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REPORT ON

**ECOLOGICAL STUDY FOR THE BAKABUNG/LEDIG
INTEGRATED MIXED USE DEVELOPMENT**

Report Number: 2015/022/01/01

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EXECUTIVE SUMMARY

K2M Environmental appointed Hudson Ecology Pty Ltd to undertake terrestrial ecology assessment of the proposed development adjacent to Ledig and Sun City. The proposed development is located approximately 25 kilometres north of Rustenburg, in the North-West Province, South Africa.

Based primarily on physiognomy, moisture regime, rockiness, slope, species composition and soil properties, four vegetation communities were recognised. Although, these communities were recorded as such, there is variation within these communities as a result of current and historic anthropogenic disturbance. The communities are:

- Secondary clay thornveld;
- Foothlope broadleafed bushveld;
- Secondary turf thornveld; and
- Secondary riparian vegetation.

In addition, areas of complete or severe transformation and disturbance occur throughout the study area. These include inter alia, villages and roads, these areas were noted and delineated but not surveyed intensively.

No flora species of concern were observed or recorded during the site survey.

A total of 21 arthropod taxa, 4 reptile taxa, 0 amphibians, 19 birds and 5 mammal species were recorded during the 2015 site survey. None of the species recorded are listed as species of concern, but a small number of species of concern have a moderate probability of occurrence in the area.

Much, if not all, of the vegetation within the study area has been disturbed, but in general the thornveld is of moderate ecological integrity. In addition, other anthropogenic activities including agriculture, livestock grazing and mining outside the study area have also disturbed large tracts of vegetation. This notwithstanding, at a landscape level these communities are important dispersal habitats, linking the mountainous Pilanesberg to the hills and ridges located in the study area, and to other habitats located north-west of the study area. Where not transformed or heavily degraded, the ecological function of the riparian zones and broadleaf bushveld can be considered high. The transformed and severely degraded areas have low ecological integrity.

The conservation importance of the broadleaf foothlope vegetation is considered moderate, as although in large areas it has been transformed and disturbed, the presence of the Red Data species cannot be excluded.

Rivers (including non-perennial streams) are longitudinal ecosystems, and their condition at any point is a reflection of not only upstream activities, but also of those within adjacent and upstream parts of the catchment. River systems are subject to strict legislation (e.g. National Water Act) to protect the water resources in South Africa.

The majority of the area is characterised as being transformed or secondary vegetation communities and therefore have low conservation importance, due to the lack of species of conservation importance being present in, or reliant on these vegetation communities..

TABLE OF CONTENTS

SECTION	PAGE
1 Introduction	5
2 Project description	5
2.1 Background and location	5
4 Scope of Work	5
4.1 Flora component.....	5
4.2 Fauna component	5
5 Assumption and limitations	6
6 Methodology	6
6.1 Methodologies	6
6.1.1 General Floristic Attributes	6
6.1.2 Red Data Floral Assessment	7
6.1.3 Floristic Sensitivity Analysis.....	7
6.1.4 General Faunal Attributes	8
6.1.5 Red Data Faunal Assessment	8
7 Assumptions and limitations	9
8 Results	9
8.1 Physical Setting	9
8.1.1 Zeerust Thornveld (SVcb3).....	10
8.2 Flora Assessment	11
8.2.1 Vegetation Communities	11
8.2.2 Flora species of concern.....	14
8.3 Fauna Assessment.....	14
8.3.1 Arthropoda.....	14
8.3.2 Herpetofauna.....	15
8.3.3 Avifauna	16
8.3.4 Mammalia	17
8.4 Ecological Integrity.....	18
8.5 Conservation Importance.....	19
9 Discussion and conclusions	20
10 REFERENCES	22

LIST OF FIGURES

Figure 1: Vegetation types occurring in the study area (Mucina and Rutherford, 2006)	10
Figure 2: Study area showing vegetation communities	12
Figure 3: Ecological integrity within the study area	19
Figure 4: Conservation importance within the study area	20

LIST OF TABLES



Table 1: Spatial scale of vegetation communities recorded within the study area	11
Table 2: Red Data floral species possibly occurring in the area	14
Table 3: Arthropod species recorded	14
Table 4: Herpetofauna species of concern possibly occurring in the study area	15
Table 5: Herpetofauna species of concern possibly occurring in the study area	16
Table 6: Species recorded during the study	16
Table 7: Avifauna species of concern possibly occurring in the study area	17
Table 8: Mammal species recorded	17
Table 9: Mammal species of concern possibly occurring in the area	18

LIST OF APPENDICES

APPENDIX A

APPENDIX B

APPENDIX C

APPENDIX D

APPENDIX E

APPENDIX F



1 INTRODUCTION

K2M Environmental appointed Hudson Ecology Pty Ltd to undertake terrestrial ecology assessment of the proposed development adjacent to Ledig and Sun City. The proposed development is located approximately 25 kilometres north of Rustenburg, in the North-West Province, South Africa.

2 PROJECT DESCRIPTION

2.1 Background and location

The area under investigation for this development is situated between Ledig, Sun City and Pilanesberg Nature Reserve in the North-West province and is bordered to the south by the R556 provincial road. The area is approximately 290 ha and is currently not formally utilised.

3 AIMS AND OBJECTIVES

The terms of reference for the terrestrial ecosystems specialist study are:

- To conduct a flora and fauna survey of the site;
- To identify the potential for threatened species (Red Data fauna and flora species) to occupy the study site;
- To conduct a habitat suitability assessment for fauna species, particularly Red Data species;
- To provide an indication of the ecological function of the study site and identify specific areas of sensitivity or conservation importance;
- To assess the impacts of the proposed activity on the species and ecological integrity and processes of the study site; and
- To recommend suitable mitigation and enhancement measures to avoid or reduce any significant adverse impacts.

4 SCOPE OF WORK

4.1 Flora component

The scope of work comprises the following tasks:

- Conduct an initial literature review of vegetation likely to occur in the study area;
- Develop a species list of Red Data and protected plants according to the relevant literature for the IUCN and South Africa;
- Conduct a field survey of the study area (using standard scientific methodology);
- Identify general vegetation communities in the study area;
- Identify dominant plant species;
- Record Red Data and protected species;
- Identify invader or exotic species;
- Identify sensitive landscapes and habitats including wetland and riparian habitats as these are often intricately linked to the surrounding terrestrial habitats; and
- Identify possible impacts of the proposed development.

4.2 Fauna component

The tasks for the fauna component comprise the following:

- Conduct initial literature review of fauna species likely to occur in the study area;

- Develop a species list of Red Data and protected animals according to the IUCN and South African protected and Red Data species lists;
- Conduct a field survey (using standard scientific methodology);
- Identify terrestrial fauna occurring within the study area;
- Record Red Data and protected fauna species;
- Identify any exotic species; and
- Identify possible impacts of the proposed development on fauna populations.

5 ASSUMPTION AND LIMITATIONS

The report is based on the following assumptions:

- The accuracy of GPS points taken in the field is within 15m;
- Delineations and related spatial data generated by GAA can be supplied in GIS (shapefile) format only and will be for use in conceptual planning purposes only and not detailed design;
- The assessment of the impact of past activities on the ecosystems will be based on professional judgement;
- Historical data relating to terrestrial ecosystems provided to GAA by the client is assumed to be correct;
- Data and information obtained through official documents or websites, peer reviewed scientific articles and previous ecological studies are assumed to be correct;
- No review or correction of any data obtained by any means, other than the study itself, will be undertaken by GAA;
- It is noted that unusual environmental conditions (such as unusual high or low rainfall) may cause unusual states of biodiversity during the period of study, which may not normally exist; and
- It is noted that the site survey was conducted during the wet season, although very dry conditions were prevalent due to the persistent drought, and over a single sampling bout and will not account for seasonal variation or long term temporal changes in biodiversity

6 METHODOLOGY

6.1 Methodologies

During November 2015 a field study was conducted in the study area. During this period 10 sites were selected for intensive study of flora and fauna.

6.1.1 General Floristic Attributes

The vegetation assessment was based on a variation of the Braun-Blanquet method (Mueller-Dombois & Ellenberg, 1974; Westhoff & Van der Maarel, 1978) whereby vegetation is stratified, by means of aerial or satellite imagery with physiognomic characteristics as a first approximation. Stratification was further augmented by sites being selected to represent each of the areas that will be impacted by the current development footprint. Representative areas within these stratifications are then surveyed by means of line-point transects for grasses, sedges and forbs, as well as belt transects for shrubs and trees. Data obtained from these surveys are then subject to analysis to establish differences or similarities between observed units. Results and species lists provided should be interpreted with the above mentioned survey limitations in mind.

During the floral surveys conducted during the August 2015 survey, cognisance was taken of the following environmental attributes and general information:

- Biophysical environment (geology, topography, aspect, slope etc.);
- Regional vegetation;
- Current status of habitats;

- Red Data habitat suitability;
- Digital photographs; and
- GPS reference points.

Phytosociological data accumulated include the following:

- Plant species and growth forms;
- Dominant plant species;
- Cover abundance values; and
- Samples or digital images of unidentified plant species.

The desktop analysis of data was used to establish differences or similarities between vegetation communities, which were then described in terms of floristic species composition as well as driving environmental parameters. Results and species lists provided should be interpreted with the abovementioned survey limitations in mind.

6.1.2 Red Data Floral Assessment

- Compared data collected during the surveys and the IUCN Red Data plant species list and South African Threatened and Protected species (TOPS) list to compile a list of plant species of concern that may potentially occur within the study area and that were recorded in the study area.
- A survey of this kind (instantaneous sampling bout or “snapshot” investigations) poses limitations to the identification of Red Data plant species. Therefore, emphasis was placed on the identification of habitat that would be suitable for sustaining Red Data plant species, by associating available habitat to known habitat requirements of Red Data plant species.

6.1.3 Floristic Sensitivity Analysis

Floristic sensitivity analysis was determined by taking two factors into account namely ecological function and conservation importance. This sensitivity was quantified by subjectively assessing the ecological function and conservation importance of the vegetation. These were defined as follows:

Ecological Function:

- High ecological function: Sensitive ecosystems with either low inherent resistance or resilience towards disturbance factors or highly dynamic systems considered to be stable and important for the maintenance of ecosystems integrity (e.g. pristine grasslands, pristine wetlands and pristine ridges);
- Medium ecological function: Relatively important ecosystems at gradients of intermediate disturbances. An area may be considered of medium ecological function if it is directly adjacent to sensitive/pristine ecosystem; and
- Low ecological function: Degraded and highly disturbed systems with little or no ecological function.

Conservation Importance:

- High conservation importance: Ecosystems with high species richness and usually provide suitable habitat for a number of threatened species. Usually termed ‘no-go’ areas and unsuitable for development, and should be protected;
- Medium conservation importance: Ecosystems with intermediate levels of species diversity without any threatened species. Low-density development may be allowed, provided the current species diversity is conserved; and
- Low conservation importance: Areas with little or no conservation potential and usually species poor (most species are usually exotic).

The Precautionary Principle was applied throughout this investigation (COMEST, 2005).

6.1.4 General Faunal Attributes

6.1.4.1 Reptilia

Suitable areas were identified and sampled using active search and capture methods, searches were concentrated in rocky areas and disused ant hills were investigated for the presence of snakes. Snakes and other reptiles are identified visually and only captured if visual identification is hampered by swift-moving snakes or if the snake is obscured from view. Branch (1996) and Broadley (1971) were used as identification guides, where necessary.

6.1.4.2 Amphibia

Suitable areas for frogs were sampled by means of active search and capture and acoustic identification methods, especially at night when highest amphibian activity is expected. Areas were also netted for tadpoles and amphibian species identified by means of tadpoles. Du Preez and Carruthers (2009) was used to confirm identification where necessary.

6.1.4.3 Aves

Avifauna were surveyed by means of transects and point counts (Bibby, et al., 1993) and visual identification and the calls of bird species were used to identify species. Wherever possible, visual identification was used to confirm call identifications. Bird ranges were confirmed using Harrison *et al* (1997). Other guides were also utilised (Hockey, et al., 2005) (BirdLife International, 2000) (Sinclair & Ryan, 2003)

6.1.4.4 Mammalia

Visual sightings and ecological indications were used to identify the small mammal inhabitants of the study area. Scats were also collected and used for identification of nocturnal small mammals. A number of reference sources *inter alia* Stuart and Stuart (2007) and Smithers (1983) were used for identification purposes.

6.1.5 Red Data Faunal Assessment

The following parameters were used to assess the Probability of Occurrence of each Red Data species:

- Habitat requirements (HR) – Most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics in the study area was evaluated;
- Habitat status (HS) – The status or ecological condition of available habitat in the area is assessed. Often a high level of habitat degradation prevalent in a specific habitat will negate the potential presence of Red Data species (this is especially evident in wetland habitats); and
- Habitat linkage (HL) – Movement between areas for breeding and feeding forms an essential part of the existence of many species. Connectivity of the study area to surrounding habitat and the adequacy of these linkages are evaluated for the ecological functioning of Red Data species within the study area.

Probability of occurrence is presented in four categories, namely:

- Low;
- Medium;
- High; and
- Recorded.

In order to assess the status of fauna species of concern in the study area, the following sources were used:

- IUCN Red List Categories and Criteria (IUCN, 2001);
- IUCN Red List of Threatened Species (IUCN, 2011); and
- South African Threatened and Protected species (TOPS) list (Republic of South Africa, 2004).

7 ASSUMPTIONS AND LIMITATIONS

- Accuracy of the maps, ecosystems, routes and desktop assessments were made using Google earth and converting the .kml files to .shp files and are subject to the accuracy of Google Earth imagery with some loss of accuracy during the conversion process;
- GPS co-ordinates are accurate to within 10m and lines drawn on maps can only be assumed to be accurate to within a distance of 100m;
- Data obtained from published articles, reference books, field guides, official databases or any other official published or electronic sources are assumed to be correct and no review of such data was undertaken by Hudson Ecology Pty Ltd;
- Satellite imagery obtained was limited to imagery on Google Earth, thus the ability to accurately map vegetation communities was limited;
- Time and budget constraints do not allow for an intensive survey of the entire study area, and as with any survey of this kind, rare and cryptic species may be overlooked during the study; and
- Every possible precaution was taken to reduce the effect of the above-mentioned limitations on the data collected for this study.
- The fact that a species or Red Data species is not recorded during a survey cannot support the assumption that the species in question does not occur in the area, it can only indicate a decreased probability of the species occurring in the area. This is particularly pertinent if the species has been recently or historically recorded in the area; and
- Ecological studies should be undertaken over a number of seasons in order to obtain long term ecological data. Studies are usually conducted in this way in order to eliminate the effects of unusual climatic conditions or other unusual conditions prevailing at the study area during the time of study. The results of this study are based on a literature review and a single wet season field survey, conducted in November 2015.

8 RESULTS

This section provides a discussion of the terrestrial ecology baseline environment and context in which the proposed project will take place.

8.1 Physical Setting

The development falls completely within Mucina & Rutherford's (2006) Zeerust Thornveld (SVcb3) vegetation type of the savanna biome. The site varies in altitude from 1123 m to 1220 m, with the northern portion dominated by a series of hills and ridges forming the border with Pilanesberg Nature Reserve. The NW Biodiversity Inventory and Database (2003) describes the habitat type occurring on these hills and ridges as Mabeskraal Ridge Bushveld. The east is dominated by flat, open thornveld of the Lekubu Mixed Thornveld habitat type (NW Biodiversity Inventory and Database 2003).

According to the NW Biodiversity Inventory and Database (2003), the region in which the study area is located has an overall biodiversity ranking of high.

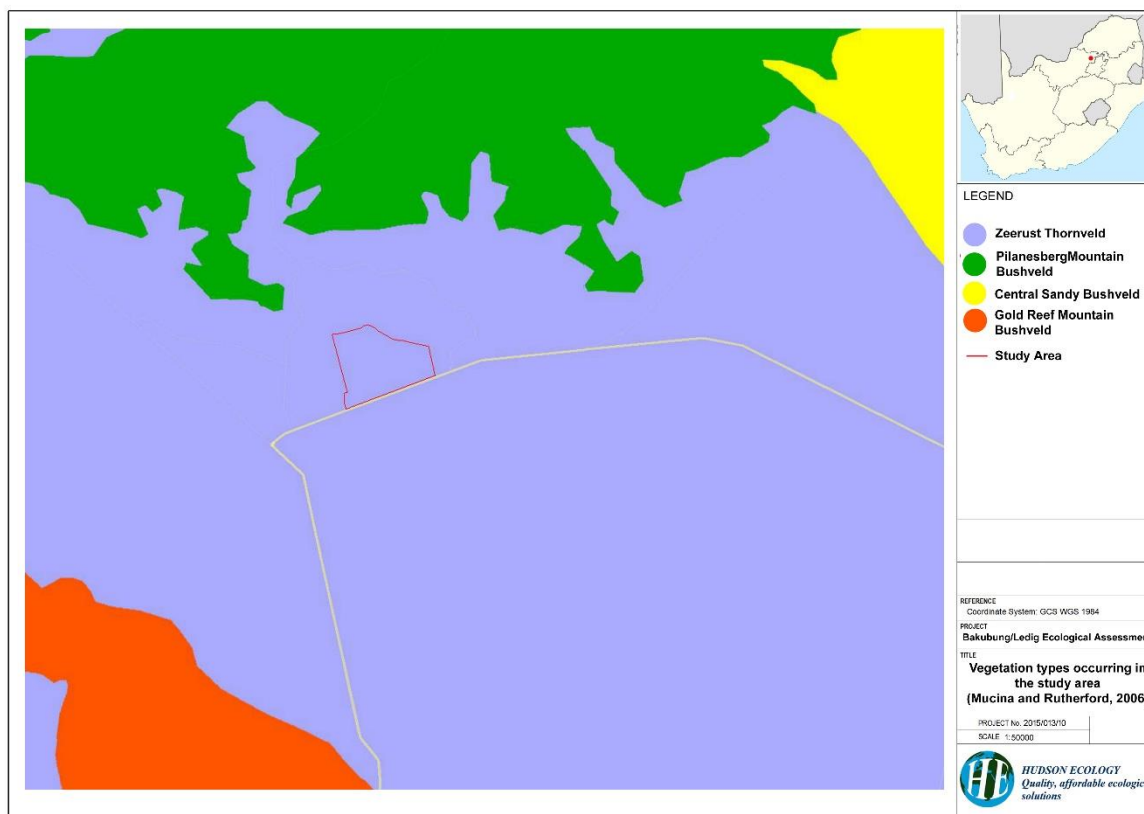


Figure 1: Vegetation types occurring in the study area (Mucina and Rutherford, 2006)

8.1.1 Zeerust Thornveld (SVcb3)

Zeerust Thornveld extends in a broad band along the plains from Zeerust and Groot Marico in the west through to the flats between the western end of the Magaliesberg Mountains and the Pilanesberg National Park in the east. This vegetation type is dominated by elements of Low & Robelo's (1996) Mixed Bushveld and Acocks (1953) Sourish Mixed Bushveld (Mucina & Rutherford, 2006). The following notes summarise the characteristics of this vegetation type:

8.1.1.1 Vegetation and Landscape features

Zeerust Thornveld is characterised by deciduous, open to dense short thorny woodland, dominated by Acacia species and a dense grass layer (Mucina & Rutherford, 2006).

8.1.1.2 Geology and Soils

The sediments of the Pretoria Group that underlie this vegetation type, particularly the Silverton and Rayton Formations, are mostly shale, while carbonates, volcanic rocks, breccias and diamictites are also present. Bronzite, harzburgite, gabbro and norite of the Rustenburg Layered Suite (Bushveld Igneous Complex) are also frequently found underlying areas of Zeerust Thornveld (Mucina & Rutherford, 2006).

Soils are mostly deep, red and yellow apedal, which drain freely and have a high base status. Both vertic and melanitic clays also occur in certain areas (Mucina & Rutherford, 2006).

8.1.1.3 Climate

As with all vegetation types in the savanna biome, areas of Zeerust Thornveld experience summer rainfall with dry, very cold winters. Frost occurs frequently in winter with temperatures as low as -4oC being recorded in the region. Summer temperatures peak at 36oC. Mean annual precipitation for this vegetation type ranges from 550-600 mm (Mucina & Rutherford, 2006).

8.1.1.4 Important Plant Taxa

Based on Mucina & Rutherford's (2006) vegetation classification, important plant taxa are those species that have a high abundance, a frequent occurrence (not being particularly abundant) or are prominent in the landscape within a particular vegetation type. They note the following species are important taxa in the Zeerust Thornveld vegetation type:

Trees: *Acacia burkei*, *A. erioloba*, *A. mellifera* subsp. *detinens*, *A. nilotica*, *A. tortilis* subsp. *heteracantha*, *A. fleckii*, *Rhus lancea*, *Peltophorum africanum*, *Terminalia sericea*

Shrubs: *Diospyros lycioides* subsp. *lycioides*, *grewia flava*, *Mystroxydon aethiopicum*, subsp. *burkenum*, *Agathisanthemum bojeri*, *Chaetacanthus costatus*, *Clerodendrum ternatum*, *Indigofera filipes*, *Rhus grandidens*, *Sida chrysantha*, *Stylosanthes fruticosa*.

Graminoids: *Eragrostis lehmanniana*, *Panicum maximum*, *Aristida congesta*, *Cymbopogon pospischilii*.

Herbs: *Blepharis integrifolia*, *Chaemecrista absus*, *C. Mimosoides*, *Cleome Maculata*, *Dicoma anomala*, *Kyphocarpa angustifolia*, *Limeum viscosum*, *Lophiocarpus tenuissimus*.

Endemic Taxon: The low shrub *Rhus maricoana* is endemic to this region.

8.1.1.5 Conservation

According to Mucina & Rutherford (2006) Zeerust Thornveld is classified as Least Threatened. Although the target for conservation is 19%, only 4% of this vegetation type is currently under statutory conservation in reserves such as Pienaar Game Reserve and Marico Bushveld Nature Reserve. Cultivation and to a lesser extent urbanisation have resulted in the transformation of approximately 16% of Zeerust Thornveld. Exotic invasive plants, particularly *Cereus jamacaru* are present. Incidences of erosion are low to very low (Mucina & Rutherford, 2006).

8.2 Flora Assessment

According to the NW Biodiversity Inventory and Database (2003) the region in which the study area is located has a floral diversity ranking of high. A total of 56 plant species were recorded during the floristic survey of the study area (Appendix A). This is marginally higher than the number plant species presented in the PRECIS dataset by SANBI for the 2527AC quarter degree square and can be attributed to the level of degradation in the area and a number of exotic species occurring in all of the vegetation communities recorded in the study area.

8.2.1 Vegetation Communities

The area under investigation for this study is severely impacted and appears to have been cultivated in the past, for this reason most vegetation communities can be described as secondary vegetation communities. Based primarily on physiognomy, moisture regime, rockiness, slope, species composition and soil properties, four vegetation communities were recognised (Table 1 and Figure 2). Although, these communities were recorded as such, there is variation within these communities as a result of current and historic anthropogenic disturbance. The communities are:

- Secondary clay thornveld;
- Footslope broadleaved bushveld;
- Secondary turf thornveld; and
- Secondary riparian vegetation.

In addition, areas of complete or severe transformation and disturbance occur throughout the study area. These include inter alia, villages and roads, these areas were noted and delineated but not surveyed intensively.

Table 1: Spatial scale of vegetation communities recorded within the study area

Vegetation Community	Area in ha	% of total study area
Transformed areas (Urban)	77.9	27%
Secondary Clay Thornveld	140.43	49%

Footslope broadleaf bushveld	10.4	4%
Secondary turf thornveld	40.4	14%
Degraded riparian vegetation	16.9	6%
Total	286.03	100%

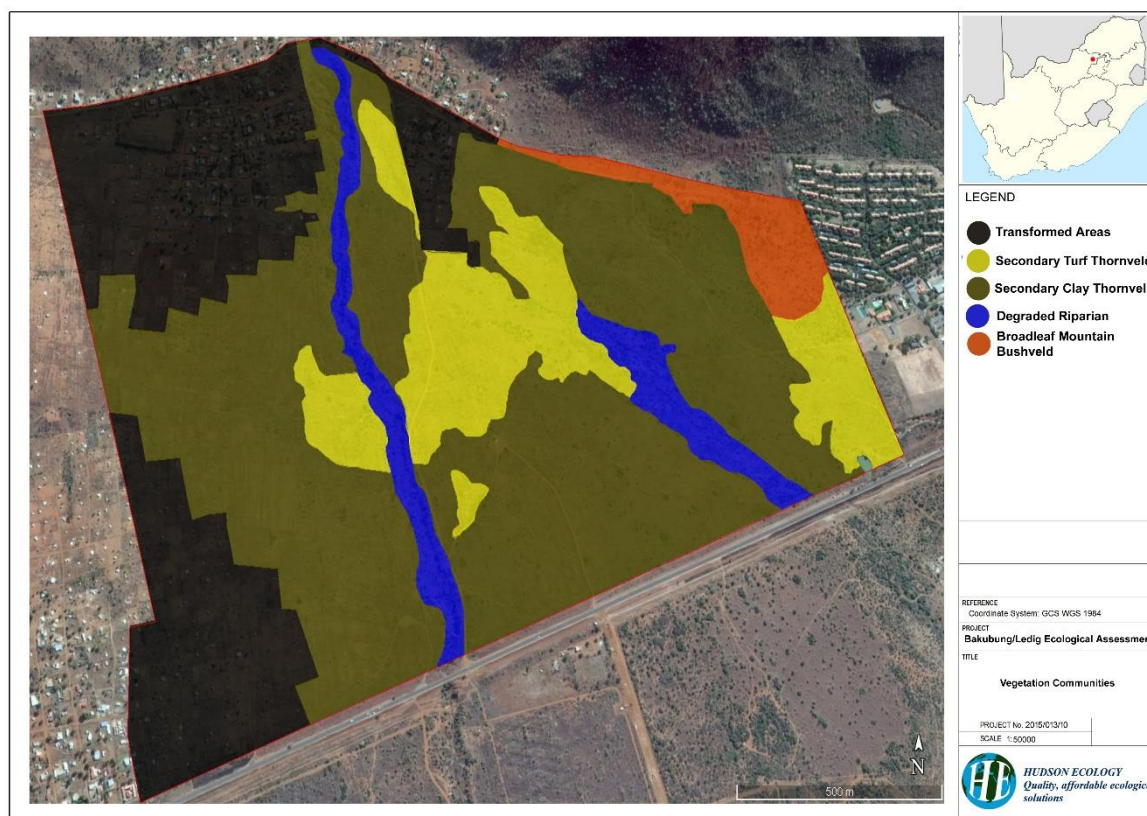


Figure 2: Study area showing vegetation communities

A list of plant species known to occur in the region are given in APPENDIX recorded species are highlighted in the Appendix. A complete list of recorded species will be given after the wet season survey.

8.2.1.1 Secondary Clay bushveld

The vegetation community that occurs to the north of the Eland’s River is found on gravelly deposits, possibly originating from the slopes of the Pilanesberg, where these have created landscape with high rock cover, but relatively flat slopes. The species composition is intermediate between open savanna and rocky outcrop vegetation, but with many of the woody species typical of rocky outcrops, e.g. *Pappea capensis*, *Olea europaea* subsp. *africana*, *Dichrostachys cinerea*, *Acacia nilotica*, *Acacia karroo*, *Acacia caffra*, *Rhus lancea*, *Tarchonanthus camphoratus*, *Ziziphus mucronata* and *Ehretia rigida*. The vegetation here is severely degraded due to past and present anthropogenic impacts and a large number of exotic species were recorded in this vegetation community.

Sensitivity aspects

- This vegetation occurs between Pilanesberg National Park and the Elands River, thus forming a buffer zone and connecting zone between these two systems.

- Currently the level of degradation needs to be considered and this area shows a very high level of degradation.

8.2.1.2 Broadleaf footslope bushveld

This is a broad-leaved deciduous bushveld dominated by trees and shrubs with the grass layer dominating mostly on the footslopes of mountains and hills. Common and dominant species include the small trees, *Combretum apiculatum*, *Combretum molle*, *Combretum zeyheri*, *Strychnos cocculoides*, *Croton gratissimus*, *Englerophytum magalismontanum*, *Rhus leptodictya* and *Vangueria parvifolia*, the tall shrubs, *Diplorhynchus condylocarpon*, *Elephantorrhiza burkei*, *Grewia flava*, *Hibiscus calyphyllus*, *Mundulea sericea*, *Steganotaenia araliacea* and *Vitex rehmannii*, the grasses, *Chrysopogon serrulatus*, *Elionurus muticus*, *Panicum maximum*, *Themeda triandra*, *Enneapogon scoparius*, *Hyperthelia dissoluta* and *Panicum deustum*, and the herbaceous species, *Polygala hottentotta*, *Abutilon pycnodon*, *Chamaesyce inaequilatera*, *Hermannia depressa*, *Nidorella resedifolia*, *Xerophyta retinervis* and *Crassula lanceolata* subsp. *transvaalensis*.

Sensitivity aspects

- The vegetation of these areas contains a relatively high diversity of plant species.
- Although no Red List plant species were encountered during the present survey, those that have been historically recorded in the region have a higher likelihood of occurrence in this vegetation type.
- This bushveld forms a preferred habitat for a number of possible rare and protected animal species due to the availability of shelter amongst the rocks as well as more dense woody cover than surrounding areas.

8.2.1.3 Secondary turf thornveld

There are a few areas where black turf soils tend to occur near to the non-perennial drainage lines and in other places where the soil depth was too shallow or surface stoniness too high for cultivation. As a result, the species composition is not typical of the original vegetation. These occur on slightly sloping areas adjacent to the non-perennial streams where the soil is gravelly and shallow. This vegetation community is characterised by the species *Acacia mellifera* (dominant), *Bothriochloa insculpta*, *Aristida bipartita*, *Enneapogon cenchroides*, *Tephrosia multijuga*, *Ischaemum afrum* and *Urochloa panicoides*. and the absence of *Heteropogon contortus*, *Melinis repens*, *Eragrostis rigidior*, *Panicum maximum*, *Themeda triandra*, *Hyparrhenia hirta*, *Panicum maximum*, *Themeda triandra*, *Tragus berteronianus* and *Acacia caffra*.

Sensitivity aspects

- The remaining patches of untransformed vegetation in the study area contain a relatively high diversity of plant species.
- Due to its suitability for agriculture, very little of this vegetation type still remains intact and, at a national level, it has been assessed as an endangered vegetation type
-

8.2.1.4 Secondary riparian vegetation

There are two of the Elands River that occur in the study area. These are severely impacted and impounded upstream of the study area species occurring in these drainage lines include: *Cyperus sexangularis*, **Flaveria bidentis*, *Tagetes minuta*, **Cyperus esculentus* and **Persicaria lapathifolia*. The drainage lines are further characterised by the presence of the graminoids *Ischaemum fasciculatum*, *Imperata cylindrica*, *Setaria sphacelata*, *Schoenoplectus corymbosus*, *Cynodon dactylon*, *Bothriochloa insculpta* and *Urochloa panicoides*. The exotic grass **Pennisetum clandestinum* was also widespread in these habitats. All these systems have been impacted upon in places through cultivation in the past, current mining activities and the effects of the local inhabitants (grazing, wood harvesting, water pollution, trampling and bank erosion).

Sensitivity aspects

- Rivers (including non-perennial streams) are longitudinal ecosystems, and their condition at any point is a reflection of not only upstream activities, but also of those within adjacent and upstream parts of the catchment.
- River systems are subject to strict legislation (e.g. National Water Act) to protect the water resources in South Africa.

8.2.2 Flora species of concern

Based on Hahn's (2011) study, 13 species of Red Data plant occur within the Bojanala Platinum District of the North West Province. According to reviewed literature, three of these species potentially occur in the study area, while five species of protected tree may occur in the study area Table 2.

No species of concern were observed or recorded during the site survey.

Table 2: Red Data floral species possibly occurring in the area

Species	South African Red Data List (2009)	IUCN Red Data List (2011)	Protected Tree Species (National Forest Act No. 84 of 1998)
<i>Ledeboria atrobrunnea</i>	Vulnerable		
<i>Delosperma macellum</i>	Endangered	CE	
<i>Erythrophysa transvaalensis</i>		Least Concern	Protected
<i>Sclerocarya birrea</i> subsp. <i>caffra</i>			Protected
<i>Boscia albitrunca</i>			Protected
<i>Combretum imberbe</i>			Protected
<i>Acacia erioloba</i>			Protected
<i>Pittosporum viridiflorum</i>			Protected

* Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001), as evaluated by the Threatened Species Programme of the South African National Biodiversity Institute in Pretoria. *IUCN (3.1) Categories: VU = Vulnerable, EN = Endangered, CR = Critically Endangered, NT = Near Threatened.

8.3 Fauna Assessment

8.3.1 Arthropoda

A total of 21 arthropod taxa were recorded during the 2015 site survey (Table 3). The low diversity may be attributable to the largenumber of anthropogenic impacts currently persisting on site. All recorded species are common to savanna areas and have widespread distributions. These species are generally subtropical and reflect the southern extension of the Afrotropical range (Picker et al 2004).

Table 3: Arthropod species recorded

Order	Family	Species Name
Lepidoptera	Nymphalidae	<i>Vanessa cardui</i>
		<i>Danaus chrysippus aegyptius</i>
		<i>Acraea eponina eponina</i>
		<i>Junonia hierta cebrene</i>
	Pieridae	<i>Mylothris rueppellii haemus</i>
		<i>Eurema brigitta</i>
Coleoptera	Coccinellidae	<i>Henosepilachna bifasciata</i>
Thysanura	Lepismatidae	
Odonata	Protoneuridae	
	Libellulidae	
Blattodea	Blattidae	<i>Periplaneta americana</i>
Isoptera	Hodotermitidae	<i>Hodotermes mossambicus</i>

Orthoptera	Gryllidae	
	Acrididae	
Phasmatodea	Bacillidae	
Diptera	Muscidae	<i>Musca domestica</i>
Hymenoptera	Vespidae	<i>Belonogaster dubia</i>
	Apidae	<i>Apis mellifera</i>
	Anthophoridae	<i>Amegilla caelestina</i>
	Formicidae	<i>Pachycondyla tarsata</i>
<i>Dorylus helvolus</i>		

8.3.1.1 Red Data and Protected Arthropoda

Four species of Red Data and Protected arthropods may occur within the study area (Table 4). Both species of flat rock scorpions from the genus *Hadogenes* occur in rocky habitats, such as that found in the study area. The probability of these species occurring in the study area is therefore high.

Table 4: Herpetofauna species of concern possibly occurring in the study area

Scientific Name	Common name	NEM:BA Threatened and Protected Species List (2007)	Probability of occurrence
<i>Hadogenes gracilis</i>	Rock Scorpion	Protected	High
<i>Hadogenes troglodytes</i>	Rock Scorpion	Protected	High
<i>Metisella meninx</i>	Marsh Sylph	Vulnerable	Low
<i>Spialia paula</i>	Mite Sandman	Vulnerable	Low

As the name suggests the Marsh Sylph (*Metisella meninx*) is a wetland specialist favouring marshy grassland (Henning & Roos, 2001). The probability of this species occurring on site is considered low. *Spialia paula* is a savanna species, occurring on the slopes of hills (Henning & Henning, 1989).

8.3.2 Herpetofauna

According to the NW Biodiversity Inventory and Database (2003) the region in which the study area is located has a reptile and amphibian biodiversity ranking of medium. Only four species, namely the Stripe-bellied Sand Snake (*Psammophis subtaeniatus*), Puff Adder (*Bitis arietans*), Mozambique Spitting cobra (*Naja mossambica*) and the Variable Skink (*Mabuya varia*) were recorded during the 2015 site survey. Both these species have wide distributions. The Stripe-bellied Sand Snake favours open, dry savanna and Thornveld, while the Variable Skink favours grassland habitats (Branch, 1994). No amphibians were recorded during the site survey.

8.3.2.1 Red Data and Protected Herpetofauna

Based on the reptile list of the adjacent Pilanesberg National Park, a total of 65 species could potentially occur in the study area. Of these, only the African Rock Python (*Python sebae natalensis*) is categorised as a Protected species, according to the NEM:BA TOPS List (2007). The African Rock Python favours open savannas and rocky areas (Branch, 1994), both of which occur in the study area. The probability of this species being present on site is therefore high.

The amphibian list for the Pilanesberg National Park indicates that 28 species occur in that protected area and could potentially occur in the study area. Of these, only the Giant Bullfrog (*Pyxicephalus adspersus*) is listed as Near Threatened by the IUCN (2011) and categorised as Protected on the NEM:BA TOPS List (2007). This species breeds in the shallows of temporary rain filled depressions in grasslands and dry savanna, and spends much of the year buried (Carruthers, 2001). Although no evidence of the presence of Giant Bullfrogs was

observed during the site survey, there is potential for this species to occur in the bottomland areas. These areas are characterised by poorly drained soils which allow for the formation of temporary pools during the wet season.

Table 5: Herpetofauna species of concern possibly occurring in the study area

Scientific Name	Common Name	NEM:BA Threatened and Protected Species List (2007)	IUCN Red Data List (2011)	Probability of occurrence
<i>Python sebae natalensis</i>	African Rock Python	Protected		High
<i>Pyxicephalus adspersus</i>	Giant Bullfrog	Protected	Near Threatened	Low

8.3.3 Avifauna

The NW Biodiversity Inventory and Database (2003) categorises the region in which the study area is located as having low-medium bird diversity. Data presented on SANBI's SIBIS database (SIBIS:SABIF, 2009, internet) indicates that a total of 140 bird species have been recorded in the 2526BB quarter degree grid square. This is substantially more than the 19 bird species recorded during the site survey (Table 6). This low diversity can be attributed to 1) dry conditions persisting in the area; 2) Anthropogenic disturbance of the vegetation, and 3) Egg collecting by adjacent land users may reduce the abundance and diversity of resident bird species.

Table 6: Species recorded during the study

Scientific Name	Common Name
<i>Mirafraba sabota</i>	Sabota Lark
<i>Fancolinus swainsonii</i>	Swainson's Spurfowl
<i>Fancolinus sephaena</i>	Crested Francolin
<i>Vanellus coronatus</i>	Crowned Lapwing
<i>Streptopelia senegalensis</i>	Laughing Dove
<i>Urocolinus indicus</i>	Redfaced Mousebird
<i>Upupa africana</i>	African Hoopoe
<i>Corvus albus</i>	Pied Crow
<i>Pyconotus barbatus</i>	Common Bulbul
<i>Cossypha humeralis</i>	Whitethroated Robin-Chat
<i>Zosterops pallidus</i>	Cape White-eye
<i>Acridotheres tristis*</i>	Indian Myna
<i>Nectarinia mariquensis</i>	Marico Sunbird
<i>Passer domesticus</i>	House Sparrow
<i>Ploceus velatus</i>	Southern Masked Weaver
<i>Uraeginthus angolensis</i>	Blue Waxbill
<i>Lagonosticta senegala</i>	Redbilled Firefinch
<i>Batis molitor</i>	Chinspot Batis

<i>Bubuculus ibis</i>	Cattle Egret
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8.3.3.1 Red Data and Protected avifauna

No bird species recorded during the 2015 survey are listed as Red Data or Protected species. This notwithstanding, of the 285 species recorded in the 2527AC quarter degree grid square and on SANBI's SIBIS database, six species are listed (Table 7). Although it is unlikely that any of these species would actively nest in the study area, considering the proximity of the Pilanesberg National Park their probability of occurrence is high.

Table 7: Avifauna species of concern possibly occurring in the study area

Scientific Name	Common name	IUCN Red Data List (2011)	NEM:BA Threatened and Protected Species List (2007)	Probability of occurrence
<i>Buphagus erythrorhynchus</i>	Red billed Oxpecker	Near threatened		High
<i>Gyps africanus</i>	African White-backed Vulture	Vulnerable	Endangered	High
<i>Gyps coprotheres</i>	Cape Griffon Vulture	Vulnerable	Endangered	High
<i>Polemaetus bellicosus</i>	Martial Eagle	Vulnerable	Vulnerable	High
<i>Pterocles gutturalis</i>	Yellow throated Sandgrouse	Near threatened		High
<i>Torgos tracheliotus</i>	Lappet-faced Vulture	Vulnerable	Endangered	High

8.3.4 Mammalia

A total of 5 mammal species were recorded during the survey of the study area (Table 8). Based on species distribution maps documented in Stuart & Stuart (1997), and considering the existing land uses in the general region, 83 species of mammal could potentially occur in the study area which has a mammal diversity ranking of medium-high (NW Biodiversity Inventory and Database 2003). The low mammal species diversity recorded during the survey can be attributed to direct and indirect disturbances resulting from anthropogenic impacts, as well as historic land uses such as agriculture and hunting. In addition, the poaching of small mammals by local communities in the study area and on the land may further reduce the diversity of mammals.

Table 8: Mammal species recorded

Scientific Name	Common Name	NEM:BA Threatened and Protected Species List (2007)	IUCN Red List of Threatened Species (2011)
<i>Lemniscomys rosalia</i>	Striped Mouse		Least concern
<i>Mastomys coucha</i>	Multimammate Mouse		Least concern
<i>Saccostomus campestris</i>	Pouched Mouse		Least concern
<i>Lepus saxatili</i>	Scrub Hare		Not listed
<i>Hystrix africaeaustralis</i>	Porcupine		Least concern

8.3.4.1 Red Data and Protected mammal species

Species recorded during the survey are common, with generally widespread distributions, and have accordingly been categorised as Least Concern on the IUCN Red Data List (2011).

Species of concern not observed during the site survey, but which show a regional distribution that includes the study area according to Stuart & Stuart (1997) are listed in Table 9.

Table 9: Mammal species of concern possibly occurring in the area

Scientific Name	Common Name	NEM:BA Threatened and Protected Species List (2007)	IUCN Red Data List (2011)	Probability of occurrence
<i>Neamblysomus julianae</i>	Juliana's Golden Mole	Vulnerable	Vulnerable	Low
<i>Amblysomus septentrionalis</i>	Highveld Golden Mole	Near Threatened		Low
<i>Eidolon helvum</i>	Straw-coloured Fruit-bat	Near Threatened		Low
<i>Parahyaena brunnea</i>	Brown Hyaena	Protected	Near Threatened	Low
<i>Mellivora capensis</i>	Honey Badger	Protected	Near Threatened	Low

8.4 Ecological Integrity

The precautionary principle was applied throughout the determination of the ecological function of the various vegetation communities. In instances where ecological function was found to be borderline between two categories, the community was classified in the higher category.

Much, if not all, of the vegetation within the study area has been disturbed, but in general the thornveld is of moderate ecological integrity. In addition, other anthropogenic activities including agriculture, livestock grazing and mining outside the study area have also disturbed large tracts of vegetation. This notwithstanding, at a landscape level these communities are important dispersal habitats, linking the mountainous Pilanesberg to the hills and ridges located in the study area, and to other habitats located north-west of the study area. Where not transformed or heavily degraded, the ecological function of the riparian zones and broadleaf bushveld can be considered high. The transformed and severely degraded areas have low ecological integrity.



Figure 3: Ecological integrity within the study area

8.5 Conservation Importance

The precautionary principle was applied throughout the determination of the conservation importance of the various vegetation communities. In instances where conservation importance was found to be borderline between two categories, the community was classified in the higher category.

The conservation importance of the broadleaf footslope vegetation is considered moderate, as although in large areas it has been transformed and disturbed, the presence of the Red Data species cannot be excluded (Figure 5).

Rivers (including non-perennial streams) are longitudinal ecosystems, and their condition at any point is a reflection of not only upstream activities, but also of those within adjacent and upstream parts of the catchment. River systems are subject to strict legislation (e.g. National Water Act) to protect the water resources in South Africa.

The majority of the area is characterised as being transformed or secondary vegetation communities and therefore have low conservation importance, due to the lack of species of conservation importance being present in, or reliant on these vegetation communities.

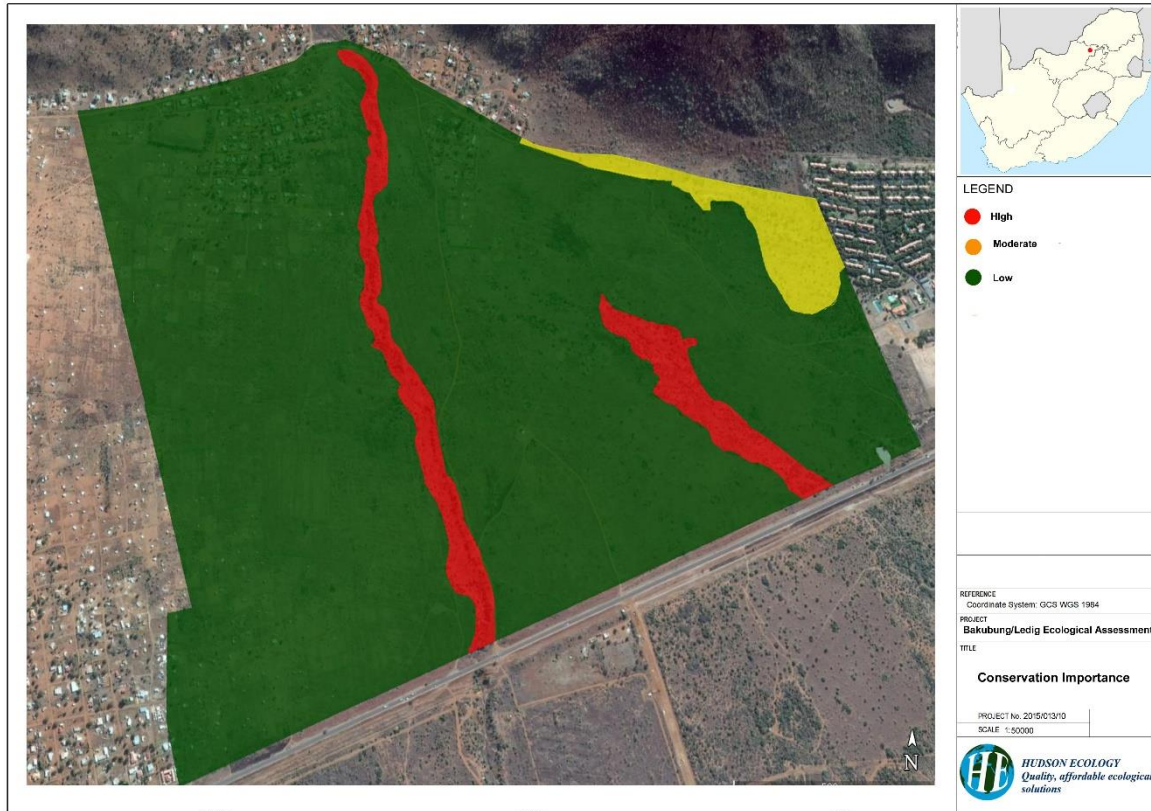


Figure 4: Conservation importance within the study area

9 DISCUSSION AND CONCLUSIONS

Based primarily on physiognomy, moisture regime, rockiness, slope, species composition and soil properties, four vegetation communities were recognised. Although, these communities were recorded as such, there is variation within these communities as a result of current and historic anthropogenic disturbance. The communities are:

- Secondary clay thornveld;
- Footslope broadleafed bushveld;
- Secondary turf thornveld; and
- Secondary riparian vegetation.

In addition, areas of complete or severe transformation and disturbance occur throughout the study area. These include inter alia, villages and roads, these areas were noted and delineated but not surveyed intensively.

No flora species of concern were observed or recorded during the site survey.

A total of 21 arthropod taxa, 4 reptile taxa, 0 amphibians, 19 birds and 5 mammal species were recorded during the 2015 site survey. None of the species recorded are listed as species of concern, but a small number of species of concern have a moderate probability of occurrence in the area.

Much, if not all, of the vegetation within the study area has been disturbed, but in general the thornveld is of moderate ecological integrity. In addition, other anthropogenic activities including agriculture, livestock grazing and mining outside the study area have also disturbed large tracts of vegetation. This notwithstanding, at a landscape level these communities are important dispersal habitats, linking the mountainous Pilanesberg to the hills and ridges located in the study area, and to other habitats located north-west of the study area.

Where not transformed or heavily degraded, the ecological function of the riparian zones and broadleaf bushveld can be considered high. The transformed and severely degraded areas have low ecological integrity.

The conservation importance of the broadleaf footslope vegetation is considered moderate, as although in large areas it has been transformed and disturbed, the presence of the Red Data species cannot be excluded (Figure 5).

Rivers (including non-perennial streams) are longitudinal ecosystems, and their condition at any point is a reflection of not only upstream activities, but also of those within adjacent and upstream parts of the catchment. River systems are subject to strict legislation (e.g. National Water Act) to protect the water resources in South Africa.

The majority of the area is characterised as being transformed or secondary vegetation communities and therefore have low conservation importance, due to the lack of species of conservation importance being present in, or reliant on these vegetation communities.

It is unlikely that development of this area will have any significantly detrimental effect on biodiversity of the area.



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APPENDIX A

Plant species recorded





Family	Species	Life Cycle	Growth Form
Poaceae	<i>Aristida canescens</i>	Perennial	Graminoid
Poaceae	<i>Aristida congesta</i> subsp. <i>barbicollis</i>	Annual	Graminoid
Poaceae	<i>Bothriochloa insculpta</i>	Annual	Graminoid
Poaceae	<i>Brachiaria eruciformis</i>	Annual	Graminoid
Poaceae	<i>Chrysopogon serrulatus</i>	Perennial	Graminoid
Poaceae	<i>Digitaria eriantha</i>	Perennial	Graminoid
Poaceae	<i>Enneapogon cenchroides</i>	Annual	Graminoid
Poaceae	<i>Eragrostis lehmanniana</i>	Perennial	Graminoid
Poaceae	<i>Eragrostis rigidior</i>	Annual	Graminoid
Poaceae	<i>Eustachys paspaloides</i>	Perennial	Graminoid
Poaceae	<i>Heteropogon contortus</i>	Perennial	Graminoid
Poaceae	<i>Hyparrhenia filipendula</i>	Perennial	Graminoid
Poaceae	<i>Hyparrhenia hirta</i>	Perennial	Graminoid
Poaceae	<i>Loudetia simplex</i>	Perennial	Graminoid
Poaceae	<i>Melinis repens</i>	Annual	Graminoid
Poaceae	<i>Panicum maximum</i>	Perennial	Graminoid
Poaceae	<i>Setaria pallide-fusca</i>	Annual	Graminoid
Poaceae	<i>Setaria verticillata</i>	Annual	Graminoid
Poaceae	<i>Themeda triandra</i>	Perennial	Graminoid
Poaceae	<i>Trachypogon spicatus</i>	Perennial	Graminoid
Poaceae	<i>Tricholaena monachne</i>	Annual	Graminoid
Poaceae	<i>Urochloa mosambicensis</i>	Perennial	Graminoid
Malvaceae	<i>Sida cordifolia</i>	Annual	Forb
Asteraceae	<i>Tagetes minuta</i> *	Annual	Herb
Velloziaceae	<i>Xerophyta retinervis</i>	Deciduous	Forb
Asparagaceae	<i>Asparagus laricinus</i>	Perennial	Forb
Asteraceae	<i>Bidens pilosa</i> *	Annual	Forb
Malvaceae	<i>Sida cordifolia</i>	Annual	Forb
Solanaceae	<i>Solanum panduriforme</i>	Perennial	Herb
Mimosaceae	<i>Acacia burkei</i>	Perennial	Tree
Mimosaceae	<i>Acacia caffra</i>	Perennial	Tree
Mimosaceae	<i>Acacia karroo</i>	Perennial	Tree





Mimosaceae	<i>Acacia tortilis</i>	Perennial	Tree
Combretaceae	<i>Combretum imberbe</i> Φ	Perennial	Tree
Combretaceae	<i>Combretum molle</i>	Perennial	Tree
Burseraceae	<i>Commiphora pyracanthoides</i>	Perennial	Tree
Euphorbiaceae	<i>Croton gratissimus</i>	Perennial	Tree
Mimosaceae	<i>Dichrostachys cinerea</i>	Perennial	Tree
Sterculiaceae	<i>Dombeya rotundifolia</i>	Perennial	Tree
Ebenaceae	<i>Euclea natalensis</i>	Perennial	Tree
Euphorbiaceae	<i>Euphorbia ingens</i>	Succulent	Tree
Tiliaceae	<i>Grewia flavescens</i>	Perennial	Tree
Tiliaceae	<i>Grewia monticola</i>	Perennial	Tree
Celastraceae	<i>Gymnosporia buxifolia</i>	Evergreen	Tree
Fabaceae	<i>Mundulea sericea</i>	Perennial	Tree
Santalaceae	<i>Osyris quadripartita</i>	Evergreen	Tree
Anacardiaceae	<i>Ozoroa paniculosa</i>	Deciduous	Tree
Sapindaceae	<i>Papea capensis</i>	Deciduous	Tree
Caesalpiniaceae	<i>Peltophorum africanum</i>	Deciduous	Tree
Anacardiaceae	<i>Rhus pyroides</i>	Deciduous	Tree
Anacardiaceae	<i>Scelocarya birrea</i> Φ	Deciduous	Tree
Asteraceae	<i>Tarconanthus camphoratus</i>	Deciduous	Tree
Rubiaceae	<i>Vangueria infausta</i>	Deciduous	Tree
Verbenaceae	<i>Vitex zeyheri</i>	Deciduous	Tree
Rhamnacea	<i>Ziziphus mucronata</i>	Deciduous	Tree





APPENDIX B

Reptile species occurring in the region of the study area





Scientific Name	Common name
Reptiles	
<i>Homopholis wahlbergi</i>	Velvety Gecko
<i>Hemidactylus mabouia</i>	Tropical Gecko
<i>Lygodactylus c. capensis</i>	Common Dwarf Gecko
<i>Pachydactylus affinis</i>	Transvaal Thicktoed Gecko
<i>Pachydactylus capensis</i>	-Cape Thicktoed Gecko
<i>Pachydactylus turneri</i>	Turners Thicktoed Gecko
<i>Acanthocercus atricollis</i>	Tree Agama
<i>Agama aculeata distanti</i>	Spiny Agama
<i>Agama atra atra</i>	Southern Rock Agama
<i>Chamaeleo d. dilepis</i>	Flap-necked Chameleon
<i>Mabuya varia varia</i>	-Variegated Skink
<i>Mabuya striata punctatissimus</i>	Stripped Skink
<i>Mabuya capensis</i>	Three-lined Skink
<i>Lygosoma s. sundevallii</i>	Sundeval's Skink
<i>Panaspis wahlbergii</i>	Snake-eyed Skink
<i>Acontias percevalli occidentalis</i>	Percival's Legless Skink
<i>Nucras holobi</i>	Holob's Sand Lizard
<i>Nucras intertexta</i>	Spotted Sand Lizard
<i>Ichnotropis squamulosa</i>	Rough-scaled Lizard





<i>Ichnotropis capensis</i>	Cape Rough-scaled Sand Lizard
<i>Cordylus tropidosternum jonesii</i>	Jones' Girdled Lizard
<i>Cordylus vittifer</i>	Transvaal Girdled Lizard
<i>Gerrhosaurus flavigularis</i>	Yellow-throated Plated Lizard
<i>Varanus albigularis albigularis</i>	Rock / Tree Leguaan
<i>Varanus niloticus</i>	Water Leguaan
<i>Monopeltis infuscata</i>	Cape Worm-lizard
<i>Typhlops bibronii</i>	Bibron's Blind Snake
<i>Rhinotyphlops lalandei</i>	Lalande's Blind Snake
<i>Leptotyphlops s. scutifrons</i>	Peters' Thread Snake
<i>Leptotyphlops distanti</i>	Distant's Tread Snake
<i>Python sebae natalensis</i>	African Python
<i>Lycodonomorphus rufulus</i>	Brown Water Snake
<i>Lamprophis fuliginosus</i>	Brown House Snake
<i>Lycophidion c. capense</i>	Cape Wolf Snake
<i>Mehelya c. capensis</i>	Cape File Snake
<i>Mehelya nyassae</i>	Black File Snake
<i>Philothamnus semivariegatus</i>	Spotted Bush Snake
<i>Philothamnus hoplogaster</i>	Green Water Snake
<i>Philothamnus natalensis occidentalis</i>	Natal Green Snake
<i>Prosymna bivittata</i>	Twinstriped Shovel-snout





<i>Prosymna s. sundevallii</i>	Lined Shovel-snout
<i>Pseudaspis cana</i>	Mole Snake
<i>Dasypeltis scabra</i>	Common Egg-eater
<i>Telescopus s. semiannulatus</i>	Eastern Tiger Snake
<i>Crotaphopeltis hotamboeia</i>	Herald Snake
<i>Dispholidus t. typus</i>	Tree Snake
<i>Thelotornis c. capensis</i>	Vine Snake
<i>Psammophylax tritaeniatus</i>	Striped Skaapsteker
<i>Psammophis s. subtaeniatus</i>	Yellow-bellied Sand Snake
<i>Psammophis b. brevirostris</i>	Short-snouted Sand Snake
<i>Psammophis leightoni trinasalis</i>	Fork-marked Sand Snake
<i>Psammophis angolensis</i>	Pygmy Sand Snake
<i>Aparallactus capensis</i>	Black-headed Centipede-eater
<i>Atractaspis bibronii</i>	Side-stabbing Snake
<i>Aspidelaps s. scutatus</i>	Shield-nose snake
<i>Elapsoidea boulengeri</i>	Half-banded Garter Snake
<i>Naja a. annulifera</i>	Snouted Cobra
<i>Naja mossambica</i>	Mozambique Spitting Cobra





<i>Dendroaspis polylepis</i>	Black Mamba
<i>Causus rhombeatus</i>	Rhombic Night Adder
<i>Bitis a. arietans</i>	Puff-adder
<i>Geochelone pardalis babcocki</i>	Leopard tortoise
<i>Kinixys lobatsiana</i>	Lobatse Hinged-back Tortoise
<i>Pelomedusa subrufa</i>	Marsh Terrapin
<i>Pelusios sinuatus</i>	Serrated Terrapin





APPENDIX C

Amphibian species occurring in the region of the study area





Amphibians	
<i>Xenopus laevis laevis</i>	Common Platanna
<i>Bufo gutturalis</i>	Common Toad
<i>Bufo garmani</i>	Olive Toad
<i>Schismaderma carens</i>	Red Toad
<i>Bufo fenoulheti</i>	Northern Pygmy Toad
<i>Breviceps adspersus adspersus</i>	Bushveld Rainfrog
<i>Phrynomantis bifasciatus</i>	Red-banded rubber Frog
<i>Pyxicephalus adspersus</i>	Bullfrog
<i>Pyxicephalus edulis</i>	African Bullfrog
<i>Tomopterna cryptotis</i>	Tremelo Sand Frog
<i>Tomopterna natalensis</i>	Natal Sand Frog
<i>Afrana angolensis</i>	Common Rana
<i>Ptychadena anchietae</i>	Plain Grass Frog
<i>Ptychadena mossambica</i>	Broad-banded Grass Frog
<i>Phrynobatrachus natalensis</i>	Snoring Puddle Frog
<i>Cacosternum boettgeri</i>	Common Caco
<i>Chiromantis xerampelina</i>	Foam Nest Frog
<i>Kassina senegalensis</i>	Bubbling Kassina





APPENDIX D

Avifauna species occurring in the region of the study area





Sasol Page No	Full Name	Scientific Name	RD (Regional, Global)	S	E
62	Western Cattle Egret	<i>Bubulcus ibis</i>			
72	Hamerkop	<i>Scopus umbretta</i>			
86	White-backed Vulture	<i>Gyps africanus</i>	EN, EN		
86	Cape Vulture	<i>Gyps coprotheres</i>	EN, VU		
86	Lappet-faced Vulture	<i>Torgos tracheliotos</i>	EN, VU		
94	Brown Snake Eagle	<i>Circaetus cinereus</i>			
94	Black-chested Snake Eagle	<i>Circaetus pectoralis</i>			
100	Verreauxs' Eagle	<i>Aquila verreauxii</i>	VU, LC		
100	Martial Eagle	<i>Polemaetus bellicosus</i>	EN, VU		
106	Common (Steppe) Buzzard	<i>Buteo buteo</i>			
112	Black-shouldered Kite	<i>Elanus caeruleus</i>			
112	Pale Chanting Goshawk	<i>Melierax canorus</i>			
118	Gabar Goshawk	<i>Melierax gabar</i>			
128	Greater Kestrel	<i>Falco rupicoloides</i>			
136	Natal Spurfowl	<i>Pternistis natalensis</i>			
136	Swainson's Spurfowl	<i>Pternistis swainsonii</i>			
140	Crested Francolin	<i>Dendroperdix sephaena</i>			
142	Helmeted Guineafowl	<i>Numida meleagris</i>			
144	Common (Kurrichane) Buttonquail	<i>Turnix sylvaticus</i>			
168	Crowned Lapwing	<i>Vanellus coronatus</i>			





170	Blacksmith Lapwing	<i>Vanellus armatus</i>			
218	Yellow-throated Sandgrouse	<i>Pterocles gutturalis</i>	NT, LC		
220	Speckled Pigeon	<i>Columba guinea</i>			
222	Cape Turtle Dove	<i>Streptopelia capicola</i>			
222	Red-eyed Dove	<i>Streptopelia semitorquata</i>			
222	Laughing Dove	<i>Streptopelia senegalensis</i>			
224	Namaqua Dove	<i>Oena capensis</i>			
230	Grey Go-away-bird	<i>Corythaixoides concolor</i>			
236	Diederik Cuckoo	<i>Chrysococcyx caprius</i>			
240	Western Barn Owl	<i>Tyto alba</i>			
242	Pearl-spotted Owlet	<i>Glaucidium perlatum</i>			
250	Little Swift	<i>Apus affinis</i>			
250	White-rumped Swift	<i>Apus caffer</i>			
250	Horus Swift	<i>Apus horus</i>			
252	Red-faced Mousebird	<i>Urocolius indicus</i>			
256	Brown-hooded Kingfisher	<i>Halcyon albiventris</i>			
256	Striped Kingfisher	<i>Halcyon chelicuti</i>			
256	Grey-headed Kingfisher	<i>Halcyon leucocephala</i>			
258	European Bee-eater	<i>Merops apiaster</i>			
260	Little Bee-eater	<i>Merops pusillus</i>			
262	Lilac-breasted Roller	<i>Coracias caudatus</i>			





266	Southern Yellow-billed Hornbill	<i>Tockus leucomelas</i>			
266	African Grey Hornbill	<i>Tockus nasutus</i>			
266	Southern Red-billed Hornbill	<i>Tockus rufigrostris</i>			
268	Common Scimitarbill	<i>Rhinopomastus cyanomelas</i>			
270	Greater Honeyguide	<i>Indicator indicator</i>			
272	Black-collared Barbet	<i>Lybius torquatus</i>			
272	Crested Barbet	<i>Trachyphonus vaillantii</i>			
274	Acacia Pied Barbet	<i>Tricholaema leucomelas</i>			
278	Cardinal Woodpecker	<i>Dendropicos fuscescens</i>			
278	Bearded Woodpecker	<i>Dendropicos namaquus</i>			
284	Sabota Lark	<i>Calendulauda sabota</i>			
290	Chestnut-backed Sparrow-lark	<i>Eremopterix leucotis</i>			
292	Lesser Striped Swallow	<i>Cecropis abyssinica</i>			
292	Red-breasted Swallow	<i>Cecropis semirufa</i>			
300	Fork-tailed Drongo	<i>Dicrurus adsimilis</i>			
304	Pied crow	<i>Corvus albus</i>			
304	Cape Crow	<i>Corvus capensis</i>			





306	Ashy Tit	<i>Parus cinerascens</i>			
306	Southern Black Tit	<i>Parus niger</i>			
308	Southern Pied Babbler	<i>Turdoides bicolor</i>			
308	Arrow-marked Babbler	<i>Turdoides jardineii</i>			
310	Dark-capped Bulbul	<i>Pycnonotus tricolor</i>			
314	Kurrichane Thrush	<i>Turdus libonyanus</i>			
314	Groundscraper Thrush	<i>Turdus litsitsirupa</i>			
316	Short-toed Rock Thrush	<i>Monticola brevipes</i>			
318	Familiar Chat	<i>Cercomela familiaris</i>			
320	African StoneChat	<i>Saxicola torquatus</i>			
322	Mocking Cliff Chat	<i>Thamnolaea cinnamomeiventris</i>			
324	White-throated Robin-Chat	<i>Cossypha humeralis</i>			
326	White-browed Scrub Robin	<i>Erythropygia leucophrys</i>			
326	Kalahari Scrub Robin	<i>Erythropygia paena</i>			
332	Grey Penduline-Tit	<i>Anthoscopus minutus</i>			
332	Yellow-bellied Eremomela	<i>Eremomela icteropygialis</i>			
332	Burnt-necked Eremomela	<i>Eremomela usticollis</i>			
340	Grey-backed Camaroptera	<i>Camaroptera brevicaudata</i>			
342	Chestnut-vented Tit-Babbler	<i>Sylvia subcaerulea</i>			





342	Long-billed crombec	<i>Sylvietta rufescens</i>			
344	Bar-throated Apalis	<i>Apalis thoracica</i>			
346	Neddicky	<i>Cisticola fulvicapilla</i>			
348	Rattling Cisticola	<i>Cisticola chiniana</i>			
352	Black-chested Prinia	<i>Prinia flavicans</i>			
352	Tawny-flanked Prinia	<i>Prinia subflava</i>			
354	Fiscal Flycatcher	<i>Sigelus silens</i>			(*)
356	Marico flycatcher	<i>Bradornis mariquensis</i>			
360	Chin-spot Batis	<i>Batis molitor</i>			
362	Cape Wagtail	<i>Motacilla capensis</i>			
366	African Pipit	<i>Anthus cinnamomeus</i>			
366	Buffy Pipit	<i>Anthus vaalensis</i>			
368	Striped Pipit	<i>Anthus lineiventris</i>			
372	Crimson-breasted Shrike	<i>Laniarius atrococcineus</i>			
372	Southern (Common) Fiscal	<i>Lanius collaris</i>			
374	Brown-crowned Tchagra	<i>Tchagra australis</i>			
374	Black-crowned Tchagra	<i>Tchagra senegalus</i>			
376	Orange-breasted Bush-Shrike	<i>Chlorophoneus sulfureopectus</i>			
378	Black-backed Puffback	<i>Dryoscopus cubla</i>			
378	Brubru	<i>Nilaus afer</i>			
380	Cape Glossy Starling	<i>Lamprotornis nitens</i>			





384	Red-billed Oxpecker	<i>Buphagus erythrorhynchus</i>		
384	Wattled Starling	<i>Creatophora cinerea</i>		
388	Amethyst Sunbird	<i>Chalcomitra amethystina</i>		
390	White-bellied Sunbird	<i>Cinnyris talatala</i>		
392	Marico Sunbird	<i>Cinnyris mariquensis</i>		
394	Yellow-throated Petronia	<i>Gymnoris superciliaris</i>		
394	Southern Grey-headed Sparrow	<i>Passer diffusus</i>		
394	House Sparrow	<i>Passer domesticus</i>	I	
394	Cape Sparrow	<i>Passer melanurus</i>		
394	Great Sparrow	<i>Passer motitensis</i>		
396	Red-billed Buffalo Weaver	<i>Bubalornis niger</i>		
396	White-browed Sparrow-Weaver	<i>Plocepasser mahali</i>		
398	Southern Masked Weaver	<i>Ploceus velatus</i>		
402	Red-billed Quelea	<i>Quelea quelea</i>		
404	White-winged Widowbird	<i>Euplectes albonotatus</i>		
406	Pin-tailed Whydah	<i>Vidua macroura</i>		
406	Broad-tailed Paradise Whydah	<i>Vidua obtusa</i>	V	
406	Shaft-tailed Whydah	<i>Vidua regia</i>		
410	Jameson's Firefinch	<i>Lagonosticta rhodopareia</i>		
410	Red-billed Firefinch	<i>Lagonosticta senegala</i>		
412	Black-faced Waxbill	<i>Estrilda erythronotos</i>		





412	Blue Waxbill	<i>Uraeginthus angolensis</i>			
412	Violet-eared Waxbill	<i>Uraeginthus granatinus</i>			
414	Red-headed Finch	<i>Amadina erythrocephala</i>			
414	Cut-throat Finch	<i>Amadina fasciata</i>			
414	Scaly-feathered Finch	<i>Sporopipes squamifrons</i>			
416	Green-winged Pytilia	<i>Pytilia melba</i>			
420	Yellow-fronted Canary	<i>Crithagra mozambica</i>			
424	Golden-breasted Bunting	<i>Emberiza flaviventris</i>			
424	Cinnamon-breasted Bunting	<i>Emberiza tahapisi</i>			

Red Data (RD); Regional*, Global

CR = Critically Endangered

EN = Endangered

VU = Vulnerable

NT = Near Threatened

LC = Least Concern

EX = Extinct (regionally)

DD= Data Deficient

NR= Not Recognised by BirdLife International

NA = Not Assessed

Status in South Africa (S)

V = vagrant

I = introduced

Endemism in south Africa (E)

Endemism in South Africa (E) (not southern Africa as in field guides)

* = endemic

SLS = endemic to South Africa, Lesotho and Swaziland

(*) = near endemic (i.e. ~70% or more of population in RSA)

B* = breeding endemic

BLS = breeding South Africa, Lesotho and Swaziland endemic

W* = winter endemic





§ = Refer to footnote

**The 2014 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland*





APPENDIX E

Mammal species occurring in the region of the study area



Scientific Name	Common name
<i>Neamblysomus julianae</i>	Juliana's Golden Mole
<i>Amblysomus septentrionalis</i>	Highveld Golden Mole
<i>Elephantulus brachyrhynchus</i>	Short-snouted Sengi
<i>Elephantulus myurus</i>	Eastern Rock Sengi
<i>Atelerix frontalis</i>	Southern African Hedgehog
<i>Mysorex varius</i>	Forest Shrew
<i>Crocidura mariquensis</i>	Swamp Musk Shrew
<i>Crocidura fuscomurina</i>	Tiny Musk Shrew
<i>Crocidura cyanea</i>	Reddish-grey Musk Shrew
<i>Crocidura silacea</i>	Lesser Grey Musk Shrew
<i>Crocidura hirta</i>	Lesser Red Musk Shrew
<i>Eidolon helvum</i>	Straw-coloured Fruit-bat
<i>Hipposideros caffer</i>	Sundevall's Leaf-nosed Bat
<i>Cloeotis percivali</i>	Short-eared Trident Bat
<i>Nycteris thebiaca</i>	Egyptian Slit-faced Bat
<i>Rhinolophus clivosus</i>	Geoffrey's Horseshoe Bat
<i>Rhinolophus darlingi</i>	Darling's Horseshoe Bat
<i>Rhinolophus blasii</i>	Peak-saddle Horseshoe Bat
<i>Rhinolophus simulator</i>	Bushveld Horseshoe Bat
<i>Miniopterus schreibersii</i>	Schrieber's Long-fingered Bat
<i>Myotis welwitschii</i>	Welwitch's Hairy Bat
<i>Myotis tricolor</i>	Temminck's Hairy Bat



<i>Neoromicia capensis</i>	Cape Serotine Bat
<i>Pipistrellus hesperidus</i>	African Pipistrelle
<i>Scotophilus dinganii</i>	Yellow House Bat
<i>Tadarida aegyptiaca</i>	Egyptian Free-tailed Bat
<i>Papio cynocephalus ursinus</i>	Savanna Baboon
<i>Cercopithecus pygerythrus</i>	Vervet Monkey
<i>Galago moholi</i>	Southern Lesser Galago
<i>Manis temminckii</i>	Ground Pangolin
<i>Lepus saxatillis</i>	Scrub Hare
<i>Pronolagus randensis</i>	Jameson's Red Rock Rabbit
<i>Paraxerus cepapi</i>	Tree Squirrel
<i>Cryptomys hottentotus</i>	Common (African) Mole-rat
<i>Hystrix africaeaustralis</i>	Cape Porcupine
<i>Thryonomys swinderianus</i>	Greater Cane-rat
<i>Saccostomus campestris</i>	Pouched Mouse
<i>Steatomys pratensis</i>	Fat Mouse
<i>Dendromus melanotis</i>	Grey Climbing Mouse
<i>Desmodillus auricularis</i>	Cape Short-tailed Gerbil
<i>Tatera leucogaster</i>	Bushveld Gerbil
<i>Tatera brantsii</i>	Highveld Gerbil
<i>Acomys spinosissimus</i>	Spiny Mouse
<i>Michaelamys namaquensis</i>	Namaqua Rock Mouse
<i>Aethomys chrysophilus</i>	Red Veld Rat





<i>Rhabdomys pumilio</i>	Four-striped Grass Mouse
<i>Lemniscomys rosalia</i>	Single-striped Grass Mouse
<i>Mus minutoides</i>	Pygmy Mouse
<i>Mus musculus*</i>	House Mouse
<i>Thallomys paedulcus</i>	Acacia Rat
<i>Mastomys coucha</i>	Southern Multimammate Mouse
<i>Rattus rattus*</i>	House Rat
<i>Otomys angoniensis</i>	Angoni Vlei Rat
<i>Otomys irroratus</i>	Vlei Rat
<i>Vulpes chama</i>	Cape Fox
<i>Otocyon megalotis</i>	Bat-eared Fox
<i>Canis mesomelas</i>	Black-backed Jackal
<i>Aonyx capensis</i>	Cape Clawless Otter
<i>Mellivora capensis</i>	Honey Badger (Ratel)
<i>Poecilogale albinucha</i>	African Striped Weasel
<i>Ictonyx striatus</i>	Striped Polecat
<i>Mungos mungo</i>	Banded Mongoose
<i>Gallerella sanguinea</i>	Slender Mongoose
<i>Attilax paludinosus</i>	Water (Marsh) Mongoose
<i>Helogale parvula</i>	Dwarf Mongoose





<i>Ichneumia albicauda</i>	White-tailed Mongoose
<i>Cynictis penicillata</i>	Yellow Mongoose
<i>Genetta genetta</i>	Small-spotted Genet
<i>Genetta tigrina</i>	South African Large-spotted Genet
<i>Civettictis civetta</i>	African Civet
<i>Parahyaena brunnea</i>	Brown Hyaena
<i>Proteles cristatus</i>	Aardwolf
<i>Felis silvestris lybica</i>	African Wild Cat
<i>Leptailurus serval</i>	Serval
<i>Caracal caracal</i>	Caracal
<i>Procavia capensis</i>	Rock Dassie (Hyrax)
<i>Phacochoerus africanus</i>	Common Warthog
<i>Potamochoerus larvatus</i>	Bushpig
<i>Redunca fulvorufula</i>	Mountain Reedbuck
<i>Redunca arundinum</i>	Common (Southern) Reedbuck
<i>Pelea capreolus</i>	Grey Rhebok
<i>Oreotragus oreotragus</i>	Klipspringer
<i>Raphicerus campestris</i>	Steenbok
<i>Sylvicapra grimmia</i>	Common Duiker
Source: (Stuart & Stuart, 1997) and (Skinner & Smithers, 1990)	





APPENDIX F

Details of Specialist



Appointment of specialist

Hudson Ecology Pty Ltd was commissioned by K2M Environmental (Pty) Ltd to provide specialist consulting services for the Environmental Impact Assessment for the proposed Bakubung Ledig Project in the North West Province. The consulting services comprise an assessment of potential impacts on the flora, fauna, vegetation and ecology in the study area by the proposed project.

Details of specialist

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Summary of expertise

Adrian Hudson is the owner, director and senior ecologist Hudson Ecology Pty Ltd. In this role, he provides assessments which encompass all aspects of terrestrial and wetland ecological studies including (but not limited to) baseline ecological assessments, ecological impact assessments and biodiversity management plans. He also has considerable experience in conservation, and conducted studies in veld management, stocking rates (wildlife and domestic) for a number of companies and organisations. Projects, unless otherwise requested by the client, are conducted according to the IFC Performance standard 6 criteria and Adrian Hudson is, therefore, au fait with the requirements and criteria of the Standard. Adrian has reviewed a number of projects throughout Africa for IFC Performance Standard 6 compliance, including Hassai Gold Mine in Sudan and Konkola North Copper mine in Zambia.

Adrian Hudson is a qualified ecologist and ornithologist who holds a Master's of Science degree in Ecology from the North West University and is currently completing his PhD in Ecology at the same institution. Adrian is currently still closely associated with the university as a supervisor for Honours and Masters degree students, lecturing of short courses at the university and co-authoring of scientific articles with faculty members of the university. Adrian is a member of the Zoological Society of Southern Africa and the International Society of Conservation Biology. Adrian is also a member of the Department of Environmental Affairs and Tourism (South African Government Department) roster of experts on ecology and desertification and a reviewer for a number of internationally accredited scientific journals. He is also accredited with authorship of a number of articles published in scientific journals.

Before founding Hudson Ecology Pty Ltd. in September 2014, Adrian worked for 18 years for a diverse range of organizations, including Natal Parks Board, North West University, United Nations Environmental Program /Global Environment Facility, ECOSUN cc and Golder Associates Africa Pty Ltd. In these roles, Adrian was responsible for anti- poaching, lecturing, research and consulting respectively. Thus far Adrian has worked as a consulting ecologist on more than 90 projects in 20 countries, including projects in Angola, South Africa, Lesotho, Swaziland, Namibia, Botswana, Mozambique, Zambia, Tanzania, Central African Republic, Democratic Republic of Congo, Sudan, Guinea, Guinea-Bissau, Uzbekistan and Liberia.

Independence

Hudson Ecology Pty Ltd and its Directors have no connection with K2M Environmental is not a subsidiary, legally or financially, of the proponent. Remuneration for services by the proponent in relation to this project is not linked to approval by decision-making authorities responsible for authorising this proposed project and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project. Adrian Hudson is an independent consultant to K2M Environmental and has no business, financial, personal or other interest in the activity, application or appeal in respect of which he was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of this specialist performing such work. The percentage work received directly or indirectly from the proponent in the last twelve months is approximately 0% of turnover.

Scope and purpose of report

The scope and purpose of the report are reflected in the —Terms of reference section of this report

Conditions relating to this report

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