STEVE TSHWETE LOCAL MUNICIPALITY

Proposed Township Development in Middelburg, Mpumalanga Province

Amended Biodiversity Assessment

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SPECIALIST REPORT DETAILS

This report has been prepared as per the requirements of Section 13 of Government Notice No. R. 982 dated 4 December 2014 (Environmental Impact Assessment Regulations) under sections 24(5), 24M and 44 of the National Environmental Management Act, 1998 (Act 107 of 1998).

I, **Stephen Burton** declare that this report has been prepared independently of any influence or prejudice as may be specified by the Department of Economic Development, Tourism, and Environmental Affairs (EDTEA).

Signed:  Date: 20/07/2018

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Confidentiality Statement

Executive Summary

This amendment reports acts as an update to the Proposed Township Development in Middelburg, Mpumalanga Province. The report was originally compiled on the 11th March 2011, which detailed the state of the biodiversity on the study site. Amendments on this report follow a site visit conducted on the 4th July 2018, where the *status quo* of the site was briefly assessed.

The proposed project involves the construction of a residential township in Middelburg.

The proposed site is located on Portion 341 of the remainder of Portion 27 of the Farm Middelburg Town and Townsland 387 JS, Mpumalanga Province. The proposed development will consist of 624 stands covering the study site of approximately 101 hectares.

The Steve Tshwete Local Municipality appointed SiVEST to conduct a biodiversity and wetland assessment for the site in question due to the potential sensitivities present.

A field survey was undertaken of the site in order to identify sensitive areas and potential impacts.

The investigation illustrated that the proposed development will result in significant impact on the current *status quo* without detailed mitigation measures. Sensitive habitat is present on the site which requires protection.

Impacts that may occur as a result of the development are mainly related to loss of vegetation cover, loss of habitat, loss of red data species and the edge effect. For this reason it is imperative that the mitigation measures are strictly implemented to ensure strict management should these species be encountered.

A sensitivity map has been compiled which recommends the inclusion of a ecological corridor linking the sensitive wetland areas whilst also including buffers on these areas to ensure some level of ecological functionality.

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PROPOSED TOWNSHIP DEVELOPMENT, MIDDELBURG

BIODIVERSITY ASSESSMENT

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PROPOSED TOWNSHIP DEVELOPMENT, MIDDELBURG

BIODIVERSITY ASSESSMENT

1 INTRODUCTION

SiVEST has been appointed by the Steve Tshwete Local Municipality (STLM) to undertake an ammended biodiversity impact assessment for the proposed development of a township on the Portion 341 of the remainder of Portion 27 of the Farm Middelburg Town and Townsland 387 JS, Mpumalanga Province. The proposed development will consist of 624 stands covering the study site of approximately 101 hectares.

The original assessments were undertaken in 2011, with the report being completed on the 11th March 2011. The original report detailed the status of the biodiversity (flora and fauna) on the site, and the effect that the proposed construction would have had on the biodiversity on the site. The original study aimed to identify sensitive areas from a biodiversity perspective and identified the potential presence of Red Data species.

The amendment report aims to update the *status quo* of the biodiversity and state of the habitats on site. A review and revision of the site is necessary as the previous study occurred approximately seven years ago, therefore the latest applicable legislation and government notices, as well as the condition of the site needs to be updated.

1.1 Policy and legislation

1.1.1 National Environmental Management Act: Biodiversity Act, 2004

The National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) operates in conjunction with the National Environmental Management: Protected Areas Act No. 57 of 2003. Both Acts emerge from the recommendations of the White Paper on the Conservation and Sustainable Use of South Africa's Biodiversity (1998) and were originally conceived of as one Act.

The objectives of the Act are:

- within the framework of the National Environmental Management Act, to provide for:
    - the management and conservation of biological diversity within the Republic and of the components of such biological diversity;
    - the use of indigenous biological resources in a sustainable manner; and
    - the fair and equitable sharing among stakeholders of benefits arising from bioprospecting involving indigenous biological resources;
- to give effect to ratified international agreements relating to biodiversity which are binding on the Republic;
- to provide for co-operative governance in biodiversity management and conservation; and to provide for a South African National Biodiversity Institute (SANBI) to assist in achieving the objectives of the Act.

The Act provides specifically for the issuing of permits. Before issuing a permit, the issuing authority may in writing require the applicant to furnish it, at the applicant's expense, with such independent risk assessment or expert evidence as the issuing authority may determine. Regulations may be made pertaining to various matters regulated by the Act, offences and penalties are provided for, and consultation processes are prescribed. Should Red Data species be directly affected by the township development, then the necessary permits will be required to be applied for.

1.1.2 Mpumalanga Nature Conservation Act 10 of 1998

This Act controls and manages nature conservation activities in Mpumalanga Province. It is administered by the Mpumalanga Parks Board. The Mpumalanga Nature Conservation Act 10 of 1998 provides for the following:

- Protection of wild animals with regards to hunting, capturing, purchasing and transporting of wild animals;
- Control of problem animals;
- Regulation of fisheries activities;
- Protection of indigenous plants and the use, possession, trade and transportation thereof and for the control of invader weeds and plants;
- Protection and prohibition of acts pertaining to endangered and rare fauna and flora species;

1.1.3 National Forest Act, 1998 (Act No. 84 of 1998)

The National Forest Act, 1998 (Act 84 of 1998) (NFA) was enacted to:

- Provide for the protection, management and utilisation of forests;
- The protection of certain plant and animal life;
- The regulation of trade in forest produce;

The NFA enforces the necessity for a license to be obtained prior to destroying any indigenous tree in a natural forest and, subject to certain exemptions, cutting, disturbing, damaging, destroying or removing any protected tree. The list of protected trees is currently contained in GN 32731 of 27/11/2009. Licenses are issued by the Minister and are subject to periods and conditions as may be stipulated.

The NFA is relevant to the proposed project as the removal and/or disturbance and/or clearance of indigenous vegetation may be required and a license in terms of the NFA may be required for this to be done.

1.1.4 Conservation of Agricultural Resources (Act No. 43 of 1983) as amended in 2001

Declared Weeds and Invaders in South Africa are categorised according to one of the following categories:

Category 1 *plants: are prohibited and must be controlled.*

Category 2 *plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread.*

Category 3 *plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent*

the spreading thereof, except within the flood line of watercourses and wetlands.

1.1.5 Permit / Licence requirements

In terms of the National Forests Act, 1998 (Act No. 84 of 1998) and Government Notice 1339 of 6 August 1976 (promulgated under the Forest Act, 1984 (Act No. 122 of 1984) for protected tree species), the removal, relocation or pruning of any protected plants will require a license.

Protected indigenous plants in general are controlled under the relevant provincial Ordinances or Acts dealing with nature conservation. In Mpumanga the relevant statute is the Mpumalanga Nature Conservation Act 10 of 1998. In terms of this Act, a permit must be obtained from *Mpumalanga Tourism and Parks Agency – Wildlife Protection Services* to remove or destroy any plants listed in the Ordinance.

2 METHODOLOGY

Review of Initial Specialist Reports

The biodiversity specialist reports, dated the 11th of March 2011, was revisited. This was done in order to determine if there were information gaps that will needed to be filled in terms of contemporary environmental related legislation that may be applicable to the proposed project.

Desktop Assessment

In terms of the desktop assessments, the following databases were consulted:

- Mpumalanga Biobase (2005)
- SANBI, POSA database,
- Mucina and Rutherford
- Important Bird Areas
- SABAP 2
- MammalMAP
- FrogMAP
- ReptileMAP

- Mpumalanga Biodiversity Sector Plan (MBSP) Terrestrial Assessment (2014)

Site Investigation

As the initial specialist studies were undertaken in 2011, conditions on-site and in the surrounding area have changed. Additionally, development in the area may have taken place in the greater catchment which may have implications for the proposed development. As such, a one-day site visit was conducted by the biodiversity specialists to groundtruth and verify initial biodiversity features. Additionally, to identify any new potential features that may be picked up.

The aim of the study was to determine potential impacts of the proposed development on fauna and flora, with special attention given to Red Data species.

Findings of this report are based on desktop assessments as well as field surveys conducted in the previous report, and any additions to those findings based on the current field survey.

2.1 Flora

Initial floral assessment

A series of transects were walked across the entire site to identify the habitats present and the dominant species. Data was collected by undertaking vegetation sampling according to the Braun-Blanquet method (Mueller-Dombois & Ellenberg 1974; Westhoff & van der Maarel 1978). Searches were undertaken specifically for Red List plant species (according to SANBI 2006) and any other species with potential conservation value within the study area. Furthermore vegetation types and flora therein was identified through SANBI as well as Mucina and Rutherford 2006. Mucina and Rutherford (2006) was also used to describe the various vegetation units.

The field assessment was undertaken during the growing season.

Current floral assessment

A random vegetation sampling technique and "hotspot[1]" assessment technique was utilised, which focused the sampling effort on areas with natural vegetation or where the

[1] **Hotspot in this context refers to areas in the landscape, such as rocky outcrops and wetlands that supply refugia to plant species that would otherwise not exist in said landscape due to disturbance**.

vegetation was dominated by indigenous species (i.e. not comprising a large proportion of alien invasive plant species). Individual plant species observed during the assessment were recorded to give an indication of species diversity and the overall species assemblage.

Please note that the intensity of the sampling procedure is prescribed by budgetary constraints. The sampling procedure proposed for this study is satisfactory for providing a general overview and rapid assessment of the plant diversity and assemblages that occur on site. This methodology allows sufficient information to be gathered to make the necessary inferences as to the ecological state of the receiving environment and to assess the possible impacts that may be imparted as a result of the proposed activities. Please note that the second field assessment was not undertaken during the growing season, and any paucity in the data is not the responsibility of the specialist. Further to this, the majority of the site was burned, which resulted in a poor vegetation sample; as such, most of the vegetation data is reliant on the previous vegetation assessment.

Conservation Importance Assessment

Within the context of this vegetation assessment, conservation importance is broadly defined as the importance of the encountered vegetation communities (vegetation fragment) as a whole, in terms of the role these areas will fulfil in the preservation and maintenance of biodiversity in the local area. Biodiversity maintenance / importance are a function of the specific biodiversity attributes and noteworthiness of the vegetation communities in question and the biotic integrity and future viability of these features.

The biodiversity noteworthiness of the system is a function of the following:

- species richness/diversity;
- rarity of the system;
- conservation status of the system;
- habitat (real or potential) for Red Data Species; and
- presence of unique and/or special features,

The integrity and future viability of the system is a function of the following:

- Extent of buffer around the system;
- Connectivity of system to other natural areas in the landscape;
- Level of alteration to indigenous vegetation communities within the system;
- Level of invasive and pioneer species encroachment system; and
- Presence of hazardous and/or obstructive boundaries to fauna.

The scores for each function of biodiversity maintenance were determined according to the scoring system shown in **Table 1** below. The scores were totaled and averaged to determine the biodiversity maintenance services score. Thereafter, the overall scores were rated according to the rating scale in **Table 2** below.

Table 1: Biodiversity maintenance services score sheet (Template and Description)

Biodiversity Noteworthiness	**Scores**				
	0	**1**	**2**	**3**	**4**
Diversity	Low	Med-Low	Medium	Med-High	High
Rarity	Low	Med-Low	Medium	Med-High	High
Conservation Status	Least Concern	Near-Threatened	Vulnerable	Endangered	Critically Endangered
Red Data	No	-	-	-	Yes
Uniqueness / Special features	None	Med-Low	Medium	Med-High	High
Integrity & Future Viability	**0**	**1**	**2**	**3**	**4**
Buffer	Low	Med-Low	Medium	Med-High	High
Connectivity	Low	Med-Low	Medium	Med-High	High
Alteration	>50%	25-50%	5-25%	1-5%	<1%
Invasive/pioneers	>50%	25-50%	5-25%	1-5%	<1%
Size	<1 ha	1 – 2 ha	3 - 10 ha	10 – 15 ha	>15 ha

Table 2: Rating Scale for Biodiversity Maintenance services based on Assessment scores

Score:	**0-0.8**	**0.9-1.6**	**1.7-2.4**	**2.5-3.2**	**3.3-4.0**
Rating of the likely extent to which a service is being performed	Low	Moderately Low	Intermediate	Moderately High	High

2.2 Fauna

The following faunal groupings were investigated via atlas maps, with opportunistic sightings being recorded by the specialist where applicable:

- Mammals
- Amphibians
- Birds
- Reptiles
- Invertebrates

Initial faunal assessment

During field surveys, a total of 80 Sherman traps and 60 Pitfall traps were randomly positioned at the site. Traps were monitored accordingly and trapped faunal species were identified on site and set free thereafter.
Potential species lists have been compiled with attention given to protected and endangered species in terms of the IUCN Red Data List.

Current faunal assessment

Due to budgetary and time constrains, field surveys were limited to opportunistic sightings of any fauna present on site. As such, no Sherman or Pitfall traps could be laid. The lack of vegetation on site due to burning also decreased the amount of available refugia.

2.3 Impact Assessment

2.3.1 Introduction

The EIA Methodology assists in evaluating the overall effect of a proposed activity on the environment. The determination of the effect of an environmental impact on an environmental parameter is determined through a systematic analysis of the various components of the impact. This is undertaken using information that is available to the environmental practitioner through the process of the environmental impact assessment. The impact evaluation of predicted impacts is undertaken through an assessment of the significance of the impacts.

SiVEST SA (PTY) Ltd. has created a standardised method of assessing impacts of proposed activities on the receiving environment. This method is explained below, and implemented for the vegetation and fauna of the receiving environment.

2.3.2 Impact significance

Determination of significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale i.e. site, local, national or global whereas Intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

Impact Rating System

The assessment of impacts takes into account the nature, scale and duration of effects on the environment whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact must also be assessed according to the project stages, namely:

- Planning
- Construction
- Operation

Where necessary, the proposal for mitigation or optimisation of an impact must be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance must be included.

2.3.3 **Rating system used to determine significance of impacts**

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the mitigation of an impact. Impacts have been consolidated into one rating. In assessing the significance of each issue, the following criteria (including an allocated point system/score) has been used:

Nature

Provision of a brief description of the impact of an environmental parameter being assessed in the context of the project. This criterion must include a brief written statement of the environmental aspect being impacted upon by a particular action or activity.

Geographical Extent

Defined as the area over which the impact will be expressed spatially.

Score	Extent	Description
1	Site	The impact will only affect this site
2	Local/district	The impact will affect the local area or district
3	Province/region	The impact will affect the entire province or region
4	International and National	The impact will affect the entire country

Probability

Probability describes the likelihood of the impact actually occurring.

Score	Probability	Description
1	Unlikely	The chance of the impact occurring is extremely low (less than a 25% change of occurrence)
2	Possible	The impact may occur (between a 25% to 50% chance of occurrence)
3	Probable	The impact will likely occur (between a 50% to a 75% chance of occurrence)
4	Definite	Impact will certainly occur (greater than a 75% chance of occurrence)

Reversibility

This provides a description on the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.

Score	Probability	Description
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures
4	Irreversible	The impact is irreversible and no mitigation measures exist

Irreplaceability

This provides a description on the degree to which resources will be irreplaceably lost as a result of a proposed activity.

Score	Irreplaceability	Description
1	No loss of resource	The impact will not result in the loss of any resources
2	Marginal loss of resource	The impact will result in marginal loss of resources
3	Significant loss of resource	The impact will result in significant loss of resources
4	Complete loss of resource	The impact is result in a complete loss of all resources.

Duration

This provides a description on the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.

Score	Duration	Description
1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).

3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).

Cumulative Effect

This describes the cumulative effect of the impacts on the environmental parameter. A cumulative effect/impact is an effect which in itself may not be significant but may become significant if added to other existing or potential impacts emanating from other similar or diverse activities as a result of the project activity in question.

Score	Cumulative Effect	Description
1	Negligible cumulative impact	The impact would result in negligible to no cumulative effects
2	Low cumulative impact	The impact would result in insignificant cumulative effects
3	Medium cumulative impact	The impact would result in minor cumulative effects
4	High cumulative impact	The impact would result in significant cumulative effects

Intensity/Magnitude

The magnitude or intensity describes the severity of an impact

Score	Cumulative Effect	Description
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.

4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.

2.3.4 Determining significance

Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula:

(Extent + probability + reversibility + irreplaceability + duration + cumulative effect) x magnitude/intensity.

The summation of the different criteria above (excluding the magnitude/intensity) will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which must be measured and assigned a significance rating.

Below is a table outlining the impact significance ratings and a description of the anticipated impacts:

Points	Impact Significance Rating	Description
6 to 28	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
6 to 28	Positive Low impact	The anticipated impact will have minor positive effects.
29 to 50	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
29 to 50	Positive Medium impact	The anticipated impact will have moderate positive effects.

51 to 73	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
51 to 73	Positive High impact	The anticipated impact will have significant positive effects.
74 to 96	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
74 to 96	Positive Very high impact	The anticipated impact will have highly significant positive effects.

IMPACT TABLE FORMAT		
Environmental Parameter	*A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water*	
Issue/Impact/Environmental Effect/Nature	*A brief description of the nature of the impact that is likely to affect the environmental aspect as a result of the proposed activity e.g. alteration of aquatic biota The environmental impact that is likely to positively or negatively affect the environment as a result of the proposed activity e.g. oil spill in surface water*	
Extent	*A brief description of the area over which the impact will be expressed*	
Probability	*A brief description indicating the chances of the impact occurring*	
Reversibility	*A brief description of the ability of the environmental components recovery after a disturbance as a result of the proposed activity*	
Irreplaceable loss of resources	*A brief description of the degree in which irreplaceable resources are likely to be lost*	
Duration	*A brief description of the amount of time the proposed activity is likely to take to its completion*	
Cumulative effect	*A brief description of whether the impact will be exacerbated as a result of the proposed activity*	
Intensity/magnitude	*A brief description of whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily*	
Significance Rating	*A brief description of the importance of an impact which in turn dictates the level of mitigation required*	
	Pre-mitigation impact rating	Post mitigation impact rating

Extent	4	1
Probability	4	1
Reversibility	4	1
Irreplaceable loss	4	1
Duration	4	1
Cumulative effect	4	1
Intensity/magnitude	4	1
Significance rating	**-96 (high negative)**	**-6 (low negative)**
Mitigation measures	*Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. Describe how the mitigation measures have reduced/enhanced the impact with relevance to the impact criteria used in analyzing the significance. These measures will be detailed in the EMP.*	

3 ASSUMPTIONS AND LIMITATIONS

- The floral surveys were based upon a limited sampling time period and may not reflect the actual species composition of the site due to seasonal variations in flowering times.
- The faunal surveys were based upon a limited sampling time period and may not reflect the actual species composition of the site due to seasonal variations.
- Please note that vegetation and faunal assessments are best undertaken during the warmer months of the year. As such, it must be noted that the additional site visit was undertaken during winter to verify the findings of the original summer sampling. The Competent Authority may request additional summer site visits.

4 DESCRIPTION OF THE ENVIRONMENT

4.1 Geology and soils

The geology of the study area comprises almost entirely of Tillite units (ENPAT data, (2000). There is a small portion in the northeastern corner of the site exhibiting Shale units (ENPAT data, (2000). According to Mucina, *et al,* 2006, the land is characterised by red to yellow sandy soils of the Ba-Dystrophic and/or mesotrophic; red soils widespread (30%) and Bb- Dystrophic and/or mesotrophic; red soils not widespread (65%) land types. These are found on shales and sandstones of the Madzaringwe Formation (Karoo Supergroup) (Mucina, *et al,* 2006).

In addition, field observations revealed prominence of ferricrete extrusions to the east of the study area. They are located in the higher areas of the plains as well as near the valley bottom stream in the northwestern corner of the site

4.2 Topography

In terms of topography, the study site is characterised by an undulating plain. The terrain generally slopes towards the west and the plain descends gently into a shallow valley

bottom. Here, a non-perennial stream can be observed. The altitudinal range is approximately between 1515-1545m above sea level (m.a.s.l.).

4.3 Climate

The area experiences strongly seasonal summer rainfall during the months of October to February. During this period, temperature range from 8°C to 26°C. There is a Mean Annual Precipitation of 650-900mm with an overall average of 726mm. Meanwhile the winters are very dry (Mucina, *et al,* 2006) with average temperatures of 19°C between April and August.

4.4 Land use

According ENPAT data, (2000), the study area and immediately surrounding areas are characterised as vacant / unspecified. Furthermore there is a residential area in the adjacent northern area. Moreover based on field assessment the portions of the land are being used for cattle grazing. The area to the east of the site is currently being developed into the Middelburg Mall. Properties bounding onto the southern and western parts of the site are similar in nature to the site.

4.5 Vegetation

According to Mucina and Rutherford (2006), updated in 2012, the study area falls within the Rand Highveld Grassland vegetation type (Gm11) which is classified under the Mesic Highveld Grassland bioregion of the Grassland biome. In terms of the conservation status, the Rand Highveld Grassland vegetation type is considered endangered, with only 1% protection (target is 24%). No other vegetation types are present on the site hence the absence of a vegetation map.

4.6 Ecological processes

A map (**Error! Reference source not found.**) highlighting the ecological processes has been compiled based on the information provided by the Mpumalanga Biobase. The information indicates that the site is considered to be of Least Concern whilst the wetland running on the western boundary of the site has been identified as sensitive.

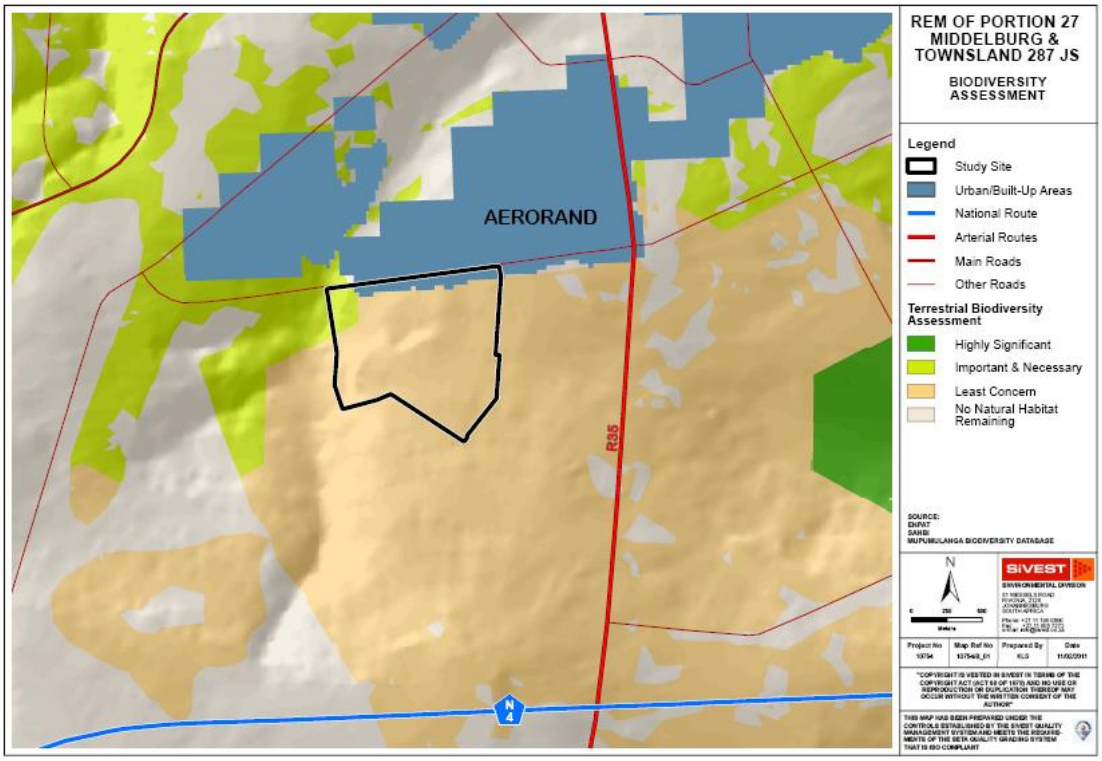

Figure 1: Ecological processes

According to the Mpumalanga Biobase (2005) the site is important for certain ecological processes. These are listed in Table 3.

Table 3: Ecological processes in the study area

Ecological Process	Rating
Amphibian importance	Low
Bird importance	Low
Landscape	Medium
Mammal importance	Low
Importance communities	Medium/ Low
Important species	Medium/ Low & Low
Biodiversity: Communities	Medium/ Low
Biodiversity: Species	Medium/ Low

Ecological Process	Rating
Muthi Plants	Low
Phyto centres of endemism	None
Phyto regions of endemism	None
Reptile importance	Low
Threatened plants	Low
Vegetation communities	**High**

The Biobase highlights the study area as being important from a vegetation perspective.

4.7 Habitats

Previous conditions on site

Faunal populations are dependent on the flora that supports them therefore assumptions regarding the presence of fauna can be made based on the flora present. Habitats within the study area are characteristic of the Rand Highveld Grassland vegetation type. The habitat remains uniform across the site with the presence of the wetland areas providing a unique habitat type for small mammals, amphibians and birds. Figures 2 to 5 visualise the habitats present on the site.

Ecological Support Areas.

According to the Mpumalanga Biodiversity Sector Plan (2014): Terrestrial Assessment; the proposed site falls within a Critically Biodiverse Area (CBA): Optimal, an Ecological Support Area Protected Area Buffer and a Protected Area (Figure 2). The Protected Area status was as a result of a degazzetted Nature Reserve called Krugerdam Private Nature Reserve. The assosciated Ecological Support Area Protected Area Buffer and CBA: Optimal status is likely due to the previous Protected Area status. Even thoug this is the case, there is potential for the land to be protected as it still supports biodiversity in a semi-intact environment.

Figure 2: Land classification according to Mpumalanga Biodiversity Sector Plan (2014).

Figure 3: Grassland vegetation dominates the site

Figure 4: Looking north west from the site towards Aeroton. Note access road to substation

Figure 5: Large wetland system on western boundary of the site

Figure 6: Existing impacts on the site from the substation construction

Current conditions on site

Habitat has not changed on site since the previous study. The area comprises of uniform Rand Highveld Grassland. The majority of the study area was recently burnt, and the remaining vegetation was in a moribund state. Patches of unburnt vegetation provided refugia for faunal species. Site is currently represented with Figures 6 to Figure 9.

Figure 7: Site was recently burnt with small patches of unburnt vegetation.

Figure 8: Looking west from the eastern boundary of site.

Figure 9: The south-west corner of site. Note the moribund state of the vegetation.

Figure 10: The drainage ditch in the north-west corner of site, bordering Middelburg Mall.

5 FLORA IN THE STUDY AREA

As mentioned above, the study area falls within the Eastern Highveld Grassland. This vegetation type is further described below.

5.1 Rand Highveld Grassland

The Rand Highveld Grassland is characterised by slightly - moderately undulating plains with short dense grassland dominated by the usual Highveld grass composition and small scattered rocky outcrops with wiry sour grasses and some woody species (Mucina and Rutherford, 2012). This vegetation type is endangered with only a small fraction (1%) conserved. Up to 44% is transformed by activities such as cultivation and urbanisation. There are no reported serious alien invasions, however *Acacia mearnsii* may become dominant in disturbed areas ((Mucina and Rutherford, 2012). Some of the critical taxa include Graminoids such as *Aristida aequiglumis, A. congesta, Digitaria monodactyla, D. tricholaenoides, Eragrostis chloromelas, E. curvula and Andropogon appendiculatus*,

Herbs namely *Berkheya setifera*, *Haplocarpha scaposa* and *Acalypha angustata,* Geophytic herbs like, *Gladiolus crassifolius* and *Haemanthus humilis subsp. hirsutus*, and low shrubs such as *Anthospermum rigidum subsp. pumilum and Stoebe plumose* (Mucina, *et al,* (2006).

The following floral species were recorded during the field survey:

Table 4: Floral species in the study area (Black writing are species noted in the previous study, while blue writing are additional species noted in this study)

Scientific name	Common Name
GRASSES	
Cymbopogon caesius	Broad-leaved Turpentine Grass
Hyparrhenia hirta	Common Thatching Grass
Urelytrum agropyroides	Quinine Grass
Trachypogon spicatus	Giant Spear Grass
Harpocloa falx	Caterpillar Grass
Elionurus muticus	Wire Grass
Tragus berteronianus	Carrot-seed Grass
Perotis patens	Cat's tail
Cenchrus ciliaris	Foxtail Buffalo Grass
Setaria sphacelata var. sphacelata	Common Bristle Grass
Aristida congesta subsp.congesta	Tassel Three-awn
Tristachya leucothrix	Hairy Trident Grass
Eragrostis racemosa	Narrow Heart Love Grass
Eragrostis capensis	Heart-seed Love Grass
Melinis nerviglumis	Bristle-leaved Red Top
Eragrostis trichophora	Hairy Love Grass
Eragrostis Lehmanniana	Lehmann's Love Grass
Eragrostis curvula	Weeping Love Grass
Agrostis lachnantha	Bent Grass
Themeda triandra	Red Grass
Pennisetum thunbergii	Thunberg's Pennisetum
Heteropogon contortus	Spear Grass
Panicum schinzii	Sweet Grass
Hyparrhenia tamba	Blue Thatching Grass
Panicum repens	Couch Panicum
FORBS	
Pachycarpus schinzianus	Bitterwortel
Gerbera piloselloides	Swartteebossie
Dicoma zeyheri	Kafferdissel
Wahlenbergia virgata	
Stoebe vulgaris	Bankrupt bush
Hypoxis rigidula	Kaffertulp

Hypoxis hemerocallidea	Gifbol
Taraxacum officinale	
Berkeya sp	
Elephantorrhiza elephantina	Elephants root
Acalypha angustata	Copper Leaf
Senecio affinis	
Ledebouria revoluta	
Vernonia galpinii	Perskwasbossie
Vernonia oligocephala	Bitterbossie
Cirsium vulgare	Scottish thistle
hermannia depressa	Rooi-opslag
Solanum sisymbrifolium	Wild tomato
Peucedanum magalismontanum	Wild parsley
Berkeya sp	
Helichrysum sp	
Sonchus oleraceus	Sow thistle
Eriosema burkei	
Lotonotis eriantha	
Gladiolus sp	
Ipomoea bathycolpos	Veldambreeltjies
Oxalis obliquifolia	Sorrel
Persicaria lapathifolia	Spotted knotweed
Wahlenbergia caledonica	
Monopsis decipiens	
Euphorbia striata	Melkgras
Verbena bonariensis	Wild verbena
Bidens pilosa	Blackjack
TREES	
Vachellia karoo	Sweet Thorn

One sensitive species was noted on site namely the Gifbol (*Hypoxis hemerocallidea*). This species is listed as declining in Gauteng. The Mpumalanga Biobase (Emery *et al.,* 2002) notes this species as Near Threatened, due to its popularity as a medicinal plant. Only one specimen was noted on site however habitat currently remains for more.

Species listed for the study area according to SANBI are listed in Appendix 1.

5.2 Vegetation Biodiversity Assessment

In terms of assessing the impacts of a proposed development on the receiving environment, it is important that the present state of the environment is assessed and the level at which it functions currently is considered and recorded.

Bearing this in mind SiVEST (Scott-Shaw, 2014) have developed an assessment matrix which assists in determining the current biodiversity and conservation value of the various landscapes (vegetation types) that were encountered during the field survey. Please note, this assessment takes into account data from the previous study which is combined with this site visit.

In addition, consideration has been given to the biodiversity noteworthiness of the receiving environment (i.e. does the environment hold any rare species, protected species and unique landscape features) as well as the functional integrity and future sustainability of the vegetation types in the immediate vicinity of the Pipeline Upgrade. The final condition score is calculated by adding the Biodiversity noteworthiness score with the Functional Integrity and Sustainability score. It must be noted that the two scores are weighted 50%:50% respectively.

5.2.1 Biodiversity noteworthiness

In terms of the vegetation classifications that were identified from the aerial photography and ground-truthed on site, the following assessment was made in terms of the noteworthiness of the vegetation that occurs along the proposed development footprint (Please see section 2.1 for score definitions).

Table 5: Biodiversity noteworthiness of the vegetation within the grassland habitat

	Scores				
Biodiversity Noteworthiness	0	1	**2**	**3**	**4**
Diversity				✓	
Rarity		✓			
Conservation Status				✓	
Red Data Species		✓			
Uniqueness / Special features			✓		
OVERALL VALUE	Total Score/number of categories is 10 / 5= **2.0**				

The biodiversity noteworthiness of the vegetation on site are as follows:
The grassland habitat scored **2.0** (**intermediate biodiversity**) with regards to Biodiversity Noteworthiness.

5.2.2 Functional Integrity and Sustainability

The functional Integrity and sustainability speaks to the impact of the proposed activity on the receiving environment. It also talks to the likelihood that it will be of significance and whether there are significant mitigation and or amelioration measures that are required to be put in place to ensure that the impacts are manageable and will not prove deleterious to the vegetation type as a whole, which falls within the current proposed area of disturbance.

Table 6. Future Integrity and viability of the vegetation within the grassland habitat

	Scores				
Integrity & Future Viability	**0**	**1**	**2**	**3**	**4**
Buffer		✓			
Connectivity					✓
Alteration	✓				
Invasive/pioneers				✓	
Size					✓
OVERALL VALUE	Total Score/number of categories is 12 / 5= **2.4**				

The future integrity and viability value of the vegetation on site are as follows:
The grassland habitat scored **2.4** (**intermediate biodiversity**) with regards to Biodiversity Noteworthiness.

5.3 Implications for Development

The study area illustrated a high level of vegetative biodiversity and displayed subclimax to climax grassland. The species present indicate the presence of grazing with the emergence of pioneer grass species such as wire grass (*Elionurus muticus*) which is quite a dominant species on the site.

The site is bounded by Tafelberg / Nelson Mandela Drive to the North and the Middelburg Mall which has being constructed to the East of the site. All other boundaries are natural areas which link in with the site in question.

The site slopes in a westerly direction towards a wetland system with depression wetlands on the eastern boundary of the site. These wetlands provide unique habitat for faunal and floral species and have thus been classified as sensitive.

Previous conditions

The level of impact present on the site is fairly low with natural grassland dominating. Small servitudes have been cleared for installation of services to the new substation on the site and this has resulted in the loss of vegetation in these areas. These areas are however small in relation to the rest of the site. Cattle grazing is present on the site as mentioned above and the impacts associated with this are especially obvious in the areas close to the water point in the south eastern corner of the site.

Current conditions

At the time of the current survey, a large portion of the site had been burned, with the remaining portions (outside of wetlands), comprising of moribund material. Although conditions may not have been favourable for vegetation sampling, the area visually represented much the same as it did in the previous study. Small areas of natural vegetation have been lost as a result of the construction of an electrical substation to the borth-west of site, and a few informal access roads have been created for no apparent reason on the site. No cattle grazing, or traces thereof could be found when sampling. Connectivity to the the surrounding grasslands is excellent, with pressure on the grassland and ecological connectivity coming from the borders of the bordering properties. Informal dumping has littered part of the eastern section of the site, close to Middelburg Mall.

The proposed development, as indicated in the layout provided by the Steve Tshwete Local Municipality, will result in the removal of all vegetation from the site. The potential for the loss of Rand Highveld Grassland, which is already Endangered and has approximately 1% conserved would result in further loss of the vegetation type. It is recommended that ecological corridors be included in the design of the properties to allow for some of the vegetation to be maintained or conserved.

6 FAUNA IN THE STUDY AREA

Due to budgetary and time constraints, faunal sampling was limited to opportunistic sightings. Databases that were used in assisting with sampling are mentioned above.

6.1 Mammals

Mammal lists have been updated from the previous study, with the Animal Demographic Units MammalMAP indictating the presence and the Redlist Status being stated in Table

7. However due the presence of anthropogenic activities in the study area, it is highly unlikely that the majority of these species exist in the study area.

Table 7: Red Data mammal species (species in black writing come from the previous study, while species in blue are species predicted to occur by using MammalMAP). Any repetition was removed and the updated Red list of Mammals of South Africa, Lesotho and Swaziland species status was written in blue.

Scientific name	Common name	Status	Probability of presence
Atelerix frontalis	South African Hedgehog	Near Threatened	Possible
Dasymys incomtus	Water Rat	Near Threatened	Possible
Hyaena brunnea	Brown Hyaena	Near Threatened	Improbable
Leptailurus serval	Serval	Near Threatened	Improbable
Lutra maculicollis	Spotted-necked Otter	Vulnerable (2016)	Unlikely
Manis temminckii	Pangolin	Vulnerable	Improbable
Mellivora capensis	Honey Badger	Least Concern (2016)	Improbable
Miniopterus schreibersii	Schreibers' Long-fingered Bat	Near Threatened	Improbable
Myotis tricolor	Temminck's Hairy Bat	Least Concern (2016)	Improbable
Myotis welwitschii	Welwitsch's Hairy Bat	Least Concern (2016)	Improbable
Ourebia ourebi	Oribi	Endangered (2016)	Improbable
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	Least Concern (2016)	Improbable
Rhinolophus darlingi	Darling's Horseshoe Bat	Least Concern (2016)	Improbable
Antidorcas marsupialis	Springbok	Least Concern (2016)	Improbable
Connochaetes gnou	Black Wildebeest	Least Concern (2016)	Improbable
Damaliscus pygargus phillipsi	Blesbok	Least Concern (2016)	Improbable
Kobus ellipsiprymnus	Waterbuck	Least Concern (2016)	Improbable
Oryx gazella	Gemsbok	Least Concern (2016)	Improbable
Tragelaphus strepsiceros	Greater Kudu	Least Concern (2016)	Improbable

Vulpes chama	Cape Fox	Least Concern (2016)	Improbable
Chlorocebus pygerythrus pygerythrus	Vervet Monkey (subspecies pygerythrus)	Least Concern (2016)	Possible
Felis silvestris	Wildcat	Least Concern (2016)	Possible
Panthera pardus	Leopard	Vulnerable (2016)	Improbable
Cynictis penicillata	Yellow Mongoose	Least Concern (2016)	Possible
Herpestes sanguineus	Slender Mongoose	Least Concern (2016)	Possible
Suricata suricatta	Meerkat	Least Concern (2016)	Possible
Pronolagus randensis	Jameson's Red Rock Hare	Least Concern (2016)	Improbable
Orycteropus afer	Aardvark	Least Concern (2016)	Improbable
Procavia capensis	Cape Rock Hyrax	Least Concern (2016)	Possible
Genetta maculata	Rusty-spotted Genet	Least Concern (2016)	Possible

Species seen in previous study

In the field, only three mammal species were trapped in Pitfall traps and Sherman traps which were randomly setup within the site. These include: Striped Mouse *(Rhabdomys pumilio)*, Vlei rat (*Otomys irroratus*) and Swamp musk shrew (*Crocidura mariquensis)*. A total of eight (8) individuals of *R. pumilio* were sampled. This species is considered to be of Least Concern (Friedman & Daly, (2004). In addition, one (1) *O*. *irroratus* and two (2) *C. mariquensis* were sampled.

- Striped Mouse (*Rhabdomys pumilio*)

According to Schradin, (2005), the striped mouse mainly nests sites in areas of dense grass. Their breeding season is usually confined to the summer months (September to May). Adult females have limited home ranges during the breeding season and are normally solitary. In the Grassland biome, females have exclusive territories whereas male territories overlap with several female territories (Schradin, and Pillay, 2005).

- Vlei rat (*Otomys irroratus*)

This species occurs mostly in moist habitats (swampy areas) as well as in grasslands near moist areas. This species builds saucer-shaped nests for shelter above water level, however occupies rodent burrows and tunnels in termite mounds. They forage singly or in pairs and sometimes family groups will forage together. They mostly feed on stems, seeds, leaves, grasses and reeds. In terms of territories, males are known to be dominant and defend territorial boundaries (Malone, A., 2008)

- Swamp musk shrew (*Crocidura mariquensis*).

The species mostly occurs in moist habitats with a preference for dense, matted vegetation. They tend to defend their territories within fixed home ranges. Foraging is a solitary activity and they mostly feed on insects, other invertebrates and perhaps small vertebrates (Stuart and Stuart, 2001)

Species seen in this study

The only mammal species seen during the current site visit was two Scrub Hares (*Lepus saxatilis*). However, traces of two other mammal species were found. Rodent burrows and droppings suggest the presence of Southern African Vlei rats (*Otomys irroratus,* Figure 10), and tracks suggest the presence of either Caracal (*Caracal caracal*) or Serval (*Leptailurus serval*, Figure 11).

Figure 11: Possible *Otomys irroratus* droppings and nesting burrow.

Figure 12: Possible tracks of a Caracal or Serval. Note the lack of claws and the tri-lobed back pad.

- Scrub Hare (*Lepus saxatilis*)

Scrub Hares are commonly found in grassland and savanna habitats which have grass or scrub cover. They are commonly seen in cultivated areas. They are mainly nocturnal but may be active in early morning and late afternoon. They lay in shallow indentations in the ground made by their bodies (called “forms”). They rely on their camoflague until the last moment, at which stage they will get up and run away in a zigzag formation. They are herbovirous and predominantly grazers, but will feed on new growth of plants (Stuart and Stuart, 2015).

- Caracal (Caracal caracal)

Caracals are widespread throughout Africa, with their preferred habitats ranging from semi-desert to savanna woodland. They are mainly nocturanal, but do show diurnal activity. Males are territorial, with individuals being solitary, except during mating. Depending on the abundance of food, home ranges can range from 400 ha to 10 000 ha in area, with females having range overlap with dominant males. They are carnivorous and opprtuistic, and with their dominant food items comprising of rodents, birds and even small antelope (Stuart and Stuart, 2015).

- Serval (Leptailurus serval)

Servals are widespread thoughout Southern Africa, with a preference for wetlands and adjacent grassland. They are usually nocturnal but can be diurnal, especially in the early morning and late afternoon. They are territorial, with home ranges varying from 150ha to 3000ha. They feed on small mammals, especially vlei rats (Stuart and Stuart, 2015).

6.2 Implications for Development

The site provides uniform grassland habitat as well as wetland habitat for mammal species. It is likely that only small mammal species would be present due to the developments in the surrounding areas and the general absence of large mammals from the landscape due to anthropogenic activities. However, the possible presence of caracal or serval suggests that the site is part of a larger territory, and the development would reduce available habitat for the species. It is recommended that ecological corridors and wetlands assosciated with this development be included in the design of the development.

6.3 Avifauna

Bird life in the study area is fairly diverse. The list of Red Data bird species is included in Table 8. This table describes each threatened species on the basis of rationale, ecology, threats, conservation as well as protected areas and Important Bird Areas (IBAs) - (Barnes, 2000). A brief description of each term is given below:

- Rationale: This is a summary relating to information on reasons why the species qualifies as threatened (Barnes, 2000).
- Ecology: Information on habitat choice including micro-habitat requirements, dietary preferences, competition, migratory behaviour, breeding success, life-history strategies and generation lengths (Barnes, 2000).
- Threats: Details of the threats faced by the species (e.g. habitat loss). Also, causes of threats are discussed for instance loss of the grassland habitat to afforestation by alien tree species (Barnes, 2000). Or in the case of this study, where vegetation will be lost to make way for the proposed development.
- Conservation: This is a discussion of recent conservation measures that have benefited or may benefit the species. Measures may relate to legislation or land-use practices impacting the species on private land (Barnes, 2000).
- Protected areas and Important Bird Areas (IBAs): This is a list of important protected areas and Important Bird Areas according to Barnes (1998) within the species range (Barnes, 2000).

Table 8: Description of each threatened bird species on the basis of rationale, ecology, threats, conservation as well as protected areas and Important Bird Areas.

Bird Species	Rationale	Ecology	Threats	Conservation	Protected Areas and IBAs
***Anthropoides paradiseus* (Blue Crane)**	It had declined by 20% between 1978 and 1998. By the year 2000, the species was declared Vulnerable.	Nest mostly in secluded open short dry grasslands and doesn't depend much on wetland habitats for breeding. Occasionally nest in	Grassland habitat loss, land use alteration as well as agrochemical poisoning. In this case the proposed development is not predicted to	In 2000, conservation was largely restricted to privately owned farmlands. It was however suggested that future planning of	Grassland Biosphere Reserve; Steenkampsberg and Amersfoort-Bethal-Carolina District

Bird Species	Rationale	Ecology	Threats	Conservation	Protected Areas and IBAs
		shallow seasonal wetlands.	threaten the survival of this species as the species has not been documented in the area.	afforestable regions within the Grassland biome include habitat management. Also chicks should not be taken from the wild.	
***Aquila rapax* (Tawny Eagle)**	About 20% of this species' regional population has been lost in three generations. The species is considered Vulnerable.	Occurs mainly in woodlands and lightly wooded areas. They are active predators, but can obtain food through scavenging and piracy. Nesting occurs in alien trees, high-tension pylons and on top of Sociable Weaver nests in predominantly grassland regions.	Decline in prey for these birds due to habitat transformation. Deaths occur due to drowning in sheer-walled reservoirs. It is the second most frequently recorded drowned eagle. Struck by motor vehicles whilst scavenging on roads. The proposed residential development is likely to affect this species as no woodland habitat is present.	Awareness and education programmes are resulting in increases in population sizes in the agricultural areas of the province.	Kruger National Park and adjacent areas

Bird Species	Rationale	Ecology	Threats	Conservation	Protected Areas and IBAs
***Balearica regulorum* (Grey Crowned Crane)**	At least 20% of the poulation had been lost by 2000 therefore the species is considered Vulnerable.	Live in mixed wetland-grassland habitats. Nest mostly in permanent or temporary marshes and wetlands. Also breed and nest in well vegetated farm dams. They forage in habitats characterised by short-medium height open grasslands.	Widespread degradation of breeding and feeding habitats Alterration of wetland habitats is the greatest threat. This species is not likely to be present within the study area due to anthropogenic activities present.	Develop sustainable management alternatives for the coexistence of this species within the prevailing matrix of land use. This could be done through development of community-based habitat conservation programmes to increase awareness and environmental education.	Grassland Biosphere Reserve; Steenkampsberg and Amersfoort-Bethal-Carolina District
***Circus ranivorus* (African Marsh Harrier)**	May have declined in numbers by 20% by the year 2000 therefore the species is considered Vulnerable.	It depends mostly on permanent wetlands for breeding, roosting and feeding. Small wetlands (1-2ha) are normally used for foraging while large	On going pressure on sensitive wetlands e.g draining and modification of wetlands for development and agriculture. Increased grazing pressure is	Importants sites should be protected. The species could be promoted as a flagship species to encourage further	Grassland Biosphere Reserve and Steenkampsberg

Bird Species	Rationale	Ecology	Threats	Conservation	Protected Areas and IBAs
		wetlands are utilized for breeding	detrimental to temporary wetlands.	protection of wetlands. The species might successfully recolonise rehabilitated areas as it can adapt to artificially modified wetlands	
Eupodotis senegalensis **(Whitebellied Korhaan)**	Area of occupancy predicted to have declined by 20% by the year 2000 hence suggesting concomitant population declines. The species is thus regarded ar Vulnerable.	The species inhabits relatively tall vegetation, fairly dense grassland in open or lightly wooded regions. However most abundant in areas at the interface between the grassland and savanna biomes.	Habitat loss through overgrazing, high human densities and commercial afforestation	Investigation of the research pertaining to species' affinity for tall undisturbed grassland. Appropriate management on private land.	Grassland Biosphere Reserve; Steenkampsberg and Amersfoort-Bethal-Carolina District
Falco naumanni **(Lesser Kestrel)**	The species is considered Vulnerable. Sweet grassveld is	Pristine grassland is preferred for foraging, but areas with	The destruction and fragmentation of grasslands is	Conservation is difficult and complex as it is a migratory bird. The	There are no conservation areas where this bird may be considered

Bird Species	Rationale	Ecology	Threats	Conservation	Protected Areas and IBAs
	the preferred habitat and is poorly conserved. This is not likely to change due to its conversion to intensive agriculture.	converted land cover i.e. small-scale pasture are also used as hunting grounds. Roost in tall trees and may continually occupy the roost for more than 30 years.	a major threat to this species.	grassland biome is threatened and this needs to be conserved in order to try and conserve this species.	"protected". However some large numbers occur in a few IBSs e.g. Grassland Biosphere Reserve; Amersfoort-Bethal-Carolina District
***Geronticus calvus* (Bald Ibis)**	A 20% decline in populations was predicted if habitat loss to increasing human populations continued	Prefers high rain fall sour and alpine grasslands characterised by absence of trees and a short, dense grass sward.	Habitat loss through commercial afforestation, dense human settlement and human interference with breeding colonies	Protection of open grassland foraging habitats. Ongoing monitoring of it's population size and breeding success.	Grassland Biosphere Reserve; Steenkampsberg;
***Neotis denhami* (Stanley's Bustard)**	20% of the species population is predicted to have disappeared due to the rapid alteration of	Occurs in high rainfall open, exposed, hilly, sour grassland at high altitudes during the breeding season.	Habitat loss through overgrazing, high human densities. Commercial afforestation envisaged as future threat	Provide incentives for kandowners to manage grassland patches on their farms.	Grassland Biosphere Reserve; Steenkampsberg and Amersfoort-Bethal-Carolina District

Bird Species	Rationale	Ecology	Threats	Conservation	Protected Areas and IBAs
	the habitat. It's a Vulnerable species	During nonbreeding season, it occurs in lower lying regions.			
***Podica senegalensis* (African Finfoot)**	Was predicted to undergo a 20% decline in population in the following three generations due to rapid degradation and destruction of habitats. The species is considered vulnerable	Occurs in perennial rivers and streams lined with reeds and overhanging trees and shrubs. Avoids stagnant and fast moving water. It's largely sedentary and breeds mainly in summer	Reduction of water flow through commercial afforestation of catchment areas and degradation riverine vegetation	Protect rivers and riparian vegetation and reduce human disturbance	Kruger National Park and adjacent areas
***Polemaetus bellicosus* (Martial Eagle)**	About 20% of this species' regional population has been lost in three generations, but remains widespread. The species is considered Vulnerable.	Occur singly or as a pair. Widespread and therefore tolerates a variety of vegetation types i.e. open grassland, scrub, Karoo and woodland; but relies on large	Reduction in available prey due to habitat transformation. Many deaths from drowning in sheer-walled reservoirs occur. The major threats are shooting and trapping by	Population numbers are declining due to persecution on privately owned land or where poisoned carcasses (set for Blackbacked Jackal) are set and are first	Kruger National Park and adjacent areas

Bird Species	Rationale	Ecology	Threats	Conservation	Protected Areas and IBAs
		trees for nest sites.	game farmers and small-stock farmers and accidental poisoning.	found by the eagles, therefore awareness and education programmes in rural areas surrounding stock farms are vital.	
***Tyto capensis* (African Grass Owl)**	Had declined by 10% in 2000 and was expected to continue declining by 20% in the following three generations due to the continued and rapid destruction of habitats. It falls in the category of Vulnerable species	Breeds in permanent and seasonal vleis which it vacates while hunting or post-breeding. It's not necessarily associated with wetlands and it breeds in any area of long grass. The species nests on in ground tunnels mostly in tall grass.	Habitat loss and fragmentation	There is a need to preserve its favoured rank grass habitat.	Kruger National Park and adjacent areas; Grassland Biosphere Reserve; Steenkampsberg and Amersfoort-Bethal-Carolina District

Current conditions on site

Opportunisitc birding observations were made on site. Grassland habitats tend to be rich in ground dwelling bird species such as pipits, larks and cisticolas. However, diversity during this site visit was low, most likely due to the burnt nature of the majority of the site, which reduces refugia for birds. Species to note were the presence of Capped Wheatear

(*Oenanthe pileata,* Figure 12), and the regionally Vulnerable White-bellied Korhaan (*Eupodotis senegalensis*). Additionally, non-breeding Long-tailed Widowbirds (*Euplectes progne*, Figure 13) and Levaillant's Cisticola were present (*Cisticola tinniens,* Figure 14).

Figure 13: Capped Wheatear (*Oenanthe pileata*) on the eastern section of the study site

Figure 14: Non-breeding Long-tailed Widowbird (*Euplectes progne*) on the south-western edge of the study site.

Figure 15: Levaillant's Cisticola (*Cisticola tinniens*) in the south-western edge of the study site.

6.4 Implications for Development

The prescence of the wetland provides habitat for several bird species in addition to potentially providing habitat for some of the above mentioned species. Of specific concern with regards to bird species would be the African grass owl. Suitable habitat exists for this species however it was not noted during the field visit. Additionally, the presence of the locally Vulnerable White-bellied Korhaan in a semi-intact grassland/wetland area means that the proposed development will reduce the available habitat for this species. The wetland habitat with a suitable grassland buffer must be preserved to ensure habitat provision for these two species. It is important to note that foraging area should also be provided for.

6.5 Amphibians

Previous site visit

The Guttural toad (*Amietophrynus gutturalis*) was the only amphibian species recorded during field assessments. However, according to Minter *et al.,* (2004), several amphibian species occur in the study area (See list in Appendix 2). Perhaps the most important of these is the African Giant Bullfrog (*Pyxicephalus adspersus,* Figure **16**15) which is a Red Data species. According to Minter *et al.,* (2004) it breeds in seasonal shallow grassy pans in flat open grassland or savanna areas. Furthermore, the species may occur in non-permanent vlies and shallow water on waterhole margins (Minter *et al.,* 2004). This species is considered to be Near Threatened as its specialized habitat is at risk from increasing urbanization and agricultural activity (Minter *et al.,* 2004; Du Preez and Carruthers, 2009).

Current site visit

The *status quo* remains as no amphibians were seen during this site visit.

Figure 16: Adult Giant Bullfrog (Pyxicephalus adspersus): Photo by L.H. du Preez in Minter et al., (2004)

6.6 Implications for Development

The presence of amphibian species other than the Giant bullfrog is not likely to be a limitation on the proposed development. The presence of the Giant bullfrog was not documented during the site visit however suitable habiat for the species is present on the site. This is in association with the wetland. The implementation of a buffer and ecological linkage should provide suitable habitat for the species however care will need to be taken during any construction as this species is often uncovered during bulk earthworks.

6.7 Reptiles

Although no reptiles were recorded during site surveys, according to Branch, (1998), a variety of them potentially occur in the study area (Table 9).

Table 9: Reptiles in the study area (updated species according to the Animal Demographic Unit's ReptileMAP are written in blue)

Scientific name	Common name
Afrotyphlops bibronii	Bibron's Blind Snake
Agama atra	Southern Rock Agama
Aparallactus capensis	Cape Centipede Eater

Scientific name	Common name
Atractaspis bibronii	Southern or Bibrons's Burrowing Asp
Bitis arietans	Puff Adder
Boaedon capensis	Brown House Snake
Causus rhombeatus	Rhombic Night Adder
Chamaeleo dilepis dilepis	Common Flap-neck Chameleon
Cordylus vittifer	Transvaal Girdled Lizard
Crotaphopeltis hotamboeia	Herald or Red-lipped Snake
Dasypeltis scabra	Common or Rhombic Egg Eater
Gerrhosaurus flavigularis	Yellow-throated Plated Lizard
Hemachatus haemachatus	Rinkhals
Hemidactylus mabouia	Common Tropical House Gecko
Lamprophis aurora	Aurora House Snake
Lamprophis inornatus	Olive House Snake
Leptotyphlops conjunctus	Cape and Eastern Thread Snakes
Leptotyphlops longicaudus	Long-tailed Thread Snake
Leptotyphlops Scutifrons	Peter's Thread Snake
Lycodonomorphus rufulus	Common Brown Water Snake
Lycophidion capense	Cape Wolf Snake
Lygodactylus capensis capensis	Common Dwarf Gecko
Mabuya capensis	Cape Skink
Pachydactylus affinis	Transvaal Gecko
Pachydactylus capensis	Cape Gecko
Pelomedusa subrufa	Marsh or Helmeted Terrapin
Psammophis brevirostris	Leopard and Short-snouted Grass Snakes
Psammophis crucifer	Cross-marked or Montane Grass Snake
Psammophylax tritaeniatus	Striped Skaapsteker
Pseudaspis cana	Mole Snake
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake
Telescopus semiannulatus semiannulatus	Eastern Tiger Snake
Trachylepis punctatissima	Speckled Rock Skink
Trachylepis punctatissima	Speckled Rock Skink
Trachylepis varia	Common Variable Skink
Trachylepis varia sensu lato	Common Variable Skink

6.8 Implications for Development

Habitat provision for reptile species on the site is abundant. A large number of reptile species prefer rocky grassland and rocky outcrops which are not present within the study

area and may be a limiting factor on reptile abundance. No Red Data reptile species were recorded in the study area. The status quo remains.

6.9 Invertebrates

A large number of invertebrates were sampled in the study area (Table **10**10). Invertebrate species of concern relate to the certain Mygalomorph spiders as well as butterfly species. Other genera of concern are the Odonata and Coleoptera which contain species of concern. None of these species were recorded on the site.

Table 10: List of invertebrates in the study area

Order: Family	Scientific name	Common name	No. of individuals sampled
Solpugida: Solifugae	*Ammotrechula peninsulana*	Sunspider	2
Araneae: Lycosidae	*Pardosa pseudoannulata*	Wolf spider	18
Araneae: Gnaphosidae		Flat-bellied ground spider or mouse spider	2
Araneae: Salticidae	*Phidippus cardinalis*	Jumping spider	2
		Millipede	5
Coleoptera: Scarabaeidae	*Heteronychus arator*	Black maize beetle	18
Coleoptera: Tenebrionidae	*Psammodes striatus*	Striped toktokkie	1
Coleoptera: Buprestidae	*Acmaeodera viridaenea*	Gliterring jewel beetle	1
Coleoptera: Curculionidae	*Protostrophus* sp.	Beaded weevil	4
Coleoptera: Tenebrionidae	*Tenebrio molitor*	Yellow mealworm	1
Coleoptera: Tenebrionidae	*Gonocephalum simplex*	Dusty maize beetle	5
Coleoptera: Silphidae		Carrion beetle	1
Coleoptera: Cicindelidae		Tiger beetle	1
Coleoptera: Lampyridae		Glow worm/fireflies	3
Orthoptera: Anostostomatidae	*Libanasidus vittatus*	Parkhurst or Parktown prawn or king cricket	1

Order: Family	Scientific name	Common name	No. of individuals sampled
Orthoptera: Acrididae	*Acanthacris ruficornis*	Garden locust	1
Orthoptera: Pamphagidae		Locust or grasshopper	3
Orthoptera: Gryllidae	*Acanthogryllus fortipes*	Brown cricket	4
Dermaptera: Forficulidae	*Forficula senegalensis*	Common earwig	3
Isoptera: Termitidae		Termite	1
Hemiptera: Cydnidae		Burrowing bug	2
Hymenoptera: Formicide	*Messoe capensis*	Harvester ant	3
Hymenoptera: Formicide	*Anoplolepis custodiens*	Pugnacious ant	3
Hymenoptera: Mutillidae		Velvet ants	3
Ephemeroptera: Baetidae		Mayfly	3
Lepidoptera:		Moth or butterflies	5

Current study

Time and budget constraints limited the amount of invertebrate sampling. Opportunistic sightings were used to add onto the previous studies results. Only two invertebrates were seen. A Yellow Pansy (*Junonia hierta cebrene*, Figure 16) and a species of Trapdoor Spider (*Araneomorphae*, Figure 17) were seen.

Figure 17: **A Yellow pansy, *Junonia hierta* cebrene.**

Figure 18: A Trapdoor Spider (*Araneomorphae*) web.

6.10 Implications for Development

The majority of insect species are relatively mobile and will be able to move away from construction into adjacent areas and areas which will be conserved on the site. Habitat for these species will however be destroyed by the development. The insect species of concern which is most likely to be present is the Marsh Sylph (*Metisella meninx*) which depends on wetland habitat, more specifically on the larval plant *Leersia hexandra* (Rice grass). No Rice grass was noted on site however the presence of the species cannot be discounted.

The *status quo* remains.

7 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON BIODIVERSITY

Based on the lay-out plans provided to SiVEST by the STLM (Figure 19), the proposed development is anticipated to cover the entire study site. The proposed development will mainly entail the construction of residential properties (57.1%) with varying densities (Residential 1, 2, 3). The 'residential 1' properties make up the bulk of the building structures. Other structures that are to be developed include a municipal and institutional building as well as associated internal access roads and a public open space.

7.1 Potential Impacts During Construction

The potential impacts of the proposed development mainly related to loss of habitat for both Red Data species as well as general species which are utilising the site. In addition, the development would result in potential loss of species richness, edge effects, erosion and siltation of the wetland. It should be noted that although no Red Data species were recorded on site, the potential occurrence of these species cannot be ruled out. Given that the proposed development could cover the entire study site (Figure 19), potential impacts are expected to be high.

Figure 19: Proposed development layout plans

7.2 Potential Impacts During Operation

Impacts associated with the proposed development during operation relate to the fragmentation of habitat and the blockage of ecological linkage with surrounding natural areas.

7.3 Biodiversity Environmental Impact Assessment

7.3.1 Potential impacts during the construction phase

- Loss of habitat for flora and fauna

The clearing of land reduces available habitat for faunal and floral species. Fauna is reliant on flora, as vegetation provides food and refuge for faunal species. This results in a local scale loss in ecosystem functionality and biodiversity and potentially reduces available habitat for red data species. Mitigation measures and the implementation of ecological corridors can reduce inevitable environmental damage to a state where long term losses are negated.

Table 11: Loss of habitat for biodiversity in the construction phase.

IMPACT TABLE FORMAT		
Environmental Parameter	Biodiversity	
Issue/Impact/Environmental Effect/Nature	Loss of habitat for Fauna and Flora of common and protected or red data species.	
Extent	The impact will only affect this site	
Probability	Impact will certainly occur (greater than a 75% chance of occurrence)	
Reversibility	The impact is partly reversible but more intense mitigation measures are required	
Irreplaceable loss of resources	The impact will result in significant loss of resources	
Duration	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).	
Cumulative effect	The impact would result in minor cumulative effects	
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).	
Significance Rating	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	1
Reversibility	2	1
Irreplaceable loss	3	1
Duration	2	1

Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	**-30 (medium negative)**	**-6 (low negative)**
Mitigation measures	▪ Ecological corridors need to be included in the design phase and corridors need to be clearly demarcated. ▪ Footprint of the activity needs to be strictly adhered to. ▪ A site specific Environmental Management Programme needs to be developed for the construction and operation phases. ▪ An Environmental Control Officer (ECO) needs to be appointed for the duration of construction. ▪ A search and rescue operation needs to be conducted by a suitably qualified botanist and ecologist to collect/capture immobile species and species of special concern. ▪ Permits for plants and animal collection/removal need to be obtained prior to search and rescue operations. ▪ Strictly no hunting, trapping or removing of any faunal or floral species without the valid permits in place. ▪ Vegetation is to be remove in a phased approach, as and when it becomes necessary. ▪ Sensitive areas need to be demarcated clearly before construction commences.	

- Transformation of habitat for fauna and flora

Hard transformation of proposed development will result in a reduction in flora and fauna for the area. With hard transformation comes the disturbance of the soil surface, and this often leads to the establishment of alien invasive plant species. Additionally, transformation of the habitat may lead to an increased erosion potential through both wind and water erosion. Mitigation measures may decrease the severity of the impact, if the mitigation measures are adhered to.

Table 12: Transformation of habitat for biodiversity in the construction phase

IMPACT TABLE FORMAT	
Environmental Parameter	Biodiversity
Issue/Impact/Environmental Effect/Nature	Transformation
Extent	The impact will only affect this site
Probability	Impact will certainly occur (greater than a 75% chance of occurrence)
Reversibility	The impact is partly reversible but more intense mitigation measures are required

Irreplaceable loss of resources	The impact will result in marginal loss of resources	
Duration	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).	
Cumulative effect	The impact would result in minor cumulative effects	
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).	
Significance Rating	The anticipated impact will have negligible negative effects and will require little to no mitigation.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	1
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	**-28 (medium negative)**	**-6 (low negative)**
Mitigation measures	▪ Where possible, indigenous vegetation needs to be retained. ▪ The contractor should implimen an alien invasive control programme, particulary in areas where soil disturbance occurs. ▪ Soil stockpiles need to be grassed with an indigenous mix or covered with shadecloth to prevent soil loss through wind and water erosion. ▪ Rehabilitation should take place as soon as construction is complete. ▪ A mix of indigenous grass species, in line with the Rand Highveld Grassland veld type, should be used for rehabilitation.	

- Erosion related impacts for the construction phase

Vegetation binds and protects the soil surface, and when removed, increases erosion potential. This may lead to water and wind removing vital topsoil and blocking up drains and eventually clogging wetlands. This will effect wetland functionality, and the ability for the construction site to rehabilitate naturally. If the mitigation measures are implemented correctly, overall impacts may be largely negated.

Table 13: Erosion related impacts in the construction phase

IMPACT TABLE FORMAT		
Environmental Parameter	Biodiversity	
Issue/Impact/Environmental Effect/Nature	Erosion	
Extent	The impact will only affect this site	
Probability	Impact will certainly occur (greater than a 75% chance of occurrence)	
Reversibility	The impact is partly reversible but more intense mitigation measures are required	
Irreplaceable loss of resources	The impact will result in marginal loss of resources	
Duration	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).	
Cumulative effect	The impact would result in minor cumulative effects	
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).	
Significance Rating	The anticipated impact will have negligible negative effects and will require little to no mitigation.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	2
Reversibility	2	1
Irreplaceable loss	2	1
Duration	2	1
Cumulative effect	3	1
Intensity/magnitude	2	1
Significance rating	**-28 (medium negative)**	**-6 (low negative)**
Mitigation measures	▪ An approved Stormwater Management Plan should be implemented before construction occurs. ▪ Where possible, indigenous vegetation needs to be retained. ▪ Soil stockpiles need to be grassed with an indigenous mix or covered with shadecloth to prevent soil loss through wind and water erosion.	

	▪ Rehabilitation should take place as soon as construction is complete. ▪ In areas of higher gradient, access roads should have erosion berms to prevent soil loss. ▪ Construction activities should be limited to the winter months to prevent loss of soil to water runoff. ▪ Spraying of the soil surface should occur when working in dusty conditions. ▪ If possible a single access road should be used.

7.3.2 Potential Impacts during operation phase

- Habitat fragmentation - edge effects

The loss of habitat and lack of habitat continuity may lead to habitat fragmentation. Faunal species reliant on larger areas and territories will have less space, which may increase species competition and reduce species numbers. This will result in an edge effect, where a lack of suitable habitat forces fauna into human areas. Ecological corridors, through Ecological Support Areas aim to reduce edge effects.

Table 14: Loss of habitat for biodiversity in the construction phase.

IMPACT TABLE FORMAT	
Environmental Parameter	Biodiversity
Issue/Impact/Environmental Effect/Nature	Habitat fragmentation
Extent	The impact will affect the local area or district
Probability	Impact will certainly occur (greater than a 75% chance of occurrence)
Reversibility	The impact is partly reversible but more intense mitigation measures are required
Irreplaceable loss of resources	The impact will result in significant loss of resources
Duration	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
Cumulative effect	The impact would result in minor cumulative effects
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately

	modified way and maintains general integrity (some impact on integrity).	
Significance Rating	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	2
Reversibility	2	1
Irreplaceable loss	3	2
Duration	2	2
Cumulative effect	3	2
Intensity/magnitude	2	2
Significance rating	**-32 (medium negative)**	**-22 (low negative)**
Mitigation measures	▪ Ecological corridors need to be monitored and maintained for establishment of alien invasive plants and erosion. ▪ A post construction monitoring programme to ensure that rehabilitation efforts are successful and that edge effects are reduced. ▪ Monthly monitoring of these sensitive areas should take place during the first year after construction to ensure that rehabilitation is successful. ▪ Six monthly checks of the area should take place for the emergence of invader species.	

- Erosion related impacts for operation phase

Erosion potential is increased in areas where vegetation has been removed. Hard transformation may increase water velocity in steeper areas and will result in a loss of topsoil and the blocking up of drains and wetlands. Wetland functionality will decrease, vegetation rehabilitation will be compromised and the loss of topsoil will delay rehabilitation efforts

Table 15: Erosion related impacts in the operation phase

IMPACT TABLE FORMAT	
Environmental Parameter	Biodiversity
Issue/Impact/Environmental Effect/Nature	Erosion
Extent	The impact will affect the local area or district

Probability	The impact will likely occur (between a 50% to a 75% chance of occurrence)
Reversibility	The impact is partly reversible but more intense mitigation measures are required
Irreplaceable loss of resources	The impact will result in marginal loss of resources
Duration	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
Cumulative effect	The impact would result in minor cumulative effects
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
Significance Rating	The anticipated impact will have negligible negative effects and will require little to no mitigation.

	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	2	1
Cumulative effect	3	2
Intensity/magnitude	2	2
Significance rating	**-28 (medium negative)**	**-20 (low negative)**
Mitigation measures	▪ An approved Stormwater Management Plan should be implemented before construction occurs. ▪ Where possible, indigenous vegetation needs to be retained. ▪ Soil stockpiles need to be grassed with an indigenous mix or covered with shadecloth to prevent soil loss through wind and water erosion. ▪ Rehabilitation should take place as soon as construction is complete. ▪ In areas of higher gradient, access roads should have erosion berms to prevent soil loss. ▪ Construction activities should be limited to the winter months to prevent loss of soil to water runoff. ▪ Spraying of the soil surface should occur when working in dusty conditions.	

	▪ If possible a single access road should be used. ▪ Six monthly checks of the area should take place for the emergence of invader species.

- Biodiversity loss due to operation phase

Biodiversity – especially many of the faunal species, are unlikely to return to the proposed site due to human disturbance, loss of habitat and possible hunting. Floral diversity may return if rehabilitation is implemented correctly.

Table 16: Loss of habitat for biodiversity in the construction phase.

IMPACT TABLE FORMAT		
Environmental Parameter	Biodiversity	
Issue/Impact/Environmental Effect/Nature	Loss of biodiversity	
Extent	The impact will affect the local area or district	
Probability	Impact will certainly occur (greater than a 75% chance of occurrence)	
Reversibility	The impact is partly reversible but more intense mitigation measures are required	
Irreplaceable loss of resources	The impact will result in significant loss of resources	
Duration	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).	
Cumulative effect	The impact would result in minor cumulative effects	
Intensity/magnitude	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).	
Significance Rating	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	2
Reversibility	2	1
Irreplaceable loss	3	2
Duration	3	2
Cumulative effect	3	2
Intensity/magnitude	2	2

Significance rating	**-34 (medium negative)**	**-22 (low negative)**
Mitigation measures	▪ Ecological corridors need to be maintained for the movement of fauna and protection of naitive flora from alien invasive species. ▪ A post construction monitoring programme to ensure that rehabilitation efforts are successful and that edge effects are reduced. ▪ Monthly monitoring of these sensitive areas should take place during the first year after construction to ensure that rehabilitation is successful. ▪ Six monthly checks of the area should take place for the emergence of invader species.	

8 SENSITIVITY MAPPING

Sensitive features relate to the various wetlands present on site which are possible habitats for various small mammals, amphibians and birds. These wetlands have been assigned a high level of sensitivity (Figure 20) due to the important habitat provision and because they are protected under the National Water Act, 1998 (Act No. 36 of 1998). In addition the vegetation which is present across the study site is considered to be of medium sensitivity (Figure 20) as it also contributes to the habitat provision on the site. The vegetation has been impacted by cattle grazing and by the construction of the substation however it is still considered to be in a good condition and important in providing linkage with other grassland areas to the south of the site. Currently conditions on site are very similar to that of the previous study (although burnt due to sampling seasons), and therefore sensitivity recommendations made in the previous study still stand.

The current layout as proposed is likely to result in significant transformation across the site with the loss of large tracts of vegetation and encroachment into the wetland. A revision of the layout is thus required in order to incorporate ecological linkage into the development and conserve the sensitive features present. This would involve the implementation of a 300m ecological corridor across the site linking the depression wetlands with the valley bottom wetlands. This would include the buffers proposed in the wetland specialist report. The mall construction has already resulted in the impact on the surface water features and the construction of the layout as presently proposed would be detrimental to the current ecological functioning of the site. Additional green areas other than those proposed in this report would be an added advantage to maintaining a level of ecological functioning. The *status quo* remains.

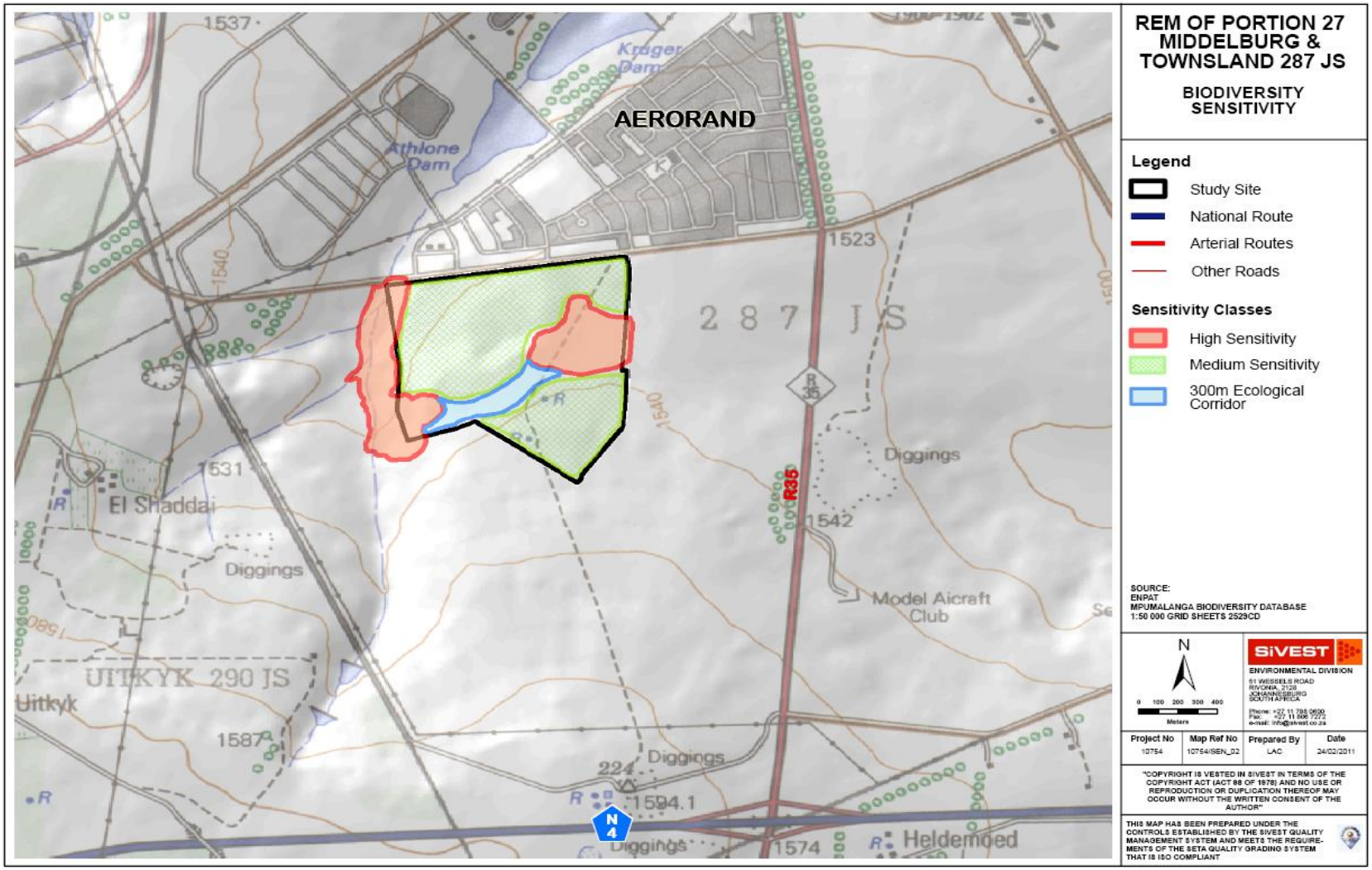

Figure 20: Biodiversity Sensitivity Map.

9 MITIGATION MEASURES

In addition to the corridors and buffers proposed above. The following mitigation measures are proposed during construction and operation.

9.1.1 Construction phase

- Construction site specific mitigation measures

The following mitigation measures are recommended for the sensitive areas which have been identified in the study area:

- An Environmental Management Programme compiled for construction and operation phases.
- An on-site ecologist should be present when excavation takes place to ensure that any uncovered species are protected from destruction (It is important to remember that even though these species have not been encountered, they could be in a dormant stage and suddenly arise during construction due to more favourable conditions.)
- Demarcation of sensitive areas prior to construction activities starting as per the sensitivity map.
- Use of appropriate construction methods in the sensitive area.
- Intensive environmental audits (frequently in sensitive areas) by an independent party during this construction period.
- A copy of the Environmental Management Programme as well as the specialist studies must be present at the construction site for easy reference to specialist recommendations in sensitive areas.
- It is recommended that the construction crew be educated about the sensitivities involved in these areas as well as the potential species they could encounter. A poster of sensitive species (compiled by a qualified specialist) should be kept on the construction site for easy reference.
- Where possible, construction should take place during winter i.e. the dormant stage to minimise impacts on vegetation during the growing season.

- Only vegetation within the footprint must be removed.
- Vegetation removal must be phased in order to reduce impact of construction.
- Permits for the removal of vegetation and fauna must be obtained prior to construction.
- Construction site office and laydown areas must be clearly demarcated and no encroachment must occur beyond demarcated areas.
- All natural areas impacted during construction must be rehabilitated with locally indigenous grasses.
- Construction areas must be well demarcated and these areas strictly adhered to.
- Rehabilitation must take place as soon as construction is complete to avoid the edge effect, the infiltration of alien species and soil erosion around the study area.
- Rehabilitation process must make use of species indigenous to the area. Seeds from surrounding seed banks can be used for re-seeding.
- The use of pesticides and herbicides in the study area must be discouraged as these impacts on important pollinator species of indigenous vegetation.
- Soils must be kept free of petrochemical solutions that may be kept on site during construction. Spillage can result in a loss of soil functionality thus limiting the re-establishment of flora.

9.1.2 Operation phase

- Operation Site Specific Mitigation Measures

The following mitigation measures are recommended for the sensitive areas which have been identified in the study area

- Monthly monitoring of these sensitive areas should take place during the first year after construction to ensure that rehabilitation is successful.
- These monitoring exercises must ensure that no erosion is taking place as a result of the development.
- Six monthly checks of the area should take place for the emergence of invader species.

- Mitigation measures mentioned for the construction phase above must be implemented for any maintenance of the development that may be undertaken during the operation phase.
- Correct rehabilitation with grasses which are locally indigenous.
- Monitoring programme to ensure that rehabilitation efforts are successful to ensure that risks such as erosion and the edge effect are avoided.
- Constant maintenance of the area to ensure re-colonisation of floral species.
- Regular removal of alien species which may jeopardise the proliferation of indigenous species.
- More recent information should be consulted to ensure that no Red Data species have colonised the areas which were previously rehabilitated.

- Achievability of Mitigation Measures

Mitigation measures included within this report are feasible and will be easy to achieve. Several of the mitigation measures included here are generic in nature and have been implemented successfully on numerous different construction sites. The unique mitigation measures stated in this report are also achievable and it is essential that these are taken into account when the proposed development is constructed.

- Management and Monitoring

It is recommended that a formal monitoring and reporting strategy/protocol be developed for monitoring the impact on the vegetation in the area during construction. This will ensure that the mitigation measures stipulated for the construction are well enforced and the identified impacts minimised as much as possible.

Specific areas of concern that require strict monitoring include:

- Containment of construction to the demarcated area
- Erosion control
- Emergence of alien species
- Rehabilitation of the site
- Containment of construction near in sensitive areas
- Protection of wetlands and ecological linkage

If Red Data species are located in the identified sensitive areas, the relevant permits from must be applied for from the relevant authorities. No listed plants may be removed without these permits. It will be the responsibility of the ECO to ensure that these permits are in place where necessary.

The precautionary principle should be applied during the construction of the township and care taken to implement the recommended mitigation measures. This is especially relevant in identified sensitive areas.

- Rehabilitation

Once the proposed development has been constructed, rehabilitation needs to take place. This needs to take place timeously to ensure that alien plant emergence and erosion do not occur.

The first stage of rehabilitation will be the reinstatement of top soil. The top soil must be exposed for the shortest possible time so that it is not lost through wind and run off erosion. The top soil layer is likely to carry a natural seed bank of the local species which will aid in re- establishing the vegetation layer. It is also likely to contain weed and alien species seed bank. For this reason, regular maintenance of the site will be required until the indigenous species have established themselves and risk of alien infestation and erosion is decreased.

In addition to the seed bank present within the top soil, it is recommended that the site be hydro-seeded with locally indigenous plant species.

10 CONCLUSIONS AND RECOMMENDATIONS

Due to the anthropogenic activities in the study area, the majority of sensitive species that may be present are of the smaller species and more inconspicuous faunal groupings. It is imperative that the mitigation measures recommended in this report are implemented in order to ensure protection of wetlands and retain a level of ecological linkage across the site with surrounding areas. This report acknowledges that the STLM has a mandate to develop housing and infrastructure however it is important to ensure that this does not take place to the detriment of the environment. The *status quo* remains.

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Appendix A

List of red data floral species in the study area

Species Name	Status
Acacia caffra (Thunb.) Willd.	LC
Acacia sieberiana DC. var. woodii (Burtt Davy) Keay & Brenan	LC
Acalypha angustata Sond.	LC
Acarospora intrusa H.Magn.	
Acarospora laevigata H.Magn.	
Acarospora tenuis H.Magn.	
Acrotome hispida Benth.	LC
Adenia digitata (Harv.) Engl.	LC
Aeschynomene rehmannii Schinz var. leptobotrya (Harms ex Baker f.) J.B.Gillett	LC
Afrosciadium magalismontanum (Sond.) P.J.D.Winter	
Agrostis eriantha Hack. var. eriantha	LC
Alchemilla woodii Kuntze	LC
Alectra vogelii Benth.	LC
Alepidea peduncularis A.Rich.	DDT
Alloteropsis semialata (R.Br.) Hitchc. subsp. eckloniana (Nees) Gibbs Russ.	LC
Aloe aculeata Pole-Evans	LC
Aloe verecunda Pole-Evans	LC
Aloe zebrina Baker	LC
Alternanthera pungens Kunth	
Andropogon huillensis Rendle	LC
Archidium ohioense Schimp. ex Müll.Hal.	
Argyrolobium pauciflorum Eckl. & Zeyh.	LC
Argyrolobium tuberosum Eckl. & Zeyh.	LC
Aristida aequiglumis Hack.	LC
Aristida congesta Roem. & Schult. subsp. congesta	LC
Aristida junciformis Trin. & Rupr. subsp. junciformis	LC
Asclepias albens (E.Mey.) Schltr.	LC
Asclepias brevipes (Schltr.) Schltr.	LC
Asclepias eminens (Harv.) Schltr.	LC
Asclepias fallax (Schltr.) Schltr.	LC
Asclepias gibba (E.Mey.) Schltr. var. gibba	LC
Ascolepis capensis (Kunth) Ridl.	LC
Asparagus flavicaulis (Oberm.) Fellingham & N.L.Mey. subsp. flavicaulis	LC
Asparagus virgatus Baker	LC
Aspilia mossambicensis (Oliv.) Wild	LC

Species Name	Status
Asplenium aethiopicum (Burm.f.) Bech.	LC
Aster harveyanus Kuntze	LC
Aster peglerae Bolus	LC
Asterella wilmsii (Steph.) S.W.Arnell	
Babiana bainesii Baker	LC
Berkheya speciosa (DC.) O.Hoffm. subsp. lanceolata Roessler	LC
Bewsia biflora (Hack.) Gooss.	LC
Blechnum australe L. subsp. australe	LC
Blepharis innocua C.B.Clarke	LC
Blumea dregeanoides Sch.Bip. ex A.Rich.	LC
Bonatea antennifera Rolfe	
Boscia foetida Schinz subsp. rehmanniana (Pestal.) Toelken	LC
Brachiaria serrata (Thunb.) Stapf	LC
Brachycorythis ovata Lindl. subsp. ovata	LC
Brachycorythis tenuior Rchb.f.	LC
Brachylaena rotundata S.Moore	LC
Brachystelma circinatum E.Mey.	LC
Brachystelma nanum (Schltr.) N.E.Br.	LC
Brachystelma rubellum (E.Mey.) Peckover	LC
Bryum argenteum Hedw.	
Bryum pycnophyllum (Dixon) Mohamed	
Buchnera ciliolata Engl.	LC
Buchnera longespicata Schinz	LC
Buchnera simplex (Thunb.) Druce	LC
Buellia olivacea Müll.Arg.	
Buellia xantholepsis (Stizenb.) Müll.Arg.	
Bulbostylis humilis (Kunth) C.B.Clarke	LC
Cadaba aphylla (Thunb.) Wild	LC
Callilepis leptophylla Harv.	Declining
Campylopus robillardei Besch.	
Carbonea latypizodes (Nyl.) Knoph & Rambold	
Centella asiatica (L.) Urb.	LC
Chaetacanthus costatus Nees	LC
Chascanum hederaceum (Sond.) Moldenke var. hederaceum	LC
Chascanum incisum (H.Pearson) Moldenke	LC
Cheilanthes hirta Sw. var. hirta	LC
Cheilanthes multifida (Sw.) Sw. subsp. lacerata N.C.Anthony & Schelpe	
Chenopodium schraderianum Roem. & Schult.	
Chironia purpurascens (E.Mey.) Benth. & Hook.f. subsp. humilis (Gilg) I.Verd.	LC
Chlorophytum fasciculatum (Baker) Kativu	LC
Chortolirion angolense (Baker) A.Berger	LC
Chrysocoma ciliata L.	LC
Citrullus lanatus (Thunb.) Matsum. & Nakai	LC
Clematis brachiata Thunb.	LC
Cleome maculata (Sond.) Szyszyl.	LC
Combretum apiculatum Sond. subsp. apiculatum	LC
Combretum moggii Exell	LC
Commelina africana L. var. lancispatha C.B.Clarke	LC
Commelina livingstonii C.B.Clarke	LC
Conium chaerophylloides (Thunb.) Sond.	LC

Species Name	Status
Convolvulus thunbergii Roem. & Schult.	LC
Conyza canadensis (L.) Cronquist	
Conyza podocephala DC.	LC
Corchorus asplenifolius Burch.	LC
Corchorus trilocularis L.	
Cordylogyne globosa E.Mey.	LC
Cotula anthemoides L.	LC
Cotyledon orbiculata L. var. oblonga (Haw.) DC.	LC
Crassula lanceolata (Eckl. & Zeyh.) Endl. ex Walp. subsp. transvaalensis (Kuntze) Toelken	LC
Crinum bulbispermum (Burm.f.) Milne-Redh. & Schweick.	Declining
Crinum graminicola I.Verd.	LC
Crinum macowanii Baker	Declining
Cryptolepis cryptolepidioides (Schltr.) Bullock	LC
Ctenium concinnum Nees	LC
Cucumis zeyheri Sond.	LC
Cyanotis lapidosa E.Phillips	LC
Cyclospermum leptophyllum (Pers.) Sprague ex Britton & P.Wilson	
Cycnium tubulosum (L.f.) Engl. subsp. tubulosum	LC
Cynodon dactylon (L.) Pers.	LC
Cynoglossum lanceolatum Forssk.	LC
Cyperus congestus Vahl	LC
Cyperus denudatus L.f. var. denudatus	LC
Cyperus longus L. var. longus	LC
Cyperus margaritaceus Vahl var. margaritaceus	LC
Cyperus marginatus Thunb.	LC
Cyperus obtusiflorus Vahl var. flavissimus (Schrad.) Boeck.	LC
Cyperus obtusiflorus Vahl var. obtusiflorus	LC
Cyperus rupestris Kunth var. rupestris	LC
Cyperus semitrifidus Schrad.	LC
Cyperus sphaerospermus Schrad.	LC
Cyperus tenax Boeck.	LC
Cyphostemma simulans (C.A.Sm.) Wild & R.B.Drumm.	LC
Denekia capensis Thunb.	LC
Dianthus mooiensis F.N.Williams subsp. mooiensis var. mooiensis	
Dicliptera minor C.B.Clarke subsp. minor	LC
Diclis rotundifolia (Hiern) Hilliard & B.L.Burtt	LC
Dicoma anomala Sond. subsp. gerrardii (Harv. ex F.C.Wilson) S.Ortíz & Rodr.Oubiña	LC
Dierama mossii (N.E.Br.) Hilliard	LC
Digitaria eriantha Steud.	LC
Digitaria ternata (A.Rich.) Stapf	LC
Digitaria tricholaenoides Stapf	LC
Diospyros lycioides Desf. subsp. lycioides	LC
Dipcadi marlothii Engl.	LC
Diploschistes caesioplumbeus (Nyl.) Vain.	
Disa baurii Bolus	LC
Disa saxicola Schltr.	LC
Dolichos falciformis E.Mey.	LC
Dolichos trilobus L. subsp. transvaalicus Verdc.	LC
Duvalia polita N.E.Br.	LC

Species Name	Status
Ebracteola wilmaniae (L.Bolus) Glen	LC
Eleocharis atropurpurea (Retz.) C.Presl	LC
Eleocharis dregeana Steud.	LC
Elephantorrhiza elephantina (Burch.) Skeels	LC
Elephantorrhiza obliqua Burtt Davy var. glabra E.Phillips	LC
Elionurus muticus (Spreng.) Kunth	LC
Encephalartos lanatus Stapf & Burtt Davy	VU
Encephalartos middelburgensis Vorster, Robbertse & S.van der Westh.	CR
Epilobium salignum Hausskn.	LC
Epilobium tetragonum L. subsp. tetragonum	LC
Eragrostis capensis (Thunb.) Trin.	LC
Eragrostis curvula (Schrad.) Nees	LC
Eragrostis gummiflua Nees	LC
Eragrostis plana Nees	LC
Eragrostis procumbens Nees	LC
Eragrostis racemosa (Thunb.) Steud.	LC
Eragrostis sclerantha Nees subsp. sclerantha	LC
Erica drakensbergensis Guthrie & Bolus	LC
Eriosema burkei Benth. ex Harv. var. burkei	LC
Eriosema cordatum E.Mey.	LC
Eriosema gunniae C.H.Stirt.	LC
Eriosema kraussianum Meisn.	LC
Eriosema salignum E.Mey.	LC
Eriosema squarrosum (Thunb.) Walp.	LC
Eriospermum cooperi Baker var. cooperi	LC
Eriospermum flagelliforme (Baker) J.C.Manning	LC
Eriospermum mackenii (Hook.f.) Baker subsp. galpinii (Schinz) P.L.Perry	
Erythrina zeyheri Harv.	LC
Eucomis autumnalis (Mill.) Chitt. subsp. clavata (Baker) Reyneke	
Euphorbia gueinzii Boiss. var. albovillosa (Pax) N.E.Br.	LC
Exormotheca holstii Steph.	
Exormotheca pustulosa Mitt.	
Faurea saligna Harv.	LC
Felicia muricata (Thunb.) Nees subsp. muricata	LC
Ficus abutilifolia (Miq.) Miq.	LC
Ficus glumosa Delile	LC
Ficus salicifolia Vahl	LC
Foeniculum vulgare Mill. var. vulgare	
Fossombronia pusilla (L.) Dumort.	
Fuirena coerulescens Steud.	LC
Galium capense Thunb. subsp. capense	LC
Gamochaeta coarctata (Willd.) Kerguélen	
Gazania krebsiana Less. subsp. serrulata (DC.) Roessler	LC
Gerbera ambigua (Cass.) Sch.Bip.	LC
Gerbera jamesonii Bolus ex Adlam	LC
Gerbera natalensis Sch.Bip.	LC
Gerbera piloselloides (L.) Cass.	LC
Gladiolus crassifolius Baker	LC
Gladiolus elliotii Baker	LC
Gladiolus longicollis Baker subsp. platypetalus (Baker) Goldblatt & J.C.Manning	LC

Species Name	Status
Gladiolus permeabilis D.Delaroche subsp. edulis (Burch. ex Ker Gawl.) Oberm.	LC
Gladiolus vinosomaculatus Kies	LC
Gnaphalium filagopsis Hilliard & B.L.Burtt	LC
Gnidia capitata L.f.	LC
Gnidia gymnostachya (C.A.Mey.) Gilg	LC
Gnidia kraussiana Meisn. var. kraussiana	LC
Gnidia microcephala Meisn.	LC
Gnidia sericocephala (Meisn.) Gilg ex Engl.	LC
Gomphocarpus rivularis Schltr.	LC
Gomphocarpus tomentosus Burch. subsp. tomentosus	LC
Graderia subintegra Mast.	LC
Grewia flava DC.	LC
Grewia monticola Sond.	LC
Grewia vernicosa Schinz	LC
Greyia radlkoferi Szyszyl.	LC
Habenaria epipactidea Rchb.f.	LC
Habenaria falcicornis (Burch. ex Lindl.) Bolus subsp. caffra (Schltr.) J.C.Manning	LC
Habenaria filicornis Lindl.	LC
Habenaria galpinii Bolus	LC
Habenaria tridens Lindl.	LC
Haplocarpha scaposa Harv.	LC
Helichrysum acutatum DC.	LC
Helichrysum argyrolepis MacOwan	LC
Helichrysum aureonitens Sch.Bip.	LC
Helichrysum caespititium (DC.) Harv.	LC
Helichrysum chionosphaerum DC.	LC
Helichrysum difficile Hilliard	LC
Helichrysum lepidissimum S.Moore	LC
Helichrysum mixtum (Kuntze) Moeser var. mixtum	LC
Helichrysum nudifolium (L.) Less. var. nudifolium	LC
Helichrysum rugulosum Less.	LC
Helichrysum setosum Harv.	LC
Helichrysum subluteum Burtt Davy	LC
Helinus integrifolius (Lam.) Kuntze	LC
Heliophila rigidiuscula Sond.	LC
Hermannia parvula Burtt Davy	LC
Hermannia tomentosa (Turcz.) Schinz ex Engl.	LC
Hermannia transvaalensis Schinz	LC
Hesperantha coccinea (Backh. & Harv.) Goldblatt & J.C.Manning	LC
Hibiscus aethiopicus L. var. ovatus Harv.	LC
Hibiscus pusillus Thunb.	LC
Hilliardiella hirsuta (DC.) H.Rob.	
Huernia kirkii N.E.Br.	LC
Huernia loeseneriana Schltr.	LC
Huernia stapelioides Schltr.	LC
Hyparrhenia dregeana (Nees) Stapf ex Stent	LC
Hyparrhenia hirta (L.) Stapf	LC
Hyparrhenia newtonii (Hack.) Stapf var. newtonii	LC
Hypericum lalandii Choisy	LC

Species Name	Status
Hypochaeris radicata L.	
Hypoxis acuminata Baker	LC
Hypoxis filiformis Baker	LC
Hypoxis hemerocallidea Fisch., C.A.Mey. & Avé-Lall.	Declining
Hypoxis iridifolia Baker	LC
Hypoxis neliana Schinz	LC
Ilex mitis (L.) Radlk. var. mitis	Declining
Imperata cylindrica (L.) Raeusch.	LC
Indigastrum burkeanum (Benth. ex Harv.) Schrire	LC
Indigofera atrata N.E.Br.	LC
Indigofera confusa Prain & Baker f.	LC
Indigofera daleoides Benth. ex Harv. var. daleoides	LC
Indigofera egens N.E.Br.	LC
Indigofera frondosa N.E.Br.	LC
Indigofera hedyantha Eckl. & Zeyh.	LC
Indigofera hilaris Eckl. & Zeyh. var. hilaris	LC
Indigofera melanadenia Benth. ex Harv.	LC
Indigofera obscura N.E.Br.	LC
Indigofera oxalidea Welw. ex Baker	LC
Indigofera oxytropis Benth. ex Harv.	LC
Indigofera sordida Benth. ex Harv.	LC
Ipomoea bathycolpos Hallier f.	LC
Ischaemum fasciculatum Brongn.	LC
Jamesbrittenia aurantiaca (Burch.) Hilliard	LC
Jasminum multipartitum Hochst.	LC
Jasminum stenolobum Rolfe	LC
Jatropha hirsuta Hochst. var. oblongifolia Prain	LC
Jatropha zeyheri Sond.	LC
Juncus effusus L.	LC
Juncus oxycarpus E.Mey. ex Kunth	LC
Justicia anagalloides (Nees) T.Anderson	LC
Karoowia adligans (Brusse) Hale	
Kniphofia ensifolia Baker subsp. ensifolia	LC
Kniphofia porphyrantha Baker	LC
Kyllinga alata Nees	LC
Kyllinga alba Nees	LC
Kyllinga erecta Schumach. var. erecta	LC
Lactuca inermis Forssk.	LC
Lagarosiphon major (Ridl.) Moss ex Wager	LC
Lagarosiphon muscoides Harv.	LC
Lapeirousia sandersonii Baker	LC
Lecanora oreinoides (Körb.) Hertel & Rambold	
Lecidea angolensis Müll.Arg.	
Lecidella viridans (Flot.) Körb.	
Ledebouria cooperi (Hook.f.) Jessop	LC
Ledebouria floribunda (Baker) Jessop	LC
Ledebouria luteola Jessop	LC
Ledebouria revoluta (L.f.) Jessop	LC
Lepidium bonariense L.	
Lepidium transvaalense Marais	LC
Lindernia parviflora (Roxb.) Haines	LC

Species Name	Status
Linum thunbergii Eckl. & Zeyh.	LC
Lipocarpha rehmannii (Ridl.) Goetgh.	LC
Lippia wilmsii H.Pearson	LC
Lobelia erinus L.	LC
Lophacme digitata Stapf	LC
Lophiocarpus tenuissimus Hook.f.	LC
Lopholaena segmentata (Oliv.) S.Moore	LC
Lotononis calycina (E.Mey.) Benth.	LC
Lotononis eriantha Benth.	LC
Lotononis foliosa Bolus	LC
Lotononis listii Polhill	LC
Lotononis solitudinis Dummer	LC
Lotus discolor E.Mey. subsp. discolor	LC
Loudetia simplex (Nees) C.E.Hubb.	LC
Ludwigia palustris (L.) Elliott	
Lycopodiella sarcocaulon (A.Braun & Welw. ex Kuhn) Pic.Serm.	LC
Macledium zeyheri (Sond.) S.Ortíz subsp. zeyheri	LC
Manulea rhodantha Hilliard subsp. aurantiaca Hilliard	LC
Mariscus uitenhagensis Steud.	LC
Maytenus undata (Thunb.) Blakelock	LC
Melinis repens (Willd.) Zizka subsp. repens	LC
Menodora africana Hook.	LC
Merremia verecunda Rendle	LC
Micarea endoviolascens Coppins	
Microchloa caffra Nees	LC
Mimulus gracilis R.Br.	LC
Mimusops zeyheri Sond.	LC
Monadenium lugardiae N.E.Br.	LC
Monocymbium ceresiiforme (Nees) Stapf	LC
Monopsis decipiens (Sond.) Thulin	LC
Monsonia angustifolia E.Mey. ex A.Rich.	LC
Moraea spathulata (L.f.) Klatt	LC
Myrothamnus flabellifolius Welw.	DDT
Nemesia fruticans (Thunb.) Benth.	LC
Neofuscelia verisidiosa (Essl.) Essl.	
Nerine rehmannii (Baker) L.Bolus	LC
Nesaea sagittifolia (Sond.) Koehne var. sagittifolia	LC
Nidorella anomala Steetz	LC
Nidorella hottentotica DC.	LC
Nolletia rarifolia (Turcz.) Steetz	LC
Nuxia congesta R.Br. ex Fresen.	LC
Ochna inermis (Forssk.) Schweinf.	LC
Ochna pulchra Hook.f.	LC
Ocimum obovatum E.Mey. ex Benth. subsp. obovatum var. obovatum	LC
Oenothera rosea L'Hér. ex Aiton	
Oldenlandia herbacea (L.) Roxb. var. herbacea	LC
Ornithogalum flexuosum (Thunb.) U.& D.Müll.-Doblies	LC
Ornithogalum tenuifolium F.Delaroche subsp. tenuifolium	LC
Oxalis obliquifolia Steud. ex A.Rich.	LC
Pachycarpus asperifolius Meisn.	LC
Pachycarpus suaveolens (Schltr.) Nicholas & Goyder	VU

Species Name	Status
Panicum natalense Hochst.	LC
Papaver aculeatum Thunb.	LC
Parapodium costatum E.Mey.	LC
Pavetta zeyheri Sond. subsp. middelburgensis (Bremek.) P.P.J.Herman	VU
Pavetta zeyheri Sond. subsp. zeyheri	LC
Pearsonia aristata (Schinz) Dummer	LC
Pearsonia cajanifolia (Harv.) Polhill subsp. cajanifolia	LC
Pearsonia grandifolia (Bolus) Polhill subsp. latibracteolata (Dummer) Polhill	LC
Pearsonia sessilifolia (Harv.) Dummer subsp. sessilifolia	LC
Pelargonium luridum (Andrews) Sweet	LC
Pellaea calomelanos (Sw.) Link var. calomelanos	LC
Pentanisia angustifolia (Hochst.) Hochst.	LC
Perotis patens Gand.	LC
Persicaria attenuata (R.Br.) Soják subsp. africana K.L.Wilson	LC
Persicaria lapathifolia (L.) Gray	
Physalis viscosa L.	
Pogonarthria squarrosa (Roem. & Schult.) Pilg.	LC
Pollichia campestris Aiton	LC
Polygala africana Chodat	LC
Polygala gracilenta Burtt Davy	LC
Polygala hottentotta C.Presl	LC
Polygala houtboshiana Chodat	LC
Polygala spicata Chodat	LC
Polygala virgata Thunb. var. decora (Sond.) Harv.	LC
Polygala virgata Thunb. var. virgata	LC
Potamogeton nodosus Poir.	
Pouzolzia mixta Solms var. mixta	LC
Protea roupelliae Meisn. subsp. roupelliae	LC
Protea welwitschii Engl.	LC
Psammotropha myriantha Sond.	LC
Psoralea pinnata L. var. pinnata	LC
Psydrax livida (Hiern) Bridson	LC
Pycnostachys reticulata (E.Mey.) Benth.	LC
Pycreus macranthus (Boeck.) C.B.Clarke	LC
Pycreus nitidus (Lam.) J.Raynal	LC
Pygmaeothamnus chamaedendrum (Kuntze) Robyns var. chamaedendrum	LC
Pygmaeothamnus zeyheri (Sond.) Robyns var. zeyheri	LC
Ranunculus multifidus Forssk.	
Raphionacme galpinii Schltr.	LC
Rhynchosia crassifolia Benth. ex Harv.	LC
Rhynchosia monophylla Schltr.	LC
Rhynchosia nervosa Benth. ex Harv. var. nervosa	LC
Riccia volkii S.W.Arnell	
Richardia scabra L.	
Rotala filiformis (Bellardi) Hiern	LC
Rotheca hirsuta (Hochst.) R.Fern.	LC
Rumex lanceolatus Thunb.	LC
Rumex woodii N.E.Br.	LC
Ruttya ovata Harv.	LC

Species Name	Status
Salvia runcinata L.f.	LC
Satyrium cristatum Sond. var. cristatum	LC
Satyrium hallackii Bolus subsp. ocellatum (Bolus) A.V.Hall	LC
Scabiosa columbaria L.	LC
Schizachyrium sanguineum (Retz.) Alston	LC
Schizachyrium ursulus Stapf	LC
Schizocarphus nervosus (Burch.) Van der Merwe	LC
Schoenoplectus decipiens (Nees) J.Raynal	LC
Scirpoides burkei (C.B.Clarke) Goetgh., Muasya & D.A.Simpson	LC
Scutellaria racemosa Pers.	
Searsia dentata (Thunb.) F.A.Barkley	LC
Searsia gerrardii (Harv. ex Engl.) Moffett	LC
Searsia magalismontana (Sond.) Moffett subsp. magalismontana	LC
Searsia montana (Diels) Moffett	LC
Searsia pyroides (Burch.) Moffett var. pyroides	LC
Sebaea grandis (E.Mey.) Steud.	LC
Sebaea leiostyla Gilg	LC
Selaginella dregei (C.Presl) Hieron.	LC
Selaginella mittenii Baker	LC
Senecio glanduloso-pilosus Volkens & Muschl.	LC
Senecio harveianus MacOwan	LC
Senecio inornatus DC.	LC
Senecio laevigatus Thunb. var. laevigatus	LC
Senecio latifolius DC.	LC
Senecio venosus Harv.	LC
Seriphium plumosum L.	LC
Setaria lindenbergiana (Nees) Stapf	LC
Setaria nigrirostris (Nees) T.Durand & Schinz	LC
Sida chrysantha Ulbr.	LC
Silene undulata Aiton	LC
Solanum capense L.	LC
Solanum lichtensteinii Willd.	LC
Sonchus nanus Sond. ex Harv.	LC
Sopubia cana Harv. var. cana	LC
Sphedamnocarpus pruriens (A.Juss.) Szyszyl. subsp. galphimiifolius (A.Juss.) P.D.de Villiers & D.J.Botha	LC
Sphedamnocarpus pruriens (A.Juss.) Szyszyl. subsp. pruriens	LC
Sphenostylis angustifolia Sond.	LC
Sporobolus natalensis (Steud.) T.Durand & Schinz	LC
Stachys natalensis Hochst. var. galpinii (Briq.) Codd	LC
Stachys natalensis Hochst. var. natalensis	LC
Stapelia gettliffei R.Pott	LC
Stiburus alopecuroides (Hack.) Stapf	LC
Strychnos pungens Soler.	LC
Stylochaeton natalensis Schott	LC
Symphyogyna brasiliensis Nees & Mont.	
Syncolostemon pretoriae (Gürke) D.F.Otieno	LC
Syngonanthus wahlbergii (Wikstr. ex Körn.) Ruhland var. wahlbergii	LC
Targionia hypophylla L.	
Tavaresia barklyi (Dyer) N.E.Br.	LC
Tephrosia macropoda (E.Mey.) Harv. var. macropoda	LC

Species Name	Status
Tephrosia multijuga R.G.N.Young	LC
Tephrosia retusa Burtt Davy	LC
Tephrosia semiglabra Sond.	LC
Tetradenia brevispicata (N.E.Br.) Codd	LC
Thamnosma africana Engl.	LC
Thelypteris confluens (Thunb.) C.V.Morton	LC
Themeda triandra Forssk.	LC
Thesium exile N.E.Br.	LC
Thesium junceum Bernh. var. junceum	LC
Thesium pallidum A.DC.	LC
Trachyandra asperata Kunth var. carolinensis Oberm.	LC
Trachyandra reflexipilosa (Kuntze) Oberm.	LC
Trachyandra saltii (Baker) Oberm. var. saltii	LC
Trachypogon spicatus (L.f.) Kuntze	LC
Trapeliopsis parilis Brusse	
Triaspis hypericoides (DC.) Burch. subsp. nelsonii (Oliv.) Immelman	LC
Tricalysia lanceolata (Sond.) Burtt Davy	LC
Trichodesma physaloides (Fenzl) A.DC.	LC
Trichostomum brachydontium Bruch	
Trifolium dubium Sibth.	
Tripogon minimus (A.Rich.) Steud.	LC
Tristachya leucothrix Trin. ex Nees	LC
Tristachya rehmannii Hack.	LC
Tritonia cooperi (Baker) Klatt subsp. cooperi	LC
Tritonia nelsonii Baker	LC
Triumfetta sonderi Ficalho & Hiern	LC
Tulbaghia acutiloba Harv.	LC
Urochloa panicoides P.Beauv.	
Utricularia livida E.Mey.	LC
Vangueria infausta Burch. subsp. infausta	LC
Verbena aristigera S.Moore	
Verbena brasiliensis Vell.	
Vernonia galpinii Klatt	LC
Vigna vexillata (L.) A.Rich. var. vexillata	LC
Xanthoparmelia tasmanica (Hook. & Taylor) Hale	
Xanthoparmelia tinctina (Maheu & A.Gillet) Hale	
Xenostegia tridentata (L.) D.F.Austin & Staples subsp. angustifolia (Jacq.) Lejoly & Lisowski	LC
Xyris capensis Thunb.	LC
Xyris congensis Büttner	LC
Xysmalobium asperum N.E.Br.	LC
Zaluzianskya katharinae Hiern	LC
Zantedeschia albomaculata (Hook.) Baill. subsp. macrocarpa (Engl.) Letty	LC
Zinnia peruviana (L.) L.	
Zornia capensis Pers. subsp. capensis	LC
Zornia linearis E.Mey.	LC
Zornia milneana Mohlenbr.	LC

Appendix B

Red data faunal species potentially occurring in the study area

Mammals

Scientific name	Common name	Status
Aepyceros melampus	Impala	LC
Alcelaphus buselaphus	Red Hartebeest	LC
Anticorcas marsupialis	Springbok	LC
Ceratothrium simum	White Rhinoceros	LC
Connochaetes gnou	Black Wildebeest	LC
Connochaetes taurinus taurinus	Blue Wildebeest	LC
Damaliscus pygargus phillipsi	Blesbok	LC
Equus burchellii	Plains Zebra	LC
Oreotragus oreotragus	Klipspringer	LC
Ourebia ourebi	Oribi	EN
Pelea capreolus	Grey Rhebok	LC
Phacochoerus africanus	warthog	LC
Potamochoerus porcus koiropotamus	Bushpig	LC
Redunca fulvorufula	Mountain Reedbuck	LC
Sylvicapra grimmia	Common Duiker	LC
Taurotragus oryx	Eland	LC
Tragelaphus strepsiceros	Kudu	LC
Procavia capensis	Rock Hyrax	LC
Aonyx capensis	Cape Clawless Otter	LC
Atilax paludinosus	Water Mongoose	LC
Canis mesomelas	Black - backed Jackal	LC
Caracal caracal	Caracal	LC
Cynictis penicillata	Yellow Mongoose	LC
Felis silvestris	African Wild Cat	LC
Galerella sanguinea	Slender Mongoose	LC
Genetta tigrina	Large-spotted Genet	LC
Helogale parvula	Dwarf Mongoose	LC
Hyaena brunnea	Brown Hyaena	NT
Ichneumia albicauda	White-tailed Mongoose	LC
Ictonyx striatus	Striped Polecat	LC
Leptailurus serval	Serval	NT
Lutra maculicollis	Spotted-necked Otter	NT
Mellivora capensis	Honey Badger	NT
Mungos mungo	Banded Mongoose	LC
Panthera pardus	Leopard	LC
Proteles cristatus	Aardwolf	LC
Vulpes chama	Cape Fox	LC

Epomophorus wahlbergi	Wahlberg's Epauletted Fruit Bat	LC
Miniopterus schreibersii	Schreibers' Long-fingered Bat	NT
Myotis tricolor	Temminck's Hairy Bat	NT
Myotis welwitschii	Welwitsch's Hairy Bat	NT
Neoromicia capensis	Cape Serotine Bat	LC
Nycteris thebaica	Egyptian Slit-faced Bat	LC
Pipistrellus hesperidus	African Pipistrelle	LC
Rhinolophus clivosus	Geoffroy's Horseshoe Bat	NT
Rhinolophus darlingi	Darling's Horseshoe Bat	NT
Rhinolophus simulator	Bushveld Horseshoe Bat	LC
Scotophilus dinganii	Yellow House Bat	LC
Scotophilus viridis	Lesser Yellow House Bat	LC
Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC
Atelerix frontalis	South African Hedgehog	NT
Crocidura cyanea	Reddish-grey Musk Shrew	Data Deficient
Crocidura flavescens	Greater Musk Shrew	Data Deficient
Crocidura fuscomurina	Tiny Musk Shrew	Data Deficient
Crocidura hirta	Lesser Red Musk Shrew	Data Deficient
Crocidura mariquensis	Swamp Musk Shrew	Data Deficient
Crocidura silacea	Lesser Grey-brown Musk Shrew	Data Deficient
Myosorex cafer	Dark-footed Forest Shrew	Data Deficient
Myosorex varius	Forest Shrew	Data Deficient
Suncus infinitesimus	Least Dwarf Shrew	Data Deficient
Suncus varilla	Lesser Dwarf Shrew	Data Deficient
Lepus capensis	Cape Hare/ Desert Hare	LC
Lepus saxatilis	Scrub Hare	LC
Pronolagus randensis	Jameson's Red Rock Rabbit	LC
Cercopithecus aethiops pygerythrus	Vervet Monkey	LC
Galago moholi	Southern Lesser Galago	LC
Papio ursinus	Chacma Baboon	LC
Acomys spinosissimus	Spiny Mouse	LC
Aethomys ineptus	Tete Veld Rat	LC
Aethomys namaquensis	Namaqua Rock Mouse	LC
Cryptomys hottentotus	Common Mole-rat	LC
Dasymys incomtus	Water Rat	NT
Dendromus melanotis	Grey Climbing Mouse	LC
Dendromus mystacalis	Chestnut Climbing Mouse	LC
Graphiurus murinus	Woodland Dormouse	LC

Graphiurus mplatyops	Rock Dormouse	Data Deficient
Hystrix africaeaustralis	Porcupine	LC
Lemniscomys rosalia	Single-striped Mouse	Data Deficient
Mastomys coucha	Multimammate Mouse	LC
Mus minutoides	Pygmy Mouse	LC
Octomys angoniensis	Angoni Vlei Rat	LC
Octomys irroratus	Vlei Rat	LC
Parexerus cepapi	Tree Squirrel	LC
Pedetes capensis	Springhare	LC
Rhabdomys pumilio	Striped Mouse	LC
Saccostomus campestris	Pouched Mouse	LC
Steatomys krebsii	Krebs' Fat Mouse	LC
Steatomys pratensis	Fat Mouse	LC
Tatera brantsii	Highveld Gerbil	LC
Tatera leucogaster	Bushveld Gerbil	Data Deficient
Thallomys paedulcus	Tree Rat	LC
Thryonomys swinderianus	Greater Cane Rat	LC
Elephantulus brachyrhynchus	Short-snouted Elephant-shrew	Data Deficient
Elephantulus myurus	Rock Elephant-shrew	LC
Manis temminckii	Pangolin	V
Crycteropus afer	Aardvark	LC

Birds

Scientific name	Common name	Status
Geronticus calvus	Bald Ibis	V
Aquila rapax	Tawny Eagle	V
Polemaetus bellicosus	Martial Eagle	V
Circus ranivorus	African Marsh Harrier	V
Falco naumanni	Lesser Kestrel	V
Anthropoides paradiseus	Blue Crane	V
Balearica regulorum	Grey Crowned Crane	V
Podica senegalensis	African Finfoot	V
Neotis denhami	Stanley's Bustard	V
Eupodotis cafra	Whitebellied Korhaan	V
Tyco capensis	Grass Owl	V

Amphibians

Scientific name	Common name	Status
Bufo fenoulheti	Northern Pygmy Toad	LC
Bufo garmani	Eastern Olive Toad	LC
Bufo gutturalis	Guttural Toad	LC
Bufo maculatus	Flat -backed Toad	LC
Bufo rangeri	Raucous Toad	LC
Schismaderma carens	Red Toad	LC
Hyperolius marmoratus	Painted Reed Frog	LC
Kassina senegalensis	Bubbling Kassina	LC

Semnodactylus wealii	Rattling Frog	LC
Phrynomantis bifasciatus	Banded Rubber Frog	LC
Cacosternum boettgeri	Boettger's Caco	LC
Phrynobatrachus natalensis	Snoring Puddle Frog	LC
Xenopus laevis	Common Platanna	LC
Afrana angolensis	Common River Frog	LC
Ptychadena anchietae	Plain Grass Frog	LC
Ptychadena porosissima	Stripped Grass Frog	LC
Pyxicephalus adspersus	Giant Bullfrog	NT
Strongylopus fasciatus	Stripped Stream Frog	LC
Tomopterna cryptotis	Tremolo Sand Frog	LC
Tomopterna natalensis	Natal Sand Frog	LC
Tomopterna tandyi	Tandy's Sand Frog	LC

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