
Fauna and Flora Baseline Study for the De Wittekrans Project Mpumalanga, South Africa

Prepared for GCS (Pty) Ltd.

By

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Executive Summary

Mashala Resources (Pty) Ltd is planning to develop a coal mine south of the town of Hendrina in the Mpumalanga province on a series of farms collectively known as the De Wittekrans project. In compliance with current legislation, they have embarked on the process to acquire environmental authorisation from the relevant authorities for their proposed mining activities. GCS (Pty) Ltd. commissioned Resource Management Services (REMS) to conduct a Faunal and Floral Assessment of the area to identify the potential direct and indirect impacts of future mining, to recommend management measures to minimise or prevent these impacts on these ecosystems and to highlight potential areas of conservation importance. This is the wet season survey which was done in the November 2008.

The study area is located within the highveld grasslands of the Msukaligwa Local Municipality in the Gert Sibande District Municipality in Mpumalanga Province on the farms Tweefontein 203 IS (RE of Portion 1); De Wittekrans 218 IS (RE of Portion 1 and Portion 2, Portions 7, 11, 10 and 5); Groblershoek 191 IS; Groblershoop 192 IS; and Israel 207 IS.

Within this region, precipitation occurs mainly in the summer months of October to March with the peak of the rainy season occurring from November to January. The majority of the site is dominated by Eastern Highveld Grassland. This vegetation unit is rated Endangered and it has been found that 72% of the Eastern Highveld Grassland is under medium pressure from mining developments. Only 0.8% of these grasslands are under statutory reserves. About 1800 ha of the study area is converted to agriculture (crop farming), approximately 18% is hydromorphic grassland and tributaries associated with the Klien Olifants River, 3% is represented by rocky outcrops and 27% is considered natural (upland) grasslands. The natural, rocky and hydromorphic grasslands consisted of a number of vegetation communities including *Seriphium plumosum* (*Stoebe vulgaris*) - *Eragrostis chloromelas* Disturbed Grassland; *Themeda triandra* - *Heteropogon contortus* Rocky Grassland; *Tristachya leucothrix* - *Diospyros lycoides* Rocky Outcrops; *Scirpoides burkei* - *Helichrysum aureonitens* Damp Grassland; *Sorghum versicolor* - *Monopsis decipiens* Moist Grassland; *Andropogon appendiculatus* - *Kyllinga erecta* Moist Grassland; *Fuirena pubescens* - *Centella asiatica* Moist Grassland. The only Red Data plant species recorded within these communities was *Eucomis autumnalis* (least concern - declining) found in the *A. appendiculatus* - *K. erecta* community. Several plants protected by Mpumalanga provincial legislation were located; *Crinum bulbispermum* found within all the hydromorphic grassland type, *Gladiolus daleni* located within the *T. leucothrix* - *D. lycoides* rocky outcrops, *Dia woodii* in the *A. appendiculatus* - *K. erecta* community and the *F. pubescens* - *C. asiatica* community. Several plants used in traditional medicine were identified in the above communities. Approximately 1.5% of the study area was covered by alien bushclumps and herbaceous alien species, associated mainly with agricultural fields and the the corridors between cropping areas.

In terms of faunal species, certain areas within the study site were rich in biodiversity and Conservation Important Species. Approximately 23 mammal species, 74 avifaunal species, 10 reptiles and amphibians and 34 invertebrate species were recorded during the survey. Conservation Important faunal species included:

1. Avifauna

The following vulnerable species, *Ciconia nigra* (Black Stork) along the Klien Olifants River System; and *Eupodotis caerulescens* (Blue Korhaans) within the *S. plumosum* (*Stoebe vulgaris*) – *E. chloromelas* Disturbed Grassland.

2. Mammals

The following near threatened species, *Leptailurus serval* (Serval) – identified by local farmers and therefore expected in the hydromorphic grasslands and *Atelerix frontalis* (South African Hedgehog) – identified by local farmers in the rockier grasslands; Near threatened, *Crocidura* (shrew) species within the hydromorphic grasslands, Data is deficient on their abundance and range.

3. Reptiles

The near threatened *Homoroselaps lacteus* (Spotted Harlequin Snake) within the *T. triandra* – *H. contortus* Rocky Grassland,.

Although no Conservation Important invertebrate species were recorded during the survey, habitat for *Metisella mennix* (Marsh Sylph) did occur within the tributaries to the Klien Olifants River System, where patches of the grass *Leersia hexandra* were recorded.

Based on the provided layout (indicating opencast and underground areas), highly sensitive areas will become negatively affected during the mining operations (particularly the open cast mining activities). Of greatest concern, are the effects of the mining operation on the Klien Olifants River associated hydromorphic grasslands and the adjacent rocky outcrops associated with this ecosystem. Therefore it has been recommended that a buffer of 250m be incorporated along with these areas into an Open Space System (approximately 40% of the open cast mining area). This has been further supported by the fact that further development within the area (mining, increased road infrastructure, expansion of rural communities due to new mining projects) will cause an increase in habitat fragmentation. Fragmentation creates many 'problems' for various organisms living in these habitats. Genetic isolation, limitation of dispersal and migration, and the decline of populations of animals requiring large territories are the most common problems connected with fragmentation. Therefore linkages between natural areas, and the wetland systems are essential in maintaining faunal movement (migration corridors) and dispersal of floristic species. In terms of biodiversity offsets, within the case of the Klein Olifants River, it is strongly recommended that attempts are made to rather conserve this system both as an important water resource within the Upper Olifants Catchment and as habitat for fauna and flora species

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List of Definitions

- Avifauna:** Birds are bipedal, warm-blooded, egg-laying vertebrates characterized primarily by feathers, forelimbs modified as wings, and hollow bones
- Biodiversity:** The variability among living organisms on the earth, including the variability within and between species and within and between ecosystems
- Biome:** Broadest division of a continent into natural units that share common ecological processes and species.
- Catchment:** The area of land drained by a river system, or a place set aside for collecting water which runs off the surface of the land.
- Conservation:** The wise use of natural resources (nutrients, minerals, water, plants, animals, etc.). Planned action or non-action to preserve or protect living and non-living resources.
- Ecological:** Ecology, or ecological science, is the study of the distribution and abundance of living organisms and how these properties are affected by interactions between the organisms and their environment.
- Ecosystem:** The complex of a community of organisms and its environment functioning as an ecological unit.
- Endemic:** Native to or confined to a certain region.
- Forb:** A broad-leaved herb other than a grass, especially one growing in a field, prairie, or meadow
- Grass:** Members of the Poaceae family. Any of various plants having slender leaves characteristic of the grass family.
- Habitat:** The area or environment where an organism or ecological community normally lives or occurs
- Herpetofauna:** The group name given to reptiles and amphibians combined.
- Hydromorphic:** Soil which is permanently or seasonally waterlogged

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- Invertebrate:** Organism that does not have vertebrae i.e. does not have a developed spine. Includes insects, snails (molluscs), worms (macro invertebrates) and smaller organisms such as mites, arthropods and collembolla (micro invertebrates).
- Precipitation:** the quantity of water falling to earth at a specific place within a specified period of time.
- Species:** A class that is defined by the common attribute or attributes possessed by all its members

List of Acronyms

CBNRM	Community Based Natural Resource Management
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora.
CR	Critically Endangered
EN	Endangered
EMPR	Environmental Management Programme Report
EMP	Environmental Management Programme
EIA	Environmental Impact Assessment
HDI	Historically Disadvantaged Individual
ICMM	International Council on Mining and Metals
mamsl	metres above mean sea level
MAP	Mean Annual Precipitation
MBCP	Mpumalanga Biodiversity Conservation Plan
NBSAP	National Biodiversity Strategy and Action Plan
NEPAD	New Partnership for Africa's Development
PS	Protected Species
REMS	Resource Management Services
QDS	Quarter Degree Square
SASS	South African Scoring System
TSP	Threatened Species Programme of South African National Biodiversity Institute
ToR	Terms of Reference
UNCCD	United Nations Convention to Combat Desertification
UNFCC	United Nations Framework Convention on Climate Change
VU	Vulnerable

Introduction

Mashala Resources (Pty) Ltd is planning to develop two coal mines south of the town of Hendrina. The mines are called the Knapdaar project and the DeWittekrans project. Both proposed mines span multiple farms. Mashala Resources will employ both an opencast and an underground mining method for the proposed projects. This report focuses on the DeWittekrans project.

In compliance with current legislation, Mashala Resources has embarked on the process to acquire environmental authorisation from the relevant authorities for their proposed mining activities. Included in this, is the investigation of the current status of biodiversity (terrestrial fauna and floral components). In South Africa the governments' commitment to the preservation of biodiversity is embodied within the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) which provided for:

- ◆ The management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act, 1998;
- ◆ The protection of species and ecosystems that warrant national protection;
- ◆ The sustainable use of indigenous biological resources; the fair and equitable sharing of benefits arising from bio prospecting involving indigenous biological resources; and
- ◆ The establishment and functions of a South African National Biodiversity Institute.

Biodiversity is defined as "***...the variability among living organisms from all sources including...terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are a part; this includes diversity within species, between species and of ecosystems***" (The Convention of Biological Diversity, 1992). In other words, plants, animals and micro-organisms, their genes, and the ecosystems that living organisms inhabit, are all facets of biodiversity.

In terms of the grasslands within Mpumalanga, over 44% have been transformed by agriculture and other development. Agriculture, specifically crop production is the major activity within the province, due to a large area of the grasslands occurring on deep fertile soils. The study area is situated on the edge of the Eastern Highveld Grassland bordering the Soweto Highveld Grassland. These grasslands are rated Endangered and it has been found that 72% of the Eastern Highveld Grassland and 61% of the Soweto Highveld Grassland are under medium pressure and neither of these grasslands are protected (NBI, 2004; Mucina and Rutherford, 2006).

In terms of grassland biodiversity in South Africa, and specifically in the Eastern Highveld Grassland, some of the determining characteristics are: Summer rainfall; Winter temperatures; Altitude; Soil forms; Moisture availability; Fire; and Grazing. For example, a large proportion of Red Data species found within grasslands are small, very localised and visible only for a few

weeks during their flowering period. Furthermore, according to Ferrar & Lotter (2007), the highest biodiversity is found in the sandier soil forms and rockier grassland areas.

Within the mining industry, the International Council on Mining and Metals (ICMM) have published a set of guidelines on good practice guidance on mining and biodiversity (Johnson & Starke, 2006). The guidelines were established as it has been acknowledged that mining has the potential to affect biodiversity throughout the life cycle of a project, both directly and indirectly. Direct or primary impacts from mining can result from any activity that involves land clearance, direct discharges to water bodies or emissions to the air. Indirect or secondary impacts can result from social or environmental changes induced by mining operations and are often harder to identify immediately. A balance therefore needs to be achieved between ecosystem protection and the social and economic importance of mining.

Despite the significant potential for negative impacts on biodiversity from mining operations, there is a great deal that companies can do to minimise or prevent such impacts in areas identified as being appropriate for mining. There are also many opportunities for companies to enhance biodiversity conservation within their areas of operations.

GCS (Pty) Ltd. commissioned Resource Management Services (REMS) to conduct a Faunal and Floral Assessment for Mashala Resources at to identify the potential direct and indirect impacts of future mining on fauna and flora, to recommend management measures to minimise or prevent these impacts and to highlight potential areas of conservation importance. The study was divided into two-phases, an initial baseline survey (conducted in the dry season) and a detailed terrestrial assessment in the summer months (wet season). This report includes the findings for both phases of the assessment.

Terms of Reference

The Scope of Work for the different Phases are as follows:

Dry Season:

- ◆ An initial desktop review of available literature including:
 - Mpumalanga Province Biodiversity data;
 - Recent Red Data Floral Listings [Produced by the Threatened Species Programme (TSP) in collaboration with the National Botanical Institute (NBI)];
 - Recent Red Data Faunal Listings;
 - Previous studies performed within the area;
 - Communications with Mpumalanga Parks and NBI; and
 - Available literature on the area.
 - Field trip to survey the area.

Wet Season:

- ◆ Detailed field investigations within the summer season
 - A two day field investigation for floral sampling within the study area (DeWittekrans Project Area) focussing mainly on any remaining natural habitats; and
 - Faunal field investigations that will include small mammal, insect and herpetofaunal trapping for a minimum period of 4 days. Trapping Points were identified within the project area within **Dry Season** of the study.
- ◆ A detailed Ecological Report including:
 - A broad description of the vegetation found within the boundary of the study area;
 - A description of vegetation communities and habitats for the proposed footprint areas (including structure, dominant plant composition and condition);
 - Mapping of each identified vegetation community/habitat utilising ArcGis 9 and aerial photographs extracted from Google Earth;
 - Flora and fauna linked to each habitat and possible occurrence of endemic, Red Data / threatened species, species with medicinal/cultural value and alien / invasive species. Species within the proposed footprint areas that have conservation significance will be recorded using a Garmin GPS. These will then be mapped and visually presented in the report;
 - Ranking of each habitat based on conservation importance (in terms of national and provincial biodiversity priorities) and ecological sensitivity;
 - Identification of impacts with particular focus on:
 - the loss of general or sensitive habitats;
 - the potential loss of rare and threatened species;
 - the loss of open space;
 - the loss of natural migration corridors; and
 - an assessment of cumulative impacts.
 - Recommendations on management and mitigation measures (including opportunities and constraints) with regards to the construction and operation and future rehabilitation of the proposed development. Recommendations will also include legal requirements related to the specific project i.e. the identification of permits required for the removal of specific species.

Applicable Legislation

The legislation, policies and guidelines listed below are applicable to the current project in terms of biodiversity and ecological systems:

1.1. International level:

- ◆ Convention on Biological Diversity;
- ◆ The Ramsar Convention (on wetlands of international importance especially as waterfowl habitat);
- ◆ The Bonn Convention (on conservation of migratory species of wild animals);
- ◆ The World Heritage Convention;
- ◆ The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES);
- ◆ Convention to combat Desertification (UNCCD);
- ◆ United Nations Framework Convention on Climate Change (UNFCCC);
- ◆ Kyoto Protocol To The United Nations Framework Convention On Climate Change;
- ◆ Stockholm Convention on Persistent Organic Pollutants.

1.2. Regional Level

- ◆ The Action Plan of the Environmental Initiative of NEPAD (the New Partnership for Africa's Development), 2003. This initiative encourages sustainable development and associated conservation and wise use of biodiversity.

1.3. National Level

- ◆ Constitution of the Republic of South Africa, 1996 (No. 108 of 1996);
- ◆ Environment Conservation Act, 1989 (Act 73 of 1989);
- ◆ Environment Conservation Amendment Act, 2003 (Act 50 of 2003);
- ◆ National Environmental Management Act, 1998 (Act 107 of 1998);
- ◆ National Environmental Management Amendment Act, 2004 (Act 8 of 2004);
- ◆ National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004);
- ◆ National Environmental Management: Biodiversity Act, 2004: Threatened and Protected Species Regulations;
- ◆ National Environmental Management: Biodiversity Act, 2004 (Act 10 Of 2004): Publication Of Lists Of Critically Endangered, Endangered, Vulnerable And Protected Species;
- ◆ Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983);
- ◆ National Environmental Management: Protected Areas Act, 2003 (Act 57 of 2003);
- ◆ National Heritage Resources Act, 1999 (Act No.25 of 1999);
- ◆ National Water Act, 1998 (Act 36 of 1998);
- ◆ National Forests Act, 1998 (Act No. 84 of 1998);

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- ◆ EIA Regulations, 2006 (Government Gazette No. 28753);
 - ◆ National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004): Commencement of Bioprospecting, Access and Benefit-Sharing Regulations, 2008.

1.3.1 National Policy /Guidelines

- ◆ South Africa's National Biodiversity Strategy and Action Plan (NBSAP);
- ◆ Laws, Policies, International Agreements and Departmental Guidelines that Support Community Based Natural Resource Management (CBNRM) Type Programmes in South Africa.

Although South Africa became a signatory to the Convention of Biological Diversity in 1998, the enactment of recent national legislation has affirmed our countries commitment to biodiversity and conservation. The National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) has been assented by the South African President and was published in the Government Gazette in June 2004 (Vol. 467; No. 26426). One of the objectives of this Act is to provide for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act, 1998 and to ensure the sustainable use of indigenous biological resources.

Furthermore, an important aspect of the biodiversity legislation was to facilitate both conservation and sustainable use of species through management interventions at species level. Chapter 4, Part 2 of this Act provides for listing of species that are threatened or in need of protection to ensure their survival in the wild, while regulating the activities, including trade, which may involve such listed threatened or protected species and activities which may have a potential impact on their long-term survival. In February 2007, this was achieved as the Minister of Environmental Affairs and Tourism published a list of CR, EN, VU and Protected Species (PS), according to Section 56(1) of the National Environmental Management: Biodiversity Act, 2004 (Act no. 10, 2004).

1.4. Provincial Level

- ◆ Mpumalanga Parks Board Act, 1995 (Act No. 6 of 1995);
- ◆ Mpumalanga Conservation Act, 1998 (Act 10 of 1998) which requires the protection of biodiversity and lists protected species within the province;
- ◆ The Mpumalanga Biodiversity Conservation Plan (MBCP);

1.5. Municipal Level

- ◆ Msukaligwa Municipality Integrated Development Plan 2007 – 2012.

1.6. Additional Guidelines

- ◆ International Council on Mining and Metals (ICMM) - Guidelines on good practice guidance on mining and Biodiversity (Johnson & Starke, 2006).

Study Area

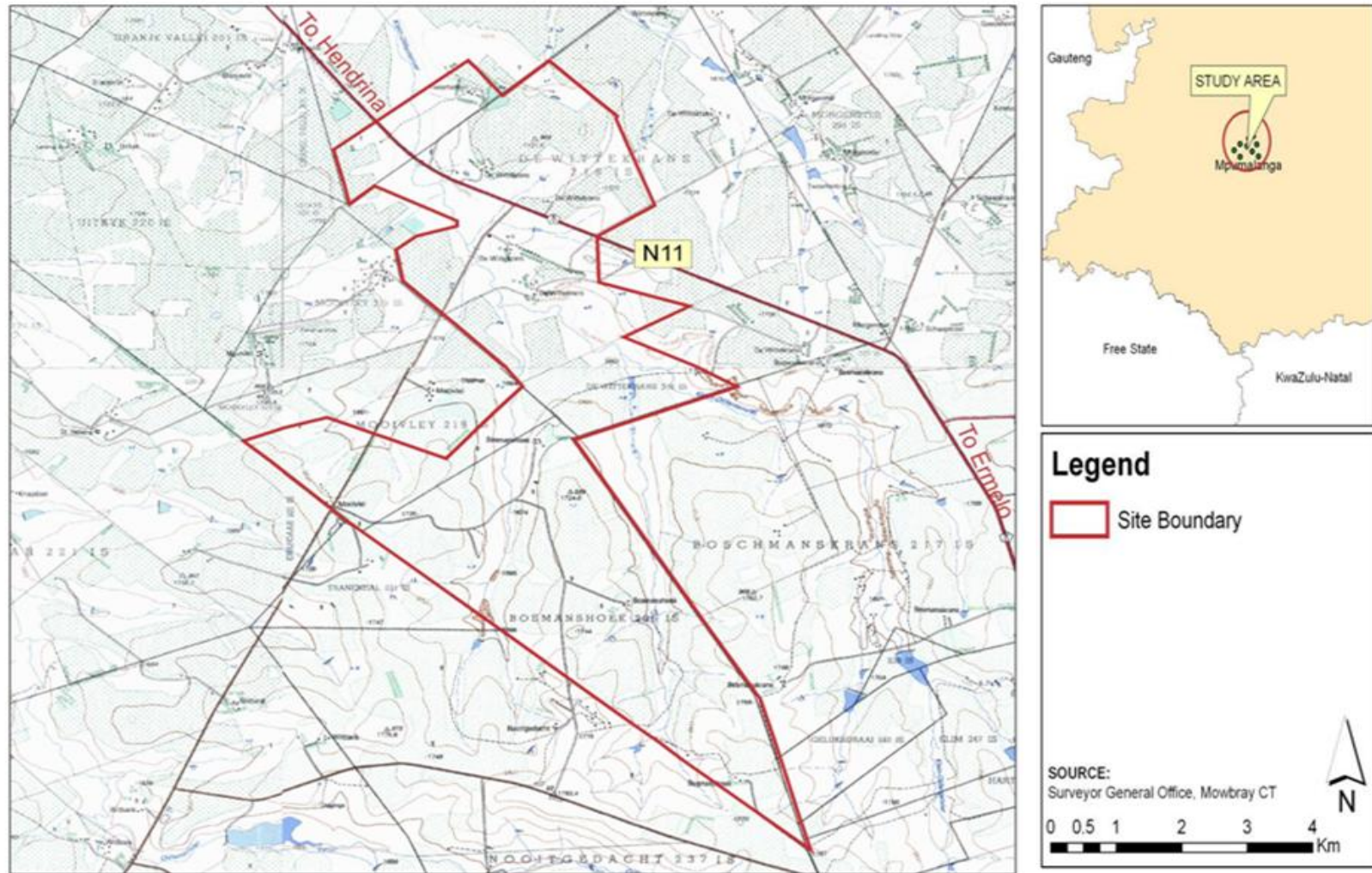
1.7. Locality

The study area is located within the Msukaligwa Local Municipality in the Gert Sibande District Municipality in Mpumalanga Province. The nearby towns are Hendrina (12km north), Ermelo (34km south-east) and Bethal (28km south-west). The study area is located on the farms:

- ◆ Tweefontein 203 IS (RE of Portion 1);
- ◆ De Wittekrans 218 IS (RE of Portion 1 and Portion 2, Portions 7, 11, 10 and 5);
- ◆ Groblershoek 191 IS;
- ◆ Groblershoop 192 IS;
- ◆ Israel 207 IS.

The location of the study area in relation to major towns and roads is illustrated in **Figure 1** and the approximately co-ordinates for the centre of the site are 26°14'52.02"S and 29°47' 16.52"E. The proposed project footprint is approximately 3755 ha.

Figure 1: Regional locality showing the study area



1.8. Characteristics of the Study Area

Within this section, a broad description is presented on the characteristics of the region that are relevant to the context of a biodiversity study. These characteristics include climate (specifically rainfall, evaporation and temperature), geology, soil structure, topography, hydrology (i.e. catchment information), vegetation and socio-economic conditions.

1.8.1 Climate

◆ Rainfall and Evaporation

The study area falls in a summer rainfall region. Three rainfall stations were used for extrapolating data:

- ◆ 479 369 (Hendrina) – S26°09' E29°43'
- ◆ 479 552 (Morgenster) – S26°12' E29°49'
- ◆ Bethal – S26°27' E29°29'

Precipitation occurs mainly in the summer months of October to March with the peak of the rainy season occurring in November and January (**Figure 2**). Summer months can receive over 110mm of rain whereas the winter months receive less than 20mm. The mean annual precipitation (MAP) varies between 680mm and 730mm.

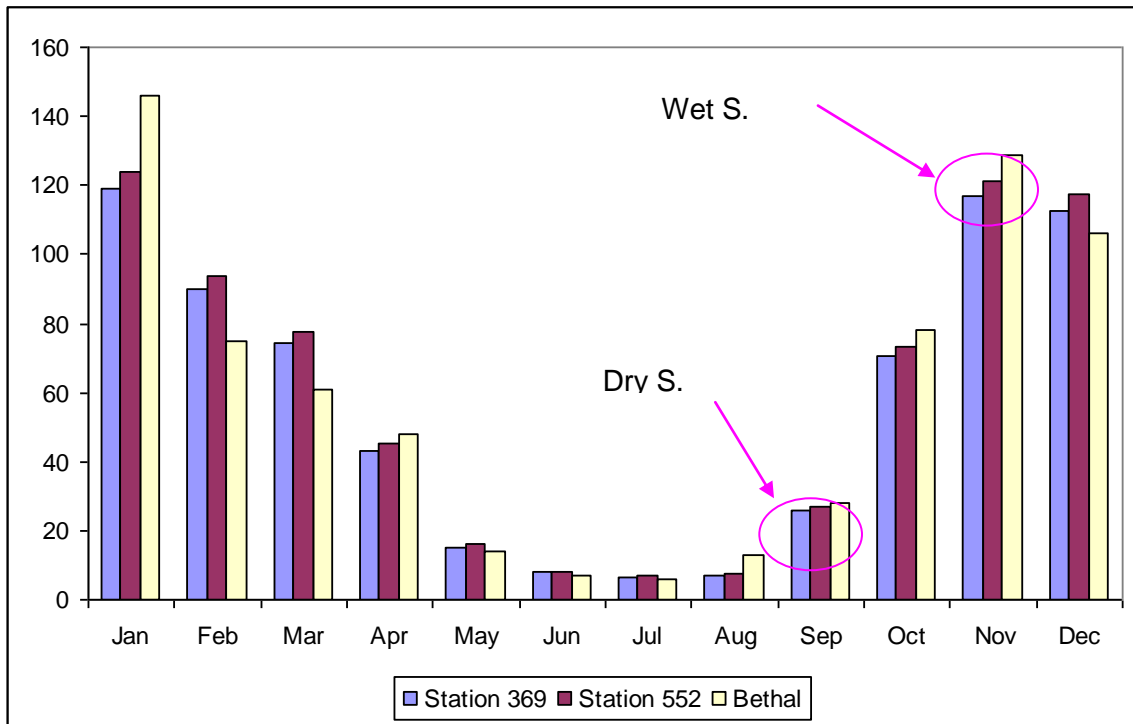


Figure 2: Mean monthly rainfall for Bethal (years 1962 – 1988), and Hendrina (Station 479 369) and Morgenster (479 552) (years 1950/1 to 1989) (WRC Report No 298/2.1/94; SA Weather Service, 2008)

The study site is situated within the evaporation zone 4A (WRC Report No 298/2.1/94). The mean annual evaporation rate at the nearest evaporation station (B1E002 – Rondevalley S25°56' E29°42') is 1905mm, which is more than twice MAP (WRC Report No 298/2.1/94). Evaporation peaks between November and January with evaporation rates over 160mm (**Figure 3**). Evaporation rates in winter vary between 90mm and 130mm.

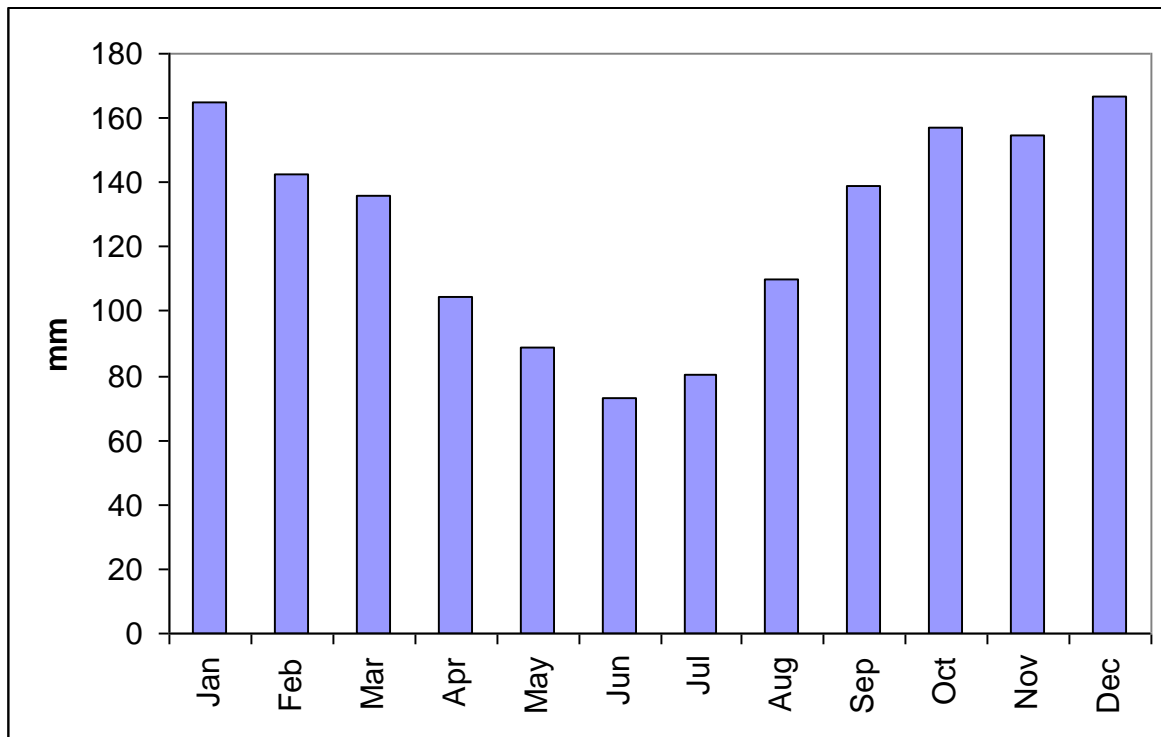


Figure 3: Mean monthly evaporation rates (S-Pan) for the evaporation zone 4A at Rondevally (B1E002) for the period 1978 – 1979 (WRC Report No 298/2.1/94).

The initial site visit was conducted at the end of September 2008 when precipitation has historically been outside of the summer rainfall season (**Figure 2**) but evaporation is relatively high (**Figure 3**). This results in the area having net evaporation of water implying that water availability may be low during this period and therefore unsuitable for a full flora and fauna study. For Wet Season of the assessment, field investigations were conducted during November 2008 once sufficient rainfall had fallen. From **Figure 2**, November is the second highest rainfall month in a given year. This is important as an increase in precipitation typically results in an increase in faunal activity and flowering of floral species.

◆ Temperature

The study area falls within the highveld region. The warmest months are from November to March where the days are warm to hot with late afternoon thunder showers (**Figure 4**). Summer temperatures range from a mean minimum of 13°C and to a mean maximum of 26°C (**Figure 4**). Winter days are dry and cool. Winter temperatures range from mean minimum of -1°C to a mean maximum of 17°C.

The initial site visit fell within the start of the summer season, with mean temperatures reaching the upper 20s (**Figure 4**), which was not to different for when Wet Season of the study was

conducted. It is important to note that temperature impacts the level of activity of faunal species such as dung beetles. Flight activity is limited when temperatures are around 20°C or lower. Although temperature plays a role in faunal activity, it is not seen as a determining factor of the flowering season for floral species. Growth during the growing season is generally influenced by moisture availability rather than by temperature (Cowling *et al*, 2004).

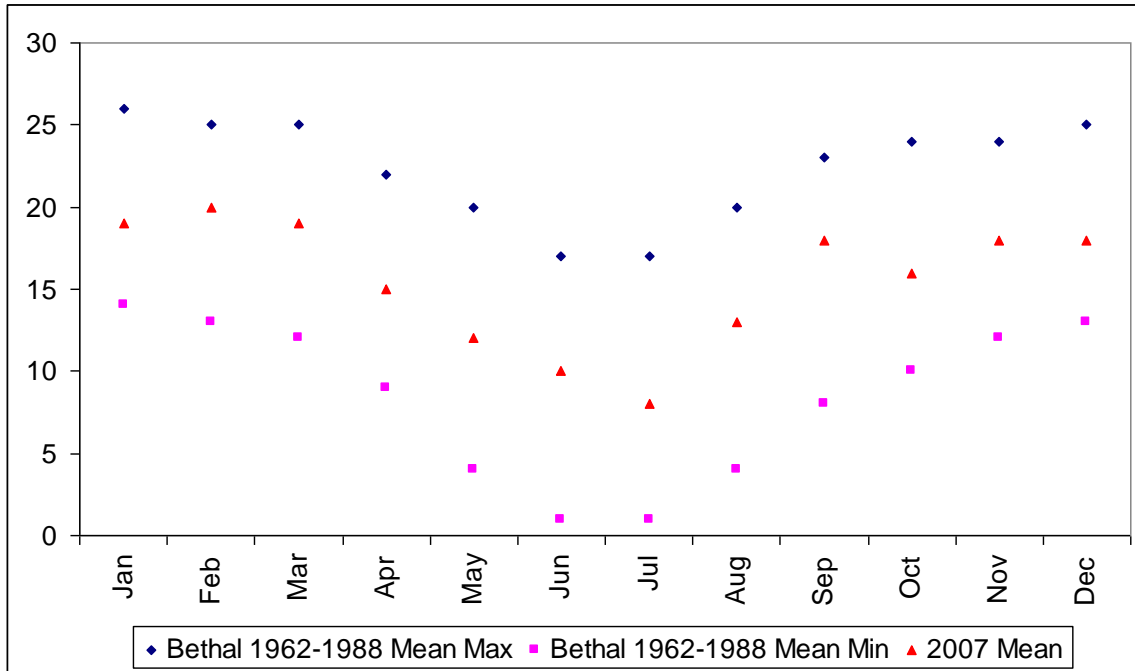


Figure 4: Historical and recent temperature data from the Bethal weather station (S26°27' E29°29'). The inclusion of historical data indicates that the temperatures around the site have not changed significantly over time. (SA Weather Service, 2008; Weather Underground, 2008).

1.8.2 Geology

The DeWittekrans project is located on part of the Witbank coal field. The coalfields surrounding the DeWittekrans project comprise sedimentary rocks (sandstones, mudstones, siltstones and coal) of the Dwyka formation and Ecca Group of the Karoo Sequence. The Ecca Group in the area is represented predominantly by the Vryheid Formation. Some displacement and tilting of the sedimentary strata has occurred due to dolerite intrusion (dykes and sills) of the Drakensberg Formation. Three coal seams of economic importance occur in the area, namely the 4 lower seams, 2 and 2A seams. The strata in which the coal seams occur consist predominantly of fine, medium and coarse grained sandstone, with subordinate mudstone, siltstone and shale.

Rocky outcrops are also scattered throughout the area specifically along the Klein Olifants River System. Rocky outcrops are vital substrates that often support a number of threatened species,

which can range from various scorpions to various cave dwelling bats. It has also been noted that woody species tend to be concentrated around these rocky outcrops (Mucina & Rutherford, 2006).

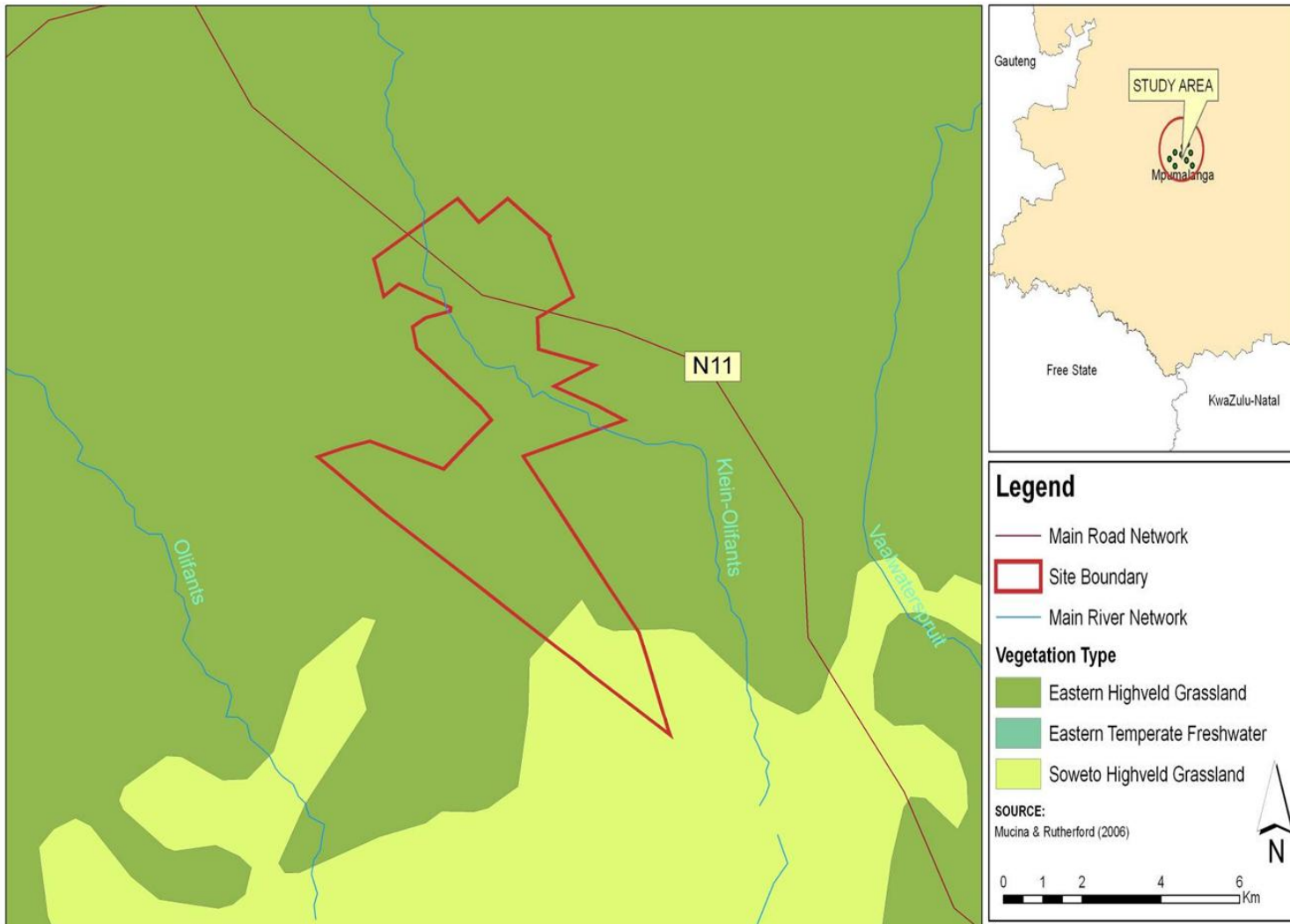
1.8.3 Regional Topography

The regions topography has been described as gently to moderately undulating, which is due to it being part of the Highveld plateau (Mucina & Rutherford, 2006). This lends itself to a proliferation of meandering rivers. Grasslands have been found to contribute to water purification. Low hills and the occasional pan depression have been noted in the region (Mucina & Rutherford, 2006). The study area has an elevation between 1595 and 1662 metres above mean sea level (mamsl).

1.8.4 Vegetation at a Regional Rcale

The study area falls within the Grassland Biome and the region the study site is situated in is characterised by Mesic Highveld Grassland, which are documented as being 'sour' (Mucina & Rutherford, 2006). The dominant grasses in the Mesic Highveld Grassland are andropogonoid grasses (Mucina & Rutherford, 2006). The region has a variety of habitats; these habitats are created by variations in topography, such as rocky outcrops cultivating shrublands and other woody cover (Mucina & Rutherford, 2006). Within the Mesic Highveld Grassland are different grassland types. These may be distinguished by their different geology, rainfall, topography and elevation (Mucina & Rutherford, 2006).

Figure 5: Regional Vegetation – mainly Eastern Highveld Grassland



The two vegetation types in the area are; Eastern Highveld Grassland the dominant types and Soweto Highveld Grassland (**Figure 5**) (Mucina & Rutherford, 2006). The presence of tree species is limited due to frost, fire and grazing. These disturbances maintain the herbaceous grass and forb layer and prevent the establishment of tall woody vegetation (Tainton, 1999). The differences between these grasslands is floristic rather than structural, with the former having larger component of sour grasses.

Table 1 highlights some vegetation types in southern Africa that are under various levels of pressure from potential mining. It has been found that 72% of the Eastern Highveld Grassland is under Medium Pressure whereas 46% of the Soweto Highveld Grassland (southern section of the site) is estimated to be under High mining pressure.

Table 1: Twelve vegetation types under high and medium pressure from mining potential in southern Africa (Mucina and Rutherford 2006).

Vegetation Types	%High	%Medium
Namib Seashore Vegetation	100	0
Subtropical Seashore Vegetation	96	0
Richtersveld Coastal Duneveld	87	0
Subtropical Dune Thicket	87	0
Northern Escarpment Dolomite Grassland	67	0
Namaqualand Seashore Vegetation	58	0
Wakkerstroom Montane Grassland	0.5	89
Nwambyia-Pumbe Sandy Bushveld	0	83
Eastern Highveld Grassland	0.2	72
Springbokvlakte Thornveld	0.3	66
Soweto Highveld Grassland	46	61
Delagoa Lowveld	0	53

1.8.5 Socio-economic Characteristics

The socio-economic data is based on the Msukaligwa Municipality: Integrated Development Plan (2007) and covers the Msukaligwa Local Municipality area.

◆ Population

The unemployment rate in Msukaligwa Local Municipality was approximately 38% and the population was growing at 2% per annum as of 2001. 59% of the population was living in urban settlements with the rest residing mostly on farmland. Ermelo to the south east of the study site is one of three nearby towns to the study site. The population of Ermelo is approximately 97 300 (Statistics South Africa Census 2001). The other two towns are Bethal (south west) and Hendrina (north).

◆ Land Use

Of the total 2001 municipal population of 124 319 36% live on farms. Thus, farming is a significant activity in and around the study area. Other significant land uses in the region are mining, urbanisation and road infrastructure (Mucina & Rutherford, 2006).

Methodology

Biodiversity/ecological studies are usually constrained by resources such as surveying time and duration, financing and support, which are all interrelated. A complete census of an area is only feasible if:

- ◆ the target population is small;
- ◆ measurement is not destructive;
- ◆ the study area is small and well delineated; and
- ◆ you have unlimited resources.

Good survey practices are essential to ensure that sufficient high quality data are generated to make defensible and robust impact predictions. In most cases, a sample is a more effective and efficient means of obtaining the required information. Sampling is the selecting of some part of a population to observe. The sample unit is that part of the population chosen for measurement. Sample units are generally of two types:

- ◆ Natural entities e.g. vegetation/habitat; and
- ◆ Artificial entities e.g. soil cores.

For vegetation, floristic diversity is usually measured on the following units:

- ◆ Individual trees, plants, or other vegetative entities;
- ◆ Predefined areas or quadrats;
- ◆ How many individuals intercept a prescribed line or line intercepts;
- ◆ What fraction of a line intersects a vegetative individual or line segments;
- ◆ Distances between individuals.

For this project, predefined areas – quadrats were used to determine vegetation communities within the study area.

Within this study, the site is considerable in extent and therefore required a two phased approach.

1.9. Dry Season

The content presented in the first phase of the study was mainly the result of a desk-top analysis and a brief visit to the study area. The desktop analysis was conducted to generate an expected checklist of flora, mammals, birds, reptiles, amphibians, and invertebrates likely to occur in the region and to identify species that are of concern to conservation.

A brief site visit was conducted in September 2008 and focused on identifying potential areas for trapping within Wet Season of the study. Any evidence of species utilizing the broad habitats for breeding, foraging or as migration corridors were also noted. Visual observations were performed

by walking and driving the site and noting vegetation/habitat types and the visual presence of animals or evidence of animals in the form of faeces, pellets, spoor, nests, burrows, feathers etc.

Limitations

- ◆ Data available for the study area i.e. the Conservation and Environmental Plans were at a National or Provincial level.
- ◆ Limited identification of species during the initial site visit, due to the season and the lack of sufficient rains

1.10. Wet Season

The assessment was conducted during the week of the 17-21 November 2008 assessing the farms Tweefontein 203 IS (RE of Portion 1); De Wittekrans 218 IS (RE of Portion 1 and Portion 2, Portions 7, 11, 10 and 5); Groblershoek 191 IS; Groblershoop 192 IS; and Israel 207 IS (**Figure 1**). At the time of the survey and compilation of the report, no infrastructural footprint areas for the plant, road access routes, conveyors and any other mine infrastructure were provided. Mashala Resources did, however, provide the proposed opencast and underground mining areas (refer to **Figure 7**). Therefore the study could not focus on specific areas as indicated within the Terms of Reference (ToR).

The methodology employed for the detailed investigation is described below.

1.10.1 Floral Investigation

A vegetation survey was conducted during 17-18 November 2008, whereby the following methodologies were applied:

Survey Methodology

- ◆ 1: 50 000 topographical maps, GoogleEarth Images (2007) (no aerial photographs were supplied at the time of the survey), were used to subjectively delineate specific areas of uniform vegetation structure;
- ◆ Field data collection was primarily plot-based and in the form of vegetation samples. The sampling plot size was standardised at 100 m². A sample entailed the compilation of a list of plant taxa, where each taxon was assigned an estimate (usually a cover-abundance estimate). Therefore, a vegetation sample can be seen as a simplified model of the vegetation stand. For each sample, the species composition, as well as the mean percentage cover of each species per sampling plot was measured. Percentage cover was not measured precisely, but was placed in one of seven categories by a visual estimate as described by Braun-Blanquet (in Mueller-Dombois & Ellenberg, 1974; see **Table 2**). Please note that agricultural pastures and cultivated land were not sampled by means of plots; and

- ◆ Further random transect walks were conducted within the study site to ensure sampling of less abundant or localised species to assist with the compilation of a species inventory.

Table 2: Braun-Blanquet Cover classes (Mueller-Dombois & Ellenberg, 1974)

Class	Range of cover (%)	Mean
5	75-100	87.5
4	50-75	62.5
3	25-50	37.5
2	5-25	15.0
1	1-5	2.5
⊕	<1	0.1
<i>r</i>	<<1	0.01

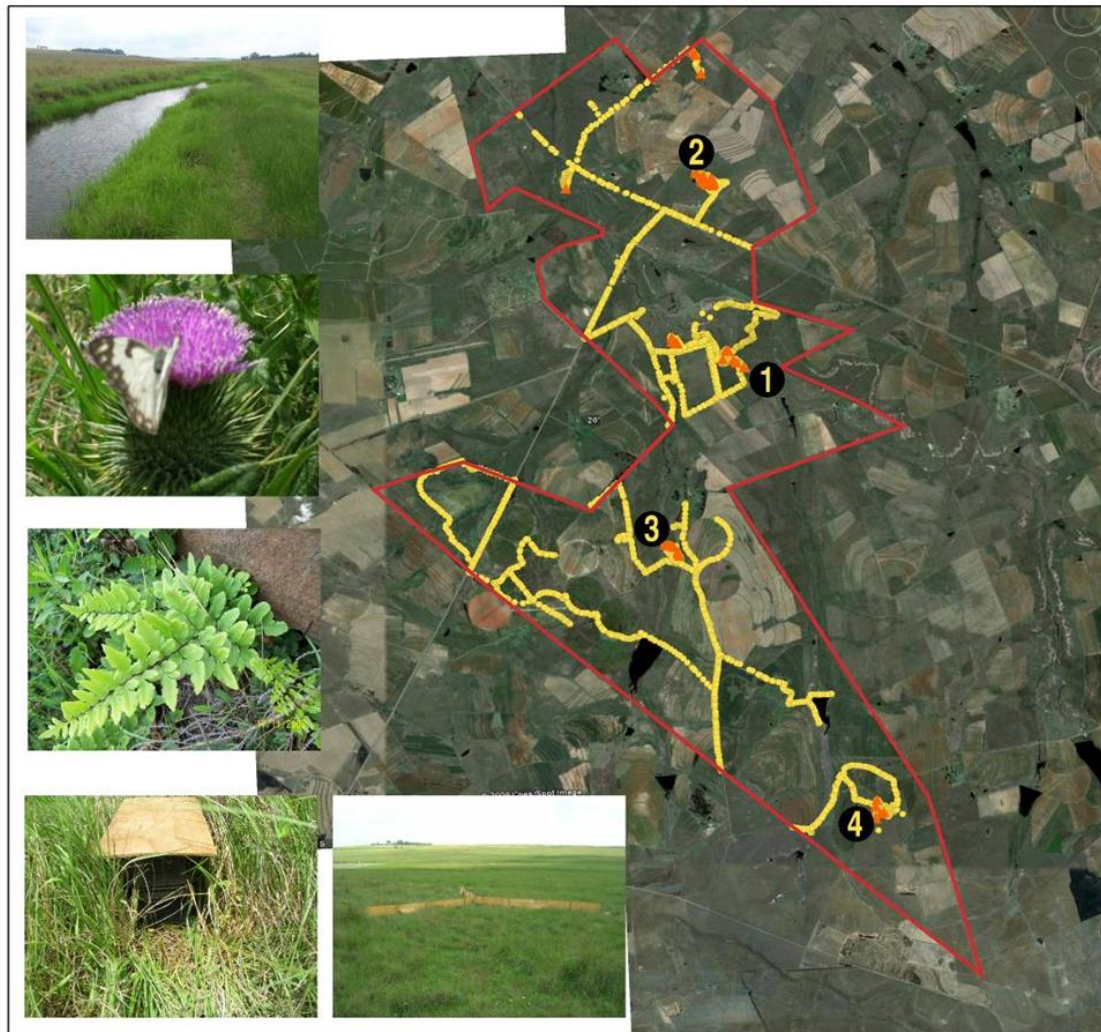
In addition, the following parameters were also documented to aid the vegetation survey:

- ◆ All plant taxa were identified to species level. Scientific names follow Germishuizen & Meyer (2003) and for non-woody species - Pooley (1998);
- ◆ A broad survey for Red Data plant taxa;
- ◆ The identification of plant species protected by provincial and national legislation;
- ◆ A survey of plant species with medicinal or cultural value; and
- ◆ The identification of declared weeds and invader species as promulgated under the amended regulations (Regulation 15) of the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983).

Analyses Methodology

- ◆ A TWINSpan analysis (Hill, 1979) for the different plant species were used to classify vegetation assemblages. The TWINSpan analysis is used to assign associations between samples with the aim to objectively delineate groups or assemblages. Therefore, sampling entities that group together (being more similar) are believed to have similar compositions. Data was left untransformed to allow for only common or dominant species to participate in the analysis.

Figure 6: Sampling areas and trapping sites



LEGEND

- Site Boundary
- Sampling Areas
- ▲ Floral Stations
- 4 Trapping Sites

SOURCE:
 Aerial Photo: Google Earth (Date Accessed: September 2008)
 Sampling Points: Field Investigations - November 2008

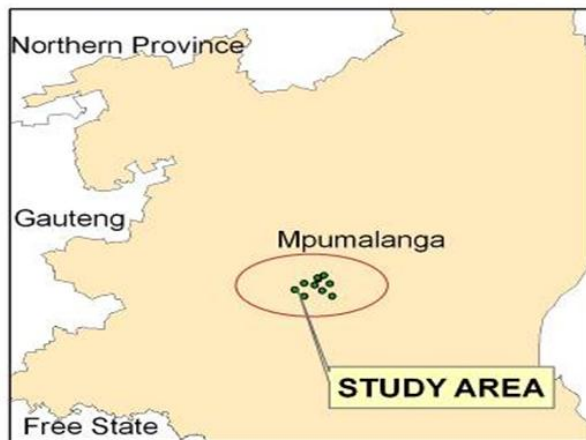
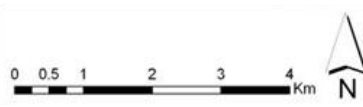
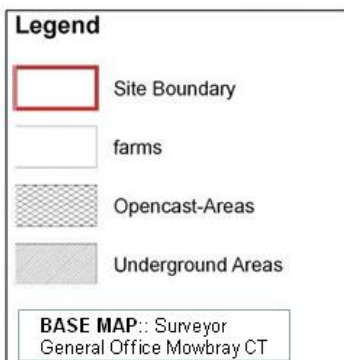
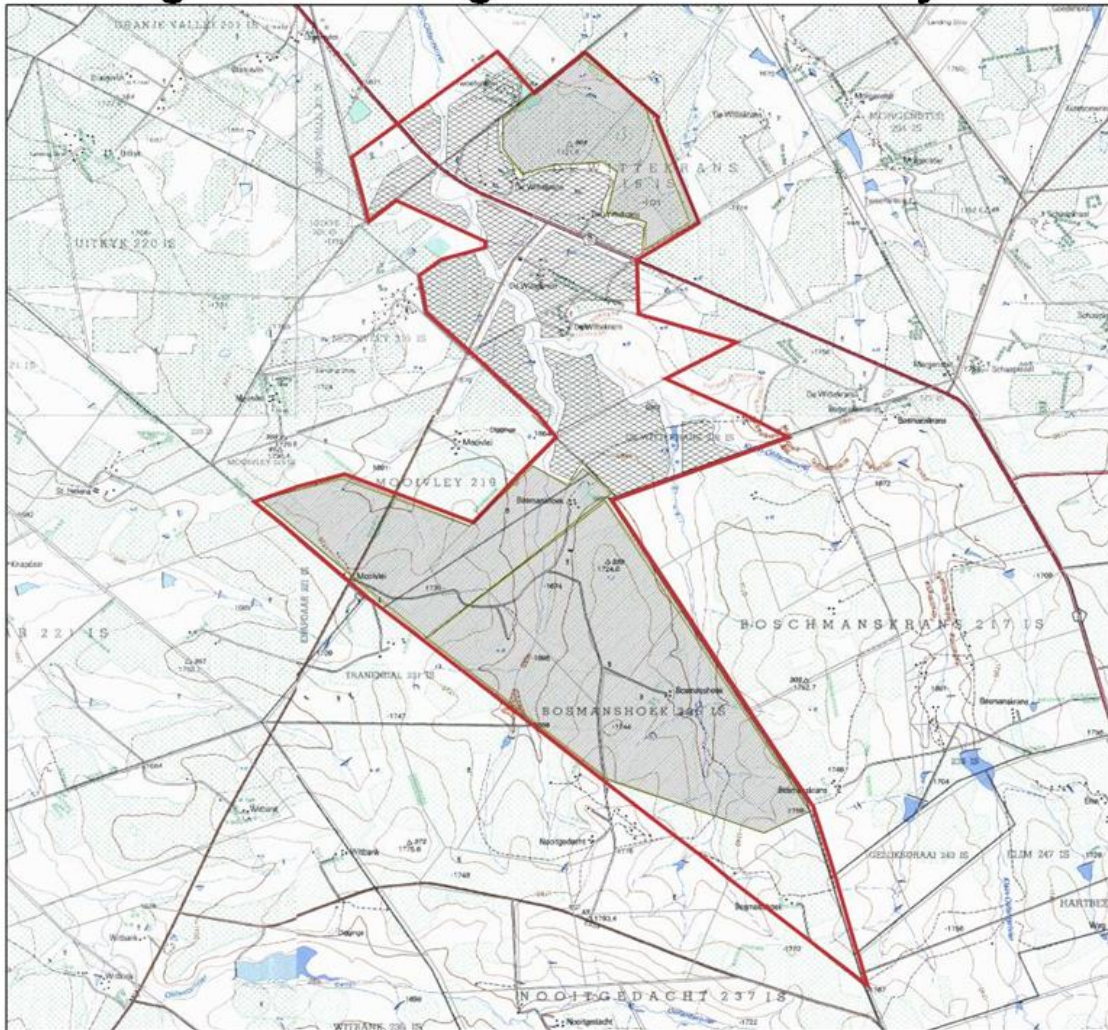


Figure 7: Proposed Opencast and Underground mining areas for the study site



1.10.2 Faunal Investigation

Prior to the field work component of the study, a desktop study in Dry Season was conducted to generate an expected checklist of mammals, avifauna, herpetofauna, and certain invertebrates likely to occur in the region and to identify species that are of concern to conservation.

The field work investigations were undertaken in November 2008 over a 5 day period (4 trap nights) and focused on identifying potential wildlife habitats and the species utilizing those habitats for breeding, foraging or as migration corridors. The following sampling methods were used in assessing the sites:

◆ *Visual Observations*

This was performed by walking the site and noting habitat types and the visual presence of animals or evidence of animals in the form of faeces, pellets, spoor, nests, burrows, feathers etc.

◆ *Live Trapping*

Four trap lines were set up within the remaining natural areas that were identified during Dry Season (**Figure 6**). As no infrastructural footprint was provided these trap sites could not coincide with any proposed surface infrastructure.

- Trapping site 1 was placed within a frequently grazed grassland habitat along side the Klein Olifants river (the soils on site are associated with wet areas). This site was along the edge of the proposed opencast footprint;
- Trapping site 2 was situated in the northern section of the site with a moist/hydromorphic grassland within the proposed opencast footprint.
- Trapping site 3 was positioned within a natural grassland (not disturbed by cattle) north of a tributary to the Klien Olifants River. This site lies within the footprint for the underground mining operations.
- Trapping site 4 was situated within an area considered to be Highly Significant in terms of Mpumalanga's C-Plan (refer to **Section 7.2**).

The following live capture and release trapping methods were employed:

- Array traps (Campbell & Christman 1982; Corn 1994; Simmons 2002) were used for herpetological and invertebrate sampling at all four sites. The traps consisted of an array of 3 wooden drift fences (each measuring 12m in length), and pitfall traps (sunken five litre buckets, level to the ground) at each end of the 3 drift fences and 1 at the centre of the array. Each pitfall trap had moist cotton wool balls to provide moisture for any amphibians caught. Funnel traps were placed along each side of the 3 drift fences of the array traps. Traps were checked early morning and late afternoon.
- Live mammal traps (Sherman traps), baited with rolled oats, peanut butter, raisins and sunflower oil were set out in line transects of 16 traps (8 pairs) for capture, identification, measurement and release of small mammals. Traps were set at all four sites, and were checked early morning and late afternoon.
- Sweep netting with hand nets was undertaken for sampling insects and spiders at all sites as well as other selected points throughout the study area.

◆ *Night Observations*

Night investigations were undertaken to record nocturnal animals such as frogs, bats, snakes, nocturnal birds and mammals etc.

Limitations

For both flora and fauna, the absence of a certain species on site does not conclude that the species is not present at the site or in terms of animals, does not utilise the site or areas near by. Reasons for not finding certain species may be due to:

- ◆ Sampling season does not coincide with flowering season of specific floral species;
- ◆ The breeding season of animals do not correlate with the time of the survey;
- ◆ Lack of suitable habitat and foraging potential on site for animal species;
- ◆ The disturbed nature of the site;
- ◆ The inconspicuous nature of the species (fauna and flora); or simply
- ◆ Lack of species presence.

1.10.3 Areas of Concern

The significance of the findings for the biodiversity assessment were assessed on a number of criteria. Identified habitat types were ranked into *High*, *Moderate-High*, *Moderate* or *low* classes in terms of how valuable or significant (Areas of Concern) they were, based on the following criteria:

◆ *Ecological Sensitivity*

Ecological sensitivity of a system is based on the determination of the sensitivity of the driving force of the ecosystem to change, and in particular human-induced change (Cowling *et al.*, 1994). Ecological sensitive areas include wetlands, rocky ridges etc.

◆ *Conservation Value on a regional and local scale.*

Conservation Value is defined as the relative importance of an area based upon the abundance and/or conservation status of the species assemblages found, e.g. an area that is undisturbed containing abundant plant or animal species is regarded important if this habitat type is poorly conserved on a national basis (Timberlake & Muller 1994). Conservation importance is determined on the following:

- How diverse and rich is the area;
- Does the area contain or possibly contain globally threatened species (Red Data species);
- Are species and habitats rapidly declining in the area;
- Are there endemic or near endemic species present;
- Does the area contain statutory designation or international recognition?

The best-known criteria for categorizing the level of threats facing species, is the IUCN's Red List criteria. According to Friedmann and Daly (2004), the IUCN Red List Categories are intended to

be an easily and widely understood system for classifying species at high risk of global extinction. The general aim of the system is to provide an explicit, objective framework for the classification of the broadest range of species according to their extinction risk. The IUCN categories are depicted below in **Figure 8**.

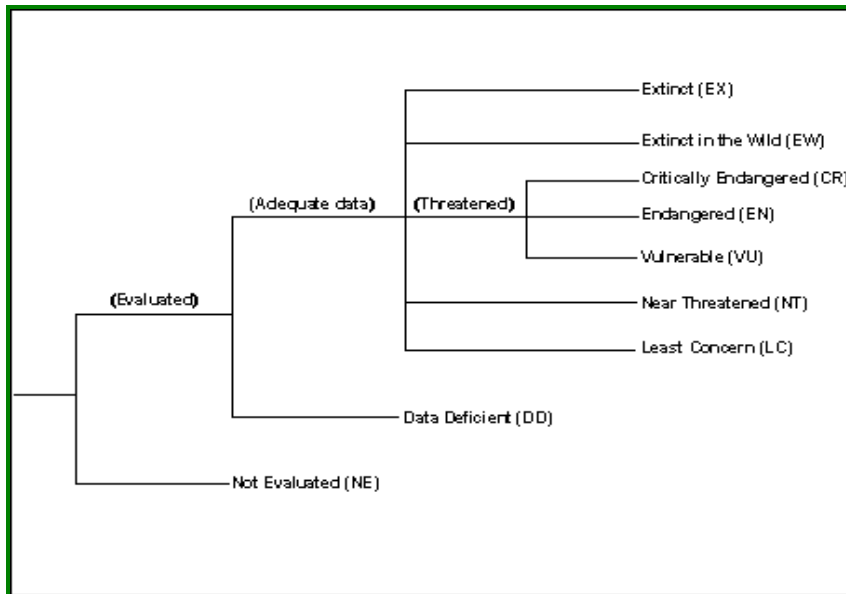


Figure 8: IUCN Red Data List categories.

On a National level, Atlases and Red Data Books for mammals, birds and frogs have been updated (Friedman & Daly, 2004; Barnes, 2000; Minter *et al.*, 2004), and the reptile Atlas is in the progress of being updated. These National listings follow the IUCN system for categorizing the conservation status of species. In addition to these National listings, in February 2007, the Minister of Environmental Affairs and Tourism published a list of Critically Endangered (CR), Endangered (EN), Vulnerable (VU) and Protected Species (PS), according to Section 56(1) of the National Environmental Management: Biodiversity Act, 2004 (Act no. 10, 2004). A PS is classified as an indigenous species of high conservation value or national importance that requires national protection.

◆ *Level of Disturbance*

The level of disturbance in a given area is based on the following:

- Invasion status, i.e. what percentage of the area is invaded by alien and weedy plant species; and
- Development status, i.e. if highly developed does the development have the ability to provide refuge for a number of species and act as a greenbelt or corridor.

1.10.4 Impact Assessment

An assessment of the potential future impacts of the proposed mining development on the surrounding environment has been based on the habitats and species identified on site. The impacts have been assessed for the three development phases; construction, operation and closure at a broad level due to the limiting information available on the project at the time of compilation. Mitigatory measures and recommendations for the various impacts identified have also been compiled. Impacts for both fauna and flora were assessed based on the scoring system supplied by GCS. The following were addressed in the form of an impact table.

- ◆ Environmental receptor
- ◆ Project phase
- ◆ Potential environmental impact
- ◆ Probability
- ◆ Extent
- ◆ Duration
- ◆ Intensity
- ◆ Significance
- ◆ Mitigation

The significance of each category was rated based on the criteria presented in **Table 3**.

Table 3: Impact Rating Table

Category	Category	Rating	Description
Probability	Improbable	0	Less than 40 % sure of a particular fact or of the likelihood of that impact occurring
	Possible	1	40 to 70 % sure of a particular fact or of the likelihood of that impact occurring
	Probable	2	70 to 90 % sure of a particular fact or of the likelihood of that impact occurring
	Definite	3	More than 90 % sure of a particular fact or of the likelihood of that impact occurring
Extent	Site	1	Immediate project site
	Local	2	Up to 5 km from the project site
	Regional	3	20 km radius from the project site
	Provincial	4	Provincial
	National	5	South African
	International	6	Neighbouring countries/overseas
Duration	Very short-term	1	Less than 1 year
	Short-term	2	1 to 5 years
	Medium-term	3	5 to 10 years

Category	Category	Rating	Description
Intensity	Long-term	4	10 to 15 years
	Very long-term	5	Greater than 15 years
	Permanent	6	Permanent
	Very low	0	Impact reduces habitat quality but does not affect the population size and breeding success
	Low	1	Impact reduces habitat quality marginally affects the population size and breeding success
	Medium	2	Impact reduces habitat quality killing off up to 40% of the population size reducing breeding success
	High	3	Where natural processes are altered to the extent that up to 90% of the population is decimated
Significance	Very high	4	Where natural processes are altered to the extent that the population is locally extinct and may not be able to recolonise the site
		2 – 4	Low
		5 – 7	Low to Moderate
		8 – 10	Moderate
		11-13	Moderate to High
		14 – 16	High
	17 – 19	Very High	

Results

1.11. Habitats

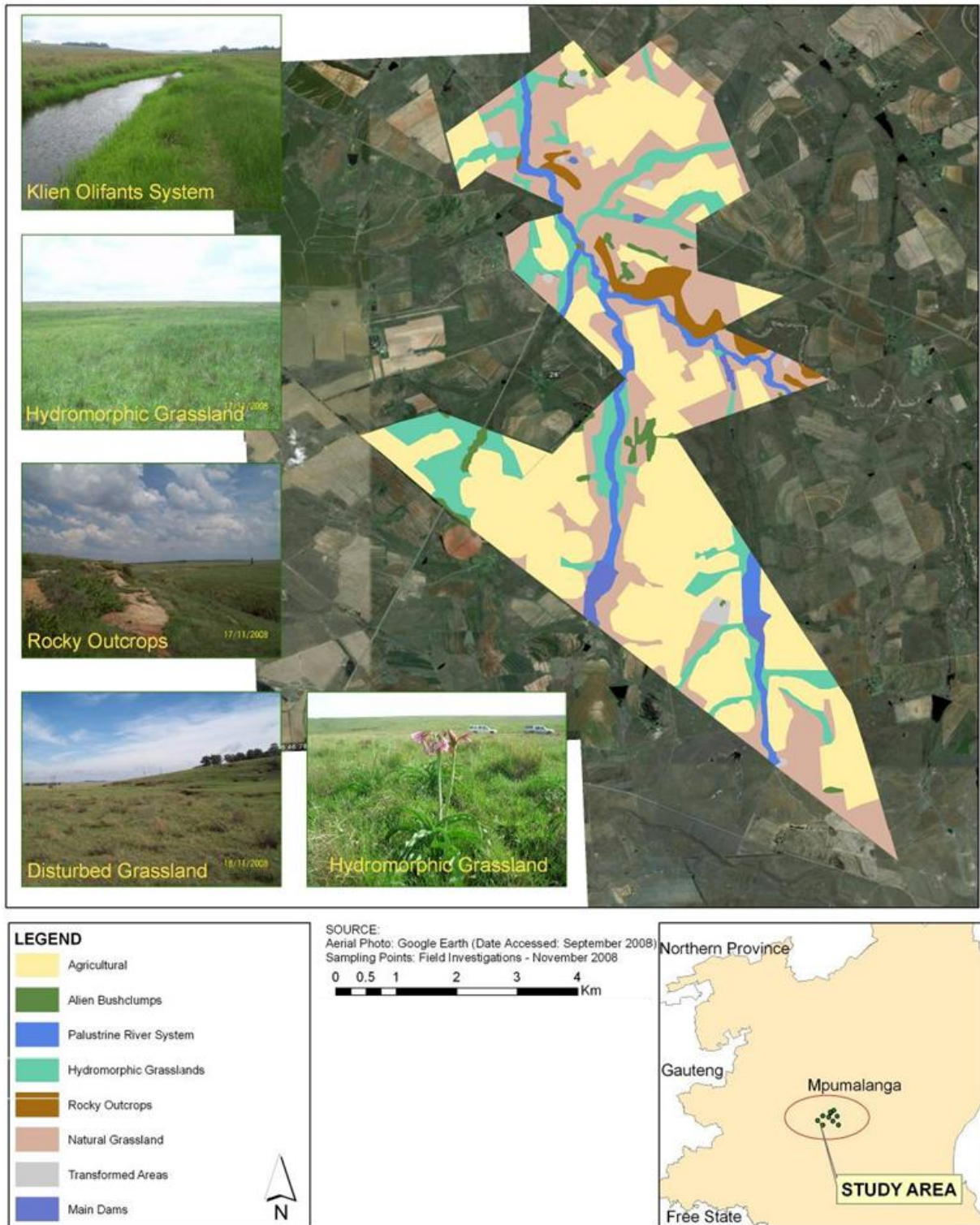
On a regional level, as discussed above, the study area falls within the *Eastern Highveld Grassland*, and the *Soweto Highveld Grassland* within the extreme southern portions, therefore, dominated by sourveld grasses. These vegetation types, like many other grasslands are highly diverse and under major threat through anthropogenic influences. From the initial site visit, it was identified that the study area contains the following zones or habitats (**Figure 9, Table 4**):

- Rocky Outcrops - These are mainly found along the Klien Olifants River System
- Grasslands
 - Natural Grasslands (often associated with rocky areas)
 - Hydromorphic Grasslands
 - Transformed/Disturbed Grassland (i.e. through intensive cattle crazing)
- Riverine & Aquatic
 - Palustrine River Systems
 - Dams
- Transformed Areas
 - Alien Bushclumps
 - Agricultural – Crop/Pasture Areas
 - Built-up

Table 4: Percentage cover of the broad habitat types found within the study area

Habitat Types	Habitat Size	% Total Area	Conservation Importance
Transformed Areas			
Agricultural Fields	1800.96	47.96	Low
Alien Bush Clumps	61.6	1.64	Low
Transformed - Built-up	36.35	0.97	Low
Riverine and Aquatic			
River Systems – specifically the Klien Olifants and associated tributaries	212.02	5.65	High
Large Dams	50.03	1.33	Moderate
Grassland Habitat			
Hydromorphic Grasslands	463.46	12.34	Moderate-High
Rocky Outcrops	105.67	2.81	High
Natural Grassland	1024.72	27.29	Moderate-High

Figure 9: Different habitats found within the De Wittekrans project



Of the habitats found on site, a large percentage of the study area has been transformed through agricultural activities (**Table 4 & Figures 10 & 11**). Almost 50% of the study area is under agricultural, either through maize (*Zea mays*), Potato (*Solanum tuberosum*) or pasture grass (*Eragrostis* spp, *Digitaria* spp) farming. However, at least 27% of the study area is under natural grassland. These are often associated with the Klien Olifants, its tributaries and the rocky outcrops. These natural areas are potential habitat for rare and threatened species (discussed in **Section 7.2**).



a. Klein Olifants River System (**Dry** Season)



b. Klein Olifants River System (**Dry** Season)



c. Dam and associated hydromorphic grassland (**Dry** season)



d. Dam and associated hydromorphic grassland (**Wet** season)



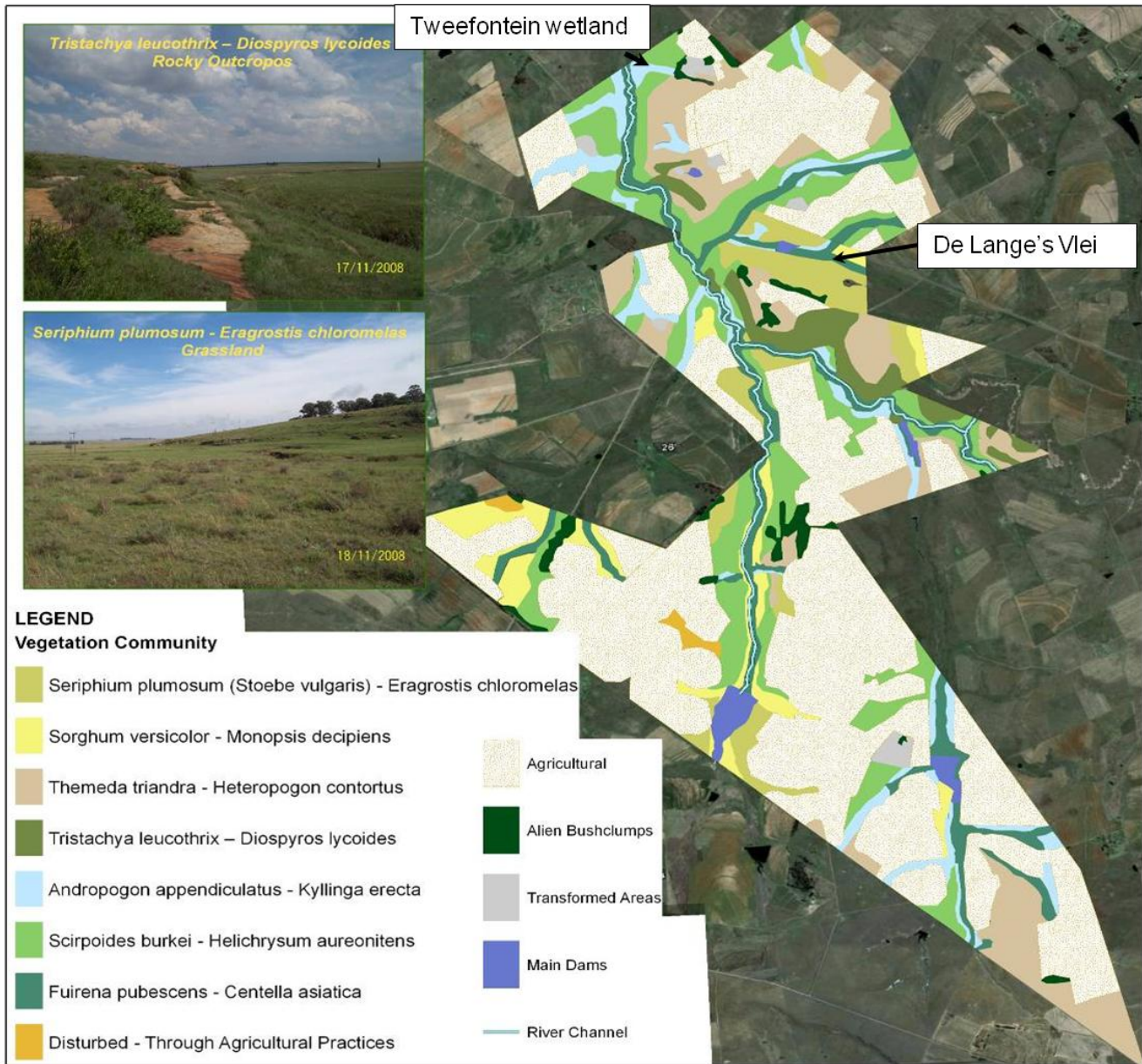
e – Rocky Outcrops associated with the Klien Olifants system (**Wet** season)



f. Transformed Areas (Dormant Potato Fields-**Dry** season)

Figure 10: Photographs of different habitats found within the study area.

Figure 11: Vegetation community map of the De Wittekrans project



SOURCE:
Aerial Photo: Google Earth
Date Accessed: September 2008)
Sampling Points: Field Investigations -
November 2008

0 400 800 1,600 2,400 3,200
m

N



1.12. Vegetation Communities

Identifying floristic species during the dry season site visit proved challenging as many species were not flowering and/or had been grazed or trampled on by cattle in the area (Refer to **Figure 10 [a,c & f]**). During the wet season of the study, vegetation communities and the species therein (indigenous, alien and conservation important species) were more easily identified due to the temperature change and developmental processes brought about by some good rains a several weeks prior to the sampling.

Seven relatively intact vegetation communities within both the lower lying hydromorphic grasslands and the higher lying undisturbed grassland and rocky areas were identified (**Figure 11**). These included:

- Mid to Upper Slope Transformed/Disturbed Grassland (i.e. through intensive cattle crazing)
Seriphium plumosum (*Stoebe vulgaris*) - *Eragrostis chloromelas* Grassland (177ha)
- Mid to Upper Slope Natural Grasslands (often associated with rocky outcrops)
Themeda triandra - *Heteropogon contortus* (403ha)
Tristachya leucothrix – *Diospyros lycoides* (111ha)
- Mid-Slope Hydromorphic - Moist Grasslands
Scirpoides burkei - *Helichrysum aureonitens* (492ha)
- Lower-Slope Hydromorphic - Moist Grasslands
Sorghum versicolor - *Monopsis decipiens* (147ha)
Andropogon appendiculatus - *Kyllinga erecta* (182ha)
Fuirena pubescens - *Centella asiatica* (267ha)

1. *Seriphium plumosum* (*Stoebe vulgaris*) - *Eragrostis chloromelas* Grassland

Community

Seriphium plumosum (*Stoebe vulgaris*) - *Eragrostis chloromelas* Grassland

Photographic Representation



Estimated

Cover:

Seriphium plumosum

Approximately 40%

Grass Sward:

Height

average >30cm

Grazing Potential

Dominated mainly by unpalatable species

Condition:

Overgrazed Grassland

Common

Species:

Refer to **Table 5**

Within the natural grassland on site, this community was found to occur in patches, specifically along the areas adjacent to the Klien Olifants system. *Seriphium plumosum* (previously known as *Stoebe vulgaris*) is dominant in terms of the woody layer. It is commonly associated with degraded areas in mostly the arid to semi-arid grasslands of South Africa. The encroachment of *Seriphium plumosum* into natural veld (induced by human activities such as overgrazing and wrongful management of fire) is a problem for farming livestock as it reduces the grazing capacity of the veld. This leads to an imbalance in the ratio between the herbaceous and woody components in the grassland. The abundance of palatable, perennial grasses (“decreasers”) is greatly reduced when the crown cover of *S. plumosum* exceeds 70%. Although it has not exceeded 70% in these area, very few Decreaser species were located.

Table 5: Frequently occurring species within the *Seriphium plumosum* - *Eragrostis chloromelas* Grassland

Scientific Name	Common Name	Growth Form
<i>Becium obovatum</i>	Cat's Whiskers	Forb
<i>Commelina africana</i> var. <i>krebsiana</i>	Yellow Commelina	Forb
<i>Crabbea ovalifolia</i>		Forb
<i>Cyperus obtusiflorus</i>	White-flowered Sedge	Sedge
<i>Delosperma sutherlandii</i>		Herbaceous Succulent
<i>Dichapetalum cymosum</i>	Poison Leaf	Forb
<i>Dicoma anomala</i> subsp. <i>gerrardii</i>	Stomach Bush	Forb
<i>Dipcadi cf ciliare</i>	Slanguintjie	Geophyte

<i>Elionurus muticus</i>	Sour Grass	Grass
<i>Eragrostis chloromelas</i>	Narrow Curly Leaf	Grass
<i>Eragrostis superba</i>	Saw - tooth Love Grass	Grass
<i>Gerbera piloselloides</i>	Small Yellow Gerbera	Forb
<i>Haplocarpha scaposa</i>	Tonteldoosbossie	Forb
<i>Helichrysum aureonitens</i>	Golden Everlasting	Forb
<i>Hermannia transvaalensis</i>		Forb
<i>Hyparrhenia hirta</i>	Thatch Grass	Grass
<i>Hypochaeris radicata</i> *	Hairy Wild Lettuce	Forb
<i>Kyllinga alba</i>	Witbiesie	Sedge
<i>Ledebouria ovatifolia</i>		Geophyte
<i>Sebaea grandis</i>	Large - flowered Sebaea	Forb
<i>Seriphium plumosum</i>	Bankrupt Bush	Shrublet

* Alien spp

2. *Themeda triandra* - *Heteropogon contortus* Grassland

Community *Themeda triandra* - *Heteropogon contortus* Grassland

Photographic Representation



Estimated Cover: *Themeda triandra* > 60%
Heteropogon contortus

Grass Sward: Height 30-50cm
 Grazing Potential Variable palatability (relatively even distribution of Increaser 2 and Decreaser species present)

Condition: Relatively natural grassland with evidence of overgrazing in certain areas

Common Species: Refer to **Table 6**

This grassland community was found within the higher lying areas within the study area with the herbaceous layer dominated by climax species. Climax species indicate a 'mature' ecosystem that is composed of species best adapted to average conditions in that area. Although grazing by cattle is evident, this community type is in relatively good condition. A list of commonly occurring species is highlighted in **Table 6**.

Table 6: Frequently occurring species within the *Themeda triandra* - *Heteropogon contortus* Grassland

Scientific Name	Common Name	Growth Form
<i>Acalypha angustata</i>	Copper Leaf	Forb
<i>Anthericum fasciculatum</i>	-	Geophyte
<i>Aristida junciformis</i>	Gongoni Three - awn	Grass
<i>Asclepias gibba</i> var. <i>gibba</i>	Large Turret - flower	Forb
<i>Asclepias stellifera</i>	Spring Stars	Forb
<i>Becium obovatum</i>	Cat's Whiskers	Forb
<i>Chaetacanthus cf. setiger</i>	-	Forb
<i>Crabbea ovalifolia</i>	-	Forb
<i>Cyperus obtusiflorus</i>	White-flowered Sedge	Sedge
<i>Delosperma sutherlandii</i>	-	Herbaceous Succulent
<i>Diclis reptans</i>	-	Forb
<i>Elionurus muticus</i>	Sour Grass	Grass
<i>Eragrostis chloromelas</i>	Narrow Curly Leaf	Grass
<i>Euphorbia striata</i>	Milkweed	Forb
<i>Gerbera viridifolia</i>	-	Forb
<i>Helichrysum rugulosum</i>	-	Forb
<i>Hermannia depressa</i>	Creeping Red Hermannia	Forb
<i>Hermannia transvaalensis</i>	-	Forb
<i>Heteropogon contortus</i>	Spear Grass	Grass
<i>Hibiscus microcarpus</i>	-	Forb
<i>Hyparrhenia tamba</i>	Blue Thatching Grass	Grass
<i>Hypoxis rigidula</i>	Silver - leaved Star - flower	Geophyte
<i>Ipomoea simplex</i>	-	Herbaceous Creeper
<i>Lotononis listii</i>	-	Forb
<i>Nemesia fruticans</i>	Wild Nemesia	Forb
<i>Oenothera rosea</i> §	Pink Evening Primrose	Forb
<i>Pentanisia angustifolia</i>	-	Forb
<i>Polygala hottentotta</i>	Small Purple Broom	Forb
<i>Scabiosa columbaria</i>	Wild Scabiosa	Forb
<i>Sebaea grandis</i>	Large - flowered Sebaea	Forb
<i>Setaria sphacelata</i>	Common Bristle Grass	Grass
<i>Solanum panduriforme</i>	Poison Apple	Forb
<i>Themeda triandra</i>	Red Grass	Grass
<i>Tristachya leucothrix</i>	Hairy Trident Grass	Grass
<i>Vernonia oligocephala</i>	Bitterbossie	Shrublet

§ Alien spp

3. *Tristachya leucothrix* – *Diospyros lycoides* Grassland

Community *Tristachya leucothrix* – *Diospyros lycoides* Grassland

Photographic Representation



Estimated Cover: *Tristachya leucothrix* 30%
Diospyros lycoides Grassland 20%

Grass Sward: Height +/- 60cm
 Grazing Potential Dominated mainly by unpalatable species

Condition: Relatively Good Condition with some evidence of disturbance due to the presents of Alien species such as *Solanum nodiflorum*

Common Species: Refer to **Table 7**

This grassland community is located within the rocky outcrops adjacent to the Klien Olifants and a number of its associated tributaries. The herbaceous layer is dominated by climax species indicating that this is a 'mature' and stable ecosystem. A list of commonly occurring species is highlighted in **Table 7**.

Table 7. Frequently occurring species within the *Tristachya leucothrix* – *Diospyros lycoides* Grassland

Scientific Name	Common Name	Growth Form
<i>Anthericum fasciculatum</i>	-	Geophyte
<i>Asclepias stellifera</i>	Spring Stars	Forb
<i>Becium obovatum</i>	Cat's Whiskers	Forb
<i>Brachiaria serrata</i>	Velvet Grass	Grass
<i>Chaetacanthus cf.setiger</i>	-	Forb
<i>Cheilanthes hirta</i>	-	Fern
<i>Cheilanthes quadripinnata</i>	-	Fern
<i>Crabbea ovalifolia</i>	-	Forb
<i>Cymbopogon validus</i>	Giant Turpentine Grass	Grass
<i>Cyperus obtusiflorus</i>	White-flowered Sedge	Sedge
<i>Diospyros lycioides</i>	Transvaal Bluebush	Shrub/Small Tree
<i>Elionurus muticus</i>	Sour Grass	Grass
<i>Eragrostis racemosa</i>	Narrow - heart Love Grass	Grass
<i>Euphorbia striata</i>	Milkweed	Forb

Scientific Name	Common Name	Growth Form
<i>Felicia filifolia</i>	Fine Leaved Felicia / Draaibos	Forb
<i>Gazania krebsiana</i> (white form)	Common Gazania (Botterblom)	Forb
<i>Gerbera piloselloides</i>	Small Yellow Gerbera	Forb
<i>Gladiolus dalenii</i>	African Gladiolus	Geophyte
<i>Gnidia microcephala</i>	Besembossie	Forb
<i>Hermannia erodooides</i>	-	Forb
<i>Heteropogon contortus</i>	Spear Grass	Grass
<i>Hypoxis rigidula</i>	Silver - leaved Star - flower	Geophyte
<i>Ledebouria ovatifolia</i>	-	Geophyte
<i>Leonotis microphylla</i>	Rock Dagga	Shrublet
<i>Panicum maximum</i>	Guinea Grass	Grass
<i>Pelargonium luridum</i>	Stalk - flowered Pelargonium	Geophyte
<i>Polygala hottentotta</i>	Small Purple Broom	Forb
<i>Seriphium plumosum</i> (<i>Stoebe vulgaris</i>)	Bankrupt Bush	Shrublet
<i>Solanum nodiflorum</i> §	-	Forb
<i>Sporobolus pectinatus</i>	-	Grass
<i>Themeda triandra</i>	Red Grass	Grass
<i>Trachyandra asperata</i> var. <i>basutunensis</i>	Wild Knoflok	Geophyte
<i>Tristachya leucothrix</i>	Hairy Trident Grass	Grass
<i>Tristachya rehmannii</i>	Broom Grass	Grass
<i>Vernonia oligocephala</i>	Bitterbossie	Shrublet
<i>Wahlenbergia krebsii</i>	-	Forb

§Alien spp

4. *Scirpoides burkei* - *Helichrysum aureonitens* Grassland

Community *Scirpoides burkei* - *Helichrysum aureonitens* Grassland

Photographic Representation



Estimated

Cover:

Grass /Sedge

Sward:

Scirpoides burkei

Helichrysum aureonitens

Height

Grazing Potential

30%

15%

+/- 70cm

The majority of species are listed as
Increaser 2 – Indicators of overgrazed veld

Condition: Semi-altered community
Common Species: Refer to **Table 8**

This grassland community is located along the mid slope of the cantena and largely consists of sub-climax and pioneer grass species. A list of commonly occurring species is highlighted in **Table 8**.

Table 8: Frequently occurring species within the *Scirpoides burkei* - *Helichrysum aureonitens* Grassland

Scientific Name	Common Name	Growth Form
<i>Andropogon appendiculatus</i>	Vlei Bluestem	Grass
<i>Anthericum fasciculatum</i>	-	Geophyte
<i>Asclepias gibba</i> var. <i>gibba</i>	Large Turret - flower	Forb
<i>Berkheya radula</i>	Boesmansrietjie	Forb
<i>Centella asiatica</i>	Asiatic Pennywort	Forb
<i>Convolvulus sagittatus</i>	-	Creeper
<i>Cyperus laevigatus</i>	-	Sedge
<i>Dichapetalum cymosum</i>	Poison Leaf	Forb
<i>Enneapogon cenchroides</i>	Nine - awned Grass	Grass
<i>Gnidia microcephala</i>	Besembossie	Forb
<i>Haplocarpha scaposa</i>	Tonteldoosbossie	Forb
<i>Helichrysum aureonitens</i>	Golden Everlasting	Forb
<i>Heteropogon contortus</i>	Spear Grass	Grass
<i>Hibiscus aethiopicus</i>	-	Forb
<i>Hypochoeris radicata</i> §	Hairy Wild Lettuce	Forb
<i>Hypoxis argentea</i>	-	Geophyte
<i>Ipomoea simplex</i>	-	Creeper
<i>Kohautia amatymbica</i>	-	Forb
<i>Lactua inermis</i>	-	Forb
<i>Monopsis decipiens</i>	Butterfly Lobelia	Forb
<i>Oenothera rosea</i> §	Pink Evening Primrose	Forb
<i>Oxalis corniculata</i> §	Creeping Sorrel	Forb
<i>Pennisetum thunbergii</i>	Thunberg's Pennisetum	Grass
<i>Plantago longissima</i>	-	Forb
<i>Ranunculus multifidus</i>	Common Buttercup	Forb
<i>Rumex</i> spp	-	Forb
<i>Scirpoides burkei</i>	-	Sedge
<i>Sorghum versicolor</i>	Black-seed Grass	Grass
<i>Tolpis capensis</i>	-	Forb
<i>Trachyandra asperata</i> var. <i>basutunensis</i>	Wild Knoflok	Geophyte
<i>Trifolium africanum</i>	Wild Clover	Forb

§ Alien spp

5. *Sorghum versicolor* - *Monopsis decipiens* Grassland

Community *Sorghum versicolor* - *Monopsis decipiens* Grassland

Photographic Representation



Estimated Cover:	<i>Sorghum versicolor</i>	30%
	<i>Monopsis decipiens</i>	15%
Grass /Sedge Sward:	Average Height	+/- 40cm
	Grazing Potential	Limited palatability – mostly Increaser species recorded within this community
Condition:	Semi-altered community	
Common Species:	Refer to Table 9	

This grassland community is located along the lower footslopes and was found predominantly in the south within and around disturbed areas. To support this, the vegetation community largely consists of sub-climax and pioneer grass species. A list of commonly occurring species is highlighted in **Table 9**.

Table 9: Frequently occurring species within the *Sorghum versicolor* - *Monopsis decipiens* Grassland

Scientific Name	Common Name	Growth Form
<i>Centella asiatica</i>	Asiatic Pennywort	Forb
<i>Crepsis hypochoeridea</i>		Forb
<i>Cyperus compressus</i>		Sedge
<i>Cyperus laevigatus</i>		Sedge
<i>Dipcadi cf ciliare</i>	Slanguintjie	Geophyte
<i>Enneapogon cenchroides</i>	Nine - awned Grass	Grass
<i>Eragrostis chloromelas</i>	Narrow Curly Leaf	Grass
<i>Fuirena pubescens</i>		Sedge
<i>Fuirena spp</i>		Sedge
<i>Helichrysum aureonitens</i>	Golden Everlasting	Forb
<i>Monopsis decipiens</i>	Butterfly Lobelia	Forb
<i>Oenothera rosea*</i>	Pink Evening Primrose	Forb
<i>Pelargonium luridum</i>	Stalk - flowered Pelargonium	Geophyte

Scientific Name	Common Name	Growth Form
<i>Ranunculus multifidus</i>	Common Buttercup	Forb
<i>Rumex spp</i>		Forb
<i>Schoenoplectus corymbosus</i>		Sedge
<i>Scirpoides burkei</i>		Sedge
<i>Scirpus ficinioides</i>		Sedge
<i>Senecio coronatus</i>	Wooly Grassland Senecio	Forb
<i>Sorghum versicolor</i>	Black-seed Grass	Grass

§Alien spp

6. *Andropogon appendiculatus* - *Kyllinga erecta* Grassland

Community *Andropogon appendiculatus* - *Kyllinga erecta* Grassland

Photographic Representation



Estimated Cover: *Andropogon appendiculatus* 25%
Kyllinga erecta 15%

Grass /Sedge Sward: Average Height +/- 45cm

Grazing Potential Limited palatability – mostly Increaser species recorded within this community

Condition: Semi-altered community

Common Species: Refer to **Table 10**

This grassland community is located along the lower lying slopes to the valley bottom along with the *Fuirena pubescens* - *Centella asiatica* grassland community. A list of commonly occurring species is highlighted in **Table 10**.

Table 10: Frequently occurring species within the *Andropogon appendiculatus* - *Kyllinga erecta* Grassland

Scientific Name	Common Name	Growth Form
<i>Andropogon appendiculatus</i>	Vlei Bluestem	Grass
<i>Centella asiatica</i>	Asiatic Pennywort	Forb
<i>Chironia palustris</i>	Marsh Chironia	Forb
<i>Commelina africana</i> var. <i>krebsiana</i>	Yellow Commelina	Forb
<i>Crepsis hypochaeridea</i>		Forb

<i>Cyperus laevigatus</i>		Sedge
<i>Eragrostis chloromelas</i>	Narrow Curly Leaf	Grass
<i>Fuirena pubescens</i>		Sedge
<i>Helichrysum aureonitens</i>	Golden Everlasting	Forb
<i>Hypericum lalandii</i>		Forb
<i>Hypochaeris radicata</i> §	Hairy Wild Lettuce	Forb
<i>Hypoxis argentea</i>		Geophyte
<i>Kyllinga erecta</i>		Sedge
<i>Ledebouria revoluta</i>		Geophyte
<i>Leersia hexandra</i>	Rice Grass	Grass
<i>Lobelia flaccida</i>	Wild Lobelia	Forb
<i>Lycium cinereum</i>	Small Honey - thorn	Forb
<i>Marsiscus</i> spp		Sedge
<i>Monopsis decipiens</i>	Butterfly Lobelia	Forb
<i>Oxalis corniculata</i> *	Creeping Sorrel	Forb
<i>Senecio erubescens</i>		Forb
<i>Silene burchellii</i>	Gun Powder Plant	Forb
<i>Sorghum versicolor</i>	Black-seed Grass	Grass
<i>Trachyandra saltii</i>		Geophyte

§Alien spp

7. *Fuirena pubescens* - *Centella asiatica* Grassland

Community *Fuirena pubescens* - *Centella asiatica* Grassland

Photographic Representation



Estimated Cover:	<i>Fuirena pubescens</i>	20%
Grass /Sedge Sward:	<i>Centella asiatica</i>	15%
	Average Height	+/- 25cm
	Grazing Potential	Limited palatability – mostly Increaser species recorded within this community
Condition:	Semi-altered community	
Common Species:	Refer to Table 11	

This grassland community is located along the valley bottom along with the *Andropogon appendiculatus* - *Kyllinga erecta* grassland. A list of commonly occurring species is highlighted in **Table 11**.

Table 11: Frequently occurring species within the *Fuirena pubescens* - *Centella asiatica* Grassland

Scientific Name	Common Name	Growth Form
<i>Andropogon appendiculatus</i>	Vlei Bluestem	Grass
<i>Anthericum fasciculatum</i>		Geophyte
<i>Centella asiatica</i>	Asiatic Pennywort	Forb
<i>Crepsis hypochoeridea</i>		Forb
<i>Cynium tubulosum</i>	Vlei Ink - flower	Grass
<i>Cyperus compressus</i>		Sedge
<i>Dipcadi cf ciliare</i>	Slanguintjie	Geophyte
<i>Eleocharis spp</i>		Sedge
<i>Eragrostis chloromelas</i>	Narrow Curly Leaf	Grass
<i>Eragrostis superba</i>	Saw - tooth Love Grass	Grass
<i>Festuca scabra</i>	Munnik Fescue	Grass
<i>Fuirena pubescens</i>		Sedge
<i>Haplocarpha lyrata</i>		Forb
<i>Harpochloa falx</i>	Caterpillar Grass	Forb
<i>Helichrysum aureonitens</i>	Golden Everlasting	Forb
<i>Hermannia transvaalensis</i>		Forb
<i>Hypericum lalandii</i>		Forb
<i>Hypochoeris radicata</i>	Hairy Wild Lettuce	Forb
<i>Leersia hexandra</i>	Rice Grass	Grass
<i>Lobelia flaccida</i>	Wild Lobelia	Forb
<i>Marsiscus spp</i>		Sedge
<i>Monopsis decipiens</i>	Butterfly Lobelia	Forb
<i>Nemesia fruticans</i>	Wild Nemesia	Forb
<i>Oxalis obliquifolia*</i>	Oblique - leaved Sorrel	Forb
<i>Pelargonium luridum</i>	Stalk - flowered Pelargonium	Geophyte
<i>Plantago longissima</i>		Forb
<i>Ranunculus multifidus</i>	Common Buttercup	Forb
<i>Rumex spp</i>		Forb
<i>Setaria sphacelata</i>	Common Bristle Grass	Grass
<i>Sorghum versicolor</i>	Black-seed Grass	Grass
<i>Themeda triandra</i>	Red Grass	Grass
<i>Verbena tenuisecta</i>		Forb

§ Alien species

1.13. Faunal Communities

Faunal species were identified throughout the study area through actual observation, capture, evidence of presence and communication with resident farmers. Complete lists of these species are included in the Appendices. The limited time available to conduct a field investigation and the

instinctive nature of most faunal species to avoid human encounters makes it difficult to conduct a complete census of faunal species in a specific habitat. The habitats of the study area were nevertheless surveyed within the context of these limitations. In reference to **Section 6**, sampling within different habitats, under such restriction, does provide data of sufficient quality that can be used to predict impacts.

An extensive faunal assessment of the area was achieved through comprehensive desktop research and both winter (Dry Season) and summer (Wet Season) field assessments. **Table 12** below presents a summary of the species (number of families for invertebrates), which were identified in each of the habitat types within the study area, and the total number of faunal species throughout the study area. Examples of species within the taxa recorded during the survey are presented in **Figure 12**. Red Data species that could potentially occur within the study area are identified in **Section 7.4**.

Table 12: Faunal species (families for invertebrates) identified within the various habitat types at each of the sites (Figure 12), and total species numbers for the study area.

Fauna	Site 1 Rocky outcrops and river system	Site 2 Hydromorphic grassland & wetland area	Site 3 River system & associated grassland	Site 4 CPLAN highly significant area	Total faunal species throughout the De Wittekrans Study Area
Mammals	12	4	8	9	23
Avifauna	41	30	41	37	74
Herpetofauna	1	5	4	5	10
Invertebrates	16	9	7	17	34



A



B



C

Figure 12: Examples of mammal, amphibian and insect observations in the study area: (A) *Rhabdomys pumilio* (Striped mouse); (B) *Cacosternum boettgeri* (Common Dainty Frog); (C) Family: REDUVIIDAE (Assassin Bug)

1.13.1 Mammals

Research has indicated that the Mpumalanga Province supports a high faunal diversity, including 163 mammal species, of which 98 species fall into the small mammal category. The grassland

and forest areas provide suitable habitat for many endemic and threatened species (Emery, *et al.*, 2002), and the grassland biome itself supports close to 89 of the 163 mammal species, many of which are insectivores. A desktop study identified 105 species potentially occurring in the Hendrina / Ermelo region (**Appendix 2**).

During the first and second site visits, 24 mammal species were identified through visual observation, capture, evidence of presence (from signs as faeces and spoor) and communication with resident farmers (**Table 12**). These represent 35% of the potential mammalian fauna of the area. Evidence of mammals in the study area are presented in **Figure 13**. The relative abundance of the mammal species to one another is indicated from the number of observations during the second site visit.

Rhabdomys pumilio (Striped Mouse) was the most abundant mammal throughout the study area, with an excess of 20% success rate achieved with Sherman mammal traps (**Table 13**). This species is typically abundant in crop production areas. Much of the study site is ploughed (almost 50%) and planted to either maize or potato crops, and the natural vegetation tends to be fragmented into smaller units between large agricultural fields. Numerous individuals of *Elanus caeruleus* (Black-shouldered Kites) were observed in the study area, which could be attracted by the large *Rhabdomys* population.

Hystrix africaeaustralis (Porcupine) are abundant throughout the study area. One of the local farmers (Mr de Vos *pers comm.*, 2008) mentioned that these animals are considered a pest in the area on account of the damage inflicted on crops. No predators with potential to impact upon porcupine populations were recorded within the study area. However, a number of snares (traps) were located outside numerous burrows (specifically within the rocky outcrop areas).



A



B



C



Figure 13: Evidence of mammalian activity within the study area: (A) *Croccidura* sp. (Shrew); (B) *Procavia capensis* (Rock Dassie); (C) *Vulpes chama* (Cape Fox) spoor, (D) *Mastomys natalensis* (Multimammate Mouse); (E) *Atilax paludinosus* (Water mongoose) spoor; (F) *Aonyx capensis* (Cape Clawless Otter) dung.

Table 13: Mammal species recorded within the study area during two site visits (Appendix 3). Relative abundance between species is based on number of observations.

Common Name	Scientific name	Relative abundance	Vegetation community	Conserv. status
Aardvark	<i>Orycteropus afer</i>	2	NG (Tt-Hc)	LC
Black Wildebeest	<i>Connochaetes gnou</i>	1	-	Introduced
Black-backed Jackal	<i>Canis mesomelas</i>	4	Widespread	LC
Blesbok	<i>Damaliscus pygargus phillipsii</i>	1	-	Introduced
Bushpig *	<i>Potamochoerus larvatus</i>	1	-	LC
Cape Clawless Otter	<i>Aonyx capensis</i>	1	HG (Fp-Ca)	LC
Cape Fox	<i>Vulpes chama</i>	1	Agric	PS ¹
Common (Grey) Duiker	<i>Sylvicapra grimmia</i>	3	HG; Agric	LC
Common Mole-rat	<i>Cryptomys hottentotus</i>	-	HG	LC
Rock Dassie	<i>Procavia capensis</i>	1	NG (TI-DI)	LC
South African Hedgehog *	<i>Atelerix frontalis</i>	1	-	PS ¹ NT
Highveld Gerbil	<i>Tatera brantsii</i>	3	TG (Sp-Ec)	LC
Multimammate mouse	<i>Mastomys natalensis</i>	2	NG (Tt-Hc)	LC
Porcupine	<i>Hystrix africaeaustralis</i>	10	Widespread	LC
Striped Mouse	<i>Rhabdomys pumilio</i>	46	HG	LC
Scrub Hare	<i>Lepus saxatilis</i>	1	HG (Sv-Md)	LC
Serval *	<i>Leptailurus serval</i>	1	-	PS ¹ NT
Shrew	<i>Croccidura</i> species	2	HG (Sb-Ha)	DD
Slender Mongoose	<i>Galerella sanguinea</i>	2	HG (Sv-Md)	LC
Steenbok	<i>Raphicerus campestris</i>	2	HG; Agric	LC
Suricat	<i>Suricata suricatta</i>	1	HG (Aa-Ke)	LC
Water Mongoose	<i>Atilax paludinosus</i>	2	HG (Fp-Ca)	LC
Yellow Mongoose	<i>Paracynictus selousi</i>	3	Widespread	LC
Feral Domestic Dog		3	Widespread	Alien

* Presence based on communication with resident farmers

¹ NEMA: Biodiversity Act 2004: Publication of lists of critically endangered, endangered, vulnerable and protected species. Feb 2007 / Source: Skinner & Chimimba (2005)

TG	Transformed/Disturbed Grassland (i.e. through intensive cattle grazing)
TG (Sp-Ec)	<i>Seriphium plumosum</i> (<i>Stoebe vulgaris</i>) - <i>Eragrostis chloromelas</i> Grassland
NG	Natural Grasslands (often associated with rocky outcrops)
NG (Tt-Hc)	<i>Themeda triandra</i> - <i>Heteropogon contortus</i>
NG (TI-DI)	<i>Tristachya leucothrix</i> - <i>Diospyros lycoides</i> (rocky outcrops)
HG	Hydromorphic - Moist Grasslands
HG (Sb-Ha)	<i>Scirpoides burkei</i> - <i>Helichrysum aureonitens</i>
HG (Sv-Md)	<i>Sorghum versicolor</i> - <i>Monopsis decipiens</i>
HG (Aa-Ke)	<i>Andropogon appendiculatus</i> - <i>Kyllinga erecta</i>
HG (Fp-Ca)	<i>Fuirena pubescens</i> - <i>Centella asiatica</i>
Agric	Cultivated land

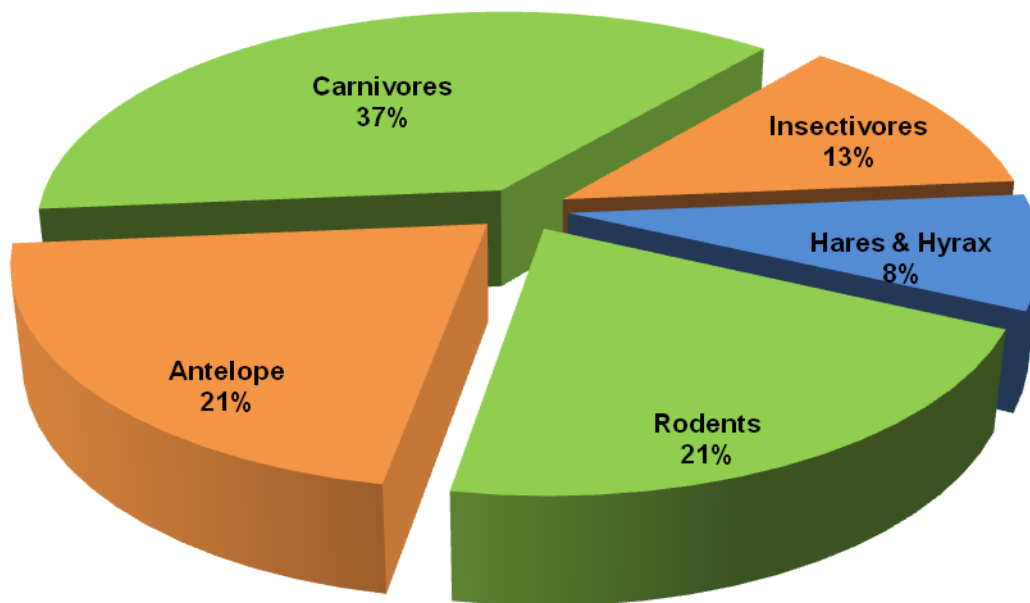


Figure 14: Percentage composition of mammalian classification groups observed within the study area.

1.13.2 Avifauna

Mpumalanga supports a highly diverse bird life, with over 567 birds recorded within the province. Of these, about 71 are Red Data species. According to the South African Bird Atlas Project, there are 219 bird species recorded within the QDS 2629 BB, BC & BD (**Appendix 4**). During the two site visits, 73 bird species were identified through visual observations and through signs such as faeces, spoor or feathers (**Table 14 & Figure 15**). In terms of distribution, over 24% of the species identified during the site visits were waterbirds (including waterfowl) (**Figure 16**) and approximately 13% were grassland specialists. This corresponds to the available habitat within

the study area as the majority of the remaining natural habitat consisted of natural, rocky grasslands, hydromorphic grassland and the riverine areas.

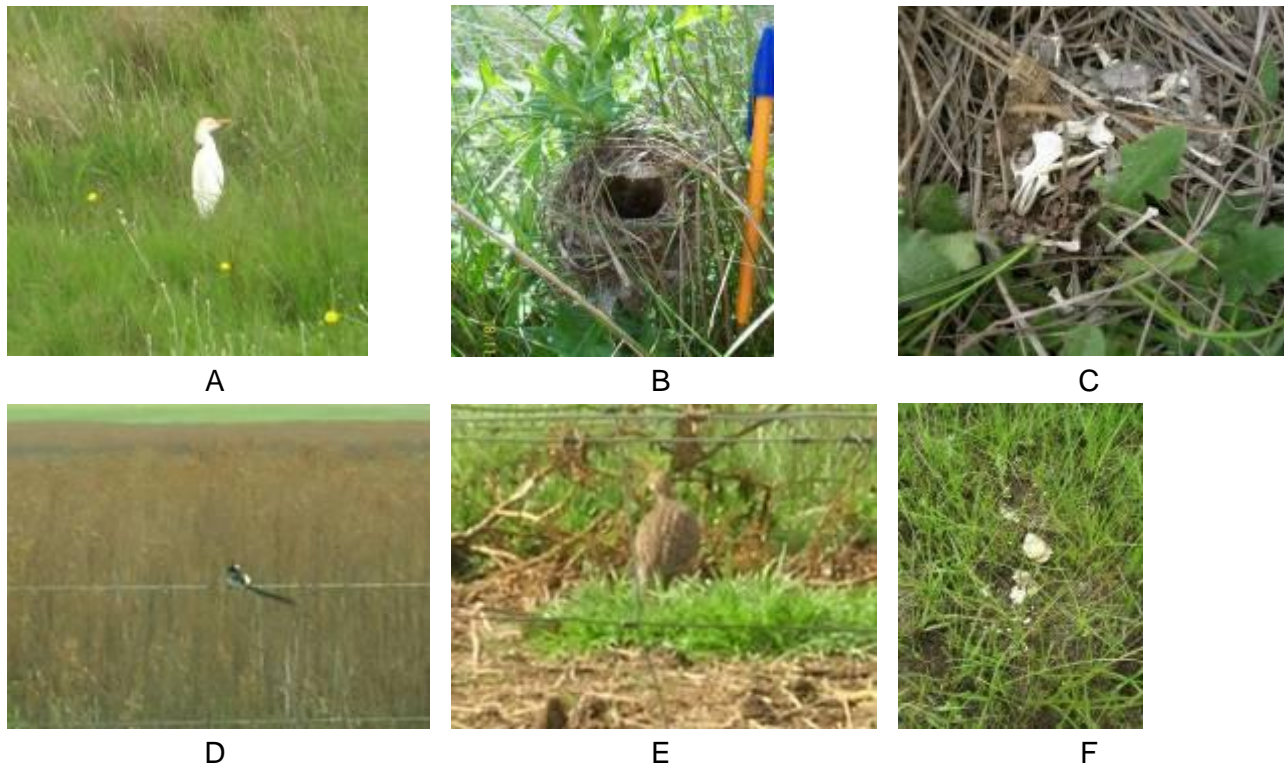


Figure 15: Evidence of avifaunal activity within the study area: (A) *Bubulcus ibis* (Cattle Egret); (B) *Quelea quelea* (Red-billed quelea) nest; (C) *Asio capensis* (Marsh Owl) pellet; (D) *Vidua macroura* (Pin-tailed Whydah); (E) *Pternistis natalensis* (Natal Spurfowl); (F) *Numida meleagris* (Helmeted Guineafowl) old nest.

Table 14: List of bird species recorded in the study site during two site visits (Appendix 5). Nomenclature according to the South African Bird Atlas Project:

Common name	Species name	Class. group	Abundance	Red list
1. Reed (Long-tailed) Cormorant	<i>Phalacrocorax africanus</i>	WB	C	
2. Grey Heron	<i>Ardea cinerea</i>	WB	B	
3. Black-headed Heron	<i>Ardea melanocephala</i>	WB	C	
4. Great White Egret	<i>Egretta alba</i>	WB	D	
5. Little Egret	<i>Egretta garzetta</i>	WB	D	
6. Cattle Egret	<i>Bubulcus ibis</i>	WB	A	
7. Black Stork	<i>Ciconia nigra</i>	WB	D	VU ¹
8. African Sacred (Sacred) Ibis	<i>Threskiornis aethiopicus</i>	WB	C	
9. Hadeda Ibis	<i>Bostrychia hagedash</i>	WB	A	
10. Spur-winged Goose	<i>Plectropterus gambensis</i>	WF	A	

Common name	Species name	Class. group	Abundance	Red list
11. Egyptian Goose	<i>Alopochen aegyptiacus</i>	WF	A	
12. Cape Shoveler	<i>Anas smithii</i>	WF	D	
13. Yellow-billed Duck *	<i>Anas undulata</i>	WF	A	
14. Hottentot Teal	<i>Anas hottentota</i>	WF	C	
15. Amur (Eastern Red-footed) Falcon (Kestrel)	<i>Falco amurensis</i>	RAP	D	
16. Black-shouldered (Winged) Kite	<i>Elanus caeruleus</i>	RAP	A	
17. Steppe (Common) Buzzard	<i>Buteo vulpinus</i>	RAP	C	
18. Natal Spurfowl (Francolin) °	<i>Pternistis natalensis</i>	GEN	C	
19. Swainson's Spurfowl (Francolin)	<i>Pternistis swainsonii</i>	GEN	A	
20. Common Quail	<i>Coturnix coturnix</i>	GEN	B	
21. Helmeted Guineafowl	<i>Numida meleagris</i>	GEN	B	
22. Red-knobbed Coot *	<i>Fulica cristata</i>	WF	B	
23. Denham's (Stanley's) Bustard	<i>Neotis denhami</i>	GEN	D	
24. Blue Korhaan	<i>Eupodotis caerulescens</i>	GEN	D	VU ¹
25. Three-banded Plover	<i>Charadrius tricollaris</i>	WB	B	
26. Crowned Lapwing (Plover)	<i>Vanellus coronatus</i>	GEN	B	
27. Blacksmith Lapwing (Plover)	<i>Vanellus armatus</i>	GEN	A	
28. African (Ethiopian) Snipe	<i>Gallinago nigripennis</i>	WB	C	
29. Marsh Sandpiper	<i>Tringa stagnatilis</i>	WB	C	
30. Spotted Thick-knee (Dikkop)	<i>Burhinus capensis</i>	GEN	C	
31. Speckled (Rock) Pigeon	<i>Columba guinea</i>	GEN	B	
32. Red-eyed Dove	<i>Streptopelia semitorquata</i>	GEN	C	
33. Cape Turtle (Ring-necked) Dove	<i>Streptopelia capicola</i>	GEN	C	
34. Laughing (Palm) Dove *	<i>Streptopelia senegalensis</i>	GEN	A	
35. Namaqua Dove	<i>Oena capensis</i>	GEN	D	
36. Dideric (Diederik) Cuckoo	<i>Chrysococcyx caprius</i>	GEN	B	
37. Barn Owl	<i>Tyto alba</i>	NOC	D	
38. Marsh Owl	<i>Asio capensis</i>	NOC	C	
39. Spotted Eagle-Owl	<i>Bubo africanus</i>	NOC	D	
40. Horus Swift	<i>Apus horus</i>	GEN	C	
41. Green (Red-billed) Wood-hoopoe	<i>Phoeniculus purpureus</i>	GEN	D	
42. Crested Barbet	<i>Trachyphonus vaillantii</i>	GEN	D	
43. Red-capped Lark	<i>Calandrella cinerea</i>	GEN	C	
44. Barn (European) Swallow	<i>Hirundo rustica</i>	GEN	A	
45. White-throated Swallow	<i>Hirundo albigularis</i>	GEN	C	
46. Greater Striped-swallow *	<i>Hirundo cucullata</i>	GEN	B	
47. Sand Martin (Bank Swallow)	<i>Riparia riparia</i>	GEN	C	
48. Banded Martin	<i>Riparia cincta</i>	GEN	C	
49. Dark-capped (Black-eyed) Bulbul	<i>Pycnonotus tricolor</i>	GEN	C	
50. Anteating (Southern Anteating) Chat	<i>Myrmecocichla formicivora</i>	GEN	A	
51. African (Common) Stonechat	<i>Saxicola torquatus</i>	GS	A	

Common name	Species name	Class. group	Abundance	Red list
52. Sedge Warbler	<i>Acrocephalus schoenobaenus</i>	GS	C	
53. Zitting (Fan-tailed) Cisticola	<i>Cisticola juncidis</i>	GEN	B	
54. Le Vaillant's (Tinkling) Cisticola	<i>Cisticola tinniens</i>	GEN	C	
55. Fiscal Flycatcher	<i>Sigelus silens</i>	GEN	C	
56. Cape Wagtail	<i>Motacilla capensis</i>	GEN	B	
57. African (Grassveld/Grassland) Pipit	<i>Anthus cinnamomeus</i>	GS	B	
58. Cape (Orange-throated) Longclaw	<i>Macronyx capensis</i>	GS	A	
59. Common (Fiscal) Fiscal (Shrike)	<i>Lanius collaris</i>	GEN	C	
60. Red-backed Shrike °	<i>Lanius collurio</i>	GEN	C	
61. Common Myna (Alien Species)	<i>Acridotheres tristis</i>	GEN	C	
62. Pied (African Pied) Starling	<i>Spreo bicolor</i>	GEN	C	
63. House Sparrow (Alien Species) *	<i>Passer domesticus</i>	GEN	C	
64. Cape Sparrow	<i>Passer melanurus</i>	GEN	C	
65. Southern Masked-weaver *	<i>Ploceus velatus</i>	GEN	B	
66. Red-billed Quelea	<i>Quelea quelea</i>	GEN	A	
67. Southern Red (Red) Bishop	<i>Euplectes orix</i>	GEN	A	
68. Red-collared Widowbird	<i>Euplectes ardens</i>	GS	C	
69. White-winged Widowbird	<i>Euplectes albonotatus</i>	GS	C	
70. Fan-tailed (Red-shouldered) Widowbird	<i>Euplectes axillaris</i>	GS	B	
71. Long-tailed Widowbird	<i>Euplectes progne</i>	GS	A	
72. Common Waxbill	<i>Estrilda astrild</i>	GEN	B	
73. Pin-tailed Whydah	<i>Vidua macroura</i>	GS	B	
74. Cape (Yellow-crowned) Canary	<i>Serinus canicollis</i>	GEN	C	
75. Black-throated Canary	<i>Crithagra atrogularis</i>	GEN	C	

* Evidence of breeding activity on site during survey;

° Normal for the region, but not recorded in the area during the First South African Bird Atlas Project

¹ NEMA: Biodiversity Act 2004: Publication of lists of critically endangered, endangered, vulnerable and protected species. Feb 2007

WB	All water birds, but excluding waterfowl	A	Abundant
WF	Waterfowl (e.g. ducks, geese, coots and moorhen)	B	Frequently observed
RAP	Raptors	C	Infrequently observed
NOC	Nocturnal birds (e.g. owls and nightjars)	D	Single observation within the study area
GS	Grassland specialists		
GEN	Generalist bird species		

Source: Sinclair et al. (2002)

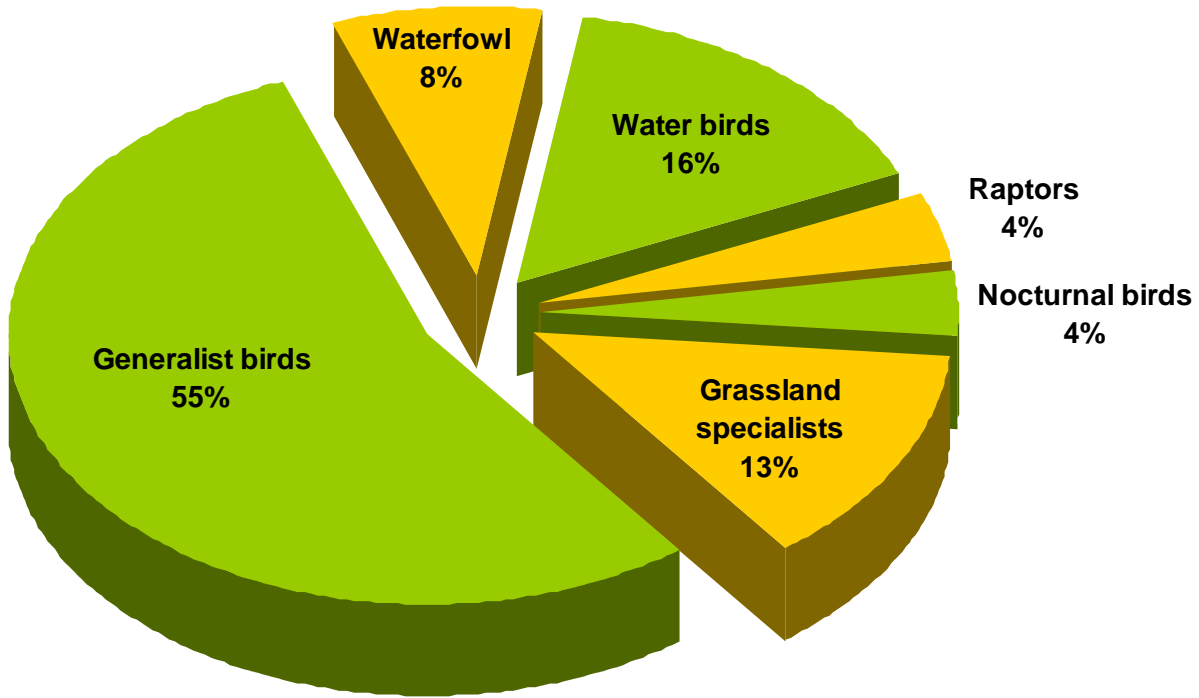


Figure 16: Percentage distribution of avian classification groups observed in the study area

To determine the proportion of coverage and assess possible sampling bias, the numbers of birds per classification group observed during the field visits are compared against the bird species per similar groups recorded in the QDS 2629BB, BC and BD by the South African Bird Atlasing Project. The results are presented below in **Figure 17**.

In terms of the grassland specialists, this survey identified over 40% of the species recorded in the Bird Atlas data for the area and, in total, approximately 34% of the total species recorded in the Bird Atlas data. Although the many of the species identified during this survey were waterbirds, including waterfowl (Figure 18), they only covered 28% of the Bird Atlas data. This could be due to the time of sampling as well as the extent of the area covered over the 5 day period (it is important to note that the bird atlas data was accumulated for three QDS).

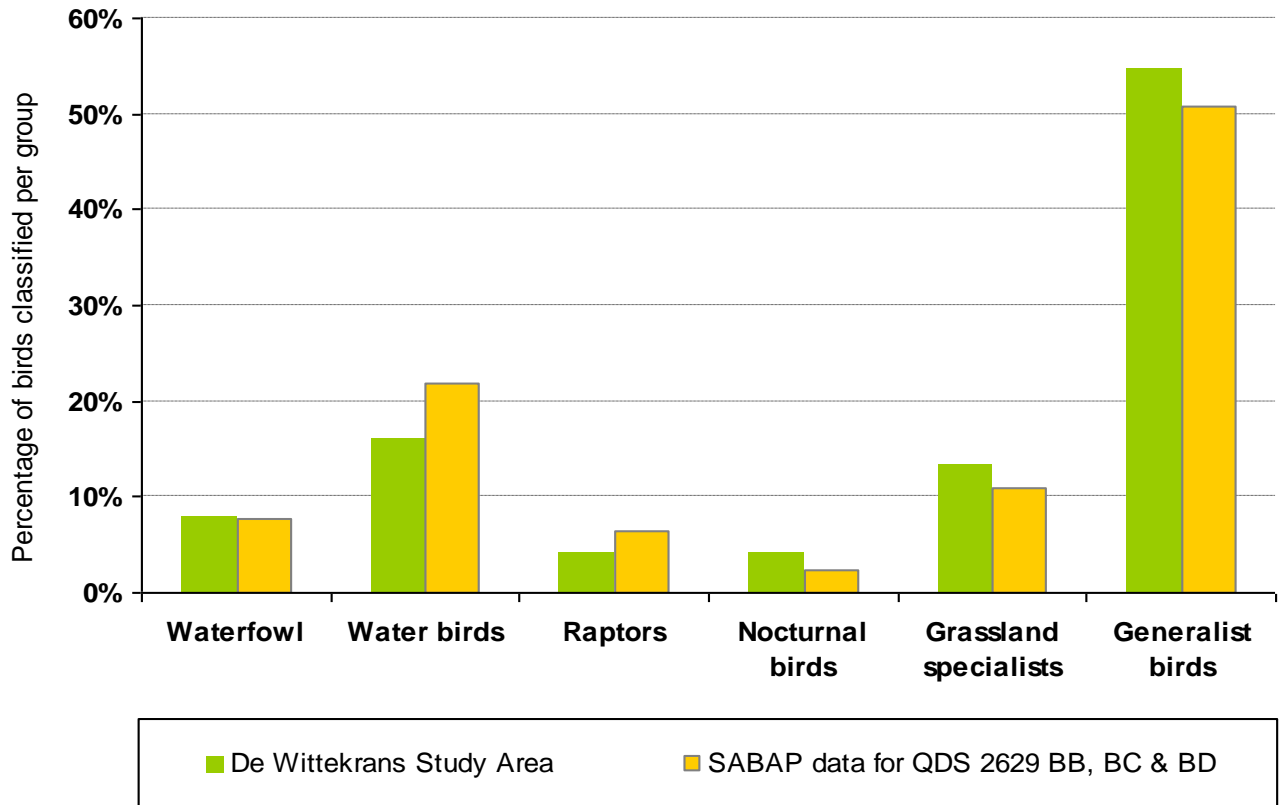


Figure 17: Percentage of birds observed per classification group compared against number of birds recorded per classification group recorded for QDS 2629BB, BC and BD of the South African Bird Atlas Project.

1.13.3 Herpetofauna

Reptiles of South Africa are still in the process of being mapped to QDS, through the South African Reptile Atlas. In terms of potential species occurring within the study site, there have been 31 snake species, 25 geckos, skinks and lizards as well as 20 frog species recorded within the 2629BB, BC and BD QDS. A detailed list of these species are highlighted in **Appendix 6** [Jacobsen (1989), Branch (1988), Minter *et al.* (2004) and the SARCA database]. Evidence of species recorded at the different sites are presented in **Figure 17** and within **Appendix 7**.



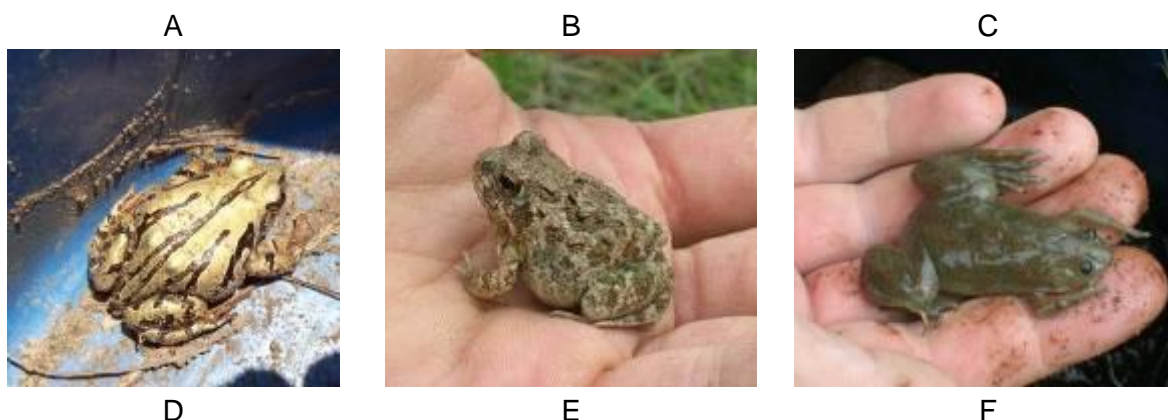


Figure 18: Evidence of Herpetofauna activity within the study area: (A) *Homoroselaps dorsalis* (Spotted Harlequin Snake); (B) *Psammophalyx rhombeatus* (Spotted Skaapsteker); (C) *Afrana angolensis* (Common River Frog); (D) *Semnodactylus wealii* (Rattling Frog); (E) *Tomopterna cryptotis* (Tremolo Sand Frog); (F) *Xenopus laevis* (Common Platanna).

Relatively few reptiles were observed within the study area, and may be due to either this taxa being inherently fearful of man, or they are not easily detected during short surveys. Nevertheless, five reptiles were recorded in the study area during the two site visits (**Table 15**) (note that the *Hemachatus haemachatus*, Rinkhals, was observed in the near vicinity of the study area during the first site visit). These species represent 9% of the potential reptile fauna of the study area.

Six amphibian species were positively identified within the study area, representing 37.5% of the amphibian species that could potentially occur there (refer to **Appendix 6 & 7**).

Table 16: Herpetofauna species recorded in the study site during two site visits

Common name	Scientific name	Conservation Status	Observed Abundance
REPTILES			
Rinkhals (cobra)	<i>Hemachatus haemachatus</i>	None	Single evidence of presence
Spotted Harlequin Snake	<i>Homoroselaps lacteus</i>	NT (Mpumalanga)	Single specimen found
Spotted Skaapsteker	<i>Psammophalyx rhombeatus</i>	None	Single specimen found
Peter's Blind Worm (Thread Snake)	<i>Leptotyphlops scutifrons</i>	None	4 specimens in 1 location
Variable Skink	<i>Trachylepis varia</i>	None	2 specimens in 1 location
AMPHIBIANS			
Common (Angola) River Frog	<i>Afrana angolensis</i>	LC	Common
Common (Boettger's) Dainty Frog	<i>Cacosternum boettgeri</i>	LC	Common
Bubbling Kassina / Running Frog	<i>Kassina senegalensis</i>	LC	Common

Common name	Scientific name	Conservation Status	Observed Abundance
Weale's Running Frog (Rattling frog)	<i>Semnodactylus wealii</i>	LC	Single specimen found
Common (Tremolo) Sand Frog	<i>Tomopterna cryptotis</i>	LC	Common
Common Platanna	<i>Xenopus laevis</i>	LC	Common

The *Homoroselaps lacteus* (Spotted Harlequin Snake) was a significant discovery in the south of the study area. This small and unusual snake (**Figure 18a**) includes young blind worm snakes within its diet. Four specimens of *Leptotyphlops scutifrons* (Peter's Blind Worm) were discovered in the same location. A small but significant population of scorpions was also discovered at this same location as described below in **Section 7.3.4**.

1.13.4 Macro-invertebrates

No invertebrates were recorded during the initial site visit on account of this visit being during the cold winter months. At least 38 invertebrate families were recorded during the second site visit when detailed investigation with pitfall trapping were conducted. These are listed in **Appendix 8**.

A small population of *Uroplectes triangulifer* scorpions was discovered in the south of the study site (**Figure 19**), close to trapping site number 4. Approximately 20 scorpions were observed under small rocks within the far southern region. The significance of this area is discussed further in **Section 7.4**.

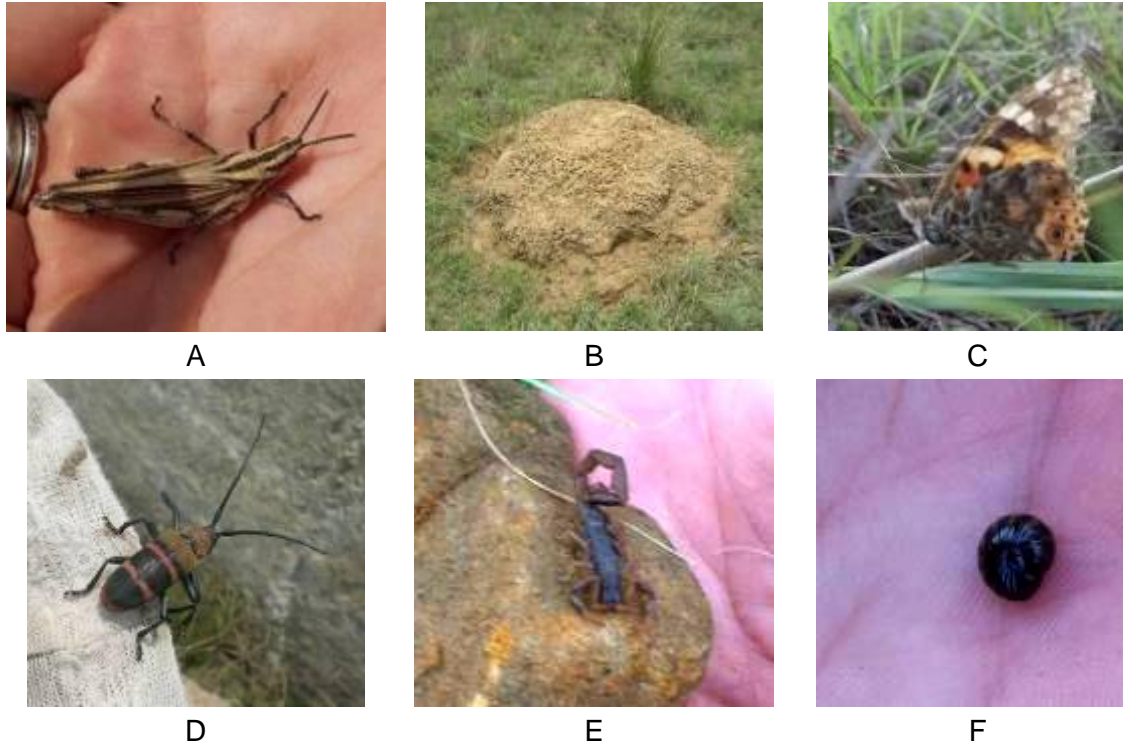


Figure 19: Evidence of insect activity within the study area: (A) Family: PYRGOMORPHIDAE (Elegant Grasshopper); (B) Family: TRINERVITERMES (Termite) nest; (C) Family: NYMPHALIDAE, *Vanessa cardui* (Painted Lady butterfly); (D) Family: Cerambycidae (Pondo Pondo Longhorn beetle); (E) *Uroplectes triangulifer* scorpion; (F) Order: Oniscomorpha (Pill millipede).

1.14. Conservation Important Species (Red Data/Endemics)

1.14.1 Flora

The Threatened Plant Species Programme (TSP) is currently revising all threatened plant species assessments made by Craig Hilton-Taylor (1996), using IUCN Red Listing Criteria modified from Davis *et al.* (1986). According to the TSP interim Red Data list of South African plant taxa (updated October 2007), there are over 201 Red Data listed species within Mpumalanga Province, of which 14 species are Critically Endangered (CE), 19 Endangered (EN) and 59 are Vulnerable (VU) (**Table 16**).

Table 16: Categories of Red Data species found within Mpumalanga Province.

Status	No. of Species
Extinct (EX)	1
Critically Endangered (CR)	14
Endangered (EN)	19
Vulnerable (VU)	59
Near Threatened (NT)	27
Data Deficient (DD)	22
Rare	40
Declining	15
Least Concern	2
Still to be assessed (STBA)	2
Mpumalanga Province	201

Although the study area is situated in an area that is currently been utilized mainly for crop cultivation and cattle farming, sufficient habitat for species of conservation significance to occur, specifically within the hydromorphic grasslands along the Klein Olifants River system. According to the Mpumalanga Parks Board (MPB), there have been a number of species recorded within the surrounding farms (**Table 17**, Figure . These preliminary finding are clearly illustrated in **Figure 20** which shows the Red Data Plants that have been recorded in the surrounding farms indicates Habitat availability for the PS are listed in **Table 17**.

Figure 20: Records of Red Data Plant Localities from the surrounding farms

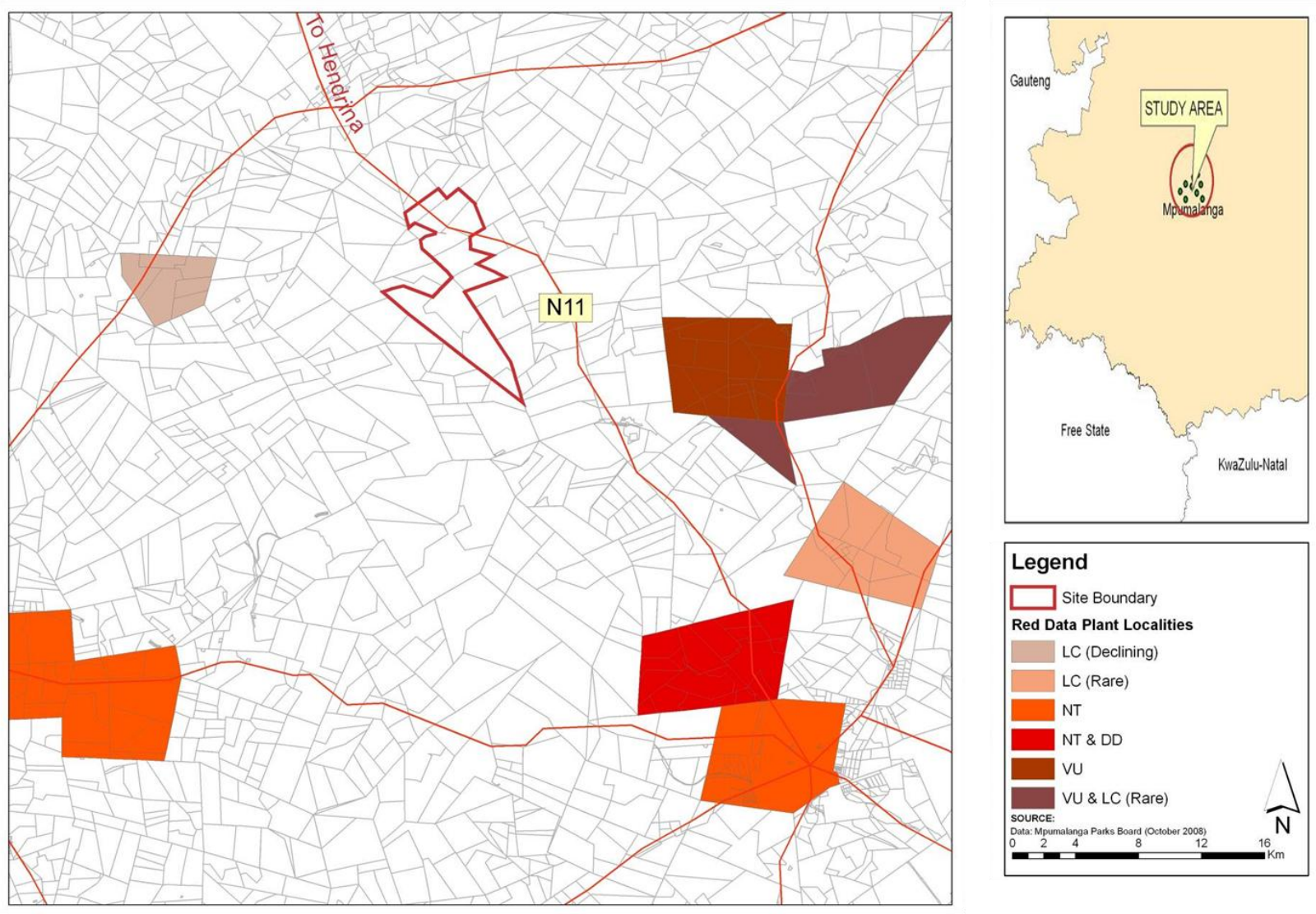


Table 17. Conservation important flora recorded within farms surrounding the study area.

Scientific Name	Common Name	MPB Status	RSA Status	Habitat	Habitat Available on Site
<i>Aspidoglossum xanthosphaerum</i>		VU D2	VU D2	Montane Grassland, Marshy Sites	Yes
<i>Eucomis autumnalis</i>	Common Pineapple Lily	LC – Declining	LC – Declining	All grassland types, including marshy areas.	Yes
<i>Eulophia cooperi</i>		LC Rare	LC	Grassland	Yes
<i>Kniphofia typhoides</i>	Bulrush Poker	NT A	NT	Heavy Clays – Low lying marshy Grassland	Yes
<i>Nerine gracilis</i>		NT	NT	Undulating grasslands in damp, moist areas; Heavy clay soils associated with sheets of dolerite	Yes

Of the species listed by MPB (**Table 17**), one Protected Species¹ was located within the north western section of the study area (within the *Andropogon appendiculatus* - *Kyllinga erecta* moist grassland) during Wet Season of the investigations. This species was *Eucomis autumnalis* (Common Pineapple Lily) (**Figure 21**).



A



B



C

Figure 21: Protected species located within the study area: (A) *E autumnalis*; (B) *Cheilanthes viridis*; (C) *Disa woodii*.

Protected Species under Schedule 11: Protected Plants [Section 69 (1)(a)] of the Mpumalanga Nature Conservation Act, 1998 [Act No. 10 (1998)] that were identified during the survey included:

¹ Protected Species: A plant species that is protected under Legislation (Not categorised according to TSP listings). No person shall pick/remove a protected plant, unless he/she is a holder of a permit

- ◆ *Crinum bulbispermum* (Orange River Lily) – Found within the *Andropogon appendiculatus* - *Kyllinga erecta* moist grassland; *Scirpoides burkei* - *Helichrysum aureonitens* damp grassland; *Sorghum versicolor* - *Monopsis decipiens* and *Fuirena pubescens* - *Centella asiatica* wet grasslands.
- ◆ *Gladiolus dalenii* (African Gladiolus) – Found within the *Tristachya leucothrix* – *Diospyros lycoides* rocky outcrops
- ◆ *Disa woodii* - Found within the *Andropogon appendiculatus* - *Kyllinga erecta* moist grassland and *Fuirena pubescens* - *Centella asiatica* wet grasslands.

In term of the old Transvaal Ordinance² [under Schedule 11 of the Nature Conservation Ordinance of Transvaal (No 12 of 1983)], the following fern species were identified within the *Tristachya leucothrix* – *Diospyros lycoides* rocky outcrops:

- ◆ *Pellaea calomelanos*
- ◆ *Cheilanthes quadripinnata*
- ◆ *Blechnum australe*
- ◆ *Cheilanthes viridis*
- ◆ *Cheilanthes hirta*
- ◆ *Cheilanthes eckloniana*

Medicinal Species

There is a growing focus on the importance of medicinal plants and traditional health systems in solving the health care problems of the world. Because of this awareness, the international trade in plants of medical importance is growing phenomenally, often to the detriment of natural habitats and mother populations in the countries of origin. According to Van Wyk *et.al.* (2000), over 3000 of the 30 000 plant species recorded within Southern Africa are used as medicines and over 350 of these are commonly used and traded for their medicinal use. Within South Africa, the need for medicinal plants is not diminishing, but rather increasing. This is evident through the establishment of large urban markets (e.g. Durban and Johannesburg) that have developed for trade in traditionally used medicinal plants and products. This shift from subsistence use to commercial trade of medicinal plants has led to an increased intensity and frequency of medicinal plant harvesting from their natural habitats (Diederichs *et.al.*, 2002). Cultivation of medicinal plants is minimal in South Africa. Consequently, certain popularly traded species have become over-exploited and are now rare or extinct in the wild. This has resulted in the forced use of alternative species and a geographical shift in the harvesting pressure to previously unexploited areas. Medicinal herb gatherers are also having an impact on certain grassland species. One plant specifically impacted on is the ‘African Potato’ (*Hypoxis hemerocallidea*) which is gathered to assist in the fight against HIV - AIDS.

² In terms of Proclamation 22 of 31 March 1995, this legislation is still applicable in the northern provinces.

Over 20% of the species recorded within the study area are commonly known for their medicinal use (locally or nationally). These species are listed in **Table 18**. A number of the species are also considered Protected (refer to text above). From the field investigations, it was evident that species were also utilised not only from a medicinal view but also for harvesting. **Figure 22** indicates a rural community harvesting firewood.

Table 18: Commonly known medicinal plant species recorded within the study area.

Scientific Name	Common Name
<i>Centella asiatica</i>	Asiatic Pennywort
<i>Cyanotis speciosa</i>	Doll's Powderpuff
<i>Datura stramonium</i>	Thorn Apple
<i>Berkheya</i> spp	-
<i>Cirsium vulgare</i>	Scottish Thistle
<i>Gerbera viridifolia</i>	-
<i>Gladiolus dalenii</i>	African Gladiolus
<i>Diospyros lycioides</i>	Transvaal Bluebush
<i>Cheilanthes viridis</i>	-
<i>Cheilanthes hirta</i>	-
<i>Helichrysum rugulosum</i>	-
<i>Hypoxis rigidula</i>	Silver - leaved Star - flower
<i>Pellaea calomelanos</i>	Maiden - hair Fern
<i>Euphorbia striata</i>	Milkweed
<i>Commelina africana</i> var. <i>krebsiana</i>	Yellow Commelina
<i>Polygala hottentotta</i>	Small Purple Broom
<i>Hypericum lalandii</i>	-
<i>Monopsis decipiens</i>	Butterfly Lobelia
<i>Ledebouria ovatifolia</i>	-
<i>Ajuga ophrydis</i>	Bugle Plant
<i>Eriosema cordatum</i>	Heart-shaped Eriosema
<i>Vernonia oligocephala</i>	Bitterbossie
<i>Senecio coronatus</i>	Wooly Grassland Senecio
<i>Solanum panduriforme</i>	Poison Apple
<i>Oxalis corniculata</i>	Creeping Sorrel
<i>Berkheya setifera</i>	Buffalo - tongue Berkheya
<i>Gerbera piloselloides</i>	Small Yellow Gerbera
<i>Helichrysum aureonitens</i>	Golden Everlasting
<i>Leonotis microphylla</i>	Rock Dagga
<i>Hypoxis argentea</i>	-
<i>Dicoma anomala</i> subsp. <i>gerrardii</i>	Stomach Bush
<i>Dichapetalum cymosum</i>	Poison Leaf
<i>Gazania krebsiana</i> (white & yellow form)	Common Gazania (Botterblom)



Figure 22: Local people harvesting firewood from wattle stands (*Acacia mearnsii*)

1.14.2 Fauna

The animals discussed in this section are prioritised because they are either threatened or are of conservation concern.

Mammals

The Mpumalanga Parks Board database listed only one large mammal species, the Endangered *Ourebia ourebi* (Oribi) of conservation concern within the vicinity of the site. Other mammals of conservation importance that have been recorded in the area or their distribution extends into the region are listed in Table 19 along with their unique habitat requirements and the availability of these on site. According to Friedmann and Daly (2004), of the species that are itinerant and could potentially occurring within the region over 13% are Data Deficient (DD), 2.5% are Endangered (EN) and over 10% are Near Threatened (NT). Many of these mammals could occur in the surrounding farms (**Figure 20**).

During the field investigations, none of the species listed in **Table 19** were observed within the study area, however *Leptailurus serval* (Serval), *Atelerix frontalis* (South African Hedgehog) are reliably reported by resident farmers to present.

The grassland vegetation of the study area is highly fragmented due to the large areas used for crop production. The grassland areas that remain are currently been utilized for cattle grazing. The habitat is therefore not well suited to larger mammals that require extensive home ranges, and large predators are more than likely persecuted by farmers within the region (this, however, is not confirmed). In terms of small antelope, *Raphicerus campestris* (Steenbok) and *Sylvicapra grimmia* (Common Duiker) are common in the study area. Suitable habitat does exist for *Ourebia ourebi* (Oribi), which has been recorded on farms south of the study area. However, it must be noted that Oribi require a high quality short grass sward, and would thus not compete with the current high cattle grazing intensities in the area.

Table 19: Mammal species that have been recorded in the region, or species whose distribution occurs within the QDS 2629BB, BC and BD.

Scientific Name	Common Name	Status	Habitat	Habitat Available
<i>Amblysomus robustus</i>	Robust Golden Mole	EN	Montane grasslands and marshes in Moist Sandy African savanna. Prefers friable soils, from sands to quite heavy clays. Avoids shallow substrates along rocky ridges (which may act as dispersal barriers), and waterlogged areas. Also found in gardens.	✓ Hydromorphic Grasslands
<i>Amblysomus septentrionalis</i>	Highveld Golden Mole	NT	The Highveld Golden Mole is found only in grasslands and around marshes.	✓ Hydromorphic Grasslands
<i>Atelerix frontalis</i>	South African Hedgehog	NT	Semi - arid and sub - temperate areas with 300 - 800 mm rain per year. Occurs in a wide variety of vegetation types but not in wet areas.	✓ recorded by farmers in the area
<i>Chrysospalax villosus</i>	Rough-haired Golden Mole	CR	Temperate shrubland, temperate grassland, arable land, pastureland, plantations, rural gardens, and urban areas.	✓ Natural, Hydromorphic Grasslands and Pasture fields
<i>Crocidura cyanea</i>	Reddish-grey Musk Shrew	DD	Occurring in a wide variety of habitats, but mostly near rivers and in grasslands.	} <i>Crocidura</i> species caught on site, however difficult to ID to species level in the field. Specimens would need to be verified by skeletal and a genetic testina.
<i>Crocidura flavescens</i>	Greater Musk Shrew	DD	Occurs in a wide range of vegetation types in areas receiving more than 500 mm of rain per year. Often found in houses and gardens.	
<i>Crocidura fuscomurina</i>	Tiny Musk Shrew	DD	Thick scrub and tall grass.	
<i>Crocidura hirta</i>	Lesser Red Musk Shrew	DD	Occupies a wide range of habitats, including gardens, but is not found in highveld grassland. Requires some cover in piles of debris or under logs and rocks; prefers damp areas but also occurs in the dry Kalahari where it dependent of water.	
<i>Crocidura mariquensis</i>	Swamp Musk Shrew	DD	Wet areas on river banks and the fringes of swamps which makes its distribution very patchy.	
<i>Crocidura silacea</i>	Lesser Grey-brown Musk Shrew	DD	Thick scrub and tall grass.	
<i>Dasymys incomtus</i>	Water Rat	NT	Swamps and wet areas along rivers and streams.	
<i>Elephantulus brachyrhynchus</i>	Short-snouted Elephant-	DD	Sandy ground with dense grass, scrub and scattered trees, woodland and savanna.	Unlikely

Scientific Name	Common Name	Status	Habitat	Habitat Available
<i>Graphiurus platyops</i>	shrew Rock Dormouse	DD	Usually found on rocky areas; also nests in trees and outbuildings.	✓ Rocky Outcrops Unlikely
<i>Hipposideros caffer</i>	Sundevall's Leaf-nosed Bat	DD	Woodland, probably dependent on open water for drinking. Roosts in caves, mines, culverts, wells or roofs.	Unlikely
<i>Hyaena brunnea</i>	Brown Hyaena	NT	Occupies a wide range of habitats from savanna woodland to desert, including Namib Coast. More common towards the drier west than in the east.	Unlikely
<i>Lemniscomys rosalia</i>	Single-striped Mouse	DD	Occupies areas of dense, tall grassland in a range of vegetation types from savanna woodland to dry open scrub.	✓ Natural, Hydromorphic Grasslands
<i>Leptailurus serval</i>	Serval	NT	Dense, well - watered grassland, reedbeds, always near water.	✓ Hydromorphic Grasslands
<i>Lutra maculicollis</i>	Spotted-necked Otter	NT	Fresh water only; dense vegetation or holes for shelter must be available. Favours deeper water than Cape Clawless otters, and is more likely to be found in lakes and dams.	✓ Klien Olifants System
<i>Manis temminckii</i>	Pangolin	VU	Occurs in a wide range of habitats except swamp, forest, open grassland and desert.	Unlikely
<i>Mellivora capensis</i>	Honey Badger	NT	Occurs widely in a wide range of habitats except desert, moist montane areas and forest, but is uncommon throughout most of its range.	✓ Natural Grasslands
<i>Miniopterus schreibersii</i>	Schreibers' Long-fingered Bat	NT	Avoids the drier western parts of the subregion. Roosts in caves, mines, hollow trees or rock crevices.	✓ Rocky Outcrops
<i>Myosorex cafer</i>	Dark-footed Forest Shrew	DD	It occurs from sea level to mountain peaks in forest, forest edges, fynbos and boggy grassland, always in moist microhabitats.	Possible – Hydromorphic Grasslands
<i>Myosorex varius</i>	Forest Shrew	DD	Moist, densely vegetated areas ranging from primary forest and montane grassland to waterside vegetation on the highveld.	✓ Hydromorphic Grasslands
<i>Myotis tricolor</i>	Temminck's Hairy Bat	NT	Open Savanna and woodland habitat	Unlikely
<i>Myotis welwitschii</i>	Welwitsch's Hairy Bat	NT	Specimens have been taken from savanna grassland, rolled up banana leaves, scrubby bush in Lebombo Mountains and narrow riverine strip of coastal forest bordered by sugar cane & open thornveld.	Unlikely

Scientific Name	Common Name	Status	Habitat	Habitat Available
<i>Mystromys albicaudatus</i>	White-tailed Rat	EN	Savanna & highveld grassland, karoo and Cape macchia.	✓ Natural, Hydromorphic Grasslands
<i>Ourebia ourebi</i>	Oribi	EN	Requires an open habitat with short grass and patches of heavy cover. Does not occur in woodland, except near grassland. Suitable habitat, and therefore the oribi, is patchly distributed.	✓ Natural, Hydromorphic Grasslands
<i>Poecilogale albinucha</i>	African Weasel	DD	Moist grassland or open woodland with more than 600 mm of rain annually.	✓ Hydromorphic Grasslands
<i>Rhinolophus clivosus</i>	Geoffroy's Horseshoe Bat	NT	Found in a wide range of habitats from desert to woodland. Roosts in caves, mines and rock cavities.	✓ Rocky Outcrops
<i>Rhinolophus darlingi</i>	Darling's Horseshoe Bat	NT	A savanna woodland species requiring substantial cover of caves or mine adits to roost in the day. In the northern parts of the subregion they are associated particularly with broken, rocky terrain.	Unlikely
<i>Suncus infinitesimus</i>	Least Dwarf Shrew	DD	Forest, savanna, bushveld and grasslands.	✓ Natural, Hydromorphic Grasslands
<i>Suncus varilla</i>	Lesser Dwarf Shrew	DD	Thick scrub and tall grass.	✓ Natural, Hydromorphic Grasslands
<i>Tatera leucogaster</i>	Bushveld Gerbil	DD	Widely distributed and common in open grass or scrub on sandy soils, also in peaty areas near marshes.	Unlikely

Small rodents (*Rhabdomys pumilo* in particular) were abundant in the study area during the second survey. Suitable habitat therefore exists for various small rodents, but their populations may experience competition from *Rhabdomys* which is not highly habitat specific. *Lemniscomys rosalia* (Single-striped Mouse) and *Mystromys albicaudatus* (White-tailed Rat) and a variety of *Crocicidura* species could occur in the same habitat. The hydromorphic grasslands (**Figures 10 and 23a**) would provide a suitable habitat for Water rat (*Dasymys incomtus*). From the field investigations the rocky outcrops in the central part of the study area (**Figure 10 and 23b**) could provide suitable habitat for the *Graphiurus platyops* (Rock Dormouse).

Another species which could occur within the area is *Lutra maculicollis* (Spotted-necked Otter). It requires extensive areas of open water Such as the number of large farm dams along the Klein Olifant system, of which one appeared to have been stocked with fish species.



Figure 23: Habitats within the study area suitable for mammal species: (A) hydromorphic grassland; (B) rocky outcrop with indigenous woody vegetation in the east of the study area; (C) large dam in the South of the study area.

Avifauna

Only one avian species, *Oxyura maccoa* (Maccoa Duck), has been highlighted by Mpumalanga Parks Board as a species of concern in this area due to the sensitivity of their habitat. The species is however not Red Data listed. The species was recorded in a similar survey in the adjacent Knapdaar Project during the week following the second survey of the De Wittekrans study. Suitable duck habitat exists in the study site, and it is possible that this itinerent species may utilise the dams during the year.

Furthermore, MPB's past records for the area indicate that *Anthropoides paradiseus* (Blue Crane) a vulnerable species and *Bugeranus carunculatus* (Wattled Crane) a Critically Endangered species have been recorded within the QDS 2629BB. In terms of habitat, *Anthropoides paradiseus* prefers open grasslands and wetlands as well as agricultural fields, therefore may well occur in the study area. The Endemic and Vulnerable species - *Geronticus calvus* (Southern Bald Ibis) was recorded nesting (with chicks in the nest) in the adjacent Knapdaar Project during the week following the second survey of the De Wittekrans study. This species range includes the natural grasslands within the study site.

According to the South African Bird Atlas Project and Barnes (2000), there are 14 Near Threatened, 1 Endangered, and 6 Vulnerable species recorded for the QDS 2629BB, BC and BD. These species are listed in **Table 20** below.

From **Table 20**, the following species were recorded within the study area during the field investigations:

- ◆ a single *Ciconia nigra* (Black Stork) classified as Near Threatened;

- ◆ A pair of *Eupodotis caerulescens* (Blue Korhaans) also classified as Near Threatened;
- ◆ Possibly *Circus pygargus* (Montagu's Harrier) – Due to the time of day at which this species was recorded (dusk) and the difficulty of identifying it from Pallids Harrier (*Circus macrourus*) a 100% confirmation cannot be made.

Table 21: Conservation Important Avifaunal Species for the 2629BB, BC and BD QDS.

Scientific Name	Common Name	Status	Habitat	Habitat Availability
<i>Alcedo semitorquata</i>	Half-collared Kingfisher	NT	Wooded streams and less often, coastal lagoons.	Possible
<i>Anthropoides paradiseus</i>	Blue Crane	VU	Vleis, grassland, Karoo scrub and agricultural lands.	Klien Olifants ✓ Natural, Hydromorphic Grasslands and agricultural fields
<i>Charadrius pallidus</i>	Chestnut-banded Plover	NT	Inhabits exclusively saline wetlands, both inland salt pans and soda lakes as well as coastal lagoons and estuaries. It is rarely found >50 m from the water's edge.	Unlikely
<i>Ciconia nigra</i>	Black Stork	NT	Feeds in streams and ponds, usually solitary. Also occurs along the coast in estuaries and lagoons.	✓ Recorded along Klien Olifants
<i>Circus maurus</i>	Black Harrier	NT	Open grassland, scrub, semi - desert and mountainous regions.	✓ Natural Grasslands
<i>Circus pygargus</i>	Montagu's Harrier	NT	Grassland and savanna.	✓ Possibly along agricultural fields
<i>Circus ranivorus</i>	African Marsh Harrier	VU	Marshland, flooded grassland and adjacent grassland.	✓ Natural, Hydromorphic Grasslands
<i>Eupodotis caerulescens</i>	Blue Korhaan	NT	Open, short grassland, extending marginally into the semi - desert eastern Karoo.	✓ Recorded within Disturbed Grassland
<i>Eupodotis melanogaster</i>	Black-bellied Bustard	NT	Woodland and tall open grassland.	✓ Natural Grasslands
<i>Falco biarmicus</i>	Lanner Falcon	NT	A wide range of habitats, from mountainous terrain to deserts and open grassland. Avoids forests.	✓ Natural, Hydromorphic Grasslands

Scientific Name	Common Name	Status	Habitat	Habitat Availability
<i>Falco naumanni</i>	Lesser Kestrel	VU	Open grassland and agricultural areas. Roosts communally in tall trees in towns.	✓ Natural, Hydromorphic Grasslands and agricultural fields
<i>Falco peregrinus</i>	Peregrine Falcon	NT	High cliffs and gorges, both coastal and inland.	Unlikely
<i>Geronticus calvus</i>	Bald Ibis	VU	Short – grazed or burnt upland grassland. Breeds on cliffs.	Recorded on adjacent farms in Rocky Outcrops
<i>Glareola nordmanni</i>	Black-winged Pratincole	NT	Grassland, fallow lands and edges of wetlands.	✓ Natural, Hydromorphic Grasslands and agricultural fields
<i>Mycteria ibis</i>	Yellow-billed Stork	NT	Lakes, large rivers and estuaries.	Possible along Klien Olifants System and Dams
<i>Phoenicopterus ruber</i>	Greater Flamingo	NT	Shallow, freshwater lakes, salt pans, estuaries and open coast.	Possible along Klien Olifants System and Dams
<i>Polemaetus bellicosus</i>	Martial Eagle	VU	Mainly a savanna species but frequents a wide range of habitats, from desert to forest edge.	Possible
<i>Rostratula benghalensis</i>	Greater Painted-snipe	NT	Skulks among reeds in marshes and on the edges of lakes, vleis, dams and seasonally inundated ponds and river flood plains.	✓ Hydromorphic Grasslands and along Klien Olifants
<i>Sagittarius serpentarius</i>	Secretarybird	NT	Savanna and open grassland from coastal regions to high altitudes. Avoids thick bush and forests.	✓ Natural, Hydromorphic Grasslands
<i>Spizocorys fringillaris</i>	Botha's Lark	EN	Heavily grazed, upland grassland.	✓ Disturbed Grasslands
<i>Tyto capensis</i>	Grass Owl	VU	Marshes and tall grassland, but not in reedbeds.	✓ Natural, Hydromorphic Grasslands

Herpetofauna

Within the relevant QDS, **Table 20** lists the Conservation Important species. Furthermore, Mpumalanga Parks Board indicated that there are a number of endemic species recorded in and around the study area, with one Near Threatened species – the *Homoroselaps lacteus* (Spotted Harlequin Snake). These species are listed in **Table 22**.

Table 22: Conservation Important species that could potentially occur within the region – taken from the relevant QDS. Data were derived from Branch (1988), Minter *et al.* (2004) and the SARCA database. Species are classified according to characteristics of occurrence, likelihood of occurrence on the site and conservation status.

Name	Common Name	Distribution	Occurrence on site	Conservation status
<i>Acontias breviceps</i>	Short-headed Legless Skink	Patchy	May occur	Rare, patchy
<i>Acontias gracilicauda</i>	Thin-tailed Legless Skink	Peripheral, patchy	May occur	Rare, patchy
<i>Chamaesaura aenea</i>	Transvaal Grass Lizard	Patchy	May occur	Rare, patchy
<i>Elapsoidea sundevalli</i>	Sundevall's Garter Snake	Peripheral, rare	Unlikely to occur	Rare
<i>Lamprophis aurora</i>	Aurora House Snake	Rare	May occur	Rare
<i>Lamprophis fuscus</i>	Yellowed-bellied House Snake	Rare, peripheral on site	Unlikely to occur	Rare (Branch 1988)
<i>Lamprophis inornatus</i>	Olive House Snake	Rare	Unlikely to occur	Rare
<i>Nucras lalandei</i>	Delalande's Sandveld Lizard	Peripheral patchy	May occur	Rare, patchy
<i>Pyxicephalus adspersus</i>	Giant Bullfrog	Peripheral at site, patchy in occurrence	May occur	Near Threatened (Minter 2004)

A single Spotted Harlequin Snake (*Homoroselaps lacteus*) was found in the southern part of the study area (**Figure 24a**). This species is recorded in the vicinity (**Table 21**) and is listed by Mpumalanga Parks Board as Near Threatened.

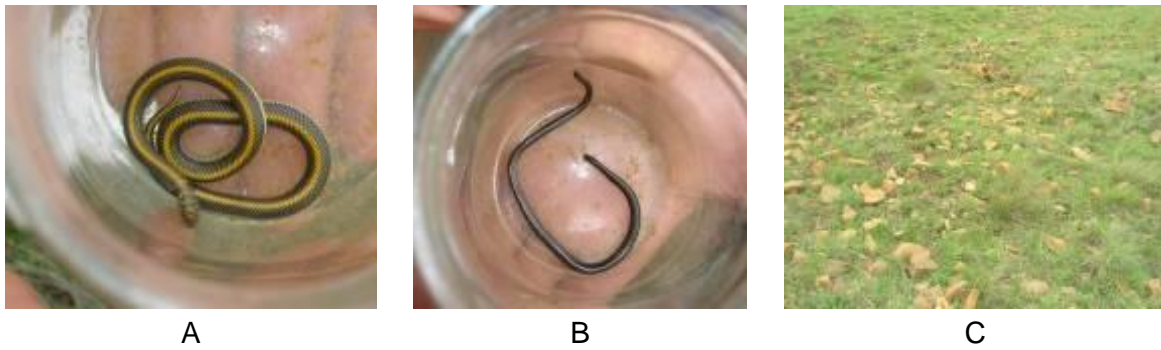


Figure 24: Conservation Important reptiles recorded in the study area: (A) *Homoroselaps lacteus* (Spotted Harlequin Snake); (B) *Leptotyphlops scutifrons* (Peter's Blind Worm); (C) Rocky grassland habitat where the above species occur in the south of the study area.

Table 23. Conservation important reptile species recorded on farms surrounding the study area (Data obtained from Mpumalanga Parks Board).

Common Name	Species	Conservation Status	Endemic Status	Habitat	Habitat Availability
Cape and Eastern Thread Snake	<i>Leptotyphlops conjunctus</i>		Southern Africa	A nocturnal fossorial snake that is seldom seen except after heavy rain. Otherwise it may be found in moist micro habitats under stones or beneath rotting logs, in compost heaps in gardens & in termite mounds. It favours bushveld & grassland habitats.	✓ Natural, Hydromorphic Grasslands
Common Slug Eater	<i>Duberria lutrix</i>		Southern Africa	Savannah, entering coastal bush and fynbos.	Possible
Cross-marked Grass Snake	<i>Psammophis crucifer</i>		Southern Africa	Found in highveld and montane grassland entering fynbos.	✓ Natural, Hydromorphic Grasslands
Drakensberg Crag Lizard	<i>Pseudocordylus melanotus</i>	Endemic	RSA	Rocky outcrops on mountain plateaus and in rolling grassland	Possible
Ground Agama	<i>Agama aculeata</i>		RSA	Semi - desert and sandveld savannah.	Unlikely
Rinkhals	<i>Hemachatus haemachatus</i>		Southern Africa	This snake is plentiful over most of its range, especially the grasslands of higher lying areas. Despite urban development, it is still very common in the greater Johannesburg area, particularly near vleis, dams,	✓ Recorded on adjacent farms in natural grassland

Spotted Harlequin Snake	<i>Homoroselaps lacteus</i>	NT (Mpumalanga)	RSA	rockeries, stables & compost heaps. Varied; semi - desert to savannah and coastal bush.	✓ On site – Natural Rocky Grassland
Spotted Skaapsteker	<i>Psammophylax rhombeatus</i>		Southern Africa	Highveld grasslands, mesic thicket and fynbos, entering karroid areas.	✓ On site in Natural Grassland
Transvaal Girdled Lizard	<i>Cordylus vittifer</i>		Southern Africa	Rock outcrops in grassland.	✓ Natural Rocky Grassland
Transvaal Thick-toed Gecko	<i>Pachydactylus affinis</i>		RSA	Rocky outcrops and dead termite nests in Highveld grassland.	✓ Natural Rocky Grassland

Macro-invertebrates

Possible species that could occur within and surrounding the study area include *Metisella mennix* (Marsh Sylph) and *Aloeides dentatis maseruna* (Roodepoort Copper butterfly). According to the Mpumalanga CPlan database, *A. d. maseruna* has been recorded within a farm southwest of the De Wittekrans Project. Although not present during the field investigations, it may well occur within the study area (**Figure 25**).

Metisella mennix (Marsh Sylph) was recorded during a similar survey in the adjacent Knapdaar Project. This butterfly requires wetland habitat with stands of *Leersia hexandra* grass (**Figure 25**). Suitable habitat occurs west of the study area, and it is possible that *Metisella mennix* occurs here too.



A



B



C

Figure 25: Grassland habitats in the study area: (A) & (B) Hydromorphic grasslands; (C) Small wetland supporting *Leersia hexandra* grass.

1.15. Alien and Invader Species

1.15.1 Flora

Alien species, especially invasive species, are a major threat to the ecological functioning of natural systems and to the productive use of land. These plants can have the following negative impacts on our natural systems:

- ◆ A loss of biodiversity and ecosystem resilience as alien species out-compete indigenous flora and in doing so reduce complex ecosystems to mono-cultures therefore destroying habitats for both plant and animals;
- ◆ Through increased evaporative transpiration rates 'alien thickets' reduce the amount of ground water thus reducing the volume of water entering our river systems;
- ◆ Alien invasives also dry out wetlands and riparian areas thereby increasing the potential for erosion in these areas;
- ◆ The loss of potentially productive land, and the loss of grazing potential and livestock production;
- ◆ Poisoning of humans and livestock;
- ◆ An increase in the cost of fire protection and damage in wildfires due to alien invasive stands being denser than natural vegetation and the wood more resinous, creating hotter fires;
- ◆ An increased level of erosion, following fires in heavily invaded areas, as well as the siltation of dams.

In terms of the amendments to the regulations under the Conservation of Agriculture Resources Act, 1983 (Act No. 43 of 1983), landowners are legally responsible for the control of alien species on their properties. Declared weeds and invasive species had been divided into three categories in accordance with the Act. These categories are as follows:

Category 1: Declared weeds that are prohibited on any land or water surface in South Africa. These species must be controlled, or eradicated where possible.

Category 2: Declared invader species that are only allowed in demarcated areas under controlled conditions and prohibited within 30m of the 1:50 year floodline of any watercourse or wetland.

Category 3: Declared invader species that may remain, but must be prevented from spreading. No further planting of these species are allowed.

The protection of our natural systems from invasive species is further strengthened within Sections 70-77 of the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004). Section 73 (2) states that a person who is the owner of land on which a listed invasive species occurs must:

- (a) notify any relevant competent authority, in writing, of the listed invasive species occurring on that land;
- (b) take steps to control and eradicate the listed invasive species and to prevent it from spreading; and
- (c) take all the required steps to prevent or minimise negative impacts to biodiversity.

During the field investigations two **Category 1** and two **Category 2** listed alien invasive species were identified (**Table 24**). *Cirsium vulgare* (Scottish Thistle) was found mainly within the moist grassland areas adjacent to the Klein Olifants and associated tributaries. In some areas this species was quite prolific, whereas *Datura stramonium* (Thorn Apple) was mainly located adjacent to agricultural fields. Although less than 1.6% of the site was dominated by alien bushclumps, the common species within these clumps - *Eucalyptus camaldulensis* (Red River Gum), is considered a **Category 2** listed alien invasive species. A study conducted by Forsyth *et al* (2004), indicated that of the *Eucalyptus* species within Mpumalanga, only *Eucalyptus camaldulensis* (Red River Gum), and *Eucalyptus grandis* (Flooded Gum) are really invasive, specifically along watercourses. A grove of *Populus alba* (White poplar) within a seasonal wetland is present in the north eastern section of the study area on the farm Tweefontein.

Table 24: Alien Invasive species found on site

Scientific Name	Common Name	Invader Category
<i>Acacia mearnsii</i>	Black Wattle	Category 2
<i>Ciclospermum leptophyllum</i>	Wild Celery	
<i>Cirsium vulgare</i>	Scottish Thistle	Category 1
<i>Datura stramonium</i>	Thorn Apple	Category 1
<i>Eucalyptus camaldulensis</i>	Red River Gum	Category 2
<i>Gamochaeta pensylvanicum</i>	-	
<i>Hypochaeris radicata</i>	Hairy Wild Lettuce	
<i>Oenothera rosea</i>	Pink Evening Primrose	Category 3
<i>Oenothera tetraptera</i>	White Evening Primrose	Category 3
<i>Oxalis corniculata</i>	Creeping Sorrel	
<i>Paspalum dilatatum</i>	Dallis Grass	
<i>Paspalum notatum</i>	Bahia Grass	
<i>Poa annua</i>	Annual Blue Grass	
<i>Populus alba</i>	White poplar	Category 2
<i>Solanum sisymbriifolium</i>	Dense - thorn Bitter Apple	Category 1
<i>Verbena brasiliensis</i>	-	
<i>Verbena tenuisecta</i>	-	

1.15.2 Fauna

Alien or domesticated mammal species that were observed during field investigations included cattle, sheep and domestic dogs. Evidence of grazing by cattle was widespread in the grasslands of the study area, however grazing intensity was not assessed. Evidence of feral domestic dogs were seen in a few places within the study area. Farmers mentioned that these animals are considered a

problem in the area and every effort possible is made to control their numbers. Signs of poaching for porcupine were observed in the west of the study area. It can be expected that poaching and the presence of semi-feral domestic dogs (**Figure 26**) are interlinked.

Although not observed during the field assessment the presence of domestic cats in the vicinity of the study area is likely. *Felis silvestris* (African Wild Cat), hybridises freely with domestic cats, indicating that it is unlikely that pure bred individuals still survive in the general area (adjacent QDS).

Other alien species observed in the study area include *Acridotheres tristis* (Common Myna) and *Passer domesticus* (House Sparrows). These species are dependant on woody vegetation or buildings for nesting sites and appeared to be associated only with human settlements. It is unlikely that they have much impact on the natural grassland habitats.



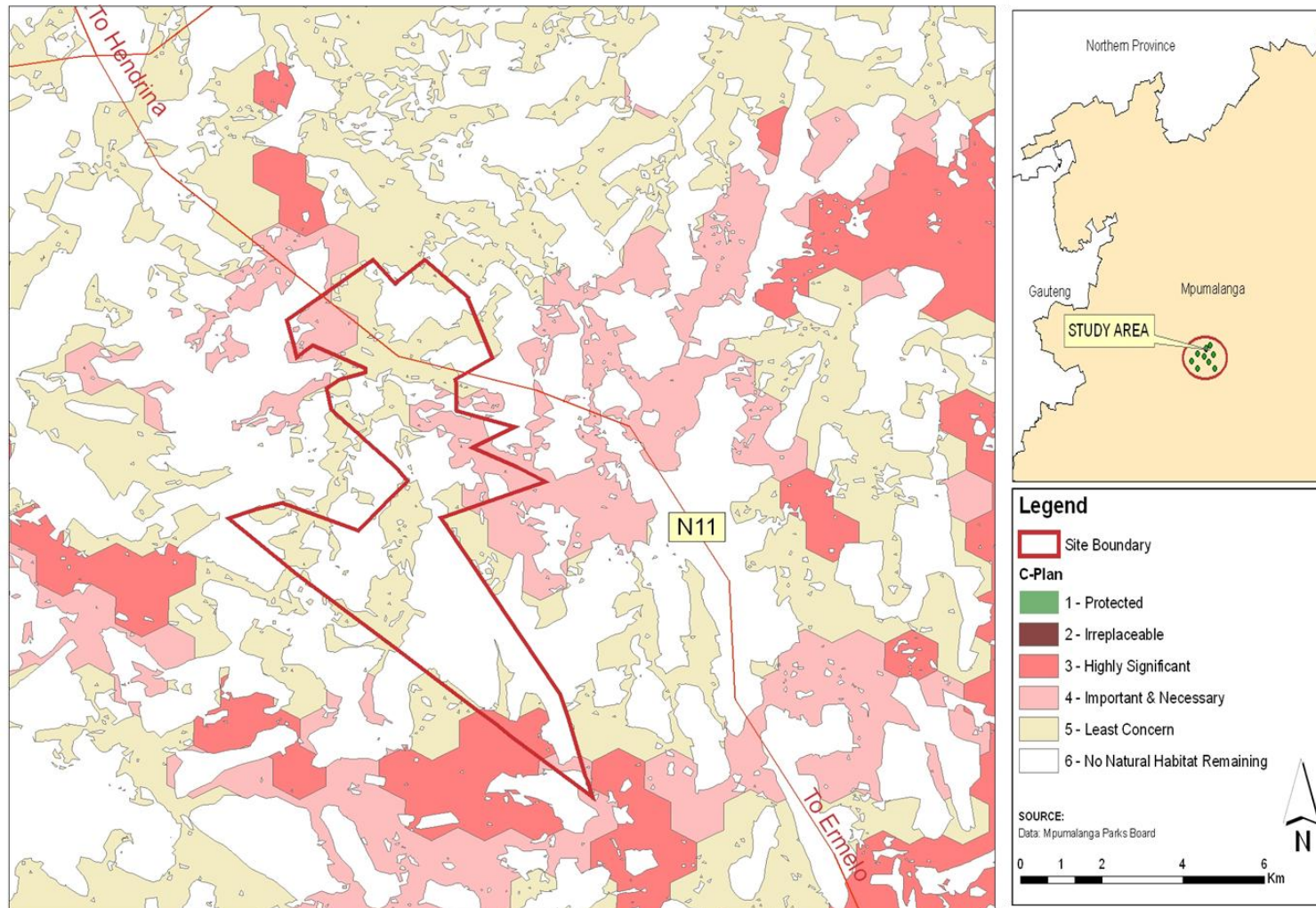
Figure 26: Alien and human impacts in the study area: (A) Feral domestic dog spoor; (B) Porcupine burrow with a strong support loop to hold a snare; (C) Domestic cattle grazing natural grassland.

1.16. Areas of Concern

Mpumalanga Parks Board (MPB) has developed a biodiversity database, for Mpumalanga, using years of data collected during the provincial Biobase Project (MDALA, 2006). The MBCP highlights Irreplaceable, Highly Significant, Important and Least Concern sites within the province. The study area has been highlighted as having Least Concern, Important and Necessary as well as Highly Significant areas (**Figure 27**).

The Mpumalanga CPlan data identifies an area of grassland in the south of the study area (Site 4) as being Highly Significant (**Figure 27**). According to Ferrar & Lotter (2007), Highly Significant areas should be maintained as natural vegetation cover and all cultivation based agriculture and all urban/industrial development should not be permitted. This area was investigated during the second site survey and found to support a high level of biodiversity, which included over 25% of the floral species within the *Themeda triandra-Heteropogon contortus* Grassland (**Figure 11**), 39% of the recorded mammal species, 50% of the recorded bird species, 50% of the recorded frog and reptile

Figure 27: Conservation categories in the De Wittekrans locality



species and 50% of the recorded invertebrate species. Significant observations at this site include *Homoroselaps dorsalis* (Spotted Harlequin Snake), *Leptotyphlops scutifrons* (Peter's Blind Worm) and *Uroplectes triangulifer* scorpions. The number of mammal species observed was low in comparison to other sites due to reduced accessibility, and no nocturnal observations were possible. However, key observations during this study indicate that the Highly Significant status assigned to this area is justified, and should be reviewed by MPB to a higher status (i.e. Irreplaceable).



Figure 28: Images of Site 4 and the surrounding habitat in the south of the study area that is classified by the Mpumalanga Parks Board C-Plan database as Highly Significant.

The East-Central part of the study area (dominated by the rocky outcrops, *Themeda* grassland and Klien Olifants System—**Figure 10 & 11**) surrounding Site 1 (**Figure 28**) is classified by the Mpumalanga CPlan data as Important and Necessary. According to Ferrar & Lotter (2007), these areas are significantly important areas of natural vegetation that play an important role in meeting biodiversity targets (refer to Areas of Concern – **Figure 27**). It is highlighted that no significant increase in the occurrence of land use types 5-9 should be permitted. These land use types include:

- ◆ Rural Development
- ◆ Dryland Crop Cultivation
- ◆ Intensive Animal Farming
- ◆ Irrigated Crop Cultivation
- ◆ Timber production



Figure 29: Images of rocky outcrops and the Klein Olifants River in the vicinity of Site 1, in an area classified by the Mpumalanga Parks Board CPLAN database as Important and Necessary.

This area is dominated by a large hill that appears to have been overgrazed in the past. The area was investigated, a few highly significant observations were made. Extensive rocky outcrops occur at the top of this hill that are unique to the study area and support mature *Diospyros lycioides* and *Rhus dentata* (Nana – Berry) shrubs (**Figure 29**). These outcrops further support a number of Protected fern species such as *Blechnum australe*, *Cheilanthes eckloniana*, *Cheilanthes hirta*, *Cheilanthes quadripinnata*, *Cheilanthes viridis* and *Pellaea calomelanos*. Site 1 was located at the foot of this hill alongside the Klein Olifants River. A pair of *Eupodotis caerulescens* (Blue Korhaan) listed as Near Threatened, were recorded on two occasions close to this site in the *Seriphium plumosum* (*Stoebe vulgaris*) - *Eragrostis chloromelas* Grassland. The presence of Near Threatened species and some unique habitat within the area does provide justification for the Important and Necessary status assigned to the area.

The Mpumalanga C-Plan has identified an area of grassland in the north of the study area, but south of the N11 national road as being Highly Significant (**Figure 27**). *Ciconia nigra* (Black Stork), listed as Near Threatened, was observed at this site, however the status of the vegetation at the time of the survey showed signs of overgrazing. A farm dam slightly to the north of this area at Trapping Site 2 was investigated and found to support a high diversity of water birds, *Paracynictus selousi* (Yellow mongoose) and an active *Suricata suricatta* (Suricat) population.

From the field investigations, the vegetation communities and habitats of concern were:

- ◆ The Natural Grasslands;
- ◆ Rocky Outcrops;
- ◆ Hydromorphic - Moist Grasslands; and the
- ◆ Klien Olifants River System

A summary of the Areas of Concern and their significance are presented in **Table 24** and **Figure 29**.

Table 25. Areas of Concern and main reasons for their significance rating (Area of Low significance are excluded)

Areas of Concern	Significance	Reason
<i>Themeda triandra</i> - <i>Heteropogon contortus</i> Rocky Grassland	Moderate - High	<ul style="list-style-type: none"> ◆ High diversity - over 25% of the recorded floral species, 39% of the recorded mammal species, 50% of the recorded bird species, 50% of the recorded frog and reptile species and 50% of the recorded invertebrate species. ◆ Endangered Eastern Highveld Grassland ◆ Possible habitat for <i>Ourebia ourebi</i> (Oribi) ◆ Minimal Disturbance

Areas of Concern	Significance	Reason
- Southern region of this vegetation community	High	<ul style="list-style-type: none"> ◆ Presence of rare and threatened species such as: <ul style="list-style-type: none"> ○ <i>Homoroselaps lacteus</i> (Spotted Harlequin Snake) ○ <i>Leptotyphlops scutifrons</i> (Peter's Blind Worm) ○ <i>Uroplectes triangulifer</i> scorpions ◆ Endangered Soweto Highveld Grassland ◆ Minimal Disturbance
<i>Tristachya leucothrix</i> – <i>Diospyros lycoides</i> Rocky Outcrops	High	<ul style="list-style-type: none"> ◆ Protected floral species such as <ul style="list-style-type: none"> ○ <i>Pellaea calomelanos</i> ○ <i>Cheilanthes quadripinnata</i> ○ <i>Blechnum australe</i> ○ <i>Cheilanthes viridis</i> ○ <i>Cheilanthes hirta</i> ○ <i>Cheilanthes eckloniana</i> ◆ Habitat for a number of faunal species including: <ul style="list-style-type: none"> ○ <i>Atelerix frontalis</i> (South African Hedgehog) ○ Possibly <i>Geronticus calvus</i> (Southern Bald Ibis) ◆ Endangered Eastern Highveld Grassland ◆ Disturbance minimal ◆ Environmentally sensitive to change
<i>Scirpoides burkei</i> - <i>Helichrysum aureonitens</i> Damp Grassland	Moderate	<ul style="list-style-type: none"> ◆ Protected Floral Species ◆ Disturbance in areas is evident ◆ Endangered Eastern Highveld Grassland
<i>Sorghum versicolor</i> - <i>Monopsis decipiens</i> Moist Grassland	Moderate	<ul style="list-style-type: none"> ◆ Disturbance is evident ◆ Endangered Eastern Highveld Grassland
<i>Andropogon appendiculatus</i> - <i>Kyllinga erecta</i> Moist-Wet Grassland	Moderate High	<ul style="list-style-type: none"> ◆ Protected floral Species ◆ Red Data species: Least Concern <i>Eucomis autumnalis</i> (Common Pineapple Lily) ◆ Habitat for a number of faunal species including: <ul style="list-style-type: none"> ○ <i>Leptailurus serval</i> (Serval)

Areas of Concern	Significance	Reason
<i>Fuirena pubescens</i> - <i>Centella asiatica</i> Moist-Wet Grassland	Moderate – High	<ul style="list-style-type: none"> ◆ Protected floral species such as: <ul style="list-style-type: none"> ○ <i>Crinum bulbispermum</i> ○ <i>Disa woodii</i> ◆ Habitat for a number of faunal species including: <ul style="list-style-type: none"> ○ <i>Metisella mennix</i> (Marsh Sylph) ○ <i>Leptailurus serval</i> (Serval)
<i>Seriphium plumosum</i> (<i>Stoebe vulgaris</i>) - <i>Eragrostis chloromelas</i> Disturbed Grassland	Moderate	<ul style="list-style-type: none"> ◆ Disturbed through Overgrazing ◆ Change in Vegetation Structure ◆ Presence of a pair of <i>Eupodotis caeruleascens</i> (Blue Korhaans);
Klien Olifants River System	High	<ul style="list-style-type: none"> ◆ Possible habitat for a number of Red Data faunal species: <ul style="list-style-type: none"> ○ <i>Lutra maculicollis</i> (Spotted-necked Otter) ○ <i>Ciconia nigra</i> (Black Stork) ◆ Provides an important corridor for linkage between biodiversity hotspots ◆ Environmentally sensitive to change

The Klein Olifants River and its major tributaries links a set of areas within the study area identified by the C-Plan data as Least Concern and Important and Necessary. The river system provides an important corridor for linkage between biodiversity hotspots such as the Rocky Outcrops and Grasslands, and therefore deserves protection from mining activity. In terms of a buffer zone, this depends on the species that requires conservation, however, when looking to preserve the landscape, there is much debate in the extent of the buffer. According to the US Fish and Wildlife Service a buffer on a wetland should be at least 100ft (approximately 30m). In the US these are known as riparian buffers and are naturally vegetated areas adjacent to waterways, including streams, ponds, estuaries and wetlands. Buffers on river systems protects the land adjoining a waterway by preserving the floodplain, keeping native soils intact, and maintaining the streambanks. Vegetative buffers help encourage infiltration of rainfall and runoff, and provide absorption for high stream flows – this sponge like action and infiltration provided by the buffer helps reduce flooding and drought. However, in this study we are not just looking to conserve the actual river system but to also conserve as much natural habitat as possible to provide foraging and nesting sites for the number of Conservation Important species found in the area. Furthermore, using the Klein Olifants River and its associated tributaries, a natural corridor must be maintained. This system will therefore connect isolated blocks of habitat along the river course allowing faunal migration and floral dispersal upstream and downstream from one community to another.

Global best practice establishing the width of a buffer zone for the conservation of migration corridors include:

- Within California (USA), a 300-foot (90m) buffer zone around limestone deposits has been proposed to protect habitat (Hansen and Papenfuss 1994).
- A 250m buffer on internationally recognised sites has been implemented i.e. World Heritage Sites (This is a distance often used by environmentalists, for example as the minimum distance between a source of particulates and a sensitive site). An example of where this has been used in relation to mining is the 2007 Hampshire County Council Minerals and Waste Strategy. It must be noted that although the concept of a buffer zone is included in the World Heritage Operational Guidelines of 2005, the inclusion of a buffer zone into a nomination of a site to the World Heritage List is strongly recommended but not mandatory.

There are a number of issues identified by the Olifants River Forum that affect the Upper Olifants Catchment including the increased water quality problems, specifically related to mining activities. Therefore this adds strength to our motivation that the Klein Olifants River system along with its associated habitats are protected in the long-term. For the long term, a buffer system of 250m is recommended for where the open cast mining is to occur (refer to **Figure 31**).

Figure 30: Areas of Conservation Concern within the study area

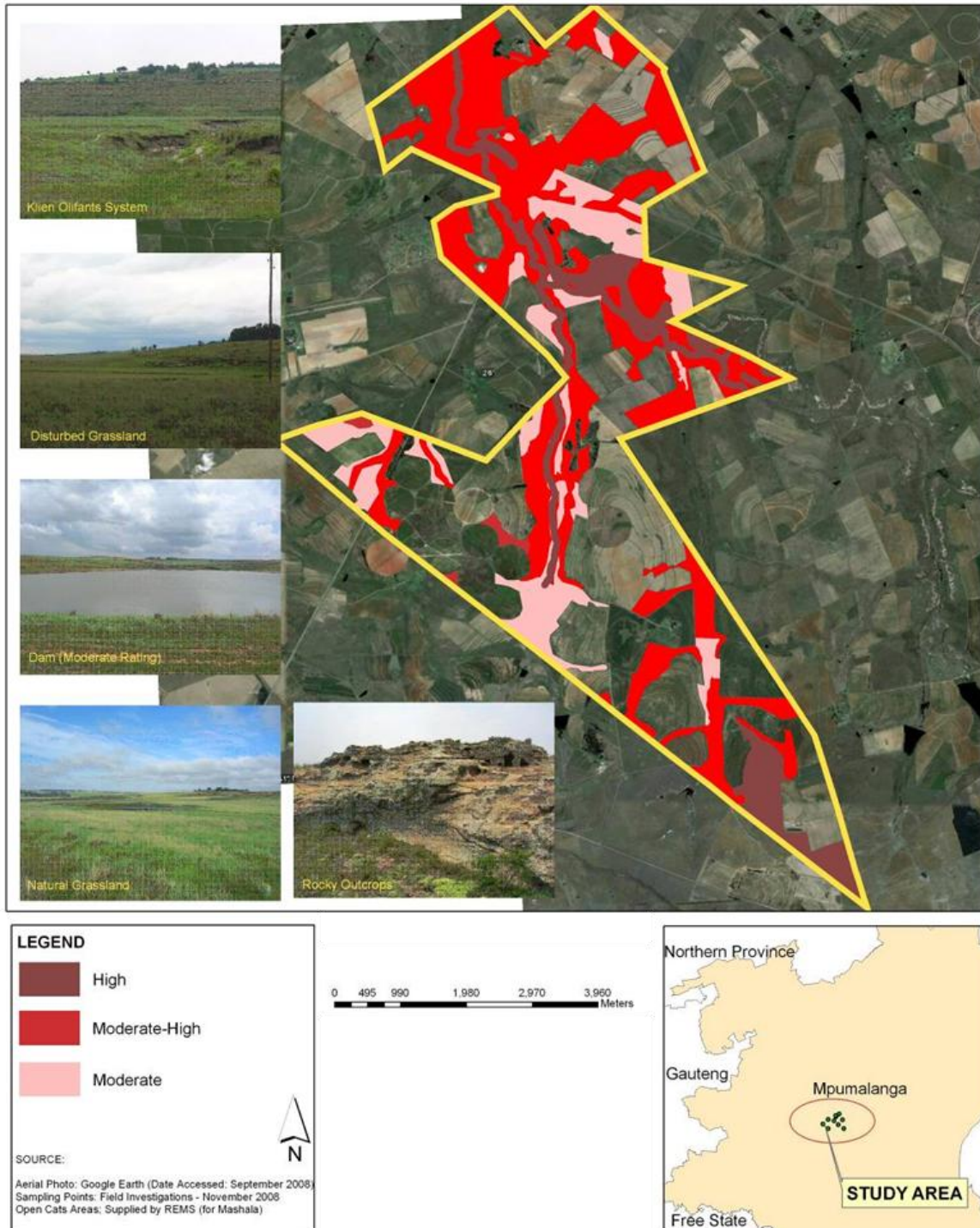
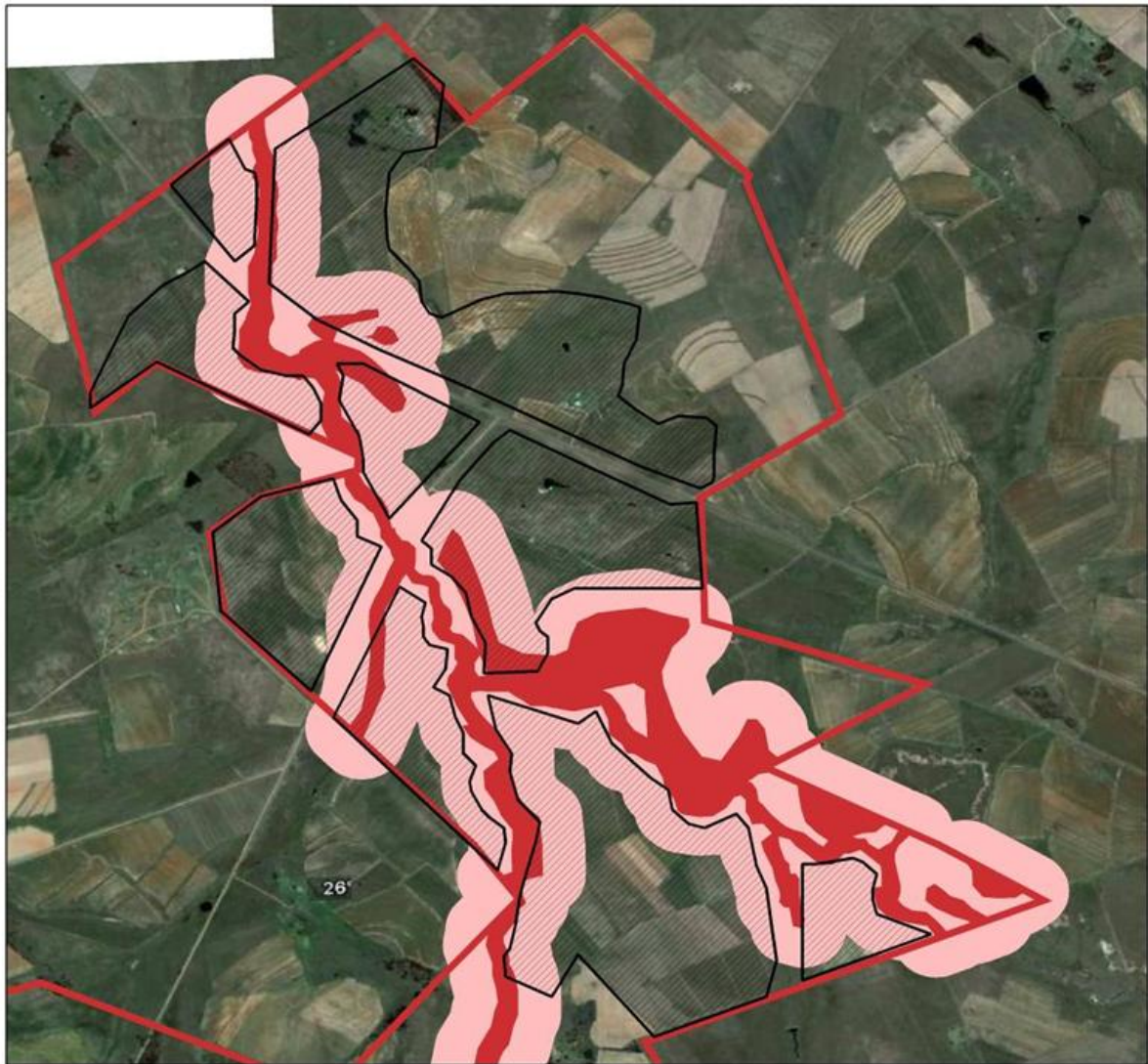


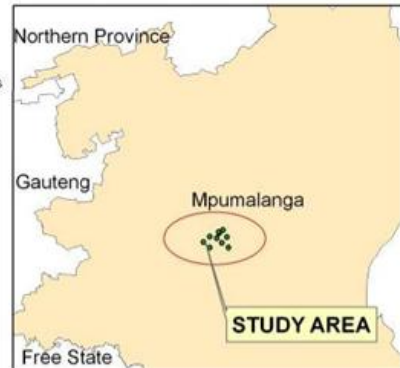
Figure 31: Assigned Buffer Zones for the northern portion of the study area



LEGEND

- Main Areas of Concern
- Buffer Zones
- Opencast-Areas

SOURCE:
 Aerial Photo: Google Earth (Date Accessed: September 2008)
 Sampling Points: Field Investigations - November 2008
 Open Casts Areas: Supplied by REMS (for Mashala)



Existing Threats & Predicted Impacts

Within this section the current impacts occurring on the site and within the surrounds are highlighted, the potential future impacts are discussed and possible mitigatory measures are recommended.

1.17. Existing Threats to Biodiversity

The existing disturbances that threaten the viability of the habitats, and therefore the animals associated with them include, but are not limited to:

- Human disturbances in terms of harvesting of plants and hunting of animals.
- Agricultural activities such as cattle, pasture and crop farming.
- Alien plant invasion, with particular reference to problem species associated with crop farming.
- Alien animal invasions – domestic dogs, cats, pest rodents and birds species impact on the functioning of the natural ecosystems.
- Increased Erosion of the River Systems due to extensive cattle grazing within the wetland areas.
- Use of insecticides and herbicides.

1.18. Significant Impacts

According to Limpitlaw *et al* (2005), the diversity of species is a key characteristic of ecosystems, and these ecosystems, in turn, form the basis of all ecosystem *goods and services* on which humans depend. The level of *goods and services* provided will vary between ecosystems depending on their levels of structural diversity and degrees of disturbance. Through mining activities, these systems take many years to recover with highly proactive management such as soil remediation and vegetation restoration techniques, full recovery may take millennia (Cooke, 1999). Consequently the impacts on the biophysical environment caused by the mining and minerals processing industry have frequently been accompanied by a significant loss in biodiversity.

The potential future mining operations within the study area will have a further impact on the current plant and animal life, particularly if no mitigation measures are put into place. Major impacts that have been identified include:

- ◆ Habitat destruction;
- ◆ Increased fragmentation;
- ◆ Dispersal of faunal species;
- ◆ Potential loss of Conservation Important Species; and
- ◆ Pollution of the wetland systems.

Although the study area is largely transformed through agricultural activities (approximately 50%), there are semi-altered natural areas, specifically adjacent to the Klien Olifants system and its associated tributaries, which can be incorporated into an open space system (**Figure 30**), providing corridors for faunal movement and floral dispersal. Within the areas proposed for the open cast mining, this constitutes less than 40 %.

Potential impacts are detailed in **Table 25** (Impact Table).

1.19. Mitigatory Measures & Recommendations

1.19.1 General Mitigatory Measures

The following general management commitments should be implemented for the DeWittekrans Project:

- ◆ An **Open Space System**. The Klien Olifants system and associated habitats are currently functioning as important dispersal corridors. It is therefore, vital to maintain these systems, as far as practically possible, into an Open Space System for the mine (refer to **Figure 30**). The open space system should be registered against the title deeds as a conservation servitude. An ecological management plan for the open space system should be compiled by a specialist registered in accordance with the Natural Scientific Professions Act (No. 27 of 2003) in the fields of Botanical/Ecological/Zoological Science.
- ◆ **Fire Management Plan**: The importance of a Fire Management Plan is that fire has been a common feature of the African landscape for millennia and natural vegetation has adapted to, and is often maintained by, frequent fires. The fire management plan must particularly ensure the persistence of the hydromorphic grasslands.
- ◆ **Alien Invasive Programme**. It is recommended that a monitoring programme be implemented to enforce continual eradication of alien and invasive species, especially along the Klien Olifants, its tributaries and open space systems. An Alien Invasive Programme is an essential component to the successful conservation of habitats and species. Alien species, especially invasive species are a major threat to the ecological functioning of natural systems and to the productive use of land. In terms of the amendments to the regulations under the Conservation of Agriculture Resources Act, 1983 (Act No. 43 of 1983), landowners are legally responsible for the control of alien species on their properties. The protection of our natural systems from invasive species is further strengthened within Sections 70-77 of the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004). This programme should include monitoring procedures and should be approved by DWAF.
- ◆ **Surface Runoff and Stormwater Management Plan**. This plan must indicate how all surface runoff generated as a result of the mine and associated activities (during both the construction and operational phases) will be managed (e.g. artificial wetlands/stormwater

and flood retention ponds) prior to entering any natural drainage system or wetland and how surface water runoff will be retained outside of any demarcated buffer/flood zones and subsequently released to simulate natural hydrological conditions.

- ◆ **Training and Awareness Programmes**, with regards to the protection of natural systems, the importance of biodiversity and wetland systems, with all staff and contractors.
- ◆ **Rehabilitation Programme:** In order to apply effective rehabilitation measures during closure of the mine, successful management of existing systems is essential. The areas identified in **Figure 30 & 31** should be excluded from the mine's surface infrastructural developments and a Rehabilitation Programme should be established before operation, incorporating assistance and co-operation from surrounding land-owners (farming community) The programme must address the rehabilitation of the existing habitats as well as rehabilitation after closure. This Rehabilitation Programme must be approved by the relevant government departments. There are two main priorities which need to be considered when planning for rehabilitation:
 - The restoration of the area must be of sufficient quality to support pre-mining landuse potential
 - Restoration of the ecological function of mined land and in the case of degraded land i.e. agriculture, the ecological function must be improved.
- ◆ The appointment of an Environmental Control Officer for the duration of the project. An independent suitably qualified individual registered in accordance with the Natural Scientific Professions Act (No. 27 of 2003) should act as the environmental control officer.
- ◆ External Environmental Audits should be undertaken to review performances of commitments made in the Environmental Management Programme Report (EMPR).

1.19.2 Specific Mitigatory Measures

Specific management commitments that should be implemented for the DeWittekrans Project are highlighted in **Table 25**.

Table 26. Impact Assessment Table

Environmental receptor	Project phase	Potential environmental impact	Probability	Extent	Duration	Intensity	Significance- before Mitigation	Mitigation
Ecosystems – specifically the Klien Olifants and associated habitats	All Phases	Degradation of Ecosystems	3	2	5	2	Moderate - High	<ul style="list-style-type: none"> • A water quality monitoring programme must be implemented. The engineering designs and operational activities must ensure adequate water pollution control, i.e. that all dirty water is contained and does not seep or flow into the catchment. • Monitoring of the effects of mining operations on the ecological integrity of the Klien Olifants should be performed on an annual basis. • Effective pollution control measures must be implemented to prevent/ reduce levels of soil, air and water contamination that could adversely impact on the ecology of the area. i.e. A Zero Discharge policy must be investigated; Revegetation of overburden, should happen throughout the life of the mine and not just on closure, Dust suppression must be controlled by frequent wetting of haul roads. All roads to have underpasses every 75-100 m for small mammals. • All sewage related facilities, temporary or permanent should be bunded to capture any potential spillages

Environmental receptor	Project phase	Potential environmental impact	Probability	Extent	Duration	Intensity	Significance- before Mitigation	Mitigation
								<ul style="list-style-type: none"> As there was no infrastructural map supplied at the time of this report compilation it is difficult to say whether further crossings on the Klein Olifants and associated tributaries will be established. Therefore any crossing of rivers should only occur under the regulation of a DWAF license. The crossings should be minimized and only constructed at the shortest possible route, perpendicular to the natural drainage system, so as to ensure the least ecological damage as possible. Culverts under road crossings must be sized and positioned in consultation with an aquatic ecologist to allow for the movement of fish, macro-invertebrates and amphibians. Planning and implementation of any conservation areas (open space system) should be performed in collaboration with surrounding land-owners.
	Construction	Degradation of vegetation communities through construction of surface infrastructure	3	2	2	2	Moderate	<ul style="list-style-type: none"> It is highly recommended that all surface infrastructure remain within the disturbed agricultural areas No infrastructure or activities related to the proposed project will occur within 200m of the Klien Olifants River System.

Environmental receptor	Project phase	Potential environmental impact	Probability	Extent	Duration	Intensity	Significance- before Mitigation	Mitigation
	Operation	Loss and degradation of natural vegetation	2	1	2	5	Moderate	<ul style="list-style-type: none"> • Opencast mining and operational activities must keep within designated areas. Mining should not occur within the buffer as indicated in Figure 31. • No illegal dumping to occur as a result of increased human activity and mining to the area. This is to be monitored by the mine/ environmental manager. • As dust can inhibit plant growth, adequate dust control strategies must be implemented during all phases of the project to minimise dust deposition. I.e Vehicles transporting materials to and from a designated offloading area must be covered with tarpaulins to reduce spillage. • Herbicides / Insecticides for surrounding farming activities must be kept to a minimum. Alternate natural deterrents should be utilised i.e BIOGROW Products.

Environmental receptor	Project phase	Potential environmental impact	Probability	Extent	Duration	Intensity	Significance- before Mitigation	Mitigation
Ecosystems – specifically the Klien Olifants and associated habitats	Closure	Enhancement of previously disturbed areas; Creation of new habitats	2	1	5	2	Moderate (+ve)	<ul style="list-style-type: none"> All rehabilitation should make use of indigenous species, and preferably of species native to the study site and immediate surroundings. Refer to Section 8.3.3 below. The species selected should strive to represent habitat types typical of the ecological landscape prior to construction.
								<ul style="list-style-type: none"> The Open Space system is to be maintained post-closure.
Floral Species	All Phases	Loss of Conservation Important Species	3	1	6	1	Moderate - High	<ul style="list-style-type: none"> Contact and commission Operation Wildflower to remove any Red Data Listed, Protected or where possible medicinal species prior to clearing
								<ul style="list-style-type: none"> Should any Red Data species be discovered on or near the site at any stage of the project, Mpumalanga Parks is to be consulted regarding the possible relocation of this species or recommendations on additional mitigation measures.
		Invasion of Alien Species	2	2	5	1	Moderate	<ul style="list-style-type: none"> Any areas that are rehabilitated during operation of the mine must be monitored for alien species invasion. This should be

Environmental receptor	Project phase	Potential environmental impact	Probability	Extent	Duration	Intensity	Significance- before Mitigation	Mitigation
								performed at least once per season and more frequently during a very wet season. Should alien species be identified, these should be removed according to the Alien Invasive Programme.
Fauna	Construction phase	Death or injury of species due to open trenches for the laying of surface infrastructure	2	1	2	1	Low-Moderate	<ul style="list-style-type: none"> Trenches must be dug in stages and closed as soon as possible. From survey taken along an open pipeline, a 250m stretch found 9 small mammal and amphibian mortalities
		Loss of habitat	3	1	5	2	Moderate-High	<ul style="list-style-type: none"> Avoid mining of crucial habitats and within the demarcated buffer zones
	All phases	Hunting i.e through the setting of snares	2	2	5	1	Moderate	<ul style="list-style-type: none"> Provide Educational Training to the staff and the communities in the area. This can be arranged in the form of presentations and pamphlets, informing the employees of the mine, the importance of biodiversity.
		Death or injury from machinery	1	2	5	1	Moderate	<ul style="list-style-type: none"> In preparation for the opencast activities, the area should be surveyed prior to any earth moving activities. On gaining access to the site, speed bumps must be incorporated into the design of the road network. This will reduce the speed of the vehicles and assist in the prevention of animal fatalities.
	Operational	Disturbance of Fauna	1	2	5	1	Moderate	<ul style="list-style-type: none"> Let off a lower decibel alert sound 60 decibels

Environmental receptor	Project phase	Potential environmental impact	Probability	Extent	Duration	Intensity	Significance- before Mitigation	Mitigation
	phase	through blasting						prior to the blast
		General disturbance of Fauna	1	1	5	0	Low- Moderate	<ul style="list-style-type: none"> • Outside lighting within and surrounding the mining activities and offices should be designed to minimize impacts on fauna. All outside lighting should be directed away from sensitive areas. Fluorescent and mercury vapour lighting should be avoided and sodium vapour (yellow) lights should be used wherever possible.

1.19.3 Mitigatory Measures to Ensure Successful Rehabilitation

It is important to note that past rehabilitation projects have only returned the land to **low** levels of biodiversity as the programmes have used commercially available seed with high nutrient and water requirements. According to Limpitlaw *et al* (2005), through over fertilisation, grass monocultures are promoted, preventing the establishment of biodiverse pastures. The commonly used *Eragrostis* species (species such as *Eragrostis curvula* and *E. tef*) in rehabilitation programmes is a prime example. These species secrete a hormone from its roots prohibiting the germination of other seeds. Furthermore, these monospecific stands are unable to sustain economic grazing systems because of the dependence on one species that has high input requirements.

It is important to ensure that the surface for establishment contains sufficient organic matter and topsoil, as a number of collieries only have utilised rocky surfaces for revegetation. According to Maiti (2004), organic matter in coal rehabilitation is essential as it immobilizes metals such as ZZn and Mn. The bioavailability of Zn in coal discard dumps is found to be 10 to 30 time more than in natural soils. One way of possibly encouraging diversity is to vary the depth of soil replaced after open cast mining. This might occur unintentionally, as it must be difficult to ensure an even covering during rehabilitation.

Further measures which should be taken to achieve successful rehabilitation include:

1. *Removal of Species prior to Mining*

- Establish a nursery on site
- Rescue all transplantable species (e.g. geophytes, succulents) and pot up into bags using local soil. Maintain in the nursery for later re-establishment. Species such as *Ledebouria* and *Hypoxis hemerocallidea* are examples of species which are transplantable.
- Collect seed for sowing after operation, which shall be dried under cool airy conditions; the seed shall be insect free and stored under appropriate cool, dry, rodent and/or pest-free conditions. It is best to store seeds at 6 - 15°C at a relative humidity of 15 - 30%. At these conditions the seeds will stay viable for 10 - 20 years - It is important to note that grass seeds are dormant for at least 1 year after harvesting.
- Cut, collect and bag indigenous plant material from the construction footprint area to use for mulch during restoration.

2. *Stockpiling Topsoil*

- Depending on the depth of the topsoil, it is recommended to remove between 100 and 200 mm of topsoil and stockpile in small mounds. Stockpiling should occur for the shortest possible time to minimize propagule death.

- Stockpile dimensions should be shaped to prevent excessive diffusion of oxygen throughout the whole pile but also to allow oxygen diffusion to stockpile bottom; this would also prevent too much leaching of nutrients and minerals;
- The exposed surface area should also be kept as small as possible. This should keep the volume of soil exposed to higher oxygen levels low;
- A study by Harris *et al*, (1989) states stockpiled soil exceeding a meter deep results in chemical effects such as accumulation of ammonium and anaerobic conditions at the base of the pile. The suggested height of the stock pile is below 2 m (1 - 1.5 m preferably) and not to segregate the stored topsoil (Agriculture Research Council, *pers comm*).
- The introduction of top soil supports the opportunity to support a higher diversity of plants than would have been the case had the top soil not been introduced.

3. *Plant Selection for Rehabilitation*

- Mainly perennial grasses and some natural veld grasses are selected as a basis for a re-vegetation programme. However, if seed collection was performed and correctly stored a large proportion of species could be used successfully. Criteria for the selection of the plants are their possible agricultural use, the adapting to the prevailing climatic conditions, tolerance to adverse soil conditions and easier management.
- Species located on site that could be harvested include:

Scientific name	Common name
<i>Alloteropsis semialata</i>	Black Seed Grass
<i>Andropogon appendiculatus</i>	Vlei Bluestem
<i>Aristida junciformis</i>	Gongoni Three - awn
<i>Aristida transvaalensis</i>	Rock Three Awns
<i>Brachiaria serrata</i>	Velvet Grass
<i>Cymbopogon validus</i>	Giant Turpentine Grass
<i>Elionurus muticus</i>	Sour Grass
<i>Enneapogon cenchroides</i>	Nine - awned Grass
<i>Eragrostis chloromelas</i>	Narrow Curly Leaf
<i>Eragrostis curvula</i>	Weeping Love Grass
<i>Eragrostis gummiflua</i>	Gum Grass
<i>Eragrostis racemosa</i>	Narrow - heart Love Grass
<i>Eragrostis superba</i>	Saw - tooth Love Grass
<i>Festuca scabra</i>	Munnik Fescue
<i>Harpochloa falx</i>	Caterpillar Grass
<i>Heteropogon contortus</i>	Spear Grass
<i>Hyparrhenia hirta</i>	Thatch Grass
<i>Hyparrhenia tamba</i>	Blue Thatching Grass
<i>Imperata cylindrica</i>	Cottonwool Grass
<i>Melinis nerviglumis</i>	Bristle - Leaved Red Top
<i>Panicum maximum</i>	Guinea Grass
<i>Setaria sphacelata</i>	Common Bristle Grass
<i>Sorghum versicolor</i>	Black-seed Grass
<i>Sporobolus africanus</i>	Rat's - tail Dropseed
<i>Sporobolus pectinatus</i>	

Themeda triandra
Tristachya leucothrix
Tristachya rehmarii

Red Grass
Hairy Trident Grass
Broom Grass

Discussion & Conclusions

From the initial and detailed site visits, it was evident that a large proportion of the study area is utilised for crop cultivation (approximately 50%) and cattle grazing, with the remaining natural habitat mainly located along the wetland and Klien Olifants River systems within the study area (**Figure 9** and **Figure 11**). These remaining grassland units are supporting unique floral assemblages that are enhancing local biodiversity richness and also providing habitat for a number of faunal species of conservation importance. Conservation Important faunal species that are threatened (Red Data list) and were recorded on site the included a variety of *Crocidura* (shrew) species; *Leptailurus serval* (Serval – identified by farmers), *Atelerix frontalis* (South African Hedgehog - identified by farmers); *Ciconia nigra* (Black Stork); *Eupodotis caerulescens* (Blue Korhaans) and *Homoroselaps lacteus* (Spotted Harlequin Snake). Rare birds that were seen in the adjacent area are the *Sagittarius serpentarius* (Secretarybird) – near threatened, *Eupodotis barrowii* (Barrows Korhaan) - vulnerable, *Geronticus calvus* (Southern Bald Ibis) - vulnerable, and *Circus pygargus* (African Marsh Harrier) - vulnerable.

In terms of floral species there was a diverse number of protected, medicinal and cultural species. Notably numerous fern species that are protected under the Transvaal ordinance included: *Pellaea calomelanos*; *Cheilanthes quadripinnata*; *Blechnum australe*; *Cheilanthes viridis*; *Cheilanthes hirta* and *Cheilanthes eckloniana*. Furthermore, where the Mpumalanga CPlan data identifies areas of grassland being Highly Significant, this is supported by the findings of our field surveys. Within these areas, MBP stresses that the habitats should be maintained as natural vegetation cover and all cultivation based agriculture and all urban/industrial development should not be permitted.

Based on the provided layout (indicating opencast and underground areas), it is inevitable that highly sensitive areas will become negatively affected during the mining operations (particularly the open cast mining activities). Of greatest concern, are the effects of the mining operation on the Klien Olifants River, hydromorphic grasslands and rocky outcrops associated with this ecosystem. Furthermore, according to the farming community bushman paintings have been found along the rocky outcrops just outside the study boundary. It is therefore possible, although not found during the survey, that paintings could occur on site. A heritage specialist should be commissioned to explore these areas. The hydromorphic grasslands assemblages may also play an important role in reducing the energy associated with surface-runoff, thereby reducing sedimentation. Furthermore, they may act as a filter, thereby improving the water quality through increased bioaccumulation of pollutants (particularly nitrates and phosphates).

On a larger scale, further development within the area (mining, increased road infrastructure, expansion of rural communities due to new mining projects) will cause an increase in habitat fragmentation. Fragmentation creates many 'problems' for various organisms living in these

habitats, particularly the fauna. Genetic isolation, limitation of dispersal and migration, and the decline of populations of animals requiring large territories are the most common problems connected with fragmentation. Therefore linkages between natural areas, and the wetland systems specifically the Klien Olifants River are essential in maintaining faunal movement (migration corridors) and dispersal of floristic species. This report concludes that a buffer (Open Space System) is required along the Klien Olifants System and its associated habitats. This buffer incorporates approximately 40% of the open cast footprint. All mitigation should be performed on site to conserve this important system both as an important water resource within the Upper Olifants³ and as habitat for fauna and flora species.

³ There are a number of issues identified by the Olifants River Forum that affect the Upper Olifants Catchment including the increased water quality problems, specifically related to mining activities.

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Appendices

1.20. Appendix 1: Floral List

FAMILY	SCIENTIFIC NAME	COMMON NAME	ORIGIN	GROWTH FORM
Acanthaceae	<i>Chaetacanthus cf. setiger</i>	White Lady	Indigenous	Forb
	<i>Crabbea ovalifolia</i>		Indigenous	Forb
Aizoaceae	<i>Delosperma sutherlandii</i>		Indigenous	Succulent
Alliaceae	<i>Tulbaghia acutiloba</i>	Wild Garlic	Indigenous	Geophyte
Amaryllidaceae	<i>Crinum bulbispermum</i>	Orange River Lily	Indigenous	Geophyte
Anacardiaceae	<i>Searsia (Rhus) dentata</i>	Nana - Berry	Indigenous	Tree
Anthericaceae	<i>Anthericum fasciculatum</i>		Indigenous	Geophyte
Apiaceae	<i>Ciclospermum leptophyllum</i>	Wild Celery	Alien	Forb
Apocynaceae	<i>Sisyranchus randii</i>	Grass Flower	Indigenous	Forb
Asclepiadaceae	<i>Asclepias aurea</i>		Indigenous	Forb
	<i>Asclepias gibba var. gibba</i>	Large Turret - flower	Indigenous	Forb
	<i>Asclepias macropus</i> (Possibly)	Tailed Cartwheels	Indigenous	Forb
	<i>Asclepias stellifera</i>	Spring Stars	Indigenous	Forb
Asphodelaceae	<i>Trachyandra asperata var. basutunensis</i>	Wild Knoflok	Indigenous	Geophyte
	<i>Trachyandra saltii</i>		Indigenous	Geophyte
Asteraceae	<i>Aster harveyanus</i>	Bloublommetjie	Indigenous	Forb
	<i>Berkheya radula</i>	Boesmansrietjie	Indigenous	Forb
	<i>Berkheya setifera</i>	Buffalo - tongue Berkheya	Indigenous	Forb
	<i>Berkheya spp</i>		Indigenous	Forb
	<i>Crepsis hypochoeridea</i>		Indigenous	Forb
	<i>Dicoma anomala subsp. gerrardii</i>	Stomach Bush	Indigenous	Forb
	<i>Felicia filifolia</i>	Fine Leaved Felicia / Draaibos	Indigenous	Shrublet
	<i>Gamochoeta pensylvanicum</i>		Alien	Forb
	<i>Gazania krebsiana (white form)</i>	Common Gazania (Botterblom)	Indigenous	Forb
	<i>Gazania krebsiana (yellow form)</i>	Common Gazania (Botterblom)	Indigenous	Forb
	<i>Gerbera piloselloides</i>	Small Yellow Gerbera	Indigenous	Forb
	<i>Gerbera viridifolia</i>		Indigenous	Forb
	<i>Helichrysum aureonitens</i>	Golden Everlasting	Indigenous	Forb
<i>Helichrysum coriaceum</i>	Vaalteebossie	Indigenous	Forb	
<i>Helichrysum melanacme</i>		Indigenous	Forb	
<i>Helichrysum nudifolium</i>	Hottentot's Tea	Indigenous	Forb	
<i>Helichrysum rugulosum</i>		Indigenous	Forb	
<i>Hypochoeris radicata</i>	Hairy Wild Lettuce	Alien	Forb	

FAMILY	SCIENTIFIC NAME	COMMON NAME	ORIGIN	GROWTH FORM
	<i>Senecio consonguineus</i>	Starvatia Senecio	Indigenous	Forb
	<i>Senecio coronatus</i>	Wooly Grassland Senecio	Indigenous	Forb
	<i>Senecio erubescens</i>		Indigenous	Forb
	<i>Senecio inornatus</i>		Indigenous	Forb
	<i>Seriphium plumosum</i>	Bankrupt Bush	Indigenous	Forb
	(<i>Stoebe vulgaris</i>)			
	<i>Vernonia galpinii</i>	Perskwasbossie	Indigenous	Forb
	<i>Vernonia oligocephala</i>	Bitterbossie	Indigenous	Forb
Blechnaceae	<i>Blechnum australe</i>		Indigenous	Fern
Campanulaceae	<i>Lobelia flaccida</i>	Wild Lobelia	Indigenous	Forb
	<i>Monopsis decipiens</i>	Butterfly Lobelia	Indigenous	Forb
	<i>Wahlenbergia krebisii</i>		Indigenous	Forb
Caryophyllaceae	<i>Silene burchellii</i>	Gun Powder Plant	Indigenous	Forb
Commelinaceae	<i>Commelina africana</i> var. <i>krebisiana</i>	Yellow Commelina	Indigenous	Forb
	<i>Cyanotis speciosa</i>	Doll's Powderpuff	Indigenous	Forb
Compositae	<i>Cirsium vulgare</i>	Scottish Thistle	Alien	Forb
	<i>Lactuca inermis</i>		Indigenous	Forb
	<i>Tolpis capensis</i>		Indigenous	Forb
Convolvulaceae	<i>Convolvulus sagittatus</i>		Indigenous	Creeper
	<i>Ipomoea simplex</i>	Dwarf Ipomoea	White Indigenous	Forb
Crassulaceae	<i>Crassula lanceolata</i> subsp. <i>lanceolata</i>		Indigenous	Succulent
Cyperaceae	<i>Cyperus compressus</i>		Indigenous	Sedge
	<i>Cyperus laevigatus</i>		Indigenous	Sedge
	<i>Cyperus obtusiflorus</i>	White-flowered Sedge	Indigenous	Sedge
	<i>Cyperus semitrifidus</i>		Indigenous	Sedge
	<i>Eleocharis spp</i>		Indigenous	Sedge
	<i>Fuirena pubescens</i>		Indigenous	Sedge
	<i>Fuirena spp</i>		Indigenous	Sedge
	<i>Kyllinga alba</i>	Witbiesie	Indigenous	Forb
	<i>Kyllinga erecta</i>		Indigenous	Sedge
	<i>Marsiscus spp</i>		Indigenous	Sedge
	<i>Schoenoplectus corymbosus</i>		Indigenous	Forb
	<i>Scirpoides burkei</i>		Indigenous	Sedge
	<i>Scirpus ficinioides</i>		Indigenous	Sedge
Dichapetalaceae	<i>Dichapetalum cymosum</i>	Poison Leaf	Indigenous	Forb
Dipsacaceae	<i>Scabiosa columbaria</i>	Wild Scabiosa	Indigenous	Forb
Ebenaceae	<i>Diospyros lycioides</i>	Transvaal Bluebush	Indigenous	Tree
Eriospermaceae	<i>Eriospermum abyssinicum</i>		Indigenous	Geophyte
Euphorbiaceae	<i>Acalypha angustata</i>	Copper Leaf	Indigenous	Forb
	<i>Euphorbia striata</i>	Milkweed	Indigenous	Succulent
Fabaceae	<i>Acacia mearnsii</i>	Black Wattle	Alien	Tree

FAMILY	SCIENTIFIC NAME	COMMON NAME	ORIGIN	GROWTH FORM
Gentianaceae	<i>Indigofera hedyantha</i>	Black-bud Indigo	Indigenous	Shrublet
	<i>Trifolium africanum</i>	Wild Clover	Indigenous	Forb
	<i>Chironia palustris</i>	Marsh Chironia	Indigenous	Forb
	<i>Sebaea grandis</i>	Large - flowered Sebaea	Indigenous	Forb
Geraniaceae	<i>Pelargonium luridum</i>	Stalk - flowered Pelargonium	Indigenous	Forb
Guttiferae	<i>Hypericum lalandii</i>		Indigenous	Forb
Hyacinthaceae	<i>Dipcadi cf ciliare</i>	Slanguintjie	Indigenous	Geophyte
	<i>Ledebouria ovatifolia</i>		Indigenous	Geophyte
	<i>Ledebouria revoluta</i>		Indigenous	Geophyte
Hypoxidaceae	<i>Hypoxis argentea</i>		Indigenous	Geophyte
	<i>Hypoxis rigidula</i>	Silver - leaved Star - flower	Indigenous	Geophyte
Iridaceae	<i>Hypoxis spp</i>		Indigenous	Geophyte
	<i>Gladiolus dalenii</i>	African Gladiolus	Indigenous	Geophyte
Juncaceae	<i>Juncus effusus</i>		Indigenous	Sedge
Labiatae	<i>Leonotis microphylla</i>	Rock Dagga	Indigenous	Shrublet
Lamiaceae	<i>Ajuga ophrydis</i>	Bugle Plant	Indigenous	Forb
	<i>Becium obovatum</i>	Cat's Whiskers	Indigenous	Forb
	<i>Stachys hyssopoides</i>	Pienksalie	Indigenous	Forb
	<i>Eriosema cordatum</i>	Heart-shaped Eriosema	Indigenous	Forb
Mackinlayaceae	<i>Lotononis listii</i>		Indigenous	Creeper
	<i>Tephrosia capensis</i>		Indigenous	Shrublet
	<i>Centella asiatica</i>	Asiatic Pennywort	Indigenous	Forb
Malvaceae	<i>Hermannia depressa</i>	Creeping Red Hermannia	Indigenous	Forb
	<i>Hermannia erodoides</i>		Indigenous	Forb
	<i>Hermannia transvaalensis</i>		Indigenous	Forb
	<i>Hibiscus aethiopicus</i>		Indigenous	Forb
	<i>Hibiscus microcarpus</i>		Indigenous	Forb
	<i>Eucalyptus camaldulensis</i>	Red River Gum	Alien	Tree
Onagraceae	<i>Oenothera rosea</i>	Pink Evening Primrose	Alien	Forb
	<i>Oenothera tetraptera</i>	White Evening Primrose	Alien	Forb
Orchidaceae	<i>Disa woodii</i>		Indigenous	Geophyte
Orobanchaceae	<i>Cycnium tubulosum</i>	Vlei Ink - flower	Indigenous	Forb
Oxalidaceae	<i>Oxalis corniculata</i>	Creeping Sorrel	Alien	Forb
	<i>Oxalis obliquifolia</i>	Oblique - leaved Sorrel	Indigenous	Forb
Plantaginaceae	<i>Plantago longissima</i>		Indigenous	Forb
Poaceae	<i>Alloteropsis semialata</i>	Black Seed Grass	Indigenous	Grass
	<i>Andropogon appendiculatus</i>	Vlei Bluestem	Indigenous	Grass
	<i>Aristida junciformis</i>	Gongoni Three - awn	Indigenous	Grass

FAMILY	SCIENTIFIC NAME	COMMON NAME	ORIGIN	GROWTH FORM
	<i>Aristida transvaalensis</i>		Indigenous	Grass
	<i>Brachiaria serrata</i>	Velvet Grass	Indigenous	Grass
	<i>Cymbopogon validus</i>	Giant Turpentine Grass	Indigenous	Grass
	<i>Elionurus muticus</i>	Sour Grass	Indigenous	Grass
	<i>Enneapogon cenchroides</i>	Nine - awned Grass	Indigenous	Grass
	<i>Eragrostis chloromelas</i>	Narrow Curly Leaf	Indigenous	Grass
	<i>Eragrostis curvula</i>	Weeping Love Grass	Indigenous	Grass
	<i>Eragrostis gummiflua</i>	Gum Grass	Indigenous	Grass
	<i>Eragrostis racemosa</i>	Narrow - heart Love Grass	Indigenous	Grass
	<i>Eragrostis superba</i>	Saw - tooth Love Grass	Indigenous	Grass
	<i>Haplocarpha lyrata</i>		Indigenous	Forb
	<i>Haplocarpha scaposa</i>	Tonteldoosbossie	Indigenous	Grass
	<i>Harpochloa falx</i>	Caterpillar Grass	Indigenous	Grass
	<i>Heteropogon contortus</i>	Spear Grass	Indigenous	Grass
	<i>Hyparrhenia hirta</i>	Thatch Grass	Indigenous	Grass
	<i>Hyparrhenia tamba</i>	Blue Thatching Grass	Indigenous	Grass
	<i>Imperata cylindrica</i>	Cottonwool Grass	Indigenous	Grass
	<i>Leersia hexandra</i>	Rice Grass	Indigenous	Grass
	<i>Melinis nerviglumis</i>	Bristle - Leaved Red Top	Indigenous	Grass
	<i>Panicum maximum</i>	Guinea Grass	Indigenous	Grass
	<i>Paspalum dilatatum</i>	Dallis Grass	Alien	Grass
	<i>Paspalum notatum</i>	Bahia Grass	Alien	Grass
	<i>Pennisetum thunbergii</i>	Thunberg's Pennisetum	Indigenous	Grass
	<i>Phragmites australis</i>	Common Reed	Indigenous	Reed
	<i>Poa annua</i>	Annual Blue Grass	Alien	Grass
	<i>Setaria sphacelata</i>	Common Bristle Grass	Indigenous	Grass
	<i>Sorghum versicolor</i>	Black-seed Grass	Indigenous	Grass
	<i>Sporobolus africanus</i>	Rat's - tail Dropseed	Indigenous	Grass
	<i>Sporobolus pectinatus</i>		Indigenous	Grass
	<i>Themeda triandra</i>	Red Grass	Indigenous	Grass
	<i>Tristachya leucothrix</i>	Hairy Trident Grass	Indigenous	Grass
	<i>Tristachya rehmannii</i>	Broom Grass	Indigenous	Grass
Polygalaceae	<i>Polygala hottentotta</i>	Small Purple Broom	Indigenous	Forb
Polygonaceae	<i>Persicaria spp</i>			Forb
	<i>Rumex spp</i>		Indigenous	Forb
Pteridaceae	<i>Cheilanthes eckloniana</i>		Indigenous	Fern

FAMILY	SCIENTIFIC NAME	COMMON NAME	ORIGIN	GROWTH FORM
	<i>Cheilanthes hirta</i>		Indigenous	Fern
	<i>Cheilanthes quadripinnata</i>		Indigenous	Fern
	<i>Cheilanthes viridis</i>		Indigenous	Fern
	<i>Pellaea calomelanos</i>	Maiden - hair Fern	Indigenous	Fern
Ranunculaceae	<i>Ranunculus multifidus</i>	Common Buttercup	Indigenous	Forb
Rubiaceae	<i>Galium capense</i>		Indigenous	Forb
	<i>Kohautia amatymbica</i>		Indigenous	Forb
	<i>Oldenlandia herbacea</i>		Indigenous	Forb
	<i>Pentanisia angustifolia</i>		Indigenous	Forb
Salicaceae	<i>Populus alba</i>	Poplar	Alien	Tree
Santalaceae	<i>Thesium utile</i>		Indigenous	Forb
Scrophulariaceae	<i>Craterostigma wilmsii</i>	Resurrection Plant	Indigenous	
	<i>Diclis reptans</i>		Indigenous	Forb
	<i>Jamesbrittenia aurantiaca</i>	Cape Saffron	Indigenous	Forb
	<i>Nemesia fruticans</i>	Wild Nemesia	Indigenous	Forb
	<i>Veronica anagallis-aquatica</i>		Indigenous	Forb
	<i>Zaluzianskya katharinae</i>	Drumsticks	Indigenous	Forb
Solanaceae	<i>Datura stramonium</i>	Thorn Apple	Alien	Forb
	<i>Lycium cinereum</i>	Small Honey - thorn	Indigenous	Shrub
	<i>Solanum nodiflorum</i>		Indigenous	Forb
	<i>Solanum panduriforme</i>	Poison Apple	Indigenous	Forb
	<i>Solanum sisymbriifolium</i>	Dense - thorn Bitter Apple	Alien	Shrublet
Thymelaeaceae	<i>Gnidia burchellii</i>	Harpisbossie	Indigenous	Shrub
	<i>Gnidia microcephala</i>	Besembossie	Indigenous	Forb
Typhaceae	<i>Typha capensis</i>	Bulrush	Indigenous	Reed
Verbenaceae	<i>Verbena brasiliensis</i>		Alien	Forb
	<i>Verbena tenuisecta</i>		Alien	Forb
	<i>Festuca scabra</i>	Munnik Fescue	Indigenous	Grass
	<i>Senecio spp</i>		Indigenous	Forb
	<i>Sonchus wilmsii</i>	Milk Thistle	Indigenous	Forb

1.21. Appendix 2: Potential Mammal List

Mammal species that could occur within the area based on past records and extent of distribution (Conservation status according to Friedmann & Daly, 2004, unless otherwise specified.)

Common name	Scientific name	Conservation status
Aardvark	<i>Orycteropus afer</i>	LC
Aardwolf	<i>Proteles cristatus</i>	LC
African Civet	<i>Civettictis civetta</i>	LC
African Pipistrelle	<i>Pipistrellus hesperidus</i>	LC
African Wild Cat	<i>Felis silvestris</i>	LC
Angoni Vlet Rat	<i>Otomys angoniensis</i>	LC
Banana Bat	<i>Neoromicia nanus</i>	LC
Banded Mongoose	<i>Mungos mungo</i>	LC
Black-backed Jackal	<i>Canis mesomelas</i>	LC
Black-footed Cat **	<i>Felis nigripes</i>	PS ¹
Bushveld Horseshoe Bat	<i>Rhinolophus simulator</i>	LC
Cape Clawless Otter	<i>Aonyx capensis</i>	LC
Cape Fox **	<i>Vulpes chama</i>	PS ¹
Cape Hare / Desert Hare	<i>Lepus capensis</i>	LC
Cape Mole-rat	<i>Georychus capensis</i>	LC
Cape Serotine Bat	<i>Neoromicia capensis</i>	LC
Caracal	<i>Caracal caracal</i>	LC
Chestnut Climbing Mouse	<i>Dendromus mystacalis</i>	LC
Common Duiker	<i>Sylvicapra grimmia</i>	LC
Common Mole-rat	<i>Cryptomys hottentotus</i>	LC
Dwarf Mongoose	<i>Helogale parvula</i>	LC
Egyptian Free-tailed Bat	<i>Tadarida aegyptiaca</i>	LC
Egyptian Slit-faced Bat	<i>Nycteris thebaica</i>	LC
Fat Mouse	<i>Steatomys pratensis</i>	LC
Greater Cane Rat	<i>Thryonomys swinderianus</i>	LC
Grey Climbing Mouse	<i>Dendromus melanotis</i>	LC
Grey Rhebok	<i>Pelea capreolus</i>	LC
Hewitt's Red Rock Rabbit	<i>Pronolagus saundersiae</i>	LC
Highveld Gerbil	<i>Tatera brantsii</i>	LC
Jameson's Red Rock Rabbit	<i>Pronolagus randensis</i>	LC
Krebs' Fat Mouse	<i>Steatomys krebsii</i>	LC
Large-spotted Genet	<i>Genetta tigrina</i>	LC
Leopard*	<i>Panthera pardus</i>	Vulnerable ¹
Lesser Yellow House Bat	<i>Scotophilus viridis</i>	LC
Mauritian Tomb Bat	<i>Taphozous mauritanus</i>	LC
Mountain Reedbuck	<i>Redunca fulvorufula</i>	LC
Multimammate Mouse	<i>Mastomys coucha</i>	LC

Namaqua Rock Mouse	<i>Aethomys namaquensis</i>	LC
Natal Red Rock Rabbit	<i>Pronolagus crassicaudatus</i>	LC
Porcupine	<i>Hystrix africaeaustralis</i>	LC
Pouched Mouse	<i>Saccostomus campestris</i>	LC
Pygmy Mouse	<i>Mus minutoides</i>	LC
Reedbuck **	<i>Redunca arundinum</i>	PS ¹
Rock Elephant-shrew	<i>Elephantulus myurus</i>	LC
Rock Hyrax	<i>Procavia capensis</i>	LC
Scrub Hare	<i>Lepus saxatilis</i>	LC
Slender Mongoose	<i>Galerella sanguinea</i>	LC
Small-spotted Genet	<i>Genetta genetta</i>	LC
Southern Lesser Galago	<i>Galago moholi</i>	LC
Spiny Mouse	<i>Acomys spinosissimus</i>	LC
Springhare	<i>Pedetes capensis</i>	LC
Steenbok	<i>Raphicerus campestris</i>	LC
Striped Mouse	<i>Rhabdomys pumilio</i>	LC
Striped Polecat	<i>Ictonyx striatus</i>	LC
Suricate	<i>Suricata suricatta</i>	LC
Tete Veld Rat	<i>Aethomys ineptus</i>	LC
Tree Rat	<i>Thallomys paedulus</i>	LC
Tree Squirrel	<i>Paraxerus cepapi</i>	LC
Vervet Monkey	<i>Cercopithecus aethiops pygerythrus</i>	LC
Vlei Rat	<i>Otomys irroratus</i>	LC
Wahlberg's Epauletted Fruit Bat	<i>Epomophorus wahlbergi</i>	LC
Warthog	<i>Phacochoerus africanus</i>	LC
Water Mongoose	<i>Atilax paludinosus</i>	LC
White-tailed Mongoose	<i>Ichneumia albicauda</i>	LC
Woodland Dormouse	<i>Graphiurus murinus</i>	LC
Yellow House Bat	<i>Scotophilus dinganii</i>	LC
Yellow Mongoose	<i>Cynictis penicillata</i>	LC

¹ National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004): Publication Of Lists Of Critically Endangered, Endangered, Vulnerable And Protected Species;

1.22. Appendix 3: Mammal Recorded on Site

Mammal species identified per site in the study area

Common name	Scientific name	Site 1	Site 2	Site 3	Site 4	Site 5
Aardvark	<i>Orycteropus afer</i>	x				x
Black wildebeest (introduced)	<i>Connochaetes gnou</i>				x	
Black-backed jackal	<i>Canis mesomelas</i>			x	x	x
Blesbok (introduced)	<i>Damaliscus pygargus phillipsii</i>				x	
Bushpig	<i>Potamochoerus larvatus</i>					
Cape fox	<i>Vulpes chama</i>	x				

Common (Grey) duiker	<i>Sylvicapra grimmia</i>	x		x		
Rock Dassie	<i>Procavia capensis</i>	x				
South African Hedgehog	<i>Atelerix frontalis</i>					
Highveld gerbil	<i>Tatera brantsii</i>	x				x
Mastomys natalensis	<i>Procavia capensis</i>				x	
Cape clawless otter	<i>Aonyx capensis</i>				x	
Porcupine	<i>Hystrix africaeaustralis</i>	x		x	x	x
Striped Mouse	<i>Rhabdomys pumilio</i>	x	x	x	x	
Scrub hare	<i>Lepus saxatilis</i>	x				
Serval	<i>Leptailurus serval</i>					
Shrew	<i>Crocidura species</i>	x		x		
Slender mongoose	<i>Galerella sanguinea</i>			x		
Steenbok	<i>Raphicerus campestris</i>	x		x	x	x
Suricat	<i>Suricata suricatta</i>		x			
Water mongoose	<i>Atilax paludinosus</i>	x				
Yellow mongoose	<i>Paracynictus selousi</i>	x	x	x		
Feral domestic dog			x		x	

1.23. Appendix 4: Bird Species recorded within the QDS's 2629BB, BC and BD (South African Bird Atlas Project)

SPECIES	CONSERVATION STATUS	2629BB	2629BC	2629BD
Abdim's Stork			Yes	
Acacia Pied (Pied) Barbet			Yes	
African (Common) Stonechat		Yes	Yes	
African (Ethiopian) Snipe		Yes	Yes	
African (Grassveld/Grassland) Pipit		Yes	Yes	
African Black (Black) Swift				Yes
African Black Duck		Yes		Yes
African Darter		Yes	Yes	Yes
African Fish Eagle		Yes		Yes
African Grass Owl	VU		Yes	Yes
African Grey Hornbill			Yes	
African Hoopoe		Yes	Yes	Yes
African Palm Swift			Yes	Yes
African Purple (Purple) Swamphen (Gallinule)		Yes	Yes	Yes
African Quailfinch		Yes	Yes	Yes
African Reed Warbler				Yes
African Sacred (Sacred) Ibis	VU	Yes	Yes	Yes
African Spoonbill		Yes	Yes	Yes
African Wattled Lapwing (Plover)		Yes	Yes	Yes
Amur (Eastern Redfooted) Falcon (Kestrel)		Yes	Yes	Yes
Anteater (Southern Anteater) Chat		Yes	Yes	Yes
Ayres Hawk Eagle	NT			Yes
Banded Martin		Yes		Yes
Barn (European) Swallow		Yes	Yes	Yes
Barn Owl			Yes	Yes
Barthroated Apalis			Yes	
Black Crane		Yes		Yes

SPECIES	CONSERVATION STATUS	2629BB	2629BC	2629BD
Black Heron				Yes
Black Kite				Yes
Black Stork	NT		Yes	
Black winged Pratincole	NT	Yes		Yes
Blackchested Prinia		Yes	Yes	Yes
Blackcollared Barbet		Yes	Yes	Yes
Blackcrowned NightHeron		Yes	Yes	Yes
Blackheaded (Eastern) Oriole		Yes		Yes
Blackheaded Heron		Yes	Yes	Yes
Blacknecked Grebe			Yes	
Blackshouldered (Winged) Kite		Yes	Yes	Yes
Blacksmith Lapwing (Plover)		Yes	Yes	Yes
Blackthroated Canary		Yes	Yes	Yes
Blackwinged Stilt		Yes	Yes	Yes
Blue Crane	VU		Yes	Yes
Blue Korhaan	NT	Yes	Yes	Yes
Bokmakierie		Yes	Yes	Yes
Botha's Lark	EN	Yes		Yes
Bronze Mannikin			Yes	
Brownbacked (Sharpbilled) Honeybird (Honeyguide)		Yes		Yes
Brownthroated (Plain) Martin		Yes	Yes	Yes
Buffy Pipit				Yes
Cape (Black) Crow		Yes	Yes	Yes
Cape (Orangethroated) Longclaw		Yes	Yes	Yes
Cape (Yellowcrowned) Canary		Yes	Yes	Yes
Cape Batis			Yes	
Cape Bunting				Yes
Cape Clapper Lark (presplit)				Yes
Cape Eagle Owl				Yes
Cape RobinChat		Yes	Yes	Yes
Cape RockThrush				Yes
Cape Shoveler		Yes	Yes	Yes
Cape Sparrow		Yes	Yes	Yes
Cape Teal			Yes	Yes
Cape Turtle (Ringnecked) Dove		Yes	Yes	Yes
Cape Wagtail		Yes	Yes	Yes
Cape Weaver		Yes		Yes
Cape White eye (presplit)		Yes		Yes
Capped Wheatear				Yes
Cattle Egret		Yes	Yes	Yes
Chestnutbacked Sparrowlark (Finchlark)			Yes	
Cinnamonbreasted (Rock) Bunting		Yes		Yes
Cloud (Tinktink) Cisticola		Yes	Yes	Yes
Common (Fiscal) Fiscal (Shrike)		Yes	Yes	Yes
Common Greenshank		Yes	Yes	Yes
Common HouseMartin		Yes	Yes	Yes
Common Moorhen		Yes	Yes	Yes
Common Myna			Yes	Yes
Common Quail			Yes	Yes
Common Ringed Plover				Yes

SPECIES	CONSERVATION STATUS	2629BB	2629BC	2629BD
Common Sandpiper		Yes	Yes	Yes
Common Waxbill		Yes	Yes	Yes
Crested Barbet		Yes	Yes	Yes
Crowned Lapwing (Plover)		Yes	Yes	Yes
Cuckoo Finch (Parasitic Weaver)		Yes		
Curlew Sandpiper		Yes	Yes	Yes
Darkcapped (Blackeyed) Bulbul			Yes	Yes
Denham's (Stanley's) Bustard		Yes		
Dideric (Diederik) Cuckoo		Yes	Yes	Yes
Egyptian Goose		Yes	Yes	Yes
European Roller				Yes
Fairy Flycatcher (Warbler)			Yes	Yes
Familiar Chat		Yes		
Fantailed (Redshouldered) Widowbird		Yes	Yes	Yes
Fiscal Flycatcher		Yes		Yes
Forktailed Drongo				Yes
Fulvous (Whistling) Duck			Yes	
Giant Kingfisher		Yes		Yes
Glossy Ibis		Yes	Yes	Yes
Goldenbreasted Bunting				Yes
Great Crested Grebe			Yes	
Great White Egret		Yes	Yes	Yes
Greater Flamingo	NT	Yes	Yes	Yes
Greater Honeyguide		Yes		
Greater Kestrel			Yes	Yes
Greater Painted Snipe	NT		Yes	
Greater Striped Swallow		Yes	Yes	Yes
Green (Redbilled) Woodhoopoe			Yes	
Grey Crowned (Crowned) Crane		Yes		
Grey Heron		Yes	Yes	Yes
Greyheaded Gull		Yes	Yes	Yes
Greyheaded Sparrow (presplit)		Yes	Yes	Yes
Greywinged Francolin				Yes
Ground Woodpecker				Yes
Groundscraper Thrush				Yes
Hadeda Ibis		Yes	Yes	Yes
Halfcollared Kingfisher	NT			Yes
Hamerkop		Yes	Yes	Yes
Helmeted Guineafowl		Yes	Yes	Yes
Horus Swift		Yes		Yes
Hottentot Teal		Yes	Yes	Yes
House Sparrow		Yes	Yes	Yes
Jackal Buzzard			Yes	Yes
Kittlitz's Plover		Yes	Yes	Yes
Lanner Falcon	NT			Yes
Laughing (Palm) Dove		Yes	Yes	Yes
Le Vaillant's (Tinkling) Cisticola		Yes	Yes	Yes
Lesser Flamingo	NT	Yes	Yes	Yes
Lesser Honeyguide				Yes
Lesser Kestrel	VU			Yes

SPECIES	CONSERVATION STATUS	2629BB	2629BC	2629BD
Lesser StripedSwallow		Yes		
Lesser Swamp (Cape Reed) Warbler		Yes		Yes
Lilacbreasted Roller				Yes
Little Bittern				Yes
Little Egret		Yes	Yes	Yes
Little Grebe (Dabchick)		Yes	Yes	Yes
Little Rush (African Sedge) Warbler				Yes
Little Stint		Yes	Yes	Yes
Little Swift		Yes	Yes	Yes
Longtailed Widowbird		Yes	Yes	Yes
Maccoa Duck		Yes	Yes	Yes
Malachite Kingfisher		Yes		Yes
Malachite Sunbird				Yes
Marsh Owl		Yes	Yes	Yes
Marsh Sandpiper		Yes	Yes	Yes
Martial Eagle	VU		Yes	
Mocking CliffChat			Yes	Yes
Mountain Chat (Wheatear)		Yes	Yes	Yes
Namaqua Dove		Yes	Yes	Yes
Neddicky (Piping Cisticola)		Yes	Yes	Yes
Olive Thrush (presplit)				Yes
Orangebreasted (Zebra) Waxbill		Yes	Yes	Yes
Palecrowned Cisticola		Yes		Yes
Pied (African Pied) Starling		Yes		Yes
Pied (Avocet) Avocet		Yes	Yes	Yes
Pied Crow			Yes	Yes
Pied Kingfisher		Yes	Yes	Yes
Pinkbilled Lark		Yes	Yes	
Pintailed Whydah		Yes	Yes	Yes
Plainbacked Pipit		Yes		
Purple Heron		Yes		Yes
Redbilled Quelea		Yes	Yes	Yes
Redbilled Teal (Duck)		Yes	Yes	Yes
Redcapped Lark		Yes	Yes	Yes
Redchested Cuckoo		Yes		Yes
Redcollared Widowbird		Yes		Yes
Redeyed Dove		Yes	Yes	Yes
Redheaded Finch		Yes	Yes	Yes
Redknobbed Coot		Yes	Yes	Yes
Redthroated Wryneck		Yes	Yes	Yes
Redwinged Francolin				Yes
Redwinged Starling			Yes	Yes
Reed (Longtailed) Cormorant		Yes	Yes	Yes
Rock (Feral) Dove (Pigeon)		Yes	Yes	Yes
Rock Kestrel		Yes	Yes	Yes
Rock Martin		Yes	Yes	Yes
Ruff		Yes	Yes	Yes
Rufousnaped Lark			Yes	Yes
Sand Martin (Bank Swallow)		Yes		
Secretarybird	NT	Yes	Yes	Yes

SPECIES	CONSERVATION STATUS	2629BB	2629BC	2629BD
Sedge Warbler				Yes
Sentinel RockThrush				Yes
South African Cliff Swallow		Yes	Yes	Yes
South African Shelduck			Yes	
Southern Bald (Bald) Ibis	VU	Yes	Yes	Yes
Southern Boubou				Yes
Southern MaskedWeaver		Yes	Yes	Yes
Southern Pochard		Yes	Yes	Yes
Southern Red (Red) Bishop		Yes	Yes	Yes
Speckled (Rock) Pigeon		Yes	Yes	Yes
Speckled Mousebird			Yes	Yes
Spikeheeled Lark		Yes	Yes	Yes
Spotted EagleOwl			Yes	Yes
Spotted Thickknee (Dikkop)		Yes	Yes	Yes
Spurwinged Goose		Yes	Yes	Yes
Squacco Heron		Yes		
Steppe (Common) Buzzard		Yes		Yes
Streakyheaded Seedeater (Canary)		Yes		Yes
Swainson's Spurfowl (Francolin)		Yes	Yes	Yes
Tawnyflanked Prinia			Yes	Yes
Threebanded Plover		Yes	Yes	Yes
Village (Spottedbacked) Weaver		Yes		Yes
Wailing Cisticola				Yes
Whiskered Tern		Yes	Yes	
White Stork		Yes	Yes	
Whitebacked Duck		Yes	Yes	Yes
Whitebreasted (Great) Cormorant		Yes	Yes	Yes
Whitefaced (Whistling) Duck		Yes	Yes	
Whiterumped Swift		Yes	Yes	Yes
Whitethroated Swallow		Yes	Yes	Yes
Whitewinged Tern		Yes	Yes	Yes
Whitewinged Widowbird		Yes	Yes	Yes
Willow Warbler				Yes
Wingsnapping (Ayre's) Cisticola			Yes	Yes
Wood Sandpiper		Yes	Yes	Yes
Yellowbilled (Intermediate) Egret		Yes	Yes	Yes
Yellowbilled Duck		Yes	Yes	Yes
Yellowbilled Kite			Yes	Yes
Yellowbilled Stork	NT		Yes	
Yellowcrowned (Golden) Bishop		Yes	Yes	Yes
Yellowfronted (eyed) Canary		Yes	Yes	Yes
Zitting (Fantailed) Cisticola		Yes	Yes	Yes

1.24. Appendix 5; Birds Recorded on Site

Avifauna species identified per site within the study area

Common name	Scientific name	Site 1	Site 2	Site 3	Site 4	Site 5
African (Ethiopian) Snipe	<i>Gallinago nigripennis</i>			x		

African (Grassveld/Grassland) Pipit	<i>Anthus cinnamomeus</i>			x	x	
African Sacred Ibis	<i>Threskiornis aethiopicus</i>			x	x	
African Stonechat	<i>Saxicola torquatus</i>	x	x	x	x	
Amur (Eastern Red-footed) Falcon	<i>Falco amurensis</i>			x		
Anteater Chat	<i>Myrmecocichla formicivora</i>	x	x	x	x	
Banded Martin	<i>Riparia cincta</i>		x			
Barn (European) Swallow	<i>Hirundo rustica</i>			x	x	x
Barn Owl	<i>Tyto alba</i>		x			
Black Stork	<i>Ciconia nigra</i>		x			
Black-headed Heron	<i>Ardea melanocephala</i>	x		x	x	x
Black-shouldered Kite	<i>Elanus caeruleus</i>	x		x	x	x
Blacksmith Lapwing (Plover)	<i>Vanellus armatus</i>	x	x	x	x	
Black-throated Canary	<i>Crithagra atrogularis</i>	x		x		
Blue Korhaan	<i>Eupodotis caerulescens</i>	x				
Cape (Orange-throated) Longclaw	<i>Macronyx capensis</i>	x	x	x	x	
Cape (Yellow-crowned) Canary	<i>Serinus canicollis</i>	x				
Cape Shoveler	<i>Anas smithii</i>		x			
Cape Sparrow	<i>Passer melanurus</i>		x	x		x
Cape Turtle Dove	<i>Streptopelia capicola</i>	x		x		
Cape Wagtail	<i>Motacilla capensis</i>	x			x	
Cattle Egret	<i>Bubulcus ibis</i>	x	x	x	x	
Common Fiscal (Shrike)	<i>Lanius collaris</i>				x	x
Common Myna	<i>Acridotheres tristis</i>	x				
Common Quail	<i>Coturnix coturnix</i>	x	x	x	x	
Common Waxbill	<i>Estrilda astrild</i>	x				
Crested Barbet	<i>Trachyphonus vaillantii</i>				x	
Crowned Lapwing (Plover)	<i>Vanellus coronatus</i>		x	x	x	x
Dark-capped (Black-eyed) Bulbul	<i>Pycnonotus tricolor</i>		x			
Dideric (Diederik) Cuckoo	<i>Chrysococcyx caprius</i>	x		x		
Egyptian Goose	<i>Alopochen aegyptiacus</i>	x	x	x	x	x
Fan-tailed (Red-shouldered) Widowbird	<i>Euplectes axillaris</i>	x	x			
Fiscal Flycatcher	<i>Sigelus silens</i>	x		x		
Great White Egret	<i>Egretta alba</i>			x		
Greater Striped-swallow	<i>Hirundo cucullata</i>	x		x	x	
Green (Red-billed) Wood-hoopoe	<i>Phoeniculus purpureus</i>				x	
Grey Heron	<i>Ardea cinerea</i>		x			
Hadeda Ibis	<i>Bostrychia hagedash</i>	x		x	x	x
Helmeted Guineafowl	<i>Numida meleagris</i>	x		x	x	x
Horus Swift	<i>Apus horus</i>	x				
Hottentot Teal	<i>Anas hottentota</i>		x	x		
House Sparrow	<i>Passer domesticus</i>	x		x		
Laughing Dove	<i>Streptopelia senegalensis</i>	x		x	x	
Le Vaillant's (Tinkling) Cisticola	<i>Cisticola tinniens</i>		x	x		
Little Egret	<i>Egretta garzetta</i>				x	

Long-tailed Widowbird	<i>Euplectes progne</i>		x	x	x	x
Marsh Owl	<i>Asio capensis</i>	x			x	
Marsh Sandpiper	<i>Tringa stagnatilis</i>				x	
Namaqua Dove	<i>Oena capensis</i>	x				
Natal Spurfowl (Francolin)	<i>Pternistis natalensis</i>			x	x	
Northern Black Korhaan	<i>Eupodotis caerulescens</i>	x				
Pied (African Pied) Starling	<i>Spreo bicolor</i>			x		
Pin-tailed Whydah	<i>Vidua macroura</i>	x	x	x	x	x
Red-backed Shrike	<i>Lanius collurio</i>	x				
Red-billed Quelea	<i>Quelea quelea</i>	x	x	x		
Red-capped Lark	<i>Calandrella cinerea</i>				x	
Red-collared Widowbird	<i>Euplectes ardens</i>				x	
Red-eyed Dove	<i>Streptopelia semitorquata</i>		x			
Red-knobbed Coot	<i>Fulica cristata</i>	x	x	x		x
Reed Cormorant	<i>Phalacrocorax africanus</i>		x			
Sand Martin (Bank Swallow)	<i>Riparia riparia</i>	x				
Sedge Warbler	<i>Acrocephalus schoenobaenus</i>	x				
Southern Masked-weaver	<i>Ploceus velatus</i>		x	x	x	
Southern Red Bishop	<i>Euplectes orix</i>			x	x	x
Speckled (Rock) Pigeon	<i>Columba guinea</i>	x		x	x	
Spotted Eagle-Owl	<i>Bubo africanus</i>				x	
Spotted Thick-knee (Dikkop)	<i>Burhinus capensis</i>				x	
Spur-winged Goose	<i>Plectropterus gambensis</i>	x		x	x	
Steppe (Common) Buzzard	<i>Buteo vulpinus</i>		x			x
Swainson's Spurfowl (Francolin)	<i>Pternistis swainsonii</i>	x	x	x	x	
Three-banded Plover	<i>Charadrius tricollaris</i>	x			x	x
White-throated Swallow	<i>Hirundo albigularis</i>	x				x
White-winged Widowbird	<i>Euplectes albonotatus</i>		x			
Yellow-billed Duck	<i>Anas undulata</i>	x	x	x	x	x
Zitting (Fan-tailed) Cisticola	<i>Cisticola juncidis</i>	x	x	x		

1.25. Appendix 6: Herpetofaunal list for 2629BB, BC and BD

{Information obtained from Jacobsen (1989), Branch (1988), Minter *et al.* (2004), the SARCA database and Alexander (2008)}.

Scientific Name	Common Name	Conservation Status
SNAKES		
<i>Amplorhinus multimaculatus</i>	Many - spotted Snake	LC
<i>Aparallactus capensis</i>	Common Centipede - eater	LC
<i>Atractaspis bibronii</i>	Bibron's Stiletto Snake	LC
<i>Bitis arietans</i>	Puff Adder	LC
<i>Causus rhombeatus</i>	Common Night Adder	LC
<i>Crotaphopeltis hotamboeia</i>	Herald Snake	LC

Scientific Name	Common Name	Conservation Status
<i>Dasypeltis scabra</i>	Common Egg - eater	LC
<i>Duberria lutrix</i>	Common Slug Eater	LC
<i>Elapsoidea sundevalli</i>	Sundevall's Garter Snake	Rare
<i>Hemachatus haemachatus</i>	Rinkhals	LC
<i>Homoroselaps lacteus</i>	Spotted Harlequin Snake	DD (NT listed for MPB)
<i>Lamprophis aurora</i>	Aurora House Snake	LC
<i>Lamprophis capensis</i>	Brown House Snake	LC
<i>Lamprophis fuscus</i>	Yellow -bellied House Snake	Rare (Branch 1988)
<i>Lamprophis inornatus</i>	Olive House Snake	Rare
<i>Leptotyphlops distanti</i>	Distant's Worm Snake	LC
<i>Leptotyphlops scutifrons conjunctus</i>	Eastern Cape Worm Snake	LC
<i>Lycodonomorphus laevisissimus</i>	Dusky-bellied Water Snake	LC
<i>Lycodonomorphus rufulus</i>	Brown Water Snake	LC
<i>Lycophidion capensis</i>	Cape Wolf Snake	LC
<i>Lycophidion rufulus</i>	Brown Water Snake	LC
<i>Naja mossambica</i>	Mozambique Spitting Cobra	LC
<i>Philothamnus natalensis occidentalis</i>	Western Natal Green Snake	LC
<i>Philothamnus semivariatus</i>	Spotted Bush Snake	LC
<i>Psammophis brevirostris</i>	Short - snouted Grass Snake	LC
<i>Psammophis crucifer</i>	Cross - marked Grass Snake	LC
<i>Psammophylax rhombeatus rhombeatus</i>	Spotted Skaapsteker	LC
<i>Psammophylax tritaeniatus</i>	Striped Skaapsteker	LC
<i>Pseudaspis cana</i>	Mole Snake	LC
<i>Rhinotyphlops lalandei</i>	Delalande's Beaked Blind Snake	LC
<i>Typhlops bibronii</i>	Bibron's Blind Snake	LC
LIZARDS / GECKOS/ SKINKS		
<i>Homopholis wahlbergi</i>	Velvet Gecko	LC
<i>Lygodactylus ocellatus</i>	Spotted Dwarf Gecko	LC
<i>Pachydactylus vansoni</i>	Van Son's Gecko	LC
<i>Pachydactylus affinis</i>	Transvaal Thick-toed Gecko	LC
<i>Pachydactylus capensis</i>	Cape Thick-toed Gecko	LC
<i>Agama aculeata distanti</i>	Ground Agama	LC
<i>Agama atra</i>	Rock Agama	LC
<i>Chamaeleo dilepis</i>	Common Chameleon	LC
<i>Acontias breviceps</i>	Short - headed Legless Skink	Rare, patchy
<i>Acontias gracilicauda</i>	Thin - tailed Legless Skink	LC
<i>Acontias percivalli</i>	Percival's Legless Skink	LC

Scientific Name	Common Name	Conservation Status
<i>Lygosoma sundevallii</i>	Sundevall's Writhing Skink	LC
<i>Panaspis wahlbergii</i>	Wahlbergs Snake-eyed Skink	LC
<i>Trachylepis capensis</i>	Cape Skink	LC
<i>Trachylepis punctatissima</i>	Montane Speckled Skink	LC
<i>Trachylepis varia</i>	Variable Skink	LC
<i>Varanus albigularis</i>	Rock Monitor	LC
<i>Varanus niloticus</i>	Water Leguaan	LC
<i>Chamaesaura aenea</i>	Transvaal Grass Lizard	LC
<i>Cordylus vandami</i>	Vandam's Girdled Lizard	LC
<i>Cordylus vittifer</i>	Transvaal Girdled Lizard	LC
<i>Gerrhosaurus flavigularis</i>	Yellow-throated Plated Lizard	LC
<i>Nucrasalandii</i>	Delalande's Sandveld Lizard	LC
<i>Nucras ornata</i>	Ornate Sandveld Lizard	LC
<i>Pseudocordylus melanotusmelanotus</i>	Drakensberg Crag Lizard	LC
FROGS		
<i>Amietia angolensis</i>	Common River Frog	LC
<i>Amietia fuscigula</i>	Cape River Frog	LC
<i>Amietophrynus maculatus</i>	Flat-backed Toad	LC
<i>Amietophrynus rangeri</i>	Raucous Toad	LC
<i>Amietophrynus gutturalis</i>	Guttural Toad	LC
<i>Amietophrynus maculatus</i>	Flat-backed Toad	LC
<i>Amietophrynus rangeri</i>	Raucous Toad	LC
<i>Cacosternum boettgeri</i>	Common Caco	LC
<i>Kassina senegalensis</i>	Bubbling Kassina	LC
<i>Ptychadena porosissima</i>	Striped Grass Frog	LC
<i>Pyxicephalus adspersus</i>	Giant Bullfrog	NT
<i>Semnodactylus wealii</i>	Rattling Frog	LC
<i>Strongylopus fasciatus</i>	Striped Stream Frog	LC
<i>Strongylopus grayii</i>	Clicking Stream Frog	LC
<i>Tomopterna cryptotis</i>	Tremolo Sand Frog	LC
<i>Tomopterna natalensis</i>	Natal Sand Frog	LC
<i>Tomopterna tandyi</i>	Tandy's Sand Frog	LC
<i>Xenopus laevis</i>	Common Platanna	LC

1.26. Appendix 7: Recorded Herpetofauna on Site

Herpetofauna species identified per site in the study area

Common name	Scientific name	Site 1	Site 2	Site 3	Site 4	Site 5
Bubbling Kassina	<i>Kassina senegalensis</i>			x		
Common (Boettger's) Dainty Frog	<i>Cacosternum boettgeri</i>	x	x		x	x
Common (Angola) River Frog	<i>Afrana angolensis</i>			x		x

Peter's blind worm (thread snake)	<i>Leptotyphlops scutifrons</i>			x
Common Platanna	<i>Xenopus laevis</i>	x		x
Rattling Kassina	<i>Semnodactylus wealii</i>	x		
Spotted Harlequin Snake	<i>Homoroselaps dorsalis</i>			x
Rinkhals	<i>Hemachatus haemachatus</i>			
Spotted Skaapstekker	<i>Psammophalyx rhombeatus</i>		x	
Striped Skink	<i>Trachylepis varia</i>	x		
Tremolo Sand Frog	<i>Tomopterna cryptotis</i>	x	x	x

1.27. Appendix 8: Recorded Invertebrates on Site

Invertebrate families identified in the study area

Order	Family	Common name	Site 1	Site 2	Site 3	Site 4	Site 5
GASTROPODA	STYLOMMATOPHORA	Slug		x			
CRUSTACEA	DECAPODA	Freshwater crab	x		x		
MYRIAPODA	GEOPHILOMORPHA	Centipedes				x	
	JULIFORMIA	Myriapoda	x	x	x	x	
	ONISCOMORPHA	Pill millipede	x			x	
ARACHNIDA	AGELENIDAE	Grass funnel web spider	x		x		
	BUTHIDAE	Scorpion				x	
	(<i>Uroplectes triangulifer</i>)						
	CTENIZIDAE	Trapdoor spider				x	
	DIPLURIDAE	Spider	x	x	x	x	
	PHLOCIDAE	Spider	x	x			
INSECTA	APIDAE	Honey bees					
	BITTACIDAE	Crane fly		x		x	x
	BLATTIDAE	Cockroach	x				
	CALLIPHORIDAE	Blue bottle flies				x	
	CARABIDAE	Ground Beetles				x	
	CERAMBYCIDAE	Longhorn beetle	x	x			
	COENAGRIONIDAE	Damsel fly			x	x	x
	CRAMBIDAE	Moth	x				
	CTENUCHIDAE	Tiger moth	x				
	CURCULIONIDAE	Beaded weevil		x			
	FORFICULIDAE	Earwigs		x			
	HYMENOPTERA	Honey bee hive	x				
	LAMPRYNIDAE	Glow worm				x	
	LIBELLULIDAE	Dragonfly					
	LYCAENIDAE	Butterflies					
	MANTIDAE	Preying mantis	x				
	MYDIDAE	Robberfly					
	NYMPHALIDAE	African Monarch butterfly					
	(<i>Danaus chrysippus</i>)						
	NYMPHALIDAE	Painted lady butterfly	x	x			
	(<i>Vanessa cardui</i>)						
	PAMPHAGIDAE	Toad grasshopper					x

PENTATOMIDAE	Stinkbug			x
PIERIDAE	Yellow pansy butterfly	x	x	
PYRGOMORPHIDAE	Elegant grasshopper			x
REDUVIIDAE	Assassin bug			x
SCARABIDAE	Dung beetle	x	x	x
TABANIDAE	Cleg fly	x		x
TENEBRIONIDAE	Green beetle			x
TRINERVITERMES	Termites			
VESPIDAE	Paper wasp			x

Sources: Filmer (1991); Leeming (2003); Picker (2002) Woodall (2005)