chenopodiaceae	Perennial herb
Conyza bonariensis (L.) Cronquist	Asteraceae	Forb
Crepis hypochoeridea (DC.) Thell.	Asteraceae	Forb
Cymbopogon pospischilii	Poaceae	Grass
Cynodon dactylon (L.) Pers.	Poaceae	Grass
Datura stramonium L.	Solanaceae	Forb
Eragrostis chloromelas Steud.	Poaceae	Grass
Eucalyptus species	Myrsinaceae	Tree
Felicia muricata	Asteraceae	Forb
Gomphocarpus fruticosus (L.) Aiton f.	Apocynaceae	Shrub
Guilleminea densa	Amaranthaceae	Prostrate herb
Hermannia depressa N.E.Br.	Malvaceae	Prostrate herb
Hermannia lancifolia Szyszyl.	Malvaceae	Forb
Heteropogon contortus (L.) Roem. & Schult.	Poaceae	Grass
Hilliardiella oligocephala	Asteraceae	Forb
Hyparrhenia hirta (L.) Stapf	Poaceae	Grass
Hypoxis iridifolia Baker	Hypoxidaceae	Geophyte
Hypoxis rigidula	Hypoxidaceae	Geophyte

Table 4: Typical species composition of the Deteriorated Grassland Habitat		
Species Name	*Family*	*Growth Form*
Indigofera species	Fabaceae	Forb
Lactuca inermis	Asteraceae	Perennial herb
Leonotis ocymifolia	Lamiaceae	Dwarf shrub
Lepidium africanum	Brassicaceae	Forb
Melia azedarach L.	Meliaceae	Tree
Melinis repens	Poaceae	Grass
Oenothera rosea L'H,r. ex Aiton	Onagraceae	Forb
Oenothera stricta	Onagraceae	Forb
Oxalis species	Oxalidaceae	Geophyte
Papaver aculeatum	Papaveraceae	Forb
Pennisetum clandestinum Chiov.	Poaceae	Grass
Physalis viscosa L.	Solanaceae	Perennial herb
Phytolacca octandra	Phytolaccaceae	Shrub
Plantago lanceolata L.	Plantaginaceae	Forb
Polygala hottentotta C.Presl	Polygalaceae	Forb
Populus x *canescens*	Salicaceae	Tree
Pseudognaphalium luteo-album (L.) Hilliard & B.L.Burtt	Asteraceae	Forb
Richardia brasiliensis Gomes	Rubiaceae	Prostrate herb
Ricinus communis	Euphorbiaceae	Shrub
Rorippa nudiuscula	Brassicaceae	Forb
Salix babylonica L.	Salicaceae	Tree
Schkuhria pinnata (Lam.) Cabrera	Asteraceae	Forb
Selago densiflora	Selaginaceae	Prostrate herb
Senecio inornatus DC.	Asteraceae	Forb
Seriphium plumosum	Asteraceae	Shrub
Solanum mauritianum Scop.	Solanaceae	Shrub
Solanum sisymbriifolium Lam.	Solanaceae	Dwarf shrub
Sporobolus africanus (Poir.) Robyns & Tournay	Poaceae	Grass
Tagetes minuta L.	Asteraceae	Forb
Ursinia nana	Asteraceae	Forb
Verbena bonariensis L.	Verbenaceae	Dwarf shrub

13.6.2 Natural/ Rocky Grassland Matrix

Extensive parts of the study area comprise natural grassland habitat, particularly the central part of the proposed route where the extent of surface rocks is not as significant as in the Ridges/ Grassland matrix, conforming to stony soils. Biophysical habitat attributes that characterise these areas include the limited presence of surface rocks and slopes that generally do not exceed 5° (relatively flat). Parts of this community do however occur in the footslopes of the ridge habitat where limited access for cattle and farm implements prevented transformation of the vegetation through agricultural purposes. The species composition is characterised by a diverse vegetation layer that comprises herbs and grasses that are typical to the regional ecological types. Trees and shrubs are generally absent, or occur as scattered and low individuals. Brief observations made revealed that the species composition and structural components of this unit is regarded highly representative of the regional ecological type; mostly Gauteng Shale Mountain Bushveld, but also small portions of the Soweto Highveld Grassland. Furthermore, poor quality species, or indicator species that frequently reflect deteriorated grassland habitat, are generally absent from these parts.

A high floristic status and sensitivity is ascribed to these parts of the route, mainly because of the presence of pristine grassland habitat, as well as compositional and structural aspects that reflect a pristine nature, but also because of a high probability of encountering plant species of conservation importance. The construction of linear infrastructure within these parts is expected to result in significant, but manageable,

local and impacts on the status of remaining natural (sensitive) grassland types. Impacts that are regarded pertinent in this regard include:

- Direct impacts on flora species of conservation importance;
- Impacts on ecological connectivity & ecosystem functioning
- Loss of natural grassland habitat;
- Increase in local and regional fragmentation/ isolation of habitat.

A high floristic status and sensitivity is therefore ascribed to this unit and mitigation recommendations will be aimed at containment of physical impacts to a small footprint area. Species typically recorded in this unit are presented in **Table 5.**

Table 5: Typical species composition of the Natural/ Rocky Grassland Matrix Habitat

Species Name	*Family*	*Growth Form*
Acalypha angustata Sond.	Euphorbiaceae	Dwarf shrub
Ajuga ophrydis	Lamiaceae	Forb
Andropogon schirensis A.Rich.	Poaceae	Grass
Aristida aequiglumis Hack.	Poaceae	Grass
Asclepias eminens	Apocynaceae	Forb
Asparagus suaveolens Burch.	Liliaceae	Shrub
Berkheya species	Asteraceae	Forb
***Boophone disticha* (L.f.) Herb.**	**Amaryllidaceae**	**Geophyte**
Brachiaria serrata (Thunb.) Stapf	Poaceae	Grass
Bulbine species	Liliaceae	Geophyte
Chaetacanthus costatus Nees	Acanthaceae	Forb
Chenopodium album L.	Chenopodiaceae	Perennial herb
Conyza bonariensis (L.) Cronquist	Asteraceae	Forb
Conyza podocephala DC.	Asteraceae	Forb
Crinum graminicola I.Verd.	Amaryllidaceae	Geophyte
Cyanotis speciosa (L.f.) Hassk.	Commelinaceae	Forb
Cymbopogon pospischilii	Poaceae	Grass
Cyperus esculentus	Cyperaceae	Sedge
Digitaria monodactyla (Nees) Stapf	Poaceae	Grass
Diheteropogon amplectens (Nees) Clayton	Poaceae	Grass
Elephantorrhiza elephantina (Burch.) Skeels	Fabaceae	Dwarf shrub
Elionurus muticus (Spreng.) Kunth	Poaceae	Grass
Eragrostis chloromelas Steud.	Poaceae	Grass
Eragrostis racemosa (Thunb.) Steud.	Poaceae	Grass
Eriosema salignum E.Mey.	Fabaceae	Forb
Euphorbia striata	Euphorbiaceae	Succulent
Felicia muricata	Asteraceae	Forb
Gazania krebsiana	Asteraceae	Forb
Geigeria burkei	Asteraceae	Dwarf shrub
Gladiolus species	Iridaceae	Geophyte
Helichrysum caespititium (DC.) Harv.	Asteraceae	Prostrate herb
Helichrysum callicomum Harv.	Asteraceae	Forb
Helichrysum kraussii Sch.Bip.	Asteraceae	Forb
Helichrysum oreophilum Klatt	Asteraceae	Forb
Helichrysum rugulosum Less.	Asteraceae	Forb
Hermannia depressa N.E.Br.	Malvaceae	Prostrate herb
Hermannia lancifolia Szyszyl.	Malvaceae	Forb
Hermannia transvaalensis Schinz	Malvaceae	Prostrate herb
Heteropogon contortus (L.) Roem. & Schult.	Poaceae	Grass
Hilliardiella oligocephala	Asteraceae	Forb
Hyparrhenia hirta (L.) Stapf	Poaceae	Grass

Table 5: Typical species composition of the Natural/ Rocky Grassland Matrix Habitat		
Species Name	*Family*	*Growth Form*
Hypoxis iridifolia Baker	Hypoxidaceae	Geophyte
Hypoxis rigidula	Hypoxidaceae	Geophyte
Indigofera species	Fabaceae	Forb
Jamesbrittanea aurantiaca	Scrophulariaceae	Forb
Justicia anagalloides (Nees) T.Anderson	Acanthaceae	Prostrate herb
Ledebouria ovalifolia (Schrad.) Jessop	Liliaceae	Perennial herb
Loudetia simplex (Nees) C.E.Hubb.	Poaceae	Grass
Melinis repens	Poaceae	Grass
Microchloa caffra Nees	Poaceae	Grass
Nidorella anomala Steetz	Asteraceae	Forb
Parinari capensis	Chrysobalanaceae	Dwarf shrub
Pearsonia species	Fabaceae	Forb
Pellaea calomelanos	Adianthaceae	Fern
Polygala hottentotta C.Presl	Polygalaceae	Forb
Raphionacme hirsuta	Periplocaceae	Dwarf shrub
Rhynchosia totta	Fabaceae	Forb
Scabiosa columbaria L.	Dipsacaceae	Forb
Senecio coronatus (Thunb.) Harv.	Asteraceae	Forb
Senecio venosus Harv.	Asteraceae	Forb
Sphenostylis angustifolia Sond.	Fabaceae	Prostrate herb
Sporobolus ioclados (Trin.) Nees	Poaceae	Grass
Stachys species	Lamiaceae	Dwarf shrub
Stipagrostis ciliata	Poaceae	Grass
Tephrosia lupinifolia	Fabaceae	Forb
Themeda triandra Forssk.	Poaceae	Grass
Trachypogon spicatus (L.f.) Kuntze	Poaceae	Grass
Tristachya leucothrix Nees	Poaceae	Grass
Urelytrum agropyroides (Hack.) Hack.	Poaceae	Grass

13.6.3 Ridges/ Rocky Grassland Matrix

These parts represent pristine examples of the Gauteng Shale Mountain Bushveld, physically represented by steep slopes and high rockiness. These terrestrial rocky grasslands and outcrops are situated in upland positions (topographical unit 3); characterized by a short, low cover of herbaceous species, physiognomically dominated by grasses, but with a high diversity of forbs. A high degree of rockiness is characteristic of this unit, varying between 75 % and 30 % cover and manifesting as surface outcrops, often higher than 1 m. The exceptional diversity recorded in this unit attests to the regional diversity of these ecological types. The prominence of isolated stands of trees and shrubs is a characteristic feature of the vegetation.

The present status of these parts is regarded to be a primary climax status, as is attested to by the species composition recorded within this unit. The conservation status of these grasslands, on a regional scale, is regarded 'Vulnerable' and all areas within the study site where the species composition and floristic character approximates that of the regional vegetation type is therefore regarded sensitive. In addition, the following contributing factors render the floristic sensitivity of this habitat high:

- Few unfragmented areas of untransformed grassland remain within the region of the highveld within which the proposed route is situated. Grasslands are considered a threatened vegetation type due to extensive transformation on a local and national scale (Hoare & Wessels 2000; van Wyk 1998; Driver et al. 2005). Rocky grassland represents a poorly conserved and threatened vegetation type;
- These grasslands are linked to areas of natural grassland to the south, consequently forming part of continuous grassland vegetation that has high regional conservation value. The maintenance of this

uninterrupted grassland represents a much more viable conservation unit than any fragmented portions; and

- The grassland vegetation on site has a high local species richness (α-diversity) and there is high habitat variability leading to high overall species richness within the vegetation.

The estimated likelihood of conservation important plant taxa persisting within these parts are regarded high. A high floristic status and sensitivity is therefore ascribed to these parts. The realignment of the proposed route, to avoid affecting these sensitive features, is strongly recommended. It is strongly emphasised that rocky grassland areas are interpreted as being similar to a ridge and should therefore be afforded a similar conservation status. Species typically recorded in this unit are presented in **Table 6.**

Table 6: Typical species composition of the Ridges/ Rocky Grassland Matrix Habitat

Species Name	*Family*	*Growth Form*
Acacia podalyriifolia A. Cunn. Ex G. Don	Fabaceae	Tree
Acacia species	Fabaceae	Tree
Acalypha angustata Sond.	Euphorbiaceae	Dwarf shrub
Ajuga ophrydis	Lamiaceae	Forb
Andropogon schirensis A.Rich.	Poaceae	Grass
Aristida aequiglumis Hack.	Poaceae	Grass
Asparagus suaveolens Burch.	Liliaceae	Shrub
Berkheya species	Asteraceae	Forb
Bidens pilosa L.	Asteraceae	Forb
Boophone disticha (L.f.) Herb.	Amaryllidaceae	Geophyte
Brachiaria serrata (Thunb.) Stapf	Poaceae	Grass
Bulbine species	Liliaceae	Geophyte
Conyza podocephala DC.	Asteraceae	Forb
Cyanotis speciosa (L.f.) Hassk.	Commelinaceae	Forb
Cymbopogon pospischilii	Poaceae	Grass
Diheteropogon amplectens (Nees) Clayton	Poaceae	Grass
Elionurus muticus (Spreng.) Kunth	Poaceae	Grass
Eragrostis racemosa (Thunb.) Steud.	Poaceae	Grass
Eriosema salignum E.Mey.	Fabaceae	Forb
Felicia muricata	Asteraceae	Forb
Gazania krebsiana	Asteraceae	Forb
Helichrysum oreophilum Klatt	Asteraceae	Forb
Helichrysum rugulosum Less.	Asteraceae	Forb
Hermannia depressa N.E.Br.	Malvaceae	Prostrate herb
Hermannia lancifolia Szyszyl.	Malvaceae	Forb
Hermannia transvaalensis Schinz	Malvaceae	Prostrate herb
Heteropogon contortus (L.) Roem. & Schult.	Poaceae	Grass
Hyparrhenia hirta (L.) Stapf	Poaceae	Grass
Hypoxis iridifolia Baker	Hypoxidaceae	Geophyte
Hypoxis rigidula	Hypoxidaceae	Geophyte
Indigofera species	Fabaceae	Forb
Jamesbrittanea aurantiaca	Scrophulariaceae	Forb
Justicia anagalloides (Nees) T.Anderson	Acanthaceae	Prostrate herb
Lactuca inermis	Asteraceae	Perennial herb
Leonotis ocymifolia	Lamiaceae	Dwarf shrub
Lopholaena coriifolia (Sond.) E.Phillips & C.A.Sm.	Asteraceae	Dwarf shrub
Loudetia simplex (Nees) C.E.Hubb.	Poaceae	Grass
Melinis repens	Poaceae	Grass
Microchloa caffra Nees	Poaceae	Grass
Nidorella anomala Steetz	Asteraceae	Forb
Parinari capensis	Chrysobalanaceae	Dwarf shrub
Pearsonia species	Fabaceae	Forb

Table 6: Typical species composition of the Ridges/ Rocky Grassland Matrix Habitat		
Species Name	*Family*	*Growth Form*
Pellaea calomelanos	Adianthaceae	Fern
Plantago lanceolata L.	Plantaginaceae	Forb
Polygala hottentotta C.Presl	Polygalaceae	Forb
Raphionacme hirsuta	Periplocaceae	Dwarf shrub
Rhynchosia totta	Fabaceae	Forb
Rorippa nudiuscula	Brassicaceae	Forb
Scabiosa columbaria L.	Dipsacaceae	Forb
Schkuhria pinnata (Lam.) Cabrera	Asteraceae	Forb
Searsia lancea L.f.	Anacardiaceae	Tree
Searsia leptodictya Diels	Anacardiaceae	Small tree
Searsia magalismontana	Anacardiaceae	Shrub
Senecio species	Asteraceae	Forb
Senecio venosus Harv.	Asteraceae	Forb
Sphenostylis angustifolia Sond.	Fabaceae	Prostrate herb
Sporobolus africanus (Poir.) Robyns & Tournay	Poaceae	Grass
Sporobolus ioclados (Trin.) Nees	Poaceae	Grass
Stachys species	Lamiaceae	Dwarf shrub
Tapiphyllum parvifolium (Sond.) Robyns	Rubiaceae	Small tree
Themeda triandra Forssk.	Poaceae	Grass
Trachypogon spicatus (L.f.) Kuntze	Poaceae	Grass
Tristachya leucothrix Nees	Poaceae	Grass
Typha capensis (Rohrb.) N.E.Br.	Typhaceae	Hydrophilic
Urelytrum agropyroides (Hack.) Hack.	Poaceae	Grass
Ursinia nana	Asteraceae	Forb
Verbena bonariensis L.	Verbenaceae	Dwarf shrub

13.6.4 Transformed Areas

Extensive urban areas occur within the near vicinity of the proposed routes and the edges of these urban developments, as well as indirect impacts associated with urban areas, have resulted in significant deterioration of the natural grasslands within some parts. The absence of a natural species, composition, the severity of surface degradation as well as the dominance of invasive species generally precludes the potential presence of conservation important species and a Low floristic status is ascribed to these parts. No surveys were conducted in these parts as the vegetation is generally entirely transformed and not representative of any natural physiognomy.

13.6.5 Wetland Habitat

Grassland habitat associated with riparian wetland systems are characterised by a dense layer of grass species with that are frequently encountered in habitat where the soils are temporarily, seasonally or periodically, inundated with moisture. These habitat types are regarded sensitive, but are also frequently targeted by cattle because of the presence of palatable grass species. A high ecological sensitivity is attributed to these parts since conservation important taxa are likely to persist in these areas. However, these riparian systems are often severely compromised in terms of ecological integrity and are heavily impacted by inappropriate grazing strategies.

Forbs typically dominate the species composition and a low diversity, but a physiognomically dominant grass layer is characteristic. It is not in the scope of this report to typify the ecological status of wetland types and the reader is therefore referred to the specialist report dealing specifically with this part of the investigation. Furthermore, the delineation of this habitat, as indicated in the plant community map, was done based on

physiognomic (visual, floristic) habitat attributes not by means of a detailed soil investigation. To obtain the correct boundaries of the wetland, the shapefiles compiled by wetland specialists should be implemented for sensitivity mapping purposes. A high similarity is noted between the species composition of this unit and the Deteriorated Grassland unit.

A moderately high conservation status and sensitivity is nonetheless ascribed this unit, despite a medium floristic status. Taking cognisance of the conservation important plants that occur in the region, these areas are highly suitable for their potential presence. Species typically recorded in this unit are presented in **Table 7.**

Table 7: Typical species composition of the Wetland Habitat

Species Name	*Family*	*Growth Form*
Argemone ochroleuca	Papaveraceae	Perennial herb
Arundo donax	Poaceae	Shrub
Berkheya species	Asteraceae	Forb
Bidens pilosa L.	Asteraceae	Forb
Bromus catharticus Vahl	Poaceae	Grass
Canna indica	Cannaceae	Perennial herb
Chenopodium album L.	Chenopodiaceae	Perennial herb
Conyza bonariensis (L.) Cronquist	Asteraceae	Forb
Conyza podocephala DC.	Asteraceae	Forb
Crepis hypochoeridea (DC.) Thell.	Asteraceae	Forb
Cymbopogon pospischilii	Poaceae	Grass
Cynodon dactylon (L.) Pers.	Poaceae	Grass
Cyperus esculentus	Cyperaceae	Sedge
Datura stramonium L.	Solanaceae	Forb
Eragrostis chloromelas Steud.	Poaceae	Grass
Gomphocarpus fruticosus (L.) Aiton f.	Apocynaceae	Shrub
Helichrysum kraussii Sch.Bip.	Asteraceae	Forb
Helichrysum species	Asteraceae	Forb
Hermannia transvaalensis Schinz	Malvaceae	Prostrate herb
Hilliardiella oligocephala	Asteraceae	Forb
Hyparrhenia hirta (L.) Stapf	Poaceae	Grass
Indigofera species	Fabaceae	Forb
Justicia anagalloides (Nees) T.Anderson	Acanthaceae	Prostrate herb
Lactuca inermis	Asteraceae	Perennial herb
Leonotis ocymifolia	Lamiaceae	Dwarf shrub
Lepidium africanum	Brassicaceae	Forb
Oenothera rosea L'H,r. ex Aiton	Onagraceae	Forb
Oenothera stricta	Onagraceae	Forb
Oxalis species	Oxalidaceae	Geophyte
Papaver aculeatum	Papaveraceae	Forb
Pennisetum clandestinum Chiov.	Poaceae	Grass
Phragmites australis (Cav.) Steud.	Poaceae	Hydrophilic
Phytolacca octandra	Phytolaccaceae	Shrub
Plantago lanceolata L.	Plantaginaceae	Forb
Pseudognaphalium luteo-album (L.) Hilliard & B.L.Burtt	Asteraceae	Forb
Richardia brasiliensis Gomes	Rubiaceae	Prostrate herb
Salix babylonica L.	Salicaceae	Tree
Schkuhria pinnata (Lam.) Cabrera	Asteraceae	Forb
Selago densiflora	Selaginaceae	Prostrate herb
Senecio inornatus DC.	Asteraceae	Forb
Solanum mauritianum Scop.	Solanaceae	Shrub
Sporobolus africanus (Poir.) Robyns & Tournay	Poaceae	Grass
Verbena bonariensis L.	Verbenaceae	Dwarf shrub

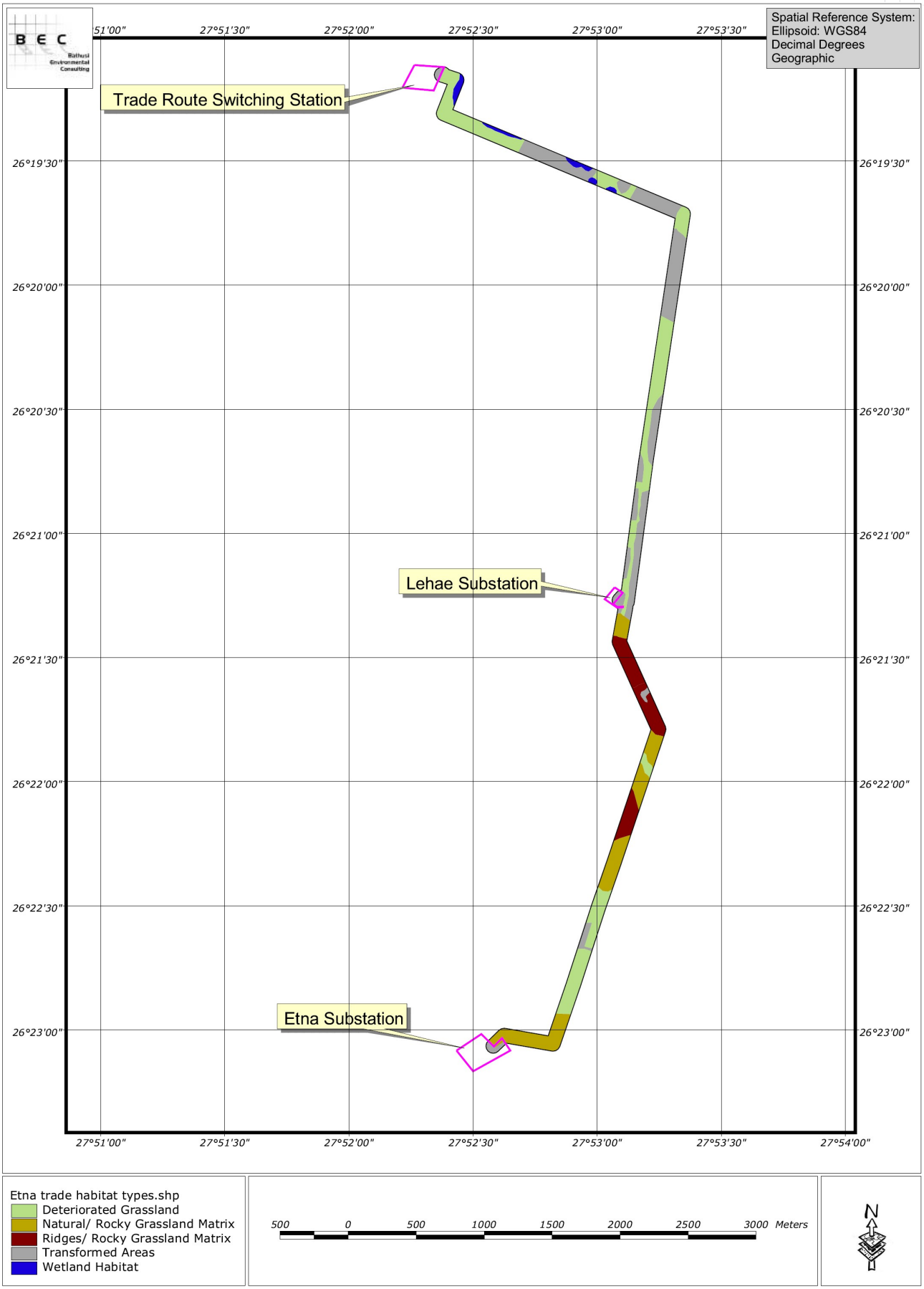


Figure 10: Illustration of micro habitat types within the study area

13.7 FLORISTIC SENSITIVITY OF THE STUDY AREA

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

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

Habitat sensitivity is categorised as follows:

Low No natural habitat remaining; this category is represented by developed/ transformed areas, nodal and linear infrastructure, areas of agriculture or cultivation, areas where exotic species dominate exclusively, mining land (particularly surface mining), etc. The possibility of these areas reverting to a natural state is impossible, even with the application of detailed and expensive rehabilitation activities. Similarly, the likelihood of plant species of conservation importance occurring in these areas is regarded negligent.

Medium – low All areas where the natural habitat has been degraded, with the important distinction that the vegetation has not been decimated and a measure of the original vegetation remain, albeit dominated by secondary climax species. The likelihood of plant species of conservation importance occurring in these areas is regarded low. These areas also occur as highly fragmented and isolated patches, typical to

cultivated fields, areas that have been subjected to clearing activities and areas subjected to severe grazing pressure. The species composition of these areas is typically low and is frequently dominated by a low number of species, or invasive plants.

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

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

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

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

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

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

These areas are also characterised by low transformation and habitat isolation levels and contribute significantly on a local and regional scale in the ecological functionality of nearby and dependent ecosystems, with specific reference to catchment areas, pollination and migration corridors, genetic resources. A major reason for the high conservation status of these areas is the low ability to respond to disturbances (low plasticity and elasticity characteristics).

Sensitivity Criteria employed in assessing the floristic sensitivity of separate units may vary between different areas comprising of a similar habitat type, depending on location, type of habitat, size, etc. General floristic sensitivity estimations are presented in **Table 8**, illustrated in **Figure 11**. Additional aspects that are taken into consideration include surrounding habitat sensitivity, conservation potential, fragmentation and habitat isolation factors.

Table 8: General floristic sensitivity estimations for the study area								
Criteria	*RD species*	*Landscape sensitivity*	*Status*	*Species diversity*	*Functionality/ fragmentation*	*TOTAL*	*SENSITIVITY INDEX*	*SENSITIVITY CLASS*
Community	**Criteria Ranking**							
Deteriorated Grassland	2	3	2	6	3	95	30%	**medium-low**
Natural/ Rocky Grassland Matrix	8	9	8	9	7	266	83%	**high**
Ridges/ Rocky Grassland Matrix	9	10	8	9	8	287	90%	**high**
Transformed Areas	1	1	1	2	1	37	12%	**low**
Wetland Habitat	6	10	7	8	6	240	75%	**medium-high**

Table 9: Extent of habitat types within the servitude		
Habitat	*Extent*	*Percentage*
Deteriorated Grassland	31.0 ha	37.1 %
Natural/ Rocky Grassland Matrix	15.2 ha	18.2 %
Ridges/ Rocky Grassland Matrix	9.4 ha	11.3 %
Transformed Areas	25.9 ha	30.9 %
Wetland Habitat	2.1 ha	2.5 %
Total	**83.7 ha**	**100.0 %**

Table 10: Extent of habitat sensitivity within the servitude		
Sensitivity	*Extent*	*Percentage*
High Floristic Sensitivity	24.6 ha	29.4 %
Medium-high Floristic Sensitivity	2.1 ha	2.5 %
Medium-low Floristic Sensitivity	31.0 ha	37.1 %
Low Floristic Sensitivity	25.9 ha	30.9 %
Total	**83.7 ha**	**100.0 %**

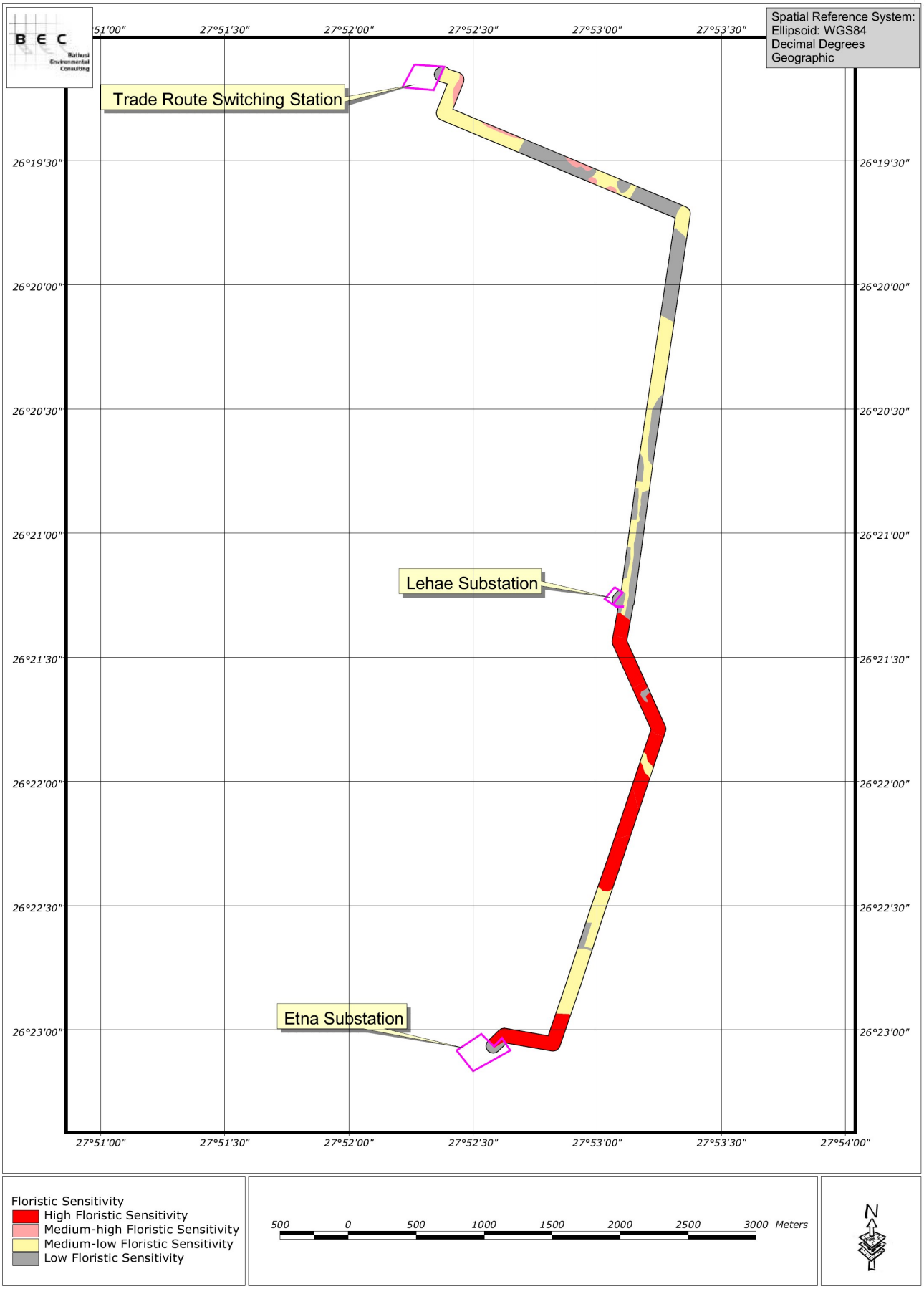


Figure 11: Floristic sensitivity of the existing servitude

13.8 SUMMATION OF RESULTS

The northern part of the line, situated between the Lehae substation and the Trade Route Switching Station, constitute habitat that mostly exhibit evidence of significant anthropogenic transformation and degradation. Residential suburbs, linear transformation and fragmentation, informal agricultural practices have resulted in deterioration and decimation of the natural vegetatal cover and the subsequent development of a secondary vegetation cover that does not constitute any significant or sensitive vegetatal attributes. The only habitat of ecological significance/ sensitivity in the northern section of the line is represented by the wetland habitat; as it is situated outside the servitude, it is unlikely to be affected directly. However, cognisance of the presence of this habitat should be taken throughout the construction process to prevent any adverse impact.

It is evident from the assessment that the southern part of the line, comprising the areas between the Lehae and the Etna substations, exhibit botanical attributes of high sensitivity, mainly in the form of natural rocky grassland and topographical heterogeneous ridge habitat. The national database indicates the 'Vulnerable' and Endangered' conservation status ascribed to the ecological types that are spatially situated in the southern part of the line. Consequently, any significant losses of natural grassland and ridge habitat, on a local and regional scale are regarded significant. The vegetation in these parts is diverse and is furthermore regarded suitable for the presence of conservation important plant taxa. A brief verification survey, as part of the normal walkdown procedure for power lines should inform final EMP guidelines for the activity.

The evaluation and quantification of expected and likely impacts on the floristic environment confirmed the significance of unmitigated impacts. However, the successful application of mitigation measures is expected to reduce the significance of impacts to an acceptable significance level, reducing the level of impacts to a level where the natural grassland environment will continue to operate in an ecological effective and efficient manner.

14 FAUNAL ATTRIBUTES OF THE STUDY SITES

14.1 INTRODUCTION

Biological diversity everywhere is at great risk as a direct result of an ever-expanding human population and its associated needs for energy, water, food and minerals. Landscape transformation needed to accommodate these activities inevitably leads to habitat loss and habitat fragmentation, resulting in the mosaical appearance of undisturbed habitat within a matrix of transformed areas. Remaining areas of natural habitat are frequently too small to support the biodiversity that previously occupied these areas, consequently the area and the region is constantly losing its ecological integrity and diversity (Kamffer 2004). Grasslands of Gauteng are no exception and urban and industrial development and expansion have led to significant transformation, degradation and fragmentation of the region's grasslands. Agriculture and pastoral activities have had a moderate impact on the biodiversity of the region, but farming is believed by some to be the most damaging sector of human activity affecting wild nature (Balmford *et al* 2012).

14.2 STUDY APPROACH

The field investigation was conducted in October 2016. Detailed faunal assessments typically include equipment-based survey methods such as small mammal traps, baited infrared camera-traps, invertebrate pitfalls, etc. However, based on the location of the study area, the land use and high numbers of pedestrians on the site and adjacent properties, the risk of equipment losses (and all data) was deemed very likely and these methods were excluded. Consequently, the study approach implemented for this study was based on qualitative and quantitative habitat assessments and collection of data based on ecological indicators such as tracks, dung, diggings, etc. of mammals present in the study area and the evaluation of habitat characteristics and variety. Qualitative and quantitative habitat assessments that were employed for this study are often applied in smaller studies, yielding accurate results for the identification and estimation of the variety, status and inherent sensitivity of the receiving environment.

This faunal investigation focused on Gauteng's fauna species of conservation concern. All faunal groups were assessed at Quarter-degree. Data on the Q-degree distribution of the major faunal groups' species of conservation concern were compiled from the following data sources:

- Dung Beetles: University of Pretoria, Department of Zoology and Entomology (pers. comm.);
- Butterflies: Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas (Mecenero *et al.*, 2013);
- Frogs: Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (Minter *et al*, 2004);
- Reptiles: South African Reptile Conservation Assessment (online: www.sarca.adu.org.za, 2015);
- Birds: South African Bird Atlas Project 2 (online: www.sabap2.adu.org.za, 2015); and
- Mammals: Virtual Museum of African Mammals (online: www.vmus.adu.org.za, 2015).

The known distribution of these species (based on above mentioned data sources) and availability of suitable habitat (qualitative and quantitative habitat assessment) were used to estimate the Probability of Occurrence (PoO) of fauna species of conservation concern from the Gauteng Province. Estimations of the PoO were grouped into five classes:

- Low: 0-20 %;
- Medium-low: 21-40 %;
- Medium: 41-60 %;
- Medium-high: 61-80 %; and
- High: 81-100 %.

14.3 RESULTS

A total of 44 animal species was recorded in the study area during this brief survey. This diversity includes:

- 6 insect species;
- 36 bird species; and
- 2 mammal species.

The alien and invasive Common Myna, *Acridotheres tristis* (Linnaeus, 1766) – (refer **Table 11**) was recorded.

14.4 GDARD SPECIES OF CONSERVATION CONCERN ASSESSMENT

A total of 15 fauna species of conservation concern are listed for the Gauteng Province, including:

- 4 invertebrates;
- 1 reptile; and
- 10 mammals.

The conservation status of these species includes the following categories:

- 2 species have not been evaluated (NE) regionally;
- 1 species is listed as Least Concern (LC);
- 7 species are listed as Near Threatened (NT);
- 1 species are listed as Vulnerable (VU); and
- 4 species are listed as Endangered (EN).

On a global perspective, the conservation status ascribed to these taxa are as follows:

- 3 species have not been evaluated (NE);
- 6 species are listed as Least Concern (LC);
- 3 species are listed as Near Threatened (NT);
- 1 species are listed as Vulnerable (VU); and
- 2 species are listed as Endangered (EN).

A basic assessment of the Probability of Occurrence (PoO) (refer **Table 12**) for these species revealed that:

- 5 species have a low PoO in the study area;
- 7 species have a moderate-low PoO in the study area;
- 2 species have a moderate PoO in the study area; and
- 1 species (Highveld Blue) is estimated to have a moderate-high PoO in the study area.

It should also be noted that the Precautionary Principle was applied and during the assessment since no long-term observations was conducted for this assessment.

Table 11: Animals recorded in the study area					
Order	*Family*	*Genus species*	*English Name*	*Regional*	*Global*
Invertebrates					
Odonata	Libellulidae	*Pantala flavescens* Fabricius, 1798	Pantala	NL	LC
Lepidoptera	Pieridae	*Eurema brigitta brigitta* (Stoll, [1780])	Broad-bordered Grass Yellow	LC	LC
		Pontia helice helice (Linnaeus, 1764)	Common Meadow White	LC	LC
	Nymphalidae	*Acraea horta* (Linnaeus, 1764)	Garden Acraea	LC	NL
		Vanessa cardui (Linnaeus, 1758)	Painted Lady	LC	LC
Hymenoptera	Apidae	*Apis mellifera scutellata* Lepeletier, 1836	African Honey Bee	NL	NL
Birds					
Ciconiiformes	Podicipedidae	*Tachybaptus ruficollis* (Pallas, 1764)	Little Grebe	LC	LC
	Phalacrocoracidae	*Microcarbo africanus* (Gmelin, 1789)	Reed Cormorant	LC	NL
	Ardeidae	*Ardea melanocephala* Children & Vigors, 1826	Black-headed Heron	LC	LC
		Bubulcus ibis (Linnaeus, 1758)	Cattle Egret	LC	LC
	Threskiornithidae	*Bostrychia hagedash* (Latham, 1790)	Hadeda Ibis	LC	LC
		Plegadis falcinellus (Linnaeus, 1766)	Glossy Ibis	LC	LC
		Threskiornis aethiopicus (Latham, 1790)	African Sacred Ibis	LC	LC
Gruiformes	Rallidae	*Fulica cristata* Gmelin, 1789	Red-knobbed Coot	LC	LC
	Otididae	*Afrotis afraoides* (A. Smith, 1831)	Northern Black Korhaan	LC	LC
Charadriiformes	Charadriidae	*Vanellus armatus* (Burchell, 1822)	Blacksmith Lapwing	LC	LC
		Vanellus senegallus (Linnaeus, 1766)	African Wattled Lapwing	LC	LC
	Laridae	*Chroicocephalus cirrocephalus* (Vieillot, 1818)	Grey-hooded Gull	LC	LC
Columbiformes	Columbidae	*Streptopelia capicola* (Sundevall, 1857)	Cape Turtle-Dove	LC	LC
		Streptopelia senegalensis (Linnaeus, 1766)	Laughing Dove	LC	LC
Coliiformes	Coliidae	*Colius striatus* Gmelin, 1789	Speckled Mousebird	LC	LC
Coraciiformes	Meropidae	*Merops apiaster* Linnaeus, 1758	European Bee-eater	LC	LC
Piciformes	Indicatoridae	*Indicator indicator* (Sparrman, 1777)	Greater Honeyguide	LC	LC
Passeriformes	Alaudidae	*Mirafra africana* Smith, 1836	Rufous-naped Lark	LC	LC
	Hirundinidae	*Hirundo rustica* Linnaeus, 1758	Barn Swallow	LC	LC
	Corvidae	*Corvus albus* Müller, 1776	Pied Crow	LC	LC
	Pycnonotidae	*Pycnonotus tricolor* (Hartlaub, 1862)	Dark-capped Bulbul	LC	NL
	Muscicapidae	*Saxicola torquatus* (Linnaeus, 1766)	African Stonechat	LC	LC
	Cisticolidae	*Cisticola fulvicapilla* (Vieillot, 1817)	Neddicky	LC	LC
		Cisticola juncidis (Rafinesque, 1810)	Zitting Cisticola	LC	LC
		Cisticola tinniens (Lichtenstein, 1842)	Levaillant's Cisticola	LC	LC
		Prinia flavicans (Vieillot, 1820)	Black-chested Prinia	LC	LC
	Motacillidae	*Macronyx capensis* (Linnaeus, 1766)	Cape Longclaw	LC	LC

Table 11: Animals recorded in the study area					
Order	*Family*	*Genus species*	*English Name*	*Regional*	*Global*
	Laniidae	*Lanius collaris* Linnaeus, 1766	Common Fiscal	LC	LC
	Sturnidae	*Acridotheres tristis* (Linnaeus, 1766)	Common Myna	LC	LC
	Nectariniidae	*Cinnyris talatala* A. Smith, 1836	White-bellied Sunbird	LC	LC
	Ploceidae	*Euplectes orix* (Linnaeus, 1758)	Southern Red Bishop	LC	LC
		Euplectes progne (Boddaert, 1783)	Long-tailed Widowbird	LC	LC
		Ploceus cucullatus (Müller, 1776)	Village Weaver	LC	LC
	Passeridae	*Passer domesticus* (Linnaeus, 1758)	House Sparrow	LC	LC
		Passer melanurus (Müller, 1776)	Cape Sparrow	LC	LC
	Viduidae	*Vidua macroura* (Pallas, 1764)	Pin-tailed Whydah	LC	LC
Mammals					
Rodentia	Muridae	*Gerbilliscus brantsii* (A. Smith, 1836)	Highveld Gerbil	LC	LC
	Bathyergidae	*Cryptomys hottentotus* (Lesson, 1826)	Common Mole-rat	LC	LC

Table 12: Gauteng animal species of concern - PoO estimations						
Order	*Family*	*Genus species*	*English Name*	*RS*	*GS*	*PoO*
Invertebrates						
Coleoptera	Scarabaeidae	*Ichnestoma stobbiai* Holm, 1992	Stobbia's Fruit Chafer	NL	NL	low
Lepidoptera	Lycaenidae	*Aloeides dentatis dentatis* (Swierstra, 1909)	Roodepoort Copper	EN	VU	low
		Chrysoritis aureus (van Son, 1966)	Heidelberg Opal	EN	NL	low
		Lepidochrysops praeterita Swanepoel, 1962	Highveld Blue	EN	NL	high
Herpetofauna						
Squamata	Elapidae	*Homoroselaps dorsalis* Smith, 1849	Striped Harlequin Snake	NT	NT	medium-low
Mammals						
Rodentia	Muridae	*Mystromys albicaudatus* (A. Smith, 1834)	White-tailed Rat	EN	EN	medium
Erinaceomorpha	Erinaceidae	*Atelerix frontalis* (A. Smith, 1831)	South African Hedgehog	NT	LC	medium
Afrosoricida	Chrysochloridae	*Neamblysomus julianae* (Meester, 1972)	Juliana's Golden Mole	VU	EN	low
Chiroptera	Miniopteridae	*Miniopterus schreibersii* (Kuhl, 1817)	Schreiber's Long-fingered Bat	NT	NT	medium-low
	Vespertilionidae	*Myotis tricolor* (Temminck, 1832)	Temminck's Myotis	NT	LC	medium-low
	Rhinolophidae	*Rhinolophus blasii* Peters, 1866	Blasius's Horseshoe Bat	VU	LC	medium-low
		Rhinolophus clivosus Cretzschmar, 1828	Geoffroy's Horseshoe Bat	NT	LC	medium-low
		Rhinolophus darlingi K. Andersen, 1905	Darling's Horseshoe Bat	NT	LC	medium-low
		Rhinolophus hildebrandtii Peters, 1878	Hildebrandt's Horseshoe Bat	NT	LC	medium-low
Carnivora	Mustelidae	*Hydrictis maculicollis* (Lichtenstein, 1835)	Spotted-necked Otter	LC	NT	low

14.5 FAUNAL HABITAT TYPES

Animals of terrestrial as well as aquatic ecosystems are closely linked to and significantly influenced by plant community structures and species diversities. Many aquatic species find refuge in extensive reedbeds that are frequently found within lowland wetland ecosystems (Sychra, *et al,* 2010). Furthermore, the structure and age of vegetal formation of ponds and impounds play a significant role in selecting species traits related to the population dynamics and feeding habits of species (Céréghinoa, *et al,* 2008). Similarly, terrestrial animals' ecological reactions depend on plant community structure; studies on species richness have indicated that for spiders, local processes are important, with assemblages in a specific patch being constrained by habitat structure (Borgesa & Browna, 2004). Likewise, plant community structure is often influenced by primary consumers; herbivores are known key drivers of ecosystem function and nutrient dynamics within grazed plant communities (Duncan, 2005).

Faunal community structure and ecological diversity cannot be evaluated without considering vegetation patterns. Plant communities or micro habitat types described in this document (refer **Section 13.6**) are considered representative of the main faunal habitats within the study area for the purposes of this assessment.

14.5.1 Transformed Micro Habitat Types

Transformed faunal habitats comprise parts of the landscape that have lost a significant extent of the original ecosystem characteristics, processes and functionality. These areas are not merely degraded; the original faunal habitats have been totally replaced by other land cover types and very little remains of the original ecological traits. Within the study area, these transformed areas include exotic tree stands, an artificial drainage channel and transformed areas such as roads and industrial areas.

Transformed faunal habitats exhibit extremely little ecological value and seldom contribute to the biodiversity richness on a local or regional scale. Although areas such exotic tree stands may harbour certain faunal species, they will always be significantly poorer in biodiversity than the original habitats. Transformed areas furthermore also act as barriers to some of the original faunal inhabitants. Roads, fences and 'ecological wastelands' will prevent certain species from crossing between fragments of natural remaining habitat. As the level of habitat fragmentation increases (transformed habitats increase and natural habitats decrease in fragment size and frequency in the general landscape), the number of species 'blocked' by these ecological barriers increases. Transformed faunal habitats replace natural faunal habitats; species are lost and the biodiversity value decreases.

Transformed habitat types of the study area were therefore ascribed a **low faunal sensitivity** (refer **Figure 12 & Table 13)**.

14.5.2 Degraded Micro Habitats

Degraded faunal habitats are areas that still exhibit, to varying degrees, some of the original ecosystem characteristics, processes and functionality. These areas are not entirely transformed, as the original faunal habitats have not been entirely replaced by other, transformed land cover categories. The status is however degraded as only some, resilient characteristics, or limited functionality, remain. Within the study area, these degraded habitats include deteriorated grassland. It is estimated that the degraded faunal micro habitats of the study area have **medium-low faunal sensitivities**.

14.5.3 Natural Micro Habitats

The natural faunal habitats of the study area comprise those fragments that still exhibit significant levels of the functional ecological processes and characteristics of the original Carletonville Dolomite Grassland, Soweto Highveld Grassland, Gauteng Shale Mountain Bushveld and Eastern Temperate Freshwater Wetlands (Mucina & Rutherford 2006). In other words, the natural faunal micro habitats of the study area constitute untransformed, ecological functioning grassland representative of the Mesic Highveld Grassland Bioregion, Central Bushveld Bioregion and Freshwater Wetlands. The natural micro habitats of the study area exhibit the following faunal sensitivities (refer **Figure 12; Table 13)**:

- Natural/rocky grassland habitat matrix: **medium-high faunal sensitivity**;
- Ridges/rocky grassland habitat matrix: **high faunal sensitivity**; and
- Wetland habitat: **medium-high faunal sensitivity**.

14.6 FAUNAL HABITAT SENSITIVITY ANALYSIS

During the field assessment, the study area was investigated and assessed in terms of the following biodiversity attributes (refer **Table 13**):

- Habitat status (ST): level of habitat transformation and degradation vs. pristine faunal habitat;
- Habitat diversity (DV): the number of different faunal habitat types (both on macro and micro-scale) found within the proposed site and bordering areas;
- Habitat linkage (LN): the degree to which the faunal habitat of the proposed site is linked to other natural areas enabling movement of animals to and from the habitat found on site;
- Red Data species (RD): the degree to which suitable habitat for the Red Data species likely to be found in the study area (larger study area) is located on each site; and
- Sensitive faunal habitat (SE): the relative presence of faunal sensitive habitat type elements such as surface rock associated with outcrops and hills as well as wetland elements.

Table 13: Faunal sensitivities of the habitat types of the study area

Status	*Habitat type*	*HS*	*HD*	*HL*	*HS*	*RD*	*AVE*	*Sens Class*
Transformed	Transformed areas	1	1	1	1	1	10%	**low**
Degraded	Deteriorated grassland	3	3	2	4	5	34%	**medium-low**
Natural	Natural/rocky grassland	7	6	7	7	7	68%	**medium-high**
	Ridges/rocky grassland	8	7	7	9	9	80%	**high**
	Wetland Habitat	5	6	7	8	6	64%	**medium-high**

Faunal habitat sensitivities are illustrated in **Figure 12.**

Table 14: Extent of habitat sensitivity within the servitude

Sensitivity	*Extent*	*Percentage*
High Faunal Sensitivity	9.4 ha	11.3 %
Medium-high Faunal Sensitivity	17.3 ha	20.7 %
Medium-low Faunal Sensitivity	31.0 ha	37.1 %
Low Faunal Sensitivity	25.9 ha	30.9 %
Total	**83.7 ha**	**100.0 %**

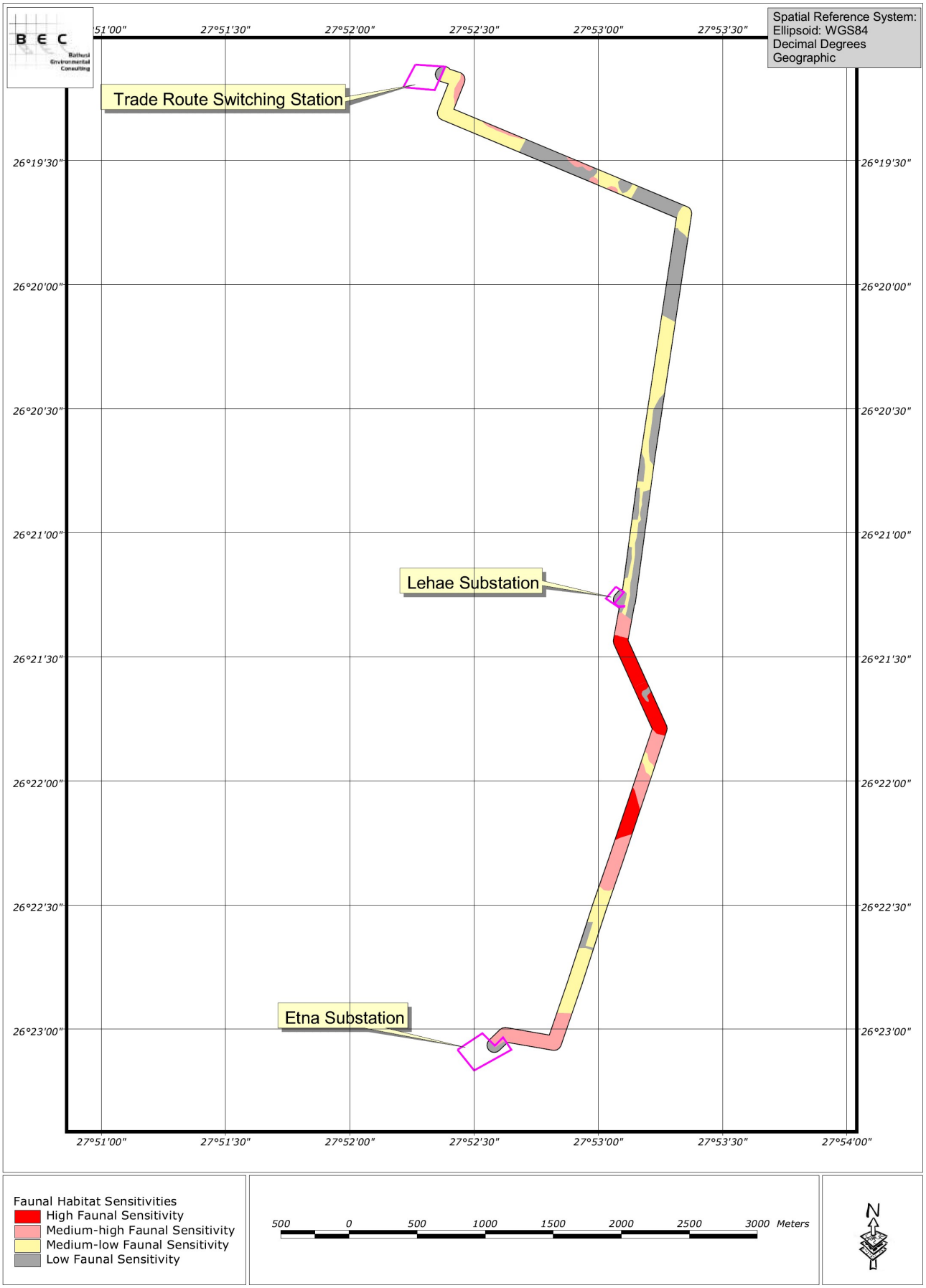


Figure 12: Faunal sensitivities of the receiving environment

14.7 ANNOTATIONS ON THE HIGHVELD BLUE (LEPIDOCHRYSOPS PRAETERITA SWANEPOEL, 1962)

GDARD required an assessment of the presence of this invertebrate species in the study area as part of the terrestrial biodiversity assessments. Time, budget and seasonal constraints prevented a detailed assessment of this species during the survey period and a brief appraisal of the habitat variability and suitability for this species is presented in this report. To elaborate on these preliminary results, it is strongly recommended that a suitable walkdown survey be completed during the activity period of this species to establish/ refute the presence of this species from the study area. This would typically be between December and March.

The Highveld Blue is listed as Endangered. It is endemic to South Africa and found from Potchefstroom in the west to Walkerville in the east, in the highveld region. The habitat of the species is listed as hillsides and koppies in the highveld grassland areas south and west of Johannesburg within approximately 100 km. It is known to frequent the following regional vegetation communities (Mucina & Rutherford 2006): Carletonville Dolomite Grassland, Gauteng Shale Mountain Bushveld, Rand Highveld Grassland and Andesite Mountain Bushveld. The larval host plant of the Highveld Blue is *Ocimum obovatum cordatum* (Lamiaceae).

The species has been recorded from the Q-grid in which the study area is located (2627BD) between 2007 and 2010 (refer **Figure 13**) and the Ridged/rocky grassland matrix habitat fragments found in the study area are considered potential habitat for the species. It is therefore considered to have a high probability of occurring in the study area.

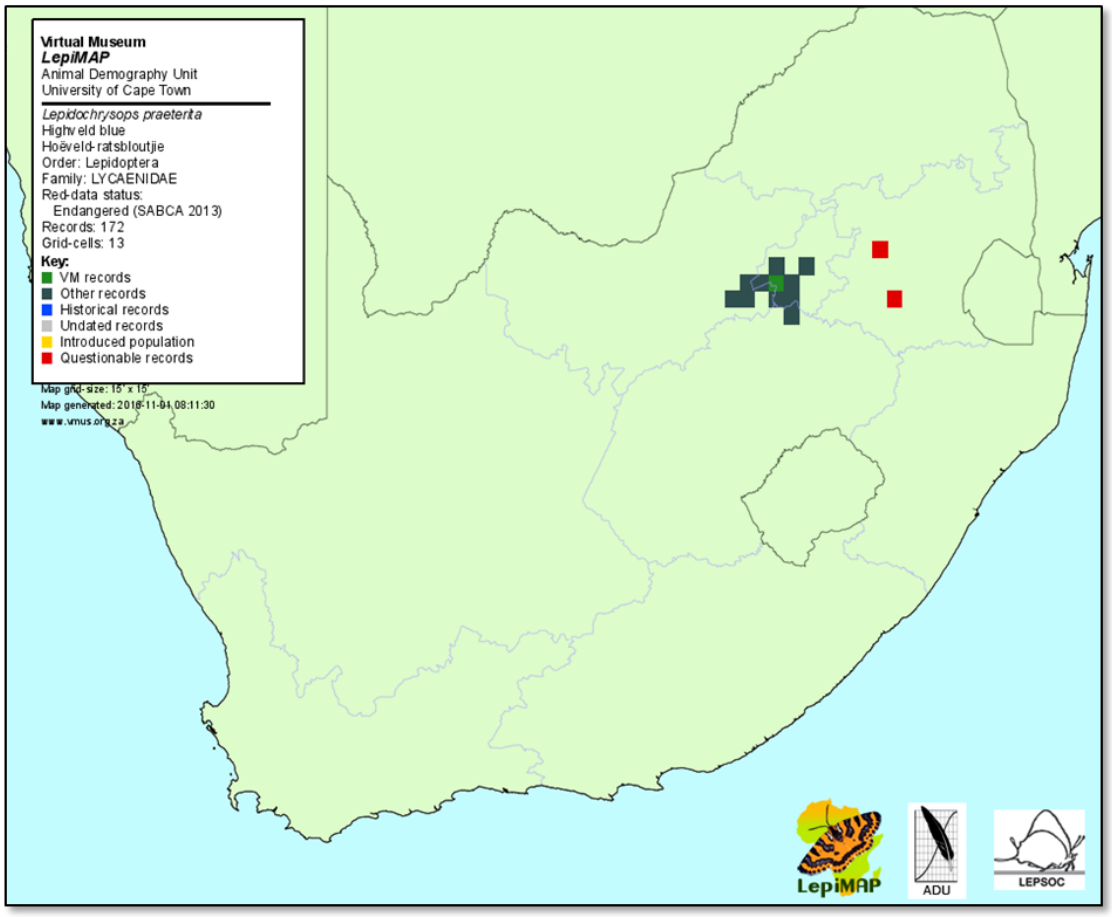


Figure 13: Known distribution of *Lepidochrysops praeterita* Swanepoel, 1962 (courtesy of The Virtual Museum, Animal Demography Unit, Univ. of Cape Town)

Figure 14: The Highveld Blue, *Lepidochrysops praeterita* Swanepoel, 1962

The presence of the Endangered Highveld Blue, *Lepidochrysops praeterita* Swanepoel, 1962, cannot be discounted at this stage and it is strongly recommended that the servitude and surrounding areas be investigated during a walkdown survey to establish the presence/ absence of the species prior to the start of construction. Results of the verification assessment will inform the Construction EMP for the development

14.8 SUMMATION OF RESULTS

The area investigated includes fragments deteriorated Gauteng Shale Mountain Bushveld and Eastern Temperate Freshwater Wetlands as well as pristine portions of Soweto Highveld Grassland, Carletonville Dolomite Grassland. It is bordered by the N12 and Soweto to the North, the R553 (Golden Highway) to the east, Lenasia to the south and Klipspruit Valley Road (M10) to the west. Roads and residential settlements that border the study area act as significant ecological barriers that prevent the movement of most land-bound animals. The industrial and urban nature of the areas surrounding the area investigated increase the isolated nature of the habitat fragments found.

The forty-four animals recorded in the study area represent species that are commonly recorded in the region where natural ecological processes within the rocky grassland and wetland habitats of the area are retained. No evidence of the presence of species of conservation concern (red data or otherwise) were made during the field investigation. However, habitat diversity and status of the study area and surrounds are such that the potential presence of some species of conservation concern cannot be discounted. Consequently, it is estimated that the Southern African Hedgehog and the African White-tailed Rat, exhibit at least a medium PoO for the study area while the Highveld Blue are estimated to exhibit a highly likely presence in the area because of suitable habitat.

Ecological connectivity of the study area is poor and some of the untransformed faunal habitat fragments of the study area have been degraded to some extent. Human disturbance factors such as noise, dust, physical presence of movement and setting of snares further accounts for the low faunal species richness of the study area (especially for small and medium-sized mammals). Wetland systems that are found within the study area, have been severely degraded for most its extent; rehabilitation of the entire systems will be costly and challenging. Impacts resulting from the proposed development on the fauna of the study area region will most likely be limited to loss and degradation of habitat, but are likely to be of low significance if properly mitigated.

15 POTENTIAL AND LIKELY IMPACTS WITHIN THE BIOLOGICAL ENVIRONMENT

The proposed activity is likely to result in limited losses of natural habitat; no impacts of a beneficial nature on the biological/ ecological environment are likely to result. Based on a generic list of impacts associated with this type of development, three categories of impacts are likely to result, namely, direct impacts, indirect impacts and impacts of a cumulative nature.

Please note that the Precautionary Principle is employed during all stages of the assessment.

15.1.1 Direct Impacts

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

1) Loss and/ or displacement of plant and animal taxa of conservation importance concern;
2) Loss of habitat associated with taxa of conservation importance;
3) Local depletion/ displacement of plant and animal individuals, species, assemblages and reduction of local biodiversity;
4) Loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance, sensitive animal refugia, etc.; and
5) Loss and alteration of ecological processes and ecosystem services on a local scale.

15.1.2 Indirect Impacts

In contrast, indirect impacts are not always immediately evident and can consequently not be measured at a specific moment in time; 'spill-over effects' are spatially and temporally removed from the actual activity and manifestations are typically subtle. The extent of the effect is frequently at a scale that is larger than the actual site of impact, but usually restricted to a local scale (and not regional). A measure of estimation, extrapolation, or interpretation is therefore required to evaluate the importance of these impacts and is usually a factor of the sensitivity of the receiving surrounding environment. This type of impact typically results in adverse effects or deterioration of surrounding areas due to uncontrolled, development related activities.

In addition, the ecological functionality of the immediate and surrounding area could be adversely affected by development, with specific reference to the ecological interaction between plants and animals. The aesthetic appeal of the region, although a personal and highly debatable and subjective attribute, is regarded a potential receiver of landscape changes through the addition of industrial plants, linear infrastructures, etc. Lastly, one of the most important impacts of indirect measures is represented by the alteration of biophysical characteristics of the surrounding areas through the introduction and proliferation of plants with an exotic nature or encroachment characteristics. Impacts of an indirect nature include the following:

6) Impacts on habitat types that are associated with plants and animals of conservation importance (decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.);
7) Altered quality and ecological functionality (including fire, erosion) of surrounding areas and natural habitat, increased human-animal conflict situations; and
8) Exacerbated encroachment of invasive, exotic and encroacher species, increased utilisation and anthropogenic utilisation factors resulting in exacerbated deterioration.

15.1.3 Cumulative Impacts

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

9) Increased plundering of natural resources due to increased human encroachment;
10) Exacerbation of existing levels of habitat fragmentation and isolation; and
11) Cumulative impacts on local/ regional and national conservation targets and obligations (loss of natural grassland habitat).

15.1.4 Basic Impact Assessment - Assumptions

In assessing, or evaluating the significance of identified potential and likely impacts, the following assumptions were made:

- Evaluation of impacts assumes that authorization for the proposed development is granted and that the proposed development proceeds as planned. Obviously, the rejection of the application will prevent the development from taking place and existing conditions and processes will continue unaltered and none of the identified impacts will occur; existing impacts will not be exacerbated;
- The proposed activity entails a typical industrial development, similar to the existing infrastructure;
- Estimation of pre-mitigation impact significance is based on a 'worst-case-scenario' whereby the specific impact assumes the worst possible status, all remaining vegetation (including natural and deteriorated types) are lost through complete habitat transformation;
- Estimation of pre-mitigation impact significance does not take any specific mitigation measures into account;
- Estimation of post-mitigation impact significance assumes that **generic and site-specific** mitigation measures are implemented in order to ameliorate or avoid the expected and likely impacts as far as possible; and
- It is important to note that, for this specific impact assessment, the recommendation not to develop ('Do Nothing' alternative) is not evaluated, as the status quo will therefore remain.

15.1.5 Impact Quantification

Table 15: Quantification of Impacts on the Biological Environment		
Direct Impacts		
Nature	**1. Direct loss and or displacement of plant and animal taxa of conservation importance concern**	
	Before Mitigation	**After Mitigation**
Status	Negative	Negative
Extent	2	1
Duration	4	3
Magnitude	8	6
Probability	5	2
Significance	**70**	**20**
Nature	**2. Direct loss of habitat associated with plant and animal taxa of conservation importance**	
	Before Mitigation	**After Mitigation**
Status	Negative	Negative
Extent	2	2
Duration	4	3
Magnitude	8	6
Probability	5	2
Significance	**70**	**22**
Nature	**3. Local depletion of plant and animal taxa and reduction of local biodiversity**	
	Before Mitigation	**After Mitigation**
Status	Negative	Negative
Extent	2	1
Duration	4	2
Magnitude	6	4
Probability	3	4
Significance	**36**	**28**
Nature	**4. Loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance, sensitive animal refugia, etc**	
	Before Mitigation	**After Mitigation**
Status	Negative	Negative
Extent	2	2
Duration	5	3
Magnitude	6	4
Probability	5	2
Significance	**65**	**18**
Nature	**5. Loss and alteration of ecological processes and ecosystem services on a local scale**	
	Before Mitigation	**After Mitigation**
Status	Negative	Negative
Extent	2	2
Duration	4	2
Magnitude	4	2
Probability	4	4
Significance	**40**	**24**
Indirect Impacts		
Nature	**6. Indirect impacts on habitat types that are associated with plants and animals of conservation importance (locally)**	
	Before Mitigation	**After Mitigation**
Status	Negative	Negative
Extent	2	2
Duration	5	2
Magnitude	8	2
Probability	5	4
Significance	**75**	**24**
Nature	**7. Indirect deterioration of habitat quality and ecological functionality (including fire, erosion) of surrounding natural areas**	
	Before Mitigation	**After Mitigation**
Status	Negative	Negative

Extent	5	3
Duration	2	2
Magnitude	5	2
Probability	5	3
Significance	**60**	**16**
Nature	**8. Exacerbated encroachment of invasive, exotic and encroacher plant species**	
	Before Mitigation	**After Mitigation**
Status	Negative	Negative
Extent	2	2
Duration	4	2
Magnitude	8	4
Probability	4	2
Significance	**56**	**16**
Cumulative Impacts		
Nature	**9. Increased plundering of natural resources due to increased human encroachment**	
	Before Mitigation	**After Mitigation**
Status	Negative	Negative
Extent	2	2
Duration	4	2
Magnitude	4	2
Probability	4	2
Significance	**40**	**12**
Nature	**10. Exacerbation of existing levels of habitat fragmentation and isolation**	
	Before Mitigation	**After Mitigation**
Status	Negative	Negative
Extent	2	2
Duration	4	2
Magnitude	4	2
Probability	4	2
Significance	**40**	**12**
Nature	**11. Cumulative impacts on local/ regional and national conservation targets and obligations**	
	Before Mitigation	**After Mitigation**
Status	Negative	Negative
Extent	2	1
Duration	5	4
Magnitude	4	2
Probability	4	2
Significance	**44**	**14**

15.1.6 Concluding Remarks

An evaluation of impacts on the biological environment revealed the potential for significant adverse impacts on sensitive biodiversity receptors, if left unmitigated and uncontrolled. Impacts of a significant nature are more likely to occur in the southern part of the line, between the Lehae and Etna substations, where natural grassland and ridge habitat abound. Sensitive biodiversity receptors include plants and animal species of conservation concern as well as sensitive and pristine grassland and ridge habitat types that are currently in a pristine condition and included in the Vulnerable and Endangered conservation categories. However, the implementation of site-specific as well as generic mitigation measures is likely to reduce the occurrence or level of significance to an acceptable level, minimising the effects of the activity to acceptable levels. A detailed walkdown, which will inform final mitigation strategies in terms of conservation important plants and animals, is regarded a crucial and important part of activities prior to the commencement of construction. Results of this walkdown will inform the final Construction EMP for the activity.

Habitat and biodiversity attributes of the northern part of the line, between the Lehae substation and Trade Route Switching Station, are generally considered to be of moderate to low sensitivity and the application of generic mitigation measures are expected to prevent any significant impacts on the biological environment.

Most of the potential and likely impacts are expected to be of relative small extent, possibly extending somewhat beyond the actual footprint of the development, and of relative short duration. Current conditions underneath the exiting lines indicated that, should actual habitat deterioration be controlled to acceptable levels, the subsequent recovery of habitat should be to the extent that normal habitat conditions could be expected to recur after an estimated period of approximately 5 seasons.

Inherent to a project of this nature is the occurrence of localised areas of severe disturbance (laydown areas, parking bays, etc.). These areas should be planned and executed in low sensitivity areas away from areas of high sensitivity such as wetlands, natural grasslands and rocky outcrops. Activities in areas of high slopes should be controlled as not to cause or exacerbate erosion of the soils.

It is ultimately the considered opinion of the specialists that impacts of the proposed activity on the biological environment, with suitable mitigation intervention, can be managed and controlled to prevent any significant and permanent damage and losses to the sensitive biodiversity receptors of the receiving environment.

16 RECOMMENDED MITIGATION STRATEGIES

16.1 BACKGROUND

The mitigation of negative impacts on biodiversity and ecosystem services is a legal requirement for authorisation purposes and must take on different forms depending on the significance of the impact and the area being affected. Mitigation requires proactive planning that is enabled by following the mitigation hierarchy, illustrated in **Figure 15**. Its application, is intended to strive to first avoid disturbance of ecosystems and loss of biodiversity, and where this cannot be avoided altogether, to minimise, rehabilitate, and then finally offset any remaining significant residual negative impacts on biodiversity, where:

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

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

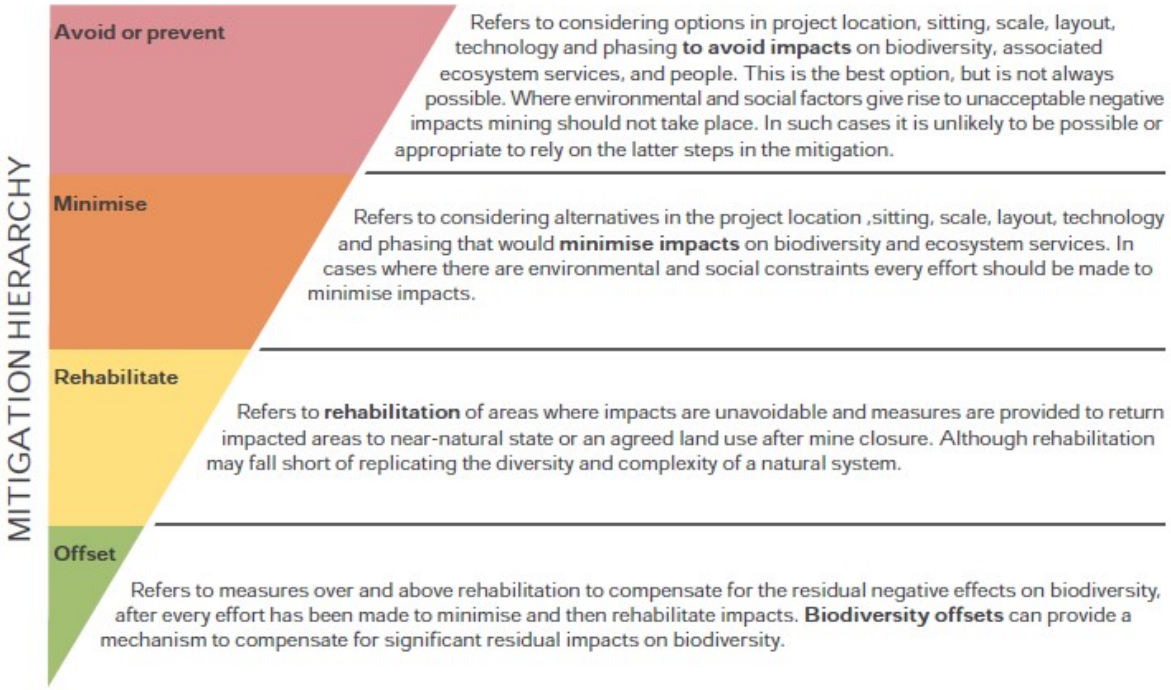
Rehabilitate impacts – refers to the rehabilitation of areas where impacts are unavoidable and measures are taken to return impacted areas to a condition ecologically similar to their 'pre-development natural state' or an agreed land use after mine closure. Although rehabilitation is important and necessary,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

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

The mitigation hierarchy is inherently proactive, requiring the on-going and iterative consideration of alternatives of project location, siting, scale, layout, technology and phasing until the proposed development best 'suits' and can be accommodated without significant negative impacts in the receiving environment. In cases where the receiving environment cannot support the development (e.g. there is insufficient water) or where the project will destroy the natural resources on which local communities are wholly dependent for their livelihoods or eradicate unique biodiversity, the development may not be feasible; the earlier the company knows of these risks, and can plan to avoid them, the better. In the case of most developments, where biodiversity impacts can be severe, the guiding principle should be "anticipate and prevent" rather

than "assess and repair". The proper application of the mitigation hierarchy is essential and requires a team of people with the relevant skills and knowledge (including consulting with specialists who might sit outside of a core project team) asking the right questions and applying the appropriate science and methods.

Figure 15: Mitigation hierarchy for dealing with negative impacts on biodiversity



16.2 SITE-SPECIFIC MITIGATION RECOMMENDATIONS

The following impacts will require site-specific mitigation measures, as detailed below:

1) Loss and/ or displacement of plant and animal taxa of conservation importance concern;
2) Loss of habitat associated with taxa of conservation importance;
3) Local depletion/ displacement of plant and animal individuals, species, assemblages and reduction of local biodiversity;
4) Loss of atypical, sensitive, conservation important habitat types or ecosystems of restricted abundance, sensitive animal refugia, etc.; and
5) Impacts on habitat types that are associated with plants and animals of conservation importance (decreased habitat quality of surrounding areas due to peripheral impacts such as spillages, litter, increased erosion, contaminants, etc.).

Mitigation Measure 1 - Effect a botanical and faunal walkdown of the servitude area to confirm/ refute the presence of Red Data flora and fauna species from the existing servitude. This walkdown exercise should take specific cognisance of the southern part of the line, between the Lehae and Etna substations;

Mitigation Measure 2 - The walkdown of the line should take cognisance of local areas of importance and the location of conservation important flora and fauna specie (if present), and recommend control measures to avoid/ preserve these specific sites, or recommend suitable strategies to minimise impacts within the local environment;

Mitigation Measure 3 - Construction activities within areas of high slopes (ridge habitat) should be kept to a minimum to avoid the exacerbation of erosion and habitat degradation;

Mitigation Measure 4 - Remove and relocate all plant species of conservation importance and/ or significant medicinal value that are present within the servitude that will be unavoidably affected by development activities. Details surrounding the relocation/ removal should take be contained as a separate section in the EMP for the activity and should take specific cognisance of the GDARD Plant Rescue Scheme (2008) for the removal of plants of horticultural and medicinal value from development sites;

Mitigation Measure 5 - A search and rescue operation should be conducted prior to the commencement of any construction activities. This search and rescue operation should take specific cognisance of the southern part of the line, between the Lehae and Etna substations; and

Mitigation Measure 6 - Removal of CI species is subject to permitting requirements.

16.3 GENERIC BOTANICAL MITIGATION RECOMMENDATIONS

Mitigation Measure 7 - Appoint a biodiversity specialist /Biodiversity Manager that is well versed with the specific and legal implications of managing and handling biodiversity related issues that are potentially being affected by the development. The Biodiversity Manager is perceived as a post that is not filed by an Environmental Officer or an Environmental Control Officer, whom is tasked with overseeing day to day operations in terms of the EMP for the project;

Mitigation Measure 8 - Minimize the area cleared for construction activities. This includes the area used by personnel and labour. Laydown sites should be located on areas with ***low*** sensitivities;

Mitigation Measure 9 - All activities should be contained within the existing footprint, with specific reference to areas of high and medium-high sensitivity;

Mitigation Measure 10 - Clearly demarcate servitude boundaries within areas of high and medium-high sensitivity within the existing servitude.

Mitigation Measure 11 - Prevent the spread of any/all impacts from development activities to affect areas of natural grassland, outcrops and ridges, as well as nearby wetlands;

Mitigation Measure 12 - Demarcate construction/ operation areas by semi-permanent means/ material, to control movement of personnel, vehicles, providing boundaries for construction sites in order to limit spread of impacts;

Mitigation Measure 13 - No painting or marking of rocks or vegetation to identify locality or other information shall be allowed, as it will disfigure the natural setting. Marking shall be done by steel stakes with tags, if required;

Mitigation Measure 14 - Fencing should allow adequate movement of small mammals between areas of natural habitat;

Mitigation Measure 15 - The Project team will compile a Fire Management Plan (FMP) and shall include *inter alia* aspects such as relevant training, equipment on site, prevention, response, rehabilitation and compliance to the National Veld and Forest Fire Act, Act No. 101 1998;

Mitigation Measure 16 - Prevent any unwanted and uncontrolled open fires;

Mitigation Measure 17 - Provide demarcated fire-safe zones, facilities and suitable fire control measures;

Mitigation Measure 18 - Use of branches of trees, shrubs or any vegetation for fire making purposes is strictly prohibited;

Mitigation Measure 19 - The irresponsible use of welding equipment, oxy-acetylene torches and other naked flames, which could result in veld fires, or constitute a hazard and should be guided by safe practice guidelines;

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

Mitigation Measure 21 - A road management plan should be compiled prior to the commencement of construction activities;

Mitigation Measure 22 - Dust control on all roads should be prioritised;

Mitigation Measure 23 - No roads should be allowed within ecologically sensitive areas.

Mitigation Measure 24 - The landowner must immediately take steps to remove alien and invasive vegetation within the property as per Conservation of Agricultural Resource Act, namely:

- Uprooting, felling or cutting of trees and shrubs;
- Treatment with a weed killer that is registered for use in connection with such plants in accordance with the directions for the use of such a weed killer;
- The application of control measures regarding the utilisation and protection of veld in terms of regulation 9 of the Act;
- The application of control measures regarding livestock reduction or removal of animals in terms of regulations 10 and 11 of the Act;
- Any other method or strategy that may be applicable and that is specified by the executive officer by means of a directive.
- According to the Conservation of Agricultural Resource Act (No. 43 of 1983) as amended, the person applying herbicide must be adequately qualified and certified as well as registered with the appropriate authority to apply herbicides.
- The implementation of this aspect should form part of the responsibilities of the Biodiversity Manager;

Mitigation Measure 25 - The size of areas subjected to land clearance will be kept to a minimum;

Mitigation Measure 26 - Only areas as instructed by the Site Manager must be cleared and grubbed;

Mitigation Measure 27 - Cleared vegetation and debris that has not been utilised will be collected and disposed of to a suitable waste disposal site. It will not be burned on site;

Mitigation Measure 28 - No vegetation will be cut or collected off construction sites for burning or for any other purpose without the prior permission of the Site Manager;

Mitigation Measure 29 - All vegetation not required to be removed will be protected against damage;

Mitigation Measure 30 - Removal of vegetation/ plants shall be avoided until such time as soil stripping is required and similarly exposed surfaces must be re-vegetated or stabilised as soon as is practically possible;

Mitigation Measure 31 - Monitoring the potential spread of declared weeds and invasive alien vegetation to neighbouring land and vice versa and protecting the agricultural resources and soil conservation works are regulated by the Conservation of Agricultural Resources Act (No 43 of 1983) and must be addressed on a continual basis, through an alien vegetation control and monitoring programme. This aspect should form part of the responsibilities of the Biodiversity Manager;

Mitigation Measure 32 - Remove and store topsoil separately in areas where excavation/ degradation takes place. Topsoil should be used for rehabilitation purposes to facilitate regrowth of species that occur naturally in the area;

Mitigation Measure 33 - Stored topsoil will be free of deleterious matter such as large roots, stones, refuse, stiff or heavy clay and noxious weeds, which would adversely affect its suitability for planting;

Mitigation Measure 34 - No spoil material will be dumped outside the defined site;

Mitigation Measure 35 - Disturbance of vegetation must be limited to areas of construction;

Mitigation Measure 36 - The removal or picking of any protected or unprotected plants shall not be permitted and no horticultural specimens (even within the demarcated working area) shall be removed, damaged or tampered with unless agreed to by the Biodiversity Manager;

Mitigation Measure 37 - Ensure proper surface restoration and resloping to prevent erosion, taking cognisance of local contours and landscaping;

Mitigation Measure 38 - Exposed areas with slopes less than 1:3 should be rehabilitated with a grass mix that blends in with the surrounding vegetation;

Mitigation Measure 39 - The grass mix should consist of indigenous grasses adapted to the local environmental/ climatic conditions;

Mitigation Measure 40 - The revegetated areas should be temporarily fenced to prevent damage by grazing animals;

Mitigation Measure 41 - Re-vegetated areas showing inadequate surface coverage (less than 30 % within eight months after re-vegetation) should be prepared and re-vegetated from scratch;

Mitigation Measure 42 - Damage to re-vegetated areas should be repaired promptly;

Mitigation Measure 43 - Exotic weeds and invaders that might establish on the re-vegetated areas should be controlled to allow the grasses to properly establish; and

Mitigation Measure 44 - Make use of selected species (locally endemic) for landscaping and visual aesthetics/ screening, with specific reference to trees and shrubs.

16.4 GENERIC FAUNAL MITIGATION RECOMMENDATIONS

Mitigation Measure 45 - Keep all construction and operational activities away from the sensitive faunal habitats as indicated in the sensitivity maps as far as possible;

Mitigation Measure 46 - Appropriate buffer zones must be implemented to sensitive features to alleviate the effect of habitat fragmentation and edge effects. In general, habitat fragmentation results in an increase in the proportion of edge effects in relation to the total area. Edges are habitat areas that are often unsuitable for some species to utilise, which subsequently becomes confined to an even smaller interior or core area of unchanged habitat

Mitigation Measure 47 - Access of larger animals (cattle, sheep, etc) to the construction/ operational site should be restricted as the presence of animals within a construction site could lead to accidental deaths of animals and unwanted human-animal conflict;

Mitigation Measure 48 - No animal may be hunted, trapped, snared or captured for any purpose whatsoever. Fences and boundaries should be patrolled weekly in order to locate and remove snares/ traps. Monitoring of this aspect should form part of the responsibilities of the Biodiversity Manager;

Mitigation Measure 49 - Vehicular traffic should not be allowed after dark in order to limit accidental killing of nocturnal animals, with particular reference to open roads and access roads to and from the mine;

Mitigation Measure 50 - Minimise the number of vehicles using access roads;

Mitigation Measure 51 - Speed of vehicles should be limited to allow for sufficient safety margins;

Mitigation Measure 52 - Compile a graphic list of potentially dangerous animals and present this to all workers as part of site induction, with particular reference to snakes and scorpions. This aspect should form part of the responsibilities of the Biodiversity Manager;

Mitigation Measure 53 - Sensitize all personnel to the presence, characteristics and behaviour of animals on the site;

Mitigation Measure 54 - Movement of personnel must be restricted to the construction site and should not gain access to surrounding natural habitat or intact grassland;

Mitigation Measure 55 - Include suitable operational procedures in the event of encountering potentially dangerous animals on the site. The control and administration of this aspect should form part of the responsibilities of the Biodiversity Manager;

Mitigation Measure 56 - No animal shall be killed. Should any potentially dangerous animal be identified within the development site, all work shall be stopped in order for the safe capture and removal of the animal from the site. The control and administration of this aspect should form part of the responsibilities of the Biodiversity Manager;

Mitigation Measure 57 - All animals should be only handled by a competent person, with particular reference to snakes and scorpions;

Mitigation Measure 58 - Ensure that a snake handler and/ or adequate and trained snake-bite protocols are available at all times;

Mitigation Measure 59 - No domestic pets should be allowed on the site, with particular reference to feral cats and dogs;

Mitigation Measure 60 - The Biodiversity Manager shall, as part of the bio-monitoring programme, keep an updated record of all human-animal conflicts, accidental animal deaths, road kills, removal and relocations, etc.;

Mitigation Measure 61 - The Biodiversity Manager shall, as part of the bio-monitoring programme, keep an updated record of all animals noted or recorded on site or surrounds during the construction and operational phases of the project;

Mitigation Measure 62 - Photographic contributions and observations from all personnel and contractors should be welcomed as this facilitates a conservation-minded approach of all workers on site. Care must however be taken to advise against interfering or activity with any animal species, with particular reference to potentially dangerous animals;

Mitigation Measure 63 - Collection records shall include suitable photographic material that will be communicated to a locally knowledgeable expert for identification purposes, or confirmed observations (with reference to larger mammals, birds, snakes and scorpions, etc.;

Mitigation Measure 64 - Reduce exterior lighting and implement operational strategies to reduce "spill light". Lightning, could attract night-migrating bird taxa and can result in collisions with buildings. If possible, outside lighting should make use of lights with blue or green hues rather than light that contains red wavelengths. In addition, features should be illuminated (for security reasons) by using "down-lighting" rather than "up-lighting".

17 PHOTOGRAPHIC RECORDS

Photo 1: Example of Deteriorated Grassland Habitat

Photo 2: Example of Deteriorated Grassland Habitat

Photo 3: Example of reed dominated wetland habitat

Photo 4: Example of Deteriorated Grassland Habitat, note presence of exotic trees

Photo 5: Example of Deteriorated Grassland Habitat, note littering and dumping

Photo 6: Example of Deteriorated Grassland Habitat in proximity to residential areas

Photo 7: Example of Ridge/ Grassland habitat, note existing impacts underneath servitude

Photo 8: Example of natural grassland/ rocky outcrops

Photo 9: Example of natural grassland/ rocky outcrops

18 APPENDIX 1: FLORISTIC DIVERSITY OF THE SERVITUDE (RECORDS FOR SITE SURVEY OCTOBER, 2016)

* denotes a declared alien and invasive species

Species Name	*Family*	*Growth Form*	*Status/ Uses*	*Common Name*
Acacia mearnsii De Wild.*	Fabaceae	Tree	Declared Invader - Category 2 (NEM:BA, 2004. AIP, 2014)	Black Wattle (e), Swartwattel (a)
Acacia podalyriifolia A. Cunn. Ex G. Don*	Fabaceae	Tree	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)	Pearl Acacia (e), Pêrelakasia (a)
Acacia species	Fabaceae	Tree	None	Acacia (e), Acacia (a)
Acalypha angustata Sond.	Euphorbiaceae	Dwarf shrub	None	Copper leaf (e), Katpisbossie (a)
Ajuga ophrydis	Lamiaceae	Forb	None	--
Andropogon schirensis A.Rich.	Poaceae	Grass	Moderately palatable, Decreaser I	Stab Grass (e), Tweevingergras (a)
*Argemone ochroleuca**	Papaveraceae	Perennial herb	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)	Mexican poppy (e), Bloudissel (a)
Aristida aequiglumis Hack.	Poaceae	Grass	None	Krulgras (a)
*Arundo donax**	Poaceae	Shrub	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)	Giant reed (e), Spanish reed (e)
Asclepias eminens	Apocynaceae	Forb	None	Large Turret Flower (e)
Asparagus suaveolens Burch.	Liliaceae	Shrub	None	Bushveld Asparagus (e), Gewonekatbos (a)
Berkheya species	Asteraceae	Forb	Weed	--
Bidens pilosa L.	Asteraceae	Forb	Naturalised exotic, edible parts, Invader Species	Black-jack (e), Knapsekêrel (a)
***Boophone disticha* (L.f.) Herb.**	**Amaryllidaceae**	**Geophyte**	**Declining Status, Poisonous, medicinal uses, Protected Plant**	**Bushman Poison Bulb (e), Gifbol (a)**
Brachiaria serrata (Thunb.) Stapf	Poaceae	Grass	Moderately palatable, indicator of good veld condition, Decreaser	Black-footed Signal Grass (e), Swartvoetjiegras (a)
Bromus catharticus Vahl	Poaceae	Grass	Weed, average grazing potential, Naturalised exotic	Resue Grass (e), Reddingsgras (a)
Bulbine species	Liliaceae	Geophyte	None	--
*Canna indica**	Cannaceae	Perennial herb	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)	--
Chaetacanthus costatus Nees	Acanthaceae	Forb	None	--
Chenopodium album L.	Chenopodiaceae	Perennial herb	Naturalised exotic, weed, edible parts	Common pigweed (e), Bloubossie (a)
Conyza bonariensis (L.) Cronquist	Asteraceae	Forb	Weed, indicator of disturbed areas	Flax-leaf Fleabane (e), Kleinskraalhans (a)
Conyza podocephala DC.	Asteraceae	Forb	Weed, indicator of disturbed areas	Bakbossie (a)
Crepis hypochoeridea (DC.) Thell.	Asteraceae	Forb	Weed, indicator of disturbed areas, Naturalised exotic	--
Crinum graminicola I.Verd.	Amaryllidaceae	Geophyte	Medicinal properties	--
Cyanotis speciosa (L.f.) Hassk.	Commelinaceae	Forb	Medicinal properties	Doll's powder puff (e), Bloupoeierkwassie (a)
Cymbopogon pospischilii	Poaceae	Grass	Aromatic grass, unpalatable, Increaser I	Narrow-leaved Turpentine Grass (e),

Species Name	Family	Growth Form	Status/ Uses	Common Name
				Smalblaarterpentyngras (a)
Cynodon dactylon (L.) Pers.	Poaceae	Grass	Indicator of disturbed areas, grazing potential	Common Couch Grass (e), Gewone kweekgras (a)
Cyperus esculentus	Cyperaceae	Sedge	Weed, edible parts (tuber)	Yellow nutsedge (e), Geeluintjie (a)
Datura stramonium L.	Solanaceae	Forb	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)	Common thorn apple (e)
Digitaria monodactyla (Nees) Stapf*	Poaceae	Grass	Palatable grazing, Increaser IIB	One-finger Grass (e), Eenvingergras (a)
Diheteropogon amplectens (Nees) Clayton	Poaceae	Grass	Moderately palatable, Decreaser	Broad-leaved Bluestem (e), Breëblaarblougras (a)
Elephantorrhiza elephantina (Burch.) Skeels	Fabaceae	Dwarf shrub	Medicinal uses, poisonous parts, dyes & tanning	Eland's Bean (e), Elandsboontjie (a)
Elionurus muticus (Spreng.) Kunth	Poaceae	Grass	Unpalatable, Increaser IIB	Wire Grass (e), Koperdraad (a)
Eragrostis chloromelas Steud.	Poaceae	Grass	Edible parts, Increaser IIB	Curly leaf (e), Krulblaar (a)
Eragrostis racemosa (Thunb.) Steud.	Poaceae	Grass	Palatable grazing, Increaser IIB	Narrow heart love grass (e), Smalhartjiesgras (a)
Eriosema salignum E.Mey.	Fabaceae	Forb	None	--
Eucalyptus species*	Myrsinaceae	Tree	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)	Eucaluptus gum tree (e), Bloekomboom (a)
Euphorbia striata	Euphorbiaceae	Succulent	None	Milkweed (e), Melkgras (a)
Felicia muricata	Asteraceae	Forb	None	Wild Aster (e), Blouheuning (a)
Gazania krebsiana	Asteraceae	Forb	Medicinal uses, food source	Butter flower (e), Botterblom (a)
Geigeria burkei	Asteraceae	Dwarf shrub	None	Vermeerbos (a)
Gladiolus species	Iridaceae	Geophyte	None	--
Gomphocarpus fruticosus (L.) Aiton f.	Apocynaceae	Shrub	Medicinal uses	Milkweed (e), Melkbos (a)
Guilleminea densa	Amaranthaceae	Prostrate herb	None	--
Helichrysum caespititium (DC.) Harv.	Asteraceae	Prostrate herb	Medicinal uses	Speelwonderboom (a)
Helichrysum callicomum Harv.	Asteraceae	Forb	None	--
Helichrysum kraussii Sch.Bip.	Asteraceae	Forb	None	--
Helichrysum oreophilum Klatt	Asteraceae	Forb	None	--
Helichrysum rugulosum Less.	Asteraceae	Forb	None	--
Helichrysum species	Asteraceae	Forb	None	--
Hermannia depressa N.E.Br.	Malvaceae	Prostrate herb	Medicinal uses	Rooiopslag (a)
Hermannia lancifolia Szyszyl.	Malvaceae	Forb	None	--
Hermannia transvaalensis Schinz	Malvaceae	Prostrate herb	None	--

Species Name	Family	Growth Form	Status/ Uses	Common Name
Heteropogon contortus (L.) Roem. & Schult.	Poaceae	Grass	Moderate grazing potential, irritant	Spear grass (e), Assegaaigras (a)
Hilliardiella oligocephala	Asteraceae	Forb	Medicinal uses	Bitterbossie (a) (previous Vernonia oligocephala)
Hyparrhenia hirta (L.) Stapf	Poaceae	Grass	Thatching & weaving	Thatch Grass (e), Dekgras (a)
Hypoxis iridifolia Baker	Hypoxidaceae	Geophyte	None	--
Hypoxis rigidula	Hypoxidaceae	Geophyte	None	Farmer's String (e), Botterblom (a)
Indigofera species	Fabaceae	Forb	None	--
Jamesbrittanea aurantiaca	Scrophulariaceae	Forb	Colours & dyes	Cape Saffron (e), Saffraanbossie (a)
Justicia anagalloides (Nees) T.Anderson	Acanthaceae	Prostrate herb	None	--
Lactuca inermis	Asteraceae	Perennial herb	None	--
Ledebouria ovalifolia (Schrad.) Jessop	Liliaceae	Perennial herb	None	--
Leonotis ocymifolia	Lamiaceae	Dwarf shrub	Medicinal uses, colours & dyes	Minaret Flower (e), Wildedagga (a)
Lepidium africanum	Brassicaceae	Forb	None	Birdseed (e), Kanariesaadgras (a)
Lopholaena coriifolia (Sond.) E.Phillips & C.A.Sm.	Asteraceae	Dwarf shrub	None	Pluisbossie (a)
Loudetia simplex (Nees) C.E.Hubb.	Poaceae	Grass	Unpalatable, poor grazing potential	Common Russet Grass (e), Stingelgras (a)
Melia azedarach L.*	Meliaceae	Tree	Declared Invader - Category 1B. Category 3 in urban areas (NEM:BA, 2004. AIP, 2014)	Seringa (e), Gewone sering (a)
Melinis repens	Poaceae	Grass	Poor grazing potential, Increaser IIC	Natal Red Top (e), Natal-rooipluim (a)
Microchloa caffra Nees	Poaceae	Grass	Low grazing potential, Increaser IIC	Pincushion Grass (e), Elsgras (a)
Nidorella anomala Steetz	Asteraceae	Forb	None	--
Oenothera rosea L'H,r. ex Aiton	Onagraceae	Forb	Weed (S. America), moist & degraded places	Rose evening primrose (e), Pienkaandblom (a)
Oenothera stricta	Onagraceae	Forb	Naturalised exotic, weed from Chile, Argentina	Yellow evening primrose (e), Geelaandblom (a)
Oxalis species	Oxalidaceae	Geophyte	Edible parts	Bobbejaanuintjie (a)
Papaver aculeatum	Papaveraceae	Forb	Weed - Europe	Wild Poppy (e), Wildepapawer (a)
Parinari capensis	Chrysobalanaceae	Dwarf shrub	Edible parts	Dwarf Mabola (e), Grysappeltjie (a)
Pearsonia species	Fabaceae	Forb	None	--
Pellaea calomelanos	Adianthaceae	Fern	Medicinal properties	Hard Fern (e), Hardevaring (a)
Pennisetum clandestinum Chiov.*	Poaceae	Grass	Declared Invader - Category 1B in protected areas and wetlands (NEM:BA, 2004. AIP, 2014)	Kikuyu Grass (e), Kikoejoegras (a)
Pentarrhinum insipidum E.Mey.	Apocynaceae	Climber	Edible parts, Non-endemic	African Heartvine (e), Donkieperske (a)
Phragmites australis (Cav.) Steud.	Poaceae	Hydrophilic	Thatching, traditional uses, medicinal properties	Common Reed (e), Fluitjiesriet (a)

Species Name	Family	Growth Form	Status/ Uses	Common Name
Physalis viscosa L.	Solanaceae	Perennial herb	Common weed (tropical America)	Sticky gooseberry (e), Klewerige appelliefie (a)
*Phytolacca octandra**	Phytolaccaceae	Shrub	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Poisonous	Inkberry (e), Bobbejaandruif (a)
Plantago lanceolata L.	Plantaginaceae	Forb	Weed (Europe)	Buckhorn Plantain (e), Oorpynhoutjie (a)
Polygala hottentotta C.Presl	Polygalaceae	Forb	None	--
Populus x *canescens**	Salicaceae	Tree	Declared Invader - Category 2 (NEM:BA, 2004. AIP, 2014), America, timber	Grey poplar (e), Gryspopulier (a)
Pseudognaphalium luteo-album (L.) Hilliard & B.L.Burtt	Asteraceae	Forb	Weed (Europe)	Jersey Cudweed (e), Roerkruid (a)
Raphionacme hirsuta	Periplocaceae	Dwarf shrub	Edible parts	Khadi-root (e), Khadiwortel (a) (=Raphionacme)
Rhynchosia totta	Fabaceae	Forb	Edible parts	Yellow Carpet Bean (e)
Richardia brasiliensis Gomes	Rubiaceae	Prostrate herb	Weed	Mexican Richardia (e), Meksikaanse Richardia (a)
*Ricinus communis**	Euphorbiaceae	Shrub	Declared Invader - Category 2 (NEM:BA, 2004. AIP, 2014)	Castor-oil plant (e), Kasterolie (a)
Rorippa nudiuscula	Brassicaceae	Forb	None	--
Salix babylonica L.	Salicaceae	Tree	None	Weeping willow (e), Treurwilger (a)
Scabiosa columbaria L.	Dipsacaceae	Forb	Medicinal uses	Morning Bride (e), Jonkmansknoop (a)
Schkuhria pinnata (Lam.) Cabrera	Asteraceae	Forb	Medicinal uses, weed (S. America)	Dwarf Marigold (e), Bitterbossie (a)
Searsia lancea L.f.	Anacardiaceae	Tree	Edible parts, tanning	Common Karree (e), Gewone Karree (a)
Searsia leptodictya Diels	Anacardiaceae	Small tree	None	Mountain Karee (e), Bergkaree (a)
Searsia magalismontana	Anacardiaceae	Shrub	None	Mountain Wild Current (e), Bergtaaibos (a)
Selago densiflora	Selaginaceae	Prostrate herb	None	--
Senecio coronatus (Thunb.) Harv.	Asteraceae	Forb	None	Sybossie (a)
Senecio erubescens	Asteraceae	Forb	None	--
Senecio inornatus DC.	Asteraceae	Forb	None, indicator of moist conditions	--
Senecio species	Asteraceae	Forb	None	--
Senecio venosus Harv.	Asteraceae	Forb	None	--
Seriphium plumosum	Asteraceae	Shrub	Invasive properties	Bankrupt bush (e), Bankrotbos (a)
Solanum mauritianum Scop.*	Solanaceae	Shrub	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)	Bugweed (a), Groot Bitterappel (a)
Solanum sisymbriifolium Lam.*	Solanaceae	Dwarf shrub	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014)	Wild tomato (e), Doringbitterappel (a)
Sphenostylis angustifolia Sond.	Fabaceae	Prostrate herb	None	Wild sweetpea (e), Wilde-ertjie (a)
Sporobolus africanus (Poir.) Robyns & Tournay	Poaceae	Grass	Palatable, indicator of degraded areas	Ratstail Dropseed (e), Fynsaadgras (a)

Species Name	Family	Growth Form	Status/ Uses	Common Name
Sporobolus ioclados (Trin.) Nees	Poaceae	Grass	Decreaser	Pan Dropseed (e), Panfynsaadgras (a)
Stachys species	Lamiaceae	Dwarf shrub	None	--
Stipagrostis ciliata	Poaceae	Grass	Palatable grazing, Decreaser	Tall Bushman Grass (e), Langbeenboesmangras (a)
Tagetes minuta L.	Asteraceae	Forb	Essential oils, colours & dyes	Khaki Weed (e), Kakiebos (a)
Tapiphyllum parvifolium (Sond.) Robyns	Rubiaceae	Small tree	Edible fruit	Wild medlar (e), Mispel (a)
Tephrosia lupinifolia	Fabaceae	Forb	None	--
Themeda triandra Forssk.	Poaceae	Grass	Palatable grazing, Decreaser	Red grass (e), Rooigras (a)
Trachypogon spicatus (L.f.) Kuntze	Poaceae	Grass	Moderate palatability, Increaser I	Giant Spear Grass (e), Bokbaardgras (a)
Tristachya leucothrix Nees	Poaceae	Grass	Moderate palatable grazing, Increaser I	Hairy trident grass (e), Harige-drieblomgras (a)
Typha capensis (Rohrb.) N.E.Br.	Typhaceae	Hydrophilic	Cosmopolitan weed, edible parts, medicinal uses	Bulrush (e), Papkuil (a)
Urelytrum agropyroides (Hack.) Hack.	Poaceae	Grass	Unpalatable, Increaser I	Quinine Grass (e), Varkstertgras (a)
Ursinia nana	Asteraceae	Forb	Weedy, indicator of slight disturbances	--
Verbena bonariensis L.*	Verbenaceae	Dwarf shrub	Declared Invader - Category 1B (NEM:BA, 2004. AIP, 2014), Weed (S. America)	Purple Top (e), Blouwaterbossie (a)

19 APPENDIX 2: METHOD STATEMENTS

To address existing information gaps and satisfy requirements for EIA investigations, an over-arching approach was followed to allow for the capture of maximum data and adequate subsequent analysis thereof during the allotted timeframe. This approach is based on a **single** summer survey, which, because of seasonal constraints in terms of the activity periods of animals and the vegetative and reproductive cycles of plants, does present significant limitations. Aerial imagery was downloaded and visually interpreted to identify preliminary habitat types as a first approximation of the study area, which was verified and refined during the deployment period. Botanical and faunal data was captured along several survey points along the proposed line, which were stratified within all identified micro habitat types were sampled adequately during the allotted timeframe.

Subsequent to the data analysis process, an impact assessment process was conducted during which the nature and extent of the proposed development on the natural environment will be assessed.

19.1 ASSESSMENT PHILOSOPHY

Inherent characteristics of a project of this nature imply that no method is foolproof. Typical shortcomings of these EIA investigations stem from the use of databases with a high degree of paucity and the lack of site-specific detail that could be obtained from limited site surveys that were conducted over a short period and during a single (part) season. These are however typical limitations of all scientific studies; it simply is not possible to know everything or to consider every aspect to a molecular level of detail. However, to present an objective opinion of the biodiversity sensitivity of the study area and how this relates to the suitability/ unsuitability of the study area in terms of the proposed development, all opinions and statements presented in this document are based on the following aspects, namely:

- A desk-top assessment of all available biological and biophysical data;
- Augmentation of existing knowledge by means of site specific and detailed field surveys;
- Specialist analysis and interpretation of collated data; and
- An objective impact assessment, estimating potential impacts on biological and biophysical attributes.

The Ecosystem Approach employed for this assessment 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. 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; and
- All relevant sectors of society and scientific disciplines should be involved.

The Ecosystem Approach includes the assessment of biophysical and societal causes, consequences of landscape heterogeneity and factors that causes disturbance to these attributes. Species conservation is therefore largely replaced by the concept of habitat conservation. This investigation will therefore aim to:

- Determine the biological sensitivity of the receiving natural environment as it relates to the construction and operation of the operation and associated infrastructure in a natural environment;
- Highlight the known level of biodiversity for the study area;
- 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, operation and decommissioning of the proposed development on the biological resources of the study area; and
- Apply the Precautionary Principal throughout the assessment[3].

19.2 FLORISTIC ASSESSMENT

The floristic assessment was conducted by R. A. J. Robbeson (Pr.Sci.Nat.).

19.2.1 Sampling Approach

The number of sample plots to be distributed in a given area depends on various factors, such as the scale of the classification, environmental heterogeneity and the accuracy required for the classification (Bredenkamp 1982). Stratification of sample plots will therefore be based on visual observations made during the initial site investigation as well as aerial imagery. The Zurich-Montpellier approach of phytosociology (Braun-Blanquet 1964) will be followed; this is a standardised and widely used sampling technique for general vegetation surveying in South Africa. During the surveys, all plant species within in sample plots were identified and recorded. Brief observations pertaining to the biophysical environment was made wherever possible.

19.2.2 Floristic Sensitivity

The aim of this exercise was to determine the inherent sensitivity of vegetation communities or habitat types by means of the comparison of weighted floristic attributes. Results of this exercise are not 'stand-alone' and will be presented in conjunction with results obtained from the faunal investigation.

Each vegetation unit was subjectively rated on a scale of 1 to 10 in terms of the following attributes:

- The confirmed presence of flora species of conservation importance, the known presence of flora species of conservation importance or the presence of protected flora species (provincially or other legislation);
- Conservation status of the regional vegetation type;
- The observed ecological status, based on degradation gradients, utilisation, habitat fragmentation and isolation, etc.
- The observed (or potential) floristic diversity, compared to surrounding areas and compared to a pristine status of the particular habitat type within the regional vegetation type; and
- The functionality of the habitat type in a larger landscape that may, or not, be dominated by degradative and transformative anthropogenic activities.

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

These values were weighted to emphasise the importance/ triviality that the individual Sensitivity Criteria have on the status of each community. Ranked Values were expressed as a percentage of the maximum possible value (Floristic Sensitivity Value) and placed in a specific class.

In addition to the general floristic attributes that were considered when estimating the sensitivity of floristic habitat types, additional (regional) attributes were also considered during the estimation process. The aim of this exercise was to present an opinion on the inherent floristic sensitivity of micro habitat types of the study area. These issues were assessed by documenting whether any important biodiversity features occur on site, including species, ecosystems or processes that maintain ecosystems and/or species. The application of these criteria is a matter of professional judgement. These criteria are ranked as follows:

- Threatened and/or Protected-:
  - plant species;
  - ecosystems;
- Critical conservation areas, including:
  - areas of high biodiversity;
  - centres of endemism;
- Important Ecological Processes, including:
  - Corridors;
  - Mega-conservancy networks;
  - Rivers and wetlands; and
  - Important topographical features.

19.3 FAUNAL ASSESSMENT

The faunal assessment was conducted by D. Kamffer (Pr.Sci.Nat.).

Field investigations commonly employed for EIA studies are normally limited by time and budget and scientific approaches generally should be adapted to allow for limitations that are normal to EIA type investigations. Ecology and biodiversity are growing fields of science and much is still unknown. Limited information pertaining to mammals and birds exist for the study area. Similarly, information on herpetofauna and invertebrates of the region and farms is lacking in detail and significant information gaps exist in this regard.

Detailed faunal assessments typically include equipment based survey methods such as small mammal traps, baited infrared camera-traps, invertebrate pitfalls, etc. However, based on the location of the study area, the land use and high numbers of pedestrians on the site and adjacent properties, the risk of equipment losses (and all data) was deemed very likely and these methods were excluded. Consequently, the study approach implemented for this study was based on qualitative and quantitative habitat assessments and collection of data based on ecological indicators such as tracks, dung, diggings, etc. of mammals present in the study area and the evaluation of habitat characteristics and variety. Qualitative and quantitative habitat assessments that were employed for this study are often applied in smaller studies, yielding accurate results for the identification and estimation of the variety, status and inherent sensitivity of the receiving environment.

Ad hoc observations and an investigation of the biophysical status and characteristics of the sites were implemented to gain an understanding of the ecology of the study area as well as the biodiversity contribution of the study area within a larger geographical context. These habitat characteristics were interpreted in terms of the habitat preferences and requirements of animals typically encountered in the region, but with particular reference to Red Data Animals.

19.4 IMPACT QUANTIFICATION

The following method was applied in estimating the significance of impacts within the terrestrial biodiversity receiving environment.

Table 16: Impact Assessment Descriptive Criteria

Nature	Category	Brief annotation on the impact
Status of Impact	**Negative**	At a cost to the environment
	Positive	At a benefit to the environment
	Neutral	Neutral effect on the environment
Extent (E)	**1**	Site only
	2	Local (site boundary and immediate surrounds)
	3	Regional (within the City of Johannesburg)
	4	National
	5	International
Duration (D)	**1**	Immediate (<1 year)
	2	Short term (1 – 5 years)
	3	Medium term (5 – 15 years)
	4	Long term (ceases after the operational life span of the project)
	5	Permanent
Magnitude of the Impact (M)	**0**	None
	2	Minor
	4	Low
	6	Moderate (environmental functions altered but continue)
	8	High (environmental functions cease temporarily)
	10	Very high/ Unsure (environmental functions permanently cease
Probability of Occurrence (P)	**0**	None (the impact will not occur)
	1	Improbable (probability very low due to design or experience)
	2	low probability (unlikely to occur)
	3	medium probability (distinct probability that the impact will occur)
	4	high probability (most likely to occur)
	5	Definite
Significance Rating	Based on the information contained in the points above, the potential impacts are assigned a Significance rating (**S**). This rating is formulated by adding the sum of the numbers assigned to extent (**E**), Duration (**D**) and Magnitude (**M**) and multiplying this sum by the Probability (**P**) of the impact, thus: **(E+D+M) x P = S**	
	Any positive value	**No impact** High to low consequence, probability not an issue as positive, **no mitigation required**
	<30	**Low** - where this impact would not have a direct influence on the decision to develop in the area
	30 – 60	**Medium** - where the impact could influence the decision to develop in the area unless it is effectively mitigated
	> 60	**high** - where the impact must have an influence on the decision process to develop in the area

20 APPENDIX 3: GDARD MINIMUM REQUIREMENTS FOR BIODIVERSITY INVESTIGATION

Brief comments pertaining to GDARD requirements include:

20.1 VEGETATION

- A vegetation survey must be undertaken by a suitably qualified specialist (at least a B.Sc.(Hons) in Plant Ecology/Botany);
- Survey must take place during the summer season;
- A general Red List plant survey must be undertaken;
- The location and extent of all plant communities on the study site must be mapped. The area (in hectares) and ecological sensitivity of each plant community must be indicated. All good condition natural vegetation must be designated as ecologically sensitive;
- A plant species list must be provided for each plant community with medicinal and invasive/exotic species indicated. The number of forb/herb, grass, shrub and tree species must be indicated for each plant community;
- The condition of any grassland on site must be assessed and the location and extent of primary grassland mapped. All primary grassland must be designated as ecologically sensitive; and
- Results must be incorporated into a sensitivity map.

20.2 PLANTS

- A survey for Red and Orange List plant species must be undertaken by a suitably qualified specialist (at least a B.Sc.(Hons) in Plant Ecology/Botany);
- Survey must take place during the flowering season of species historically recorded on site or confirmed on site by the Directorate of Nature Conservation;
- Surveys must encompass the site and all relevant adjacent properties (minimum of 200 m radius). For those species confirmed on the study site (or within 200 m) by the Directorate of Nature Conservation, as well as those located by the specialist during surveys, the entire extent of the population must be accurately mapped out with a GPS (WGS84 datum; geographic co-ordinate system), augmenting with data already collected by the Directorate of Nature Conservation; and
- Populations of Red List and Near Threatened plant species and protective buffer zones must be designated as sensitive in a sensitivity map. Buffer zone widths must be consistent with the Red List plant policy for environmental impact evaluations (refer to *Sensitivity Mapping rules for Biodiversity Assessments*).

20.3 MAMMALS

- The specialist appointed for the study must be suitably qualified (minimum MSc. in Zoology or relevant vertebrate field) and preferably an expert in the area of concern, e.g. a Mole specialist for any mole-related issues. The specialist report should contain the following information:
  - GPS co-ordinates (WGS84 datum; geographic co-ordinate system) indicating the confirmed presence of Red List mammal species and suitable Red List mammal habitat, both of which should be designated as sensitive in a sensitivity map;
  - A detailed description of the habitat, i.e. vegetation types, soil types and any aquatic habitat.
  - The season and date on which the study was undertaken;
  - Information on surrounding land uses and connectivity with other open spaces;
- The full names of the specialist appointed, qualifications and field of expertise; and

- All wetland habitat must be surveyed for the following species: *Aonyx capensis*, *Atilax paludinosus*, *Chrysospalax villosus*, *Dasymys incomptus*, *Lutra maculicollis*, *Otomys angoniensis*, *Otomys irroratus*.

20.4 AMPHIBIANS

- All specialists are required to provide a copy of their *curriculum vitae* detailing qualifications as well as relevant work experience, publications in scientific and popular literature and research projects;
- Specialists must meet one of the following requirements:
  - Post-graduate degree (minimum MSc. in Zoology or relevant vertebrate field) with relevant research projects and/or supporting publications in the scientific literature.
  - Public recognition of expertise (both in terms of species identification and ecological requirements). Specialists wishing to be considered for this category are subject to independent verification by GDACE (Directorate of Conservation).
  - Scientific publications on relevant aspects of the ecology of the target taxa/taxon. Specialist assessments must encompass the site and all relevant adjacent properties (minimum of 500 m radius). Where suitable foraging and aestivation habitat occurs on site, the nearest suitable breeding habitat must be identified for those species that breed in Gauteng;
- Survey must be conducted after good summer rains have fallen within the area under investigation (i.e. >60 mm over a day or two and limited to the period November-April);
- The report must include the following:
  - A map showing the location of the proposed development site and the area that was covered by the survey;
  - The date and hours spent on site;
  - An assessment of the availability of suitable habitat (breeding, foraging, aestivation etc.) on site and within a minimum of 500 m of the site. A larger area may be appropriate for wide-ranging species and the specialist must use his/her discretion to determine this;
  - A sensitivity map demarcating areas of suitable habitat (differentiating between breeding, foraging, aestivation etc.) for each Red List species, together with appropriate buffers and corridors. All sensitive habitats (e.g. wetlands) must be clearly demarcated using the appropriate techniques, even where the probability of Red List species utilizing them is considered small;
  - GPS coordinates (WGS84 datum; geographic co-ordinate system) for all confirmed sightings of Red List species;
  - The size and location of buffers must be motivated in terms of the latest research and publications;
- All references must be listed at the end of the report;
- Where mitigation measures are appropriate, these must be detailed together with the relevant problem statement; and
- A comprehensive, site-specific ecological management plan for all proposed open spaces, buffers and corridors that are relevant to the species and/or habitats under investigation.

20.5 REPTILES

- All specialists are required to provide a copy of their *curriculum vitae* detailing qualifications as well as relevant work experience, publications in scientific and popular literature and research projects;
- Potential specialists must meet one of the following requirements:
  - Post-graduate degree (minimum MSc. in Zoology or relevant vertebrate field) with relevant research projects and/or supporting publications in the scientific literature;
  - Public recognition of expertise (both in terms of species identification and ecological requirements);
  - Scientific publications on relevant aspects of the ecology of the target taxa/taxon;

- Specialist assessments must encompass the site and all relevant adjacent properties (minimum of 500 m radius). Where suitable foraging and aestivation habitat occurs on site, the nearest suitable breeding habitat must be identified for those species that breed in Gauteng;
- Survey must be conducted in summer following good rains once the vegetation on site has recovered sufficiently from winter fires to allow for assessment of available habitat. For predatory reptiles, relevant prey species must be active;
- The report must include the following:
  - A map showing the location of the proposed development site and the area that was covered by the survey;
  - The date and hours spent on site;
  - An assessment of the availability of suitable habitat (breeding, foraging, aestivation etc.) on site and within a minimum of 500 m of the site. A larger area may be appropriate for wide-ranging species and the specialist must use his/her discretion to determine this;
  - A sensitivity map demarcating areas of suitable habitat (differentiating between breeding, foraging, aestivation etc.) for each Red List species, together with appropriate buffers and corridors. All sensitive habitats (e.g. wetlands) must be clearly demarcated using the appropriate techniques, even where the probability of Red List species utilizing them is considered small;
- GPS coordinates (WGS84 datum; geographic co-ordinate system) for all confirmed sightings of Red List species;
- The size and location of buffers must be motivated in terms of the latest research and publications;
- All references must be listed at the end of the report;
- Where mitigation measures are appropriate, these must be detailed together with the relevant problem statement; and
- A comprehensive, site-specific ecological management plan for all proposed open spaces, buffers and corridors that are relevant to the species and/or habitats under investigation.

20.6 INVERTEBRATES

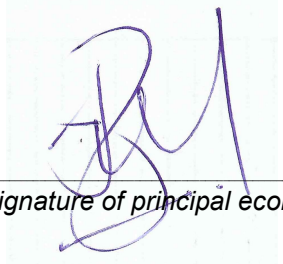
- A Red List, rare and endemic invertebrate survey must be undertaken by a suitably qualified specialist (recognized specialist or at least a B.Sc.(Hons) in Zoology with Invertebrate/Entomology focus);
- For species historically occurring on site or recorded from the same farm, the survey must take place during the flying season for flying invertebrates and during peak activity periods for non-flying invertebrates i.e. in the adult stage of development of the species. In most cases, the flying season and peak activity period is during the spring/summer months, usually after the first spring rains. In some cases, especially for ground-living spiders, visual search surveys earlier in spring before the vegetation shows appreciable growth are acceptable, as searches carried out in late summer when the grass is long can be very difficult;
- Given the nature of invertebrates and the influence of the environment, surveys must be carried out over a period of 4 weeks to ensure a comprehensive invertebrate survey, which may include trapping, preferably with quantified active search methods (most effective for distribution/abundance data), mark-recapture and population study where feasible. The 4-week period can occur continuously or at weekly visits for monitoring or for accommodating ideal weather conditions and moon phases. The minimum 4-week period can be deviated from depending on the size of the survey site, but this must be justified by the specialist in the report;
- For those species confirmed on the study site by the Directorate of Nature Conservation, as well as those located by the specialist during surveys, the entire extent of all located populations within the survey area as well as suitable habitat for those species must be accurately mapped out and designated as sensitive in a sensitivity map.

21 APPENDIX 4: DECLARATION OF INDEPENDENCE

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

- we act as independent ecologists compiling this report;
- 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 or activity as outlined in this document, other than financial compensation for work performed in a professional capacity in terms of the Environmental Impacts Assessment Regulations, 2005;
- 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 general public;
- we do not have any influence over decisions made by the governing authorities;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2005;
- will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not; and
- 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.

Should we consider ourselves in conflict with any of the above declarations, we shall formally submit a Notice of Withdrawal to all relevant parties and register as an Interested and Affected Party.



Signature of principal ecologist:

Bathusi Environmental Consulting cc (CK1999/052182/23)

Name of company:

26th March 2018

Date:

22 APPENDIX 5: REFERENCES

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