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**FLORA AND FAUNA SURVEY OF THE STUART COLLIERY,
DELMAS (MPUMALANGA)**



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Declaration of Independence

We declare that we have been appointed as independent consulting ecologists with no affiliation with or vested financial interests in the proponent, other than for work performed under the Environmental Impact Assessment Regulations, 2006. We have no conflicting interests in the undertaking of this activity and have no interests in secondary developments resulting from the authorisation of this project. Remuneration for our services by the proponent is not linked to approval by any decision-making authority responsible for authorising this development.

W.L. McClelland 21 August 2009

A.(Tony) De Castro 21 August 2009

1. INTRODUCTION

De Castro and Brits c.c. was requested by Clean Stream Environmental Services to conduct a flora and fauna survey for the Stuart Colliery mining area. The study area is just over 2 000 hectares in size and is situated in the quarter-degree grid 2628 BB, south east of Delmas (Figure 1). This document reports on the findings of a field survey that was conducted in February and April 2009.

2. TERMS OF REFERENCE AND APPROACH

2.1 Terms of reference

The objective of the survey was to provide a description of vegetation communities, a plant species list, a broad-scale vegetation map, sensitivity map and an analysis of occurring or potentially occurring threatened fauna and flora within the untransformed portions of the 2 000 ha study area.

The floristic study was to include the following aspects:

- Determination of the Vegetation Type/Types in accordance with the most current national vegetation map (Mucina and Rutherford, 2006) and local vegetation studies, as well as proximity and relationship to any Centre of Endemism (Van Wyk and Smith 2001). A description of the regional biodiversity context using all existing information to be provided.
- Broad-scale structural classification of the vegetation into homogenous units following the approach of Edwards (1983). A description of the dominant and characteristic species identified within the broad-scale plant communities comprising each of these units. These descriptions to be based on visual estimates of cover/abundance and density following established vegetation survey techniques (Kent & Coker, 1996). The number of sites to be limited by the relatively short duration of the available time for fieldwork.
- Vegetation / habitat types to be mapped on the basis of available information (aerial photography, soil types, geology) and to consist of structurally distinct vegetation units (wetland, grasslands, woodland) as well as transformed areas (cultivated land, areas of alien vegetation).
- Each identified vegetation unit to be described in terms of its sensitivity and conservation importance.
- Compilation of a species list (to provide an accurate indication of the floristic diversity) according to latest taxonomic treatments used by the South African National Biodiversity Institute (Germishuizen *et al.*, 2006). Alien invasive species, as listed in the Conservation of Agricultural Resources Act (Act No.43 of 1983), to be highlighted.
- Determination of the occurrence, or possible occurrence, of threatened and / or sensitive plant species, as per the 2009 draft National Red Data Plant List (M. Lötter *pers.comm.*), on the basis of field surveys, historical distribution records obtained from the PRECIS database of the National Botanical Institute, and available literature.

- Further botanical assessments regarded as necessary also to be identified and Terms of Reference for these assessments to be recommended. Such further assessments are likely to include additional searches for potentially occurring threatened plant species that were not in flower at the time of the field surveys conducted for this study.

The fauna study was to include the following:

- Desktop review of potentially occurring conservation-important fauna.
- Compilation of total species lists of birds, mammals, reptiles and frogs found during the survey, with emphasis being placed on species of conservation importance.
- Recommendations on aspects such as management of threatened animal species and eradication / control of alien invasive species.

2.2 Methodology

A vegetation/habitat map based on available aerial photography and topographical maps for the area was produced, and subsequently ground-truthed during field surveys in February and April 2009. Vegetation mapping was done using the 1:50 000 topographic map 2628 BB as a base map as well as high resolution aerial photograph data. Vegetation was first stratified into homogenous units on the basis of physiognomy (vegetation structure and texture). The stratification of the area into recognisable habitats was necessary to evaluate the potential of the habitat to support populations of threatened plant species as well as to evaluate vegetation condition and thus the most likely locations for plant species of special concern. The vegetation stratification also identified homogenous vegetation units within which floristic composition could be described. Lists of Red Data plants historically recorded from for the quarter-degree grids within which the study area is situated (2628 BB) were obtained from the MTPA PlantDat database, as well as from the National Herbarium (PRECIS) database (<http://posa.sanbi.org>). Lists for adjacent grids were also referred to. These lists were then used to produce a list of the threatened species most likely to occur within the study area, which informed the search strategy for these species during fieldwork.

In order to provide information about the floristic composition of vegetation units, vegetation sampling was undertaken at a limited number of sampling sites, but it must be emphasised that the data gathered in the sampling quadrats was only used to refine or ‘calibrate’ the vegetation descriptions which are based on field observations at a far greater number of sites. Quantitative data was collected in natural vegetation by undertaking vegetation sampling according to the Braun-Blanquet approach (Kent & Coker, 1996). In each sample site the following data was collected:

- species present,
- cover estimation of each species according to the Braun-Blanquet scale,
- vegetation height,
- amount of bare soil and rock cover,

- slope, aspect in degrees, latitude and longitude position (from GPS) in decimal degrees,
- presence of biotic disturbances, e.g. grazing and alien plant invasion.

Additional checklists of plant species were compiled for each vegetation unit by traversing the study area on foot and recording species as they were encountered.

The wetland vegetation unit met the criteria for wetlands as described in the Department of Water Affairs and Forestry (DWAF) document titled “A Practical field procedure for identification and delineation of wetlands and riparian areas (Final Draft)” (September, 2005). The DWAF document stipulates the use of the following indicators to identify wetlands: ‘Terrain Unit Indicator’ (terrain unit morphological classes), ‘Soils Form Indicator’ (presence of hydromorphic soils), ‘Soil Wetness Indicator’ and the ‘Vegetation Indicator’ (presence of hydrophytic and/or hygrophytic species). The areas identified as wetlands were then assigned to various wetland types using ‘Hydro-geomorphic’ classification (HGM classification) terminology described by Mentis (June, 2008), namely: pans, isolated hillslope seeps, hillslope seeps connected to a watercourse, unchannelled valley-bottom wetlands, channelled valley-bottom wetlands, and perennial rivers and floodplains.

Lists of conservation-important mammals, birds, frogs and reptiles potentially occurring within the project area were prepared using Friedmann & Daly (2004), Van Cakenberghe *et.al.* (2006), Harrison *et. al.* (1997), Barnes (2000), Minter *et.al.* (2004) and distribution data from the South African Reptile Conservation Assessment (www.sarca.adu.org.za). The above data were captured mostly at a quarter-degree spatial resolution, but were refined by excluding species unlikely to occur within the study area, due to unsuitable habitat characteristics (e.g. altitude). Bat species thought to only fly over the site and not actually utilise vegetation communities (i.e. mostly cave-roosting species) were not included in the assessment. Potential occurrence of fauna in the various vegetation communities of the study area was predicted based on knowledge of known habitat requirements, and in some cases this predicted occurrence was confirmed during fieldwork. All confirmed species are listed in Appendix 4.

All fauna observations were conducted along vegetation transects or at quadrat sites and were mostly incidental observations or through indirect evidence (spoor, scats, territory marking). Bird observations mostly took place in the first four hours of sunlight when birds were most active and vocal. Limited searching for reptiles took place through turning over rocks and logs along vegetation transects, although this did not yield much data.

3. DESCRIPTION OF STUDY AREA

The study area is situated 6 km to the south-east of Delmas, in Delmas Local Municipality, south-western Mpumalanga Province (Figure 1). The area falls within the quarter degree grid 2628 BB and comprises just over 2 000 ha.

The general environment of the study area consists primarily of a combination of cultivated lands and untransformed grassland and marsh wetland vegetation along drainage lines as well homesteads and small exotic tree plantations. The topography of the study area is gently undulating with low hills and broadly incised valleys, which falls within the landscape type Dry Undulating / Flat Highlands, which is considered to have Medium conservation importance (Emery, 2002). There are various shallow drainage lines that intersect the landscape and these drain towards Delmas and become the Bronkhorstspruit stream. The study area therefore constitutes the upper reaches of the Bronkhorstspruit. These drainage lines may be flat and fairly wide with a central channel or they may be narrower and more ephemeral. Altitude varies from 1 540 meters above sea level (m.a.s.l) to 1 596 m.a.s.l.

The geology of the study area is primarily Vryheid Formation arenite, shale and coal. The landtype of the study area, which is an area with largely uniform soils, topography and climate, is the Bb land type (Land Type Survey Staff, 1987). The rainfall in the study area is approximately 670 mm per annum and occurs mainly in the summer.

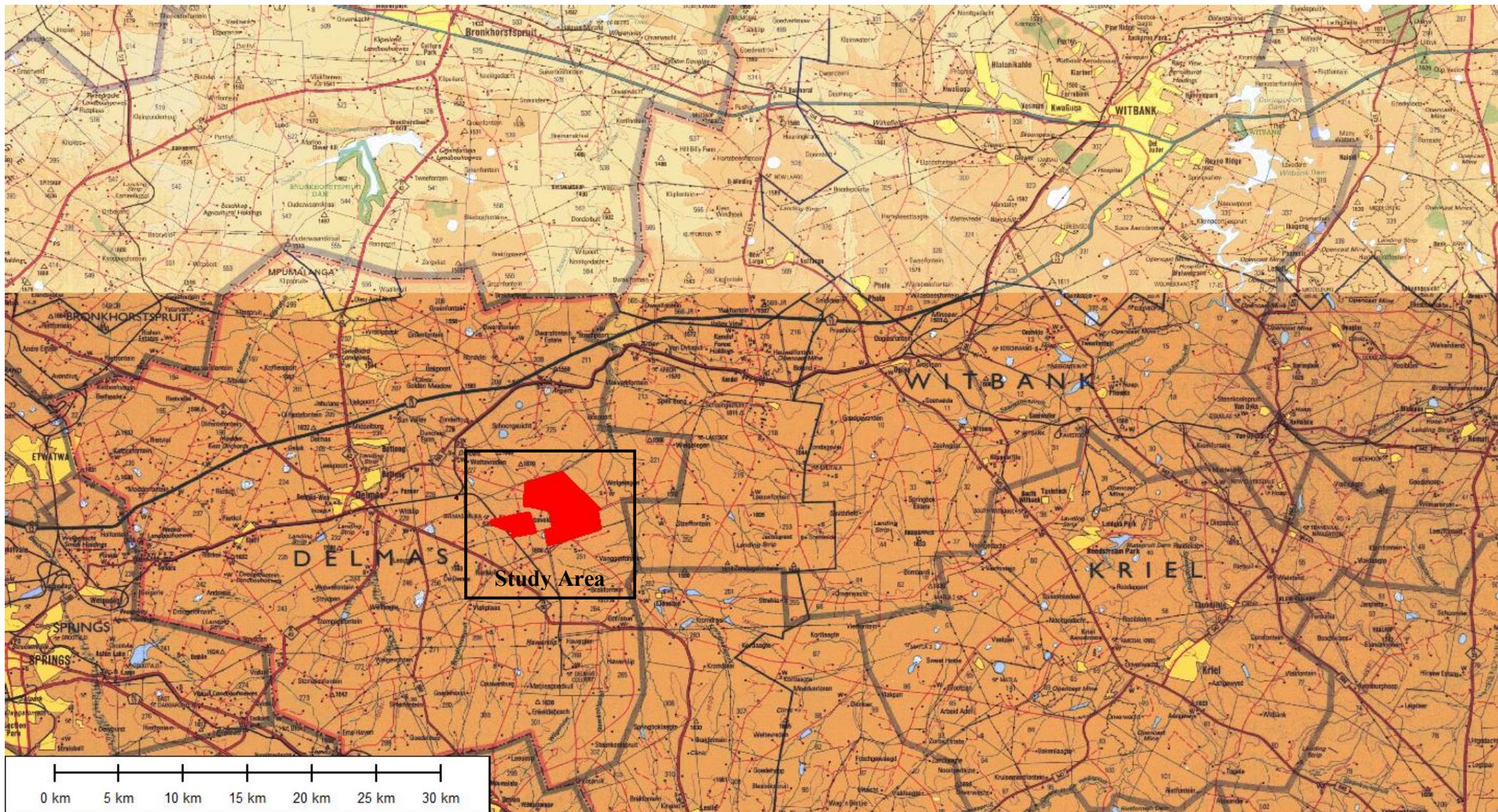


Figure 1: Location of Study Area

4. VEGETATION

According to Mucina & Rutherford (2006), the vegetation type that predominates within the study area is Eastern Highveld Grassland, which is in the Mesic Highveld Grassland Bioregion of the Grassland Biome. **Eastern Highveld Grassland** is virtually confined to Mpumalanga Province, marginally extending west into Gauteng. It occurs from Bapsfontein in the west, stretching east to Lothair, south to Dirkiesdorp and north to just south of Belfast. It originally covered about 1 241 467 ha, of which 57.2% has been transformed, mostly through cultivation, mining and urbanisation. Only 0.8% of this vegetation type has been formally protected, and it is thus considered **hardly protected**¹. The property has an ecosystem status of **Endangered** (Ferrar & Lötter, *in press*).

Typical Eastern Highveld Grassland is dominated by a variety of grass species, including *Aristida aequiglumis*, *Aristida congesta*, *Aristida junciformis*, *Brachiaria serrata*, *Cynodon dactylon*, *Digitaria monodactyla*, *Digitaria tricholaenoides*, *Elionurus muticus*, *Eragrostis chloromelas*, *Eragrostis curvula*, *Eragrostis plana*, *Eragrostis racemosa*, *Eragrostis sclerantha*, *Heteropogon contortus*, *Loudetia simplex*, *Michrochloa caffra*, *Monocymbium ceresiiforme*, *Setaria sphacelata*, *Sporobolus africanus*, *Sporobolus pectinatus*, *Themeda triandra*, *Trachypogon spicatus*, *Tristachya leucothrix* and *T. rehmannii*. A number of herbaceous plants may also be found, including *Berkheya setifera*, *Haplocarpha scaposa*, *Justicia anagalloides* and *Pelargonium luridum*.

The study area is not situated in any of South Africa's floristic centres of endemism (Van Wyk & Smith, 2001).

About 80% of the study area has been transformed through cultivated lands, roads and homesteads (Figure 2, Table 1). The rest is either semi-transformed² through overgrazing and altered fire regimes or untransformed. The largest fragments of untransformed and undisturbed vegetation in the study area occur on the central areas of the farm Vanggatfontein 250 IR and the southern portion of the farm Moabsvelden 248 IR.

The six broad-scale structural-functional vegetation units identified during this survey are as follows:

- *Themeda triandra* Untransformed Grassland (124 ha);
- *Eragrostis* - *Cynodon* Semi-transformed Grassland (61 ha);
- *Imperata cylindrica* Untransformed Valley-bottom Wetland (101 ha);
- *Helichrysum* - *Leersia* Semi-transformed Valley-bottom Wetland (94 ha);
- *Leersia hexandra* Endorheic Pan (28 ha)

¹ MTPA GIS database, 2002

² **Semi-transformed vegetation** is vegetation that has been degraded by impacts such as long-term overgrazing and altered fire regimes (burning to frequent or infrequent and unseasonal burning) and is dominated by early-seral grasses (e.g. *Eragrostis plana*, *E.chloromels*, *E.curvula* and *Cynodon dactylon*) or late-seral grasses (e.g. *Hyparrhenia hirta*). Original species richness still present and, under correct management, may usually be restored to a climax state, and therefore has *considerable conservation value*.

- Transformed areas (1 661 ha)

The vegetation units are briefly described below and mapped in Figure 2. A plant species list is provided in Appendix 1. The relative proportions of the different units are given in Table 1.

A high percentage (80%) of the study area has been transformed through cultivation, plantations of alien trees, dams and homesteads. Just under 8% of the study area can be described as semi-transformed. This leaves just over 12% of the study area as untransformed, of which *Themeda triandra* Untransformed Grassland is dominant (6%).

Table 1: Proportions of different vegetation units within the Study Area.

Vegetation Communities	Area (ha)	%
<i>Themeda triandra</i> Untransformed Grassland	124.3	6.0
<i>Eragrostis - Cynodon</i> Semi-transformed Grassland	61.1	3.0
<i>Imperata cylindrica</i> Untransformed Valley-bottom Wetland	101.4	4.9
<i>Helichrysum - Leersia</i> Semi-transformed Valley-bottom Wetland	93.9	4.5
<i>Leersia hexandra</i> Endorheic Pan	27.9	1.3
Transformed areas (cultivated fields, plantations, dams, homesteads)	1661.2	80.3
TOTAL	2069.8	100.0

A total of 135 species in 40 families were recorded during this survey, of which 22 are alien species. Of the alien species, six are declared invader or weed species (Appendix 1). The proportion of alien species (including declared invader species) is moderately high (16%) reflecting the level of disturbance and transformation in the study area.

The declared weeds and invaders recorded in the study area were:

- **Declared Weed Category 1** (Prohibited and must be controlled): *Xanthium spinosum**, *Solanum elaeagnifolium**, *Campuloclinium macrocephalum** and *Cirsium vulgare**;
- **Declared Invader Category 2** (Commercially Grown): *Acacia mearnsii** and *Eucalyptus cf. camaldulensis**;
- **Declared Invader Category 3** (Ornamental Plants): None recorded.

The three species that pose the most serious threat are *Acacia mearnsii** (patches in undisturbed grassland), *Campuloclinium macrocephalum* (potential to spread from roadsides) and *Eucalyptus cf. camaldulensis** (potential to spread into untransformed grassland).

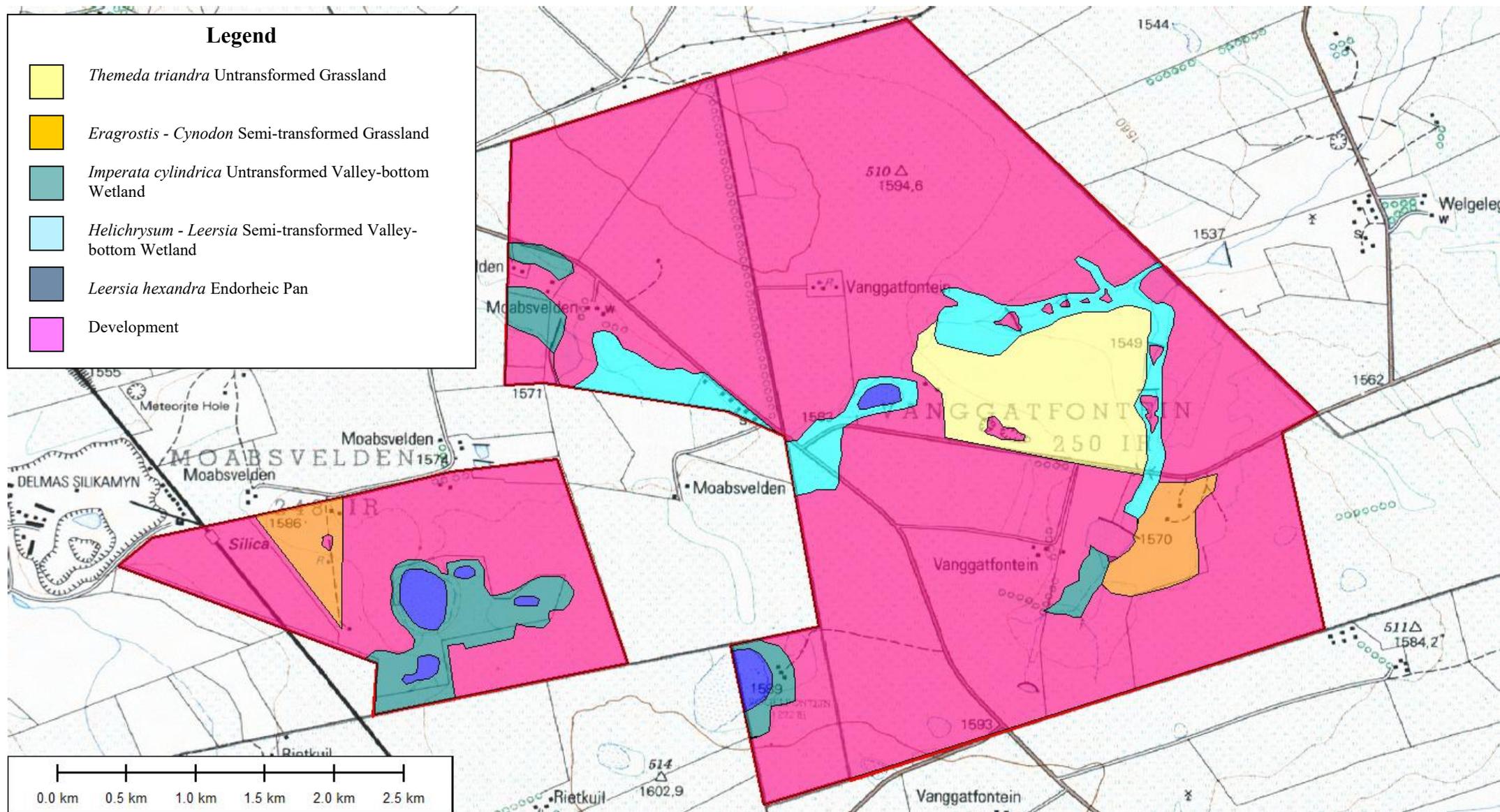


Figure 2. Vegetation units within the study area.

4.1 *Themeda triandra* Untransformed Grassland

This untransformed vegetation community covers approximately 124 ha or 6% of the study area (Figure 2, Table 1). A pocket of this grassland is located on plains and gentle slopes on Vanggatfontein 250 IR in the eastern portion of the study area. Structurally, this vegetation community can be described as Short Closed Grassland, which is grassland that has grass canopy cover of over 10% (Edwards 1983). The grassland patches are currently grazed at varying levels of intensity by cattle and sheep. See Appendix 3A for a photograph of this community.

The community is strongly dominated by grasses; the most frequently recorded species being *Themeda triandra*. Other common species include *Trachypogon spicatus* and *Hyparrhenia hirta*. Less common grass species found include *Brachiaria serrata*, *Diheteropogon amplexans*, *Setaria sphacelata*, *Eragrostis racemosa* and *Panicum natalense*. Herbaceous species are diverse and include *Helichrysum coriaceum*, *Crabbea acaulis*, *Chaetacanthus setiger*, *Dicoma zeyheri*, *Senecio erubescens*, *Ipomoea crassipes*, *Acalypha punctata*, *Rhynchosia adenodes*, *Pelargonium luridum*, *Anthospermum hispidulum*, *Hermannia depressa*, *Tephrosia capensis*, *Scabiosa columbaria* and *Vernonia natalensis*. Bulbs are also prominent and include *Boophane disticha*, *Eucomis autumnalis*, *Ledebouria ovatifolia*, *Hypoxis costata*, *Hypoxis rigidula* and *Gladiolus crassifolius*.

Dwarf shrubs are uncommon and scattered throughout and include *Barleria ovata*, *Searsia discolor*, *Chamaecrista mimosoides* and *Stoebe vulgaris*. This species composition is representative of that of typical Eastern Highveld Grassland (Mucina & Rutherford, 2006). Species richness was moderately high in these grasslands (an average of 30 species per 100 m²) (Appendix 2).

The grassland vegetation unit is considered to be of **high conservation importance and high sensitivity** (Figure 3) and is regarded as being sensitive for the following reasons:

1. It is representative of Eastern Highveld Grassland, an Endangered vegetation type. Few unfragmented areas of this vegetation type remain within the region of the highveld within which the study area is situated. Only 0.8% of Eastern Highveld Grassland is currently protected, and only 42.8% remains untransformed.
2. Species richness is high and species composition includes many species absent in disturbed areas.
3. **Three species of conservation importance** were **confirmed** to occur, of which two, *Boophane disticha* and *Eucomis autumnalis*, have been given a national Orange List status of Declining³. Three are protected under the Mpumalanga Nature Conservation Act (Act 10 of 1998): *Boophane disticha*, *Eucomis autumnalis* and *Gladiolus crassifolius*.

³ Orange List species are those that are considered to be of conservation concern (Declining, Rare and Near Threatened species), although not yet considered threatened.

4. There are six other Red or Orange List plant species that potentially occur within this vegetation unit, namely *Crinum bulbispermum* (Declining), *Alepidea peduncularis* (Data Deficient), *Callilepis leptophylla* (Declining), *Pelargonium sidoides* (Declining), *Hypoxis hemerocallidea* (Declining) and *Gladiolus robertsoniae* (Near Threatened). *Gladiolus robertsoniae* flowers from Oct-Dec and could have been overlooked during fieldwork. The remaining species are all summer flowering and quite distinct, but may have been overlooked and occur in very low numbers. There are also a number of protected and medicinally important plant species that occur in this vegetation unit.

4.2 *Eragrostis* – *Cynodon* Semi-transformed Grassland

Two patches of semi-transformed grassland are found within the study area, covering 61 ha, or 3% of the study area (Figure 2, Table 1). This vegetation unit represents areas that have not been ploughed, but have suffered some degradation through overgrazing by cattle and sheep or incorrect burning regimes (Appendix 3C). A mixture of pioneer and climax grasses is present, particularly *Eragrostis cf. biflora* and *Cynodon dactylon*, while other common species are *Themeda triandra*, *Eragrostis plana*, *Eragrostis chloromelas*, *Setaria sphacelata* and *Urochloa panicoides*. Certain areas that have experienced prolonged periods of mismanagement have been invaded by pioneer or alien dwarf shrubs and herbs including *Stoebe vulgaris*, *Conyza albida**, *Nidorella hottentota*, *Senecio polyanthemoides*, *Tagetes minuta**, *Solanum elaeagnifolium** and *Verbena bonariense**. Other less-commonly recorded herbaceous species include *Selago densiflora*, *Pygmaeothamnus chamaedendrum*, *Pentanisia angustifolia*, *Sebaea grandis*, *Indigofera sanguinea* and *Helichrysum coriaceum*.

Semi-transformed grassland has moderate species richness (26 species per 100m²) and no confirmed species of conservation concern. However, since this vegetation unit has not undergone ploughing, it is still potentially representative of Eastern Highveld Grassland and thus has **medium-high conservation importance** and sensitivity (Figure 3).

4.3 *Imperata cylindrica* Untransformed Valley-bottom Wetland

Valley-bottom Wetlands occur in most of the drainage lines and watercourses in the study area (Figure 2; Appendix 3D). Various wetland types and vegetation zones within wetlands may be distinguished in this type of habitat, based on the vegetation structure and floristic composition of the constituent plant communities. Each wetland type is characterized by a unique species composition associated with the dominant physical and hydrological characteristics of the site. The *Imperata cylindrica* Untransformed Valley-bottom Wetland vegetation unit covers an area of approximately 101 ha, or 5% of the study area (Table 1).

Wetlands along the main floodplains include typical permanent wetland species of mainly grasses and sedges. The grass *Imperata cylindrica* is the dominant species found, with other common grasses and sedges being *Helictotrichon turgidulum*,

Leersia hexandra, *Hyparrhenia cf. anamesa*, Cyperaceae species 2, *Cyperus* sp. 1 and *Kyllinga pulchella*. Forbs, herbs and bulbs are less commonly recorded but include *Helichrysum rugulosum*, *Senecio inornatus*, *Centella asiatica**, *Monopsis decipiens*, *Sebaea leiostyla*, *Chironia palustris* and *Commelina africana*.

It is difficult to assess the floristic value of affected wetlands in the study area due to the fact that no comprehensive regional conservation assessment of these systems has been undertaken for the Highveld region in the same way as terrestrial vegetation types. The value of the wetlands has therefore been assessed according to functional value and the perceived condition on the basis of species composition and disturbance factors. Many of the wetlands are in relatively good condition, despite existing impacts of agriculture.

Wetland vegetation is therefore considered to have **high conservation importance and high sensitivity** (Figure 3) for the following reasons:

- they perform an important ecological function, e.g. maintaining water purity and supply and reducing soil erosion;
- they provide habitats for various wild animal and bird populations and contain many plant species that are restricted to this habitat;
- they are linear systems in which any disturbance will affect the quality of systems further downstream;
- they have been transformed or are under threat by various factors in many parts of the country.
- There are three Red or Orange List plant species that potentially occur within this vegetation unit, namely *Crinum bulbispermum* (Declining), *Nerine gracilis* (Near Threatened) and *Kniphofia typhoides* (Near Threatened) (Appendix 3). The two Near Threatened species flower in late summer, when the survey took place, and if present occur in low numbers. *Crinum bulbispermum* flowers in spring and early summer but is distinctive even when not in flower.

A total of 27 species was recorded from this community (27 species, Appendix 1) and no species of conservation concern were confirmed to occur.

4.4 *Helichrysum* – *Leersia* Semi-transformed Valley-bottom Wetland

This vegetation community occurs in most of the drainage lines and watercourses in the eastern half of the study area (Figure 2), and is a semi-transformed version of *Imperata cylindrica* Untransformed Valley-bottom Wetland. The *Helichrysum* – *Leersia* Semi-transformed Valley-bottom Wetland vegetation unit covers an area of approximately 94 ha, or 4.5 % of the study area (Table 1).

The community is dominated by the herb *Helichrysum cf. difficile*, and the grass *Leersia hexandra*. Other commonly recorded species include *Eragrostis curvula*, *Imperata cylindrica*, *Helictotrichon turgidulum*, *Paspalum notatum*, *Paspalum urvillei* *, *Schoenoplectus muriculatus* and *Bulbostylis* sp. Forbs, herbs and bulbs are less commonly recorded and include *Helichrysum rugulosum*, *Sebaea leiostyla*,

Senecio erubescens, *Pseudognaphalium undulatum*, *Conyza albida**, *Berkheya radulosa* and *Verbena bonariense**

It is difficult to assess the floristic value of affected wetlands in the study area due to the fact that no comprehensive regional conservation assessment of these systems has been undertaken for the Highveld region in the same way as terrestrial vegetation types. The value of the wetlands has therefore been assessed according to functional value and the perceived condition on the basis of species composition and disturbance factors. Many of the wetlands are in relatively good condition, despite existing impacts of agriculture.

Wetland vegetation is therefore considered to have **high conservation importance and high sensitivity** (Figure 3) for the following reasons:

- they perform an important ecological function, e.g. maintaining water purity and supply and reducing soil erosion;
- they provide habitats for various wild animal and bird populations and contain many plant species that are restricted to this habitat;
- one protected species, *Habenaria* species, was confirmed to occur within this vegetation unit;
- they are linear systems in which any disturbance will affect the quality of systems further downstream;
- they have been transformed or are under threat by various factors in many parts of the country.
- There are three Red or Orange List plant species that potentially occur within this vegetation unit, namely *Crinum bulbispermum* (Declining), *Nerine gracilis* (Near Threatened) and *Kniphofia typhoides* (Near Threatened) (Appendix 3). The two Near Threatened species flower in late summer, when the survey took place, and if present occur in low numbers. *Crinum bulbispermum* flowers in spring and early summer but is distinctive even when not in flower.

4.5 *Leersia hexandra* Endorheic Pan

This vegetation community occurs in patches across the southern portion of the study area (Figure 2). *Leersia hexandra* Endorheic Pans cover 28 ha in total, or 1.3% of the study area (Table 1, Appendix 3E). Vegetation structure is Low Closed Grassland (Edwards, 1983). The grass *Leersia hexandra* dominates, with *Helictotrichon turgidulum*, *Paspalum urvillei* *, *Juncus oxycarpus* and *Kyllinga pulchella* commonly recorded. Forbs, herbs and bulbs are scarce but those recorded include *Persicaria attenuata**, *Verbena bonariense**, *Cycnium tuberosum*, *Lobelia erinus*, *Helichrysum rugulosum* and *Helichrysum coriaceum*.

It is difficult to assess the floristic value of endorheic pans in the study area due to the fact that no comprehensive regional conservation assessment of these systems has been undertaken for the Highveld region in the same way as terrestrial vegetation types. The value of these pans has therefore been assessed according to functional value and the perceived condition on the basis of species composition and disturbance

factors. Many of the pans are in relatively good condition, despite existing impacts of agriculture.

The *Leersia hexandra* Endorheic Pan vegetation is therefore considered to have **high conservation importance and high sensitivity** (Figure 3) for the following reasons:

- they perform an important ecological function, e.g. maintaining water purity and supply and reducing soil erosion;
- they provide habitats for various wild animal and bird populations and contain many plant species that are restricted to this habitat;
- they have been transformed or are under threat by various factors in many parts of the country.
- There are three Red or Orange List plant species that potentially occur within this vegetation unit, namely *Crinum bulbispermum* (Declining), *Nerine gracilis* (Near Threatened) and *Kniphofia typhoides* (Near Threatened) (Appendix 3). The two Near Threatened species flower in late summer, when the survey took place, and if present occur in low numbers. *Crinum bulbispermum* flowers in spring and early summer but is distinctive even when not in flower.

Species richness was low with 13 species confirmed (Appendix 1).

4.6 Transformed Areas

Cultivation is the dominant land cover type of the transformed areas, and ploughed lands cover over 1 600 ha of the study area (Figure 2, Table 1). It appears that maize is the main crop cultivated in the area. A number of annual and perennial weeds and grasses are associated with maize, particularly on the edges of crop rows. These species make up the remainder of the species list and include *Cynodon dactylon*, *Tagetes minuta**, *Verbena bonariense**, *Conyza albida**, *Bidens pilosa**, *Cosmos bipinnata** and *Persicaria lapathifolia**. There are stands of alien trees (*Eucalyptus cf. camaldulensis** and *Acacia mearnsii**) in the study area that are obviously managed as small plantations as well as some smaller areas of localised invasion. These are either associated with areas of disturbance or surround farm infrastructure. The high levels of cultivation have probably led to alien trees being controlled to some extent since little surface area remains for aliens to colonise. Many of the species mentioned above are listed in the Conservation of Agricultural Resources Act (Act No. 43 of 1983) as declared weeds or invasive species (Appendix 1).

The cultivated areas have **low conservation importance and low sensitivity** (Figure 3).

5. THREATENED, PROTECTED AND MEDICINAL SPECIES

5.1 Threatened plant species

Prior to fieldwork, lists of historical occurrences of Red List and Orange List plant species were obtained from the PRECIS Database (South African National Biodiversity Institute) and PlantDat database (Mpumalanga Tourism & Parks Agency) for the quarter degree grids 2628 BB. Eight Orange List species are included (Appendix 3). Three of these are Near-Threatened (*Gladiolus robertsoniae*, *Kniphofia typhoides*, *Nerine gracilis*), one is Data Deficient (*Alepidea peduncularis*), while four are Declining (*Callilepis leptophylla*, *Crinum bulbispermum*, *Pelargonium sidoides* and *Hypoxis hemerocallidea*). Two species *Crinum bulbispermum* and *Hypoxis hemerocallidea* have a High likelihood of occurring, while the rest have a moderate likelihood of occurring (Appendix 3). This means that the study area is within the geographical distribution of these species, that there are records on nearby farms and available habitats on site are suitable for the species, although specific microhabitat requirements may be absent. Two Declining species were confirmed during fieldwork, namely *Boophane disticha* and *Eucomis autumnalis*. The three most significant (Near Threatened) species are discussed in detail below.

Gladiolus robertsoniae occurs in a small part of the highveld of southern Mpumalanga and northern Free State provinces where it is usually found growing in crevices on rock sheets in moist areas such as seeps or riverbanks in grassland. It is only known from 12-14 populations and is considered on the verge of qualifying for the status of Vulnerable (D.Raimondo, *pers.comm.*). One of these populations has been confirmed within an adjacent quarter-degree grid (M. Lötter, MTPA, *pers.comm.*). While a search of likely habitat yielded no confirmed individuals of this species, the field survey was conducted slightly later than the known flowering period of this species (October to December) and it is possible that individuals may have been present, but not detectable. **It is for this reason that is important for a follow-up survey to take place in rocky areas in grassland, as well as moist seeps, in October or November.**

Kniphofia typhoides has been recorded in an adjacent quarter-degree grid, growing in wetlands or wet valley grassland. It has experienced a decline through loss of wetland habitat. This species prefers black clay soils along the edge of pans or wetlands, and flowers from mid-February to March (Codd, 1963). It is conspicuous and easy to identify when in flower, so it is unlikely that it was overlooked during fieldwork. However, not all wetland areas were surveyed because of time constraints and the size of the study area, and it is possible that this species was overlooked.

Nerine gracilis has been confirmed within 2628 BB, growing in moist valley grasslands and stream and pan edges. It is listed as Near Threatened due to a loss of wetland habitat. It is conspicuous and easy to identify when in flower, so it is unlikely that it was overlooked during fieldwork. However, not all wetland areas were surveyed because of time constraints and the size of the study area, and it is possible that this species was overlooked.

The two Orange List (Declining) species that were confirmed to occur are discussed in more detail below:

Eucomis autumnalis is widespread across the Mpumalanga Highveld, usually occurring in association with wet valley grassland or wetlands. This bulbous species is utilised in traditional medicine and is popular in cultivation, and there is concern that current levels of harvesting may be causing a population decline.

Boophane disticha is another widespread species across the Highveld and Escarpment of Mpumalanga; this familiar bulbous species is widely used in traditional medicine and there is concern that it is being collected illegally and unsustainably, causing a decline in populations.

In the event of any threatened or near threatened species being recorded during follow-up surveys, appropriate *in situ* and / or *ex situ* conservation measures should be developed and implemented in conjunction with the Mpumalanga Tourism & Parks Agency.

5.2 Protected plant species

A number of plant species occurring in Mpumalanga Province are not considered to be threatened but are protected under Schedule 12 of the Mpumalanga Nature Conservation Act (No.10 of 1998).

Four species protected under Schedule 12 were confirmed to occur during fieldwork (Table 2). There may also be other species that were not detected during this survey, but which occur in the study area. Many of the species listed here are worthy of rescue and, due to the fact that they are mostly bulbous species, would be relatively easy to remove prior to mining. It is recommended that:

1. Where untransformed natural habitats are to be affected by mining infrastructure that the species listed in Table 2 are rescued prior to mining;
2. Where it is not possible to rescue species then the appropriate permission must be obtained from the Provincial authorities for the destruction of these plants.

Table 2: Plants occurring in the study area that are protected under Schedule 12 of the Mpumalanga Nature Conservation Act (No.10 of 1998).

Species	Family	Habitat
<i>Eucomis autumnalis</i>	Hyacinthaceae	Valley-bottom Wetland, Endorheic Pan
<i>Boophane disticha</i>	Amaryllidaceae	Untransformed Grassland on Plains
<i>Habenaria species</i>	Orchidaceae	Valley-bottom Wetland, Endorheic Pan
<i>Gladiolus crassifolius</i>	Iridaceae	Untransformed Grassland on Plains

5.3 Medicinal plants

There are a number of plants that are used to provide medicinal products and for which, in some cases, there is merit in protecting them or translocating them before mining commences. While many of these plants are indigenous or exotic weeds that

have medicinal value and for which no action is necessary with respect to conservation, others are considered to have high economic value and are considered in need of protection.

6. FAUNA

6.1 Mammals

Most of the study area has been transformed, mostly through cropland agriculture. This habitat transformation, together with elevated human presence and impacts such as disturbance, hunting and persecution, has negatively impacted on large mammal occurrence, particularly ungulates and predators. However, several untransformed areas still remain within the study area and potentially hold at least a few mammal species.

Mammal observations were made incidentally while sampling vegetation. No trapping was conducted during the survey. Four species were confirmed to occur (Appendix 4). More extensive fieldwork, including nocturnal surveys and small mammal trapping, would have produced a larger list.

An estimated 12 Red Data mammal species potentially occur within the general vicinity of the study area (Appendix 5). Of these, seven species have been classified as **Data-Deficient**, meaning that not enough data were available in order to assess their Red Data status⁴. It is very likely that at least a few Data-Deficient species do occur. Four of the remaining Red Data mammal species that potentially occur have been assessed nationally as **Near Threatened** (Serval, Brown Hyaena, Highveld Golden Mole and Southern African Hedgehog), which means that they are close to or likely to soon qualify for the status of Vulnerable. Serval was **confirmed** to occur during fieldwork and the other three species have a Moderate chance of at least passing through or feeding in the study area.

The most significant Red Data species potentially occurring within the untransformed portions of grassland is White-tailed Rat (**Endangered**). This species has suffered a serious loss of habitat and is declining throughout its range⁵. There are few recent records of this species, which favours sandy grassland with good grass cover. Its probability of occurrence within the study area is Low.

The most important parts of the project area for conservation-important mammal species are the larger fragments of untransformed grassland and wetland scattered throughout the mining lease area.

6.2 Birds

The quarter-degree grid 2628 BB, in which the study area falls, supported over 200 bird species during the first Southern African Bird Atlas Project (SABAP1)⁶, reflecting the high species richness of this part of the Highveld. Just over 50 bird species were recorded during fieldwork (Appendix 4), some of which were only observed in transformed areas such as cultivated lands or farm dams. The fragments

⁴ Friedmann & Daly, 2004

⁵ Friedmann & Daly, 2004

⁶ Harrison et al., 1997

of untransformed grassland in the study area were found to support numerous grassland specialists, such as Long-tailed Widowbird, Yellow-crowned Bishop, Spike-heeled Lark, Marsh Owl, Montagu's Harrier, Amur Falcon and African Quailfinch.

The level of transformation of Highveld Grassland has had significant impacts on bird assemblages. For example, it is probable that populations of seed-eating species such as Red-billed Quelea and Southern Red Bishop are much higher and less nomadic than in the past because of the planting of crops, resulting in a more predictable food supply. More sensitive grassland specialists such as Botha's Lark, Denham's Bustard, White-bellied Korhaan and Blue Crane have declined dramatically in numbers as their habitat has been reduced. Thus, any sizeable fragment of untransformed grassland should be considered very valuable to populations of conservation-important birds. In this regard, the areas of untransformed grassland on Vanggatfontein 250 IR should be considered significant.

Of the potentially occurring bird species 14 have Red Data status (Appendix 5) and eleven were confirmed to occur in the grid 2628 BB during the SABAP (Harrison *et al.*, 1997). The most threatened are five **Vulnerable** species. One of these, African Grass Owl, was confirmed with photographic evidence by fieldworkers conducting wetland surveys (D. Kassier *pers.comm.*). Of the remaining four Vulnerable species, three (Blue Crane, African Marsh Harrier, Lesser Kestrel) have a moderate likelihood of occurring as irregular visitors to untransformed and semi-transformed habitats, while White-bellied Korhaan only has a low likelihood of occurring in untransformed grassland.

Four of the nine potentially occurring Near Threatened⁷ species are most likely to occur at the endorheic pans: Greater and Lesser Flamingos, Yellow-billed Stork and Caspian Tern. Secretarybird, Black-winged Pratincole, Blue Korhaan, Lanner Falcon and Pallid Harrier have a moderate likelihood of occurring in untransformed and semi-transformed grassland anywhere in the study area.

The patch of untransformed grassland on Vanggatfontein 250 IR and the valley bottom wetlands are the two most important habitats for conservation-important birds within the project area.

6.3 Reptiles & Frogs

No Red Data reptiles potentially occur within the study area. No reptiles were confirmed to occur during fieldwork, although dedicated trapping and nocturnal searches in summer would have confirmed a number of species. The only Red Data frog species that potentially occurs in the area is Giant Bullfrog, which has a status of Near Threatened. There is a moderate likelihood that this species occurs in the vicinity of endorheic pans in the study area, although there were no records in the grid 2628 BB during the South African Frog Atlas Project (Minter *et al.*, 2004). Giant

⁷ The status of Near-threatened is defined as a species that is on the verge of being classified as Vulnerable and is likely to do so in the near future (Barnes, 2000)

Bullfrogs are explosive breeders that emerge from their underground burrows in years of sufficient rainfall and return to their burrows soon after breeding. It is possible that they may already have been hibernating at the time of the survey. **Further surveys are recommended within two weeks of the first 30mm rain of the season falling (usually late September / early October) in order to locate this species while breeding.** No frogs were recorded along streams and in floodplain wetlands although no dedicated frog surveys were conducted during fieldwork.

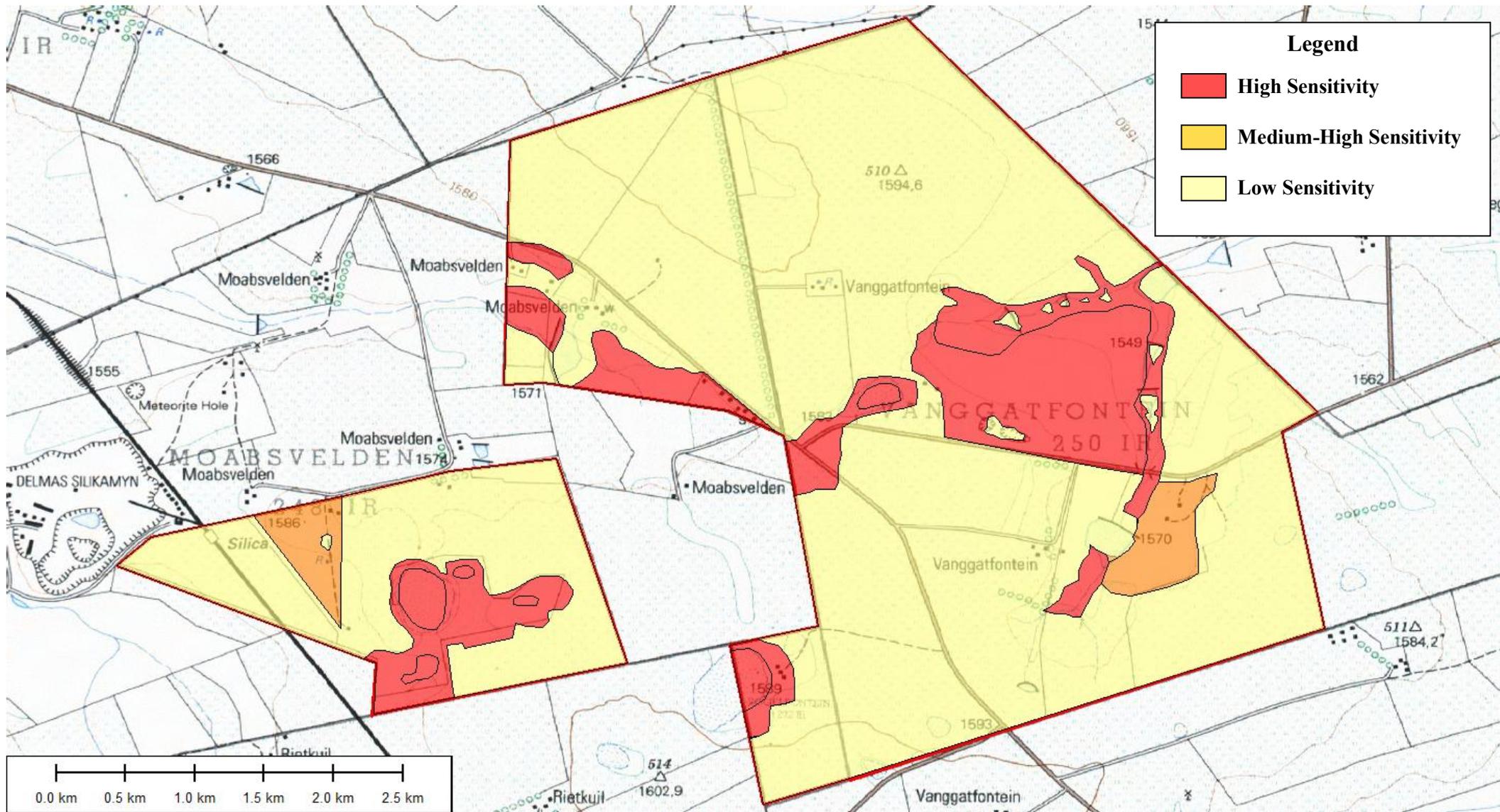


Figure 3. Sensitivity Map of the Stuart Colliery Project Area.

7. CONCLUSION

Only 124 ha of untransformed grassland and 129 ha untransformed wetlands are represented within the study area, representing about 12% of the surface area. Untransformed grassland is representative of Eastern Highveld Grassland, an Endangered vegetation type that is rapidly being transformed and is poorly protected. As such these grasslands are considered to be sensitive and have high conservation value. Wetlands make an important contribution to the maintenance of hydrological systems in the area, including steady recharge of the tributaries that feed the Bronkhorstspuit. The wetlands have functional, ecological and floristic value and are considered to be sensitive and of high conservation value. Any impacts on these systems needs to take into account overall and cumulative impacts on the greater wetland and riparian system of which they form a part. The dominant land cover is cultivation, which covers over 1 600 ha or 80% of the study area.

A total of 135 plant species were recorded on site during this survey. While the species list is not comprehensive, it provides a clear indication of the relative species richness between vegetation communities and in the study area. It is likely that additional botanical surveys will reveal additional species that were either dormant during the current survey or were overlooked due to the brief duration of the survey.

Four species of conservation concern were confirmed during fieldwork, two of which have a status of Declining (*Boophane disticha* and *Eucomis autumnalis*) (Appendix 1). Eight other Orange List species potentially occur within the project area. Three of these have a status of Near Threatened (*Gladiolus robertsoniae*, *Nerine gracilis* and *Kniphofia typhoides*), one is Data Deficient (*Alepidea peduncularis*) and four are considered to be Declining (*Crinum bulbispermum*, *Hypoxis hemerocallidea*, *Callilepis leptophylla* and *Pelargonium sidoides*). These species all have a HIGH or MODERATE chance of occurring in the types of habitats available in the study area. This means that the study area is within the geographical distribution of these species, that there are records on nearby farms and available habitats on site are potentially suitable for the species, although specific microhabitat requirements may be absent. **While most of these species are identifiable outside of the flowering season, follow-up surveys would be needed to confirm the occurrence of *Gladiolus robertsoniae* during its flowering period (Oct-Dec). Not all potentially suitable habitat for *Kniphofia typhoides* and *Nerine gracilis* was surveyed during the fieldwork, and further surveys in wetlands in late summer (Feb-Mar) would be necessary to confirm this species' presence in the project area.**

There are a number of plant species that are protected under provincial Nature Conservation Ordinances. Many of these are bulbous plants that would be able to be rescued with relative ease if it was necessary for the habitat in which they occur to be transformed by mining. These plants could be translocated to a nursery or donated to a botanical garden to be used for future rehabilitation of mined areas. Alternatively, permission may be required from the Provincial authorities to allow these plants to be destroyed.

One Near Threatened mammal, Serval, was confirmed during fieldwork through scats discovered in a valley-bottom wetland. Only one Red Data bird species was encountered within the project area during fieldwork, namely African Grass Owl (Vulnerable). A number of other species have a high or moderate likelihood of occurring, particularly at the endorheic pans and the fragment of untransformed grassland. No Red Data reptiles or frogs were encountered, and none have a high likelihood of occurrence. Giant Bullfrog (Near Threatened) has a moderate likelihood of occurring around endorheic pans.

8. RECOMMENDATIONS

A number of recommendations are made below which may reduce the impact of mining on natural ecosystems in the study area.

- According to the Conservation of Agricultural Resources Act (Act No. 43 of 1983) all declared alien weeds and declared invader plants must be effectively controlled. The EMP for the study area should provide a detailed plan for the control of alien plant species that are Declared Weeds and Declared Invaders within the study area. Development of the study site is likely to create conditions where such species can be problematic if not controlled. The EMP should provide an integrated control plan incorporating chemical, mechanical, cultural and biological control measures.
- There are a number of plants species that may be considered worthy of rescue for translocation, establishment in a nursery or donation to a botanical garden if the habitat in which they occur is to be impacted upon by mining activities. These species include protected plants, some of which may have medicinal value. All reasonable attempts should be made to rescue the indigenous species listed and relocate them according to recommendations from Mpumalanga Tourism & Parks Agency. If this is not possible then it may be necessary to obtain authorisation from the Provincial authorities to destroy these plants.
- As a precautionary measure, the occurrence of threatened species should be verified during the following follow-up surveys:
 - October or November – it is recommended that rocky ridges and moist seeps in grassland be searched for *Gladiolus robertsoniae*;
 - February or March – it is recommended that wetlands and riverbanks are searched for colonies of *Kniphofia typhoides* and *Nerine gracilis*.
 - Late September / early October – it is recommended that surveys of endorheic pans and valley-bottom wetlands are conducted within two weeks of the first 30mm rain of the season falling in order to locate breeding bullfrogs.
- In the event of any threatened or near threatened species being recorded within the study site during follow-up surveys, appropriate *in situ* and / or *ex situ* conservation measures should be developed and implemented in conjunction with the Mpumalanga Tourism & Parks Agency.
- If possible, no future above-ground development should take place within the remaining patches of undisturbed grassland within the mining lease area.

- All valley-bottom wetlands and endorheic pans should be avoid by open-cast mining activity and surface infrastructure.

9. REFERENCES

- BARNES, K.N. 2000. The Eskom Red Data Book of Birds of South Africa, Lesotho & Swaziland. BirdLife South Africa, Johannesburg.
- CODD, L.E. 1968. The South African species of *Kniphofia*. *Bothalia* 9 (3 & 4):1-363.
- EDWARDS, D. 1983. A broad-scale structural classification of vegetation for practical purposes. *Bothalia* 14 (3): 705–712.
- FERRAR, A. & LÖTTER, M.C. *in press*. Mpumalanga Biodiversity Conservation Plan. Mpumalanga Parks Board, Nelspruit.
- FRIEDMANN, Y. & DALY, B. (EDS). 2004. Red Data Book of the Mammals of South Africa: A Conservation Assessment. CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust. South Africa.
- HARRISON, J.A., ALLAN, D.G., UNDERHILL, L.G., HERREMANS, M., TREE, A.J., PARKER, V. & BROWN, C.J. 1997. The Atlas of Southern African Birds. Vols.1-2. BirdLife South Africa, Johannesburg.
- GERMISHUIZEN, G., MEYER, N.L., STEENKAMP, Y and KEITH, M. (eds.) (2006). A checklist of South African plants. Southern African Botanical Diversity Network Report No. 41, SABONET, Pretoria.
- KENT, M & COKER, P. (1996). *Vegetation Description and Analysis*. John Wiley & Sons, New York.
- LOTTER, M.C. & KRYNAUW, S. 2002. Medicinal Plants. In: EMERY, A.J. (ed) *Determining the conservation value of land in Mpumalanga*. Mpumalanga Parks Board, Nelspruit.
- MUCINA, L. AND RUTHERFORD, M.C. (editors) 2006. *Vegetation map of South Africa, Lesotho and Swaziland: an illustrated guide*. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.
- MINTER, L.R., BURGER, M., HARRISON, J.A., BRAACK, H.H., BISHOP, P.J. & KLOEPFER, D. 2004. *Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland*. SI/MAB Series No.9. Smithsonian Institution, Washington, DC.
- VAN CAKENBERGHE, V., KEARNEY, T.C. AND SEAMARK, E.C.J. 2006. *African Chiroptera Report*. African Chiroptera Project, Pretoria.
- VAN WYK, A.E. & SMITH, G.F. 2001. *Regions of floristic endemism in southern Africa: a review with emphasis on succulents*, pp. 1 – 199. Umdaus Press, Hatfield.

APPENDIX 1: Checklist of plants recorded in the project area during fieldwork.

Species	Family	Growth Form	Red Data	Protected	Declared Invaders & Weeds	Vegetation Communities					
						<i>Themeda triandra</i> Untransformed Grassland	<i>Eragrostis - Cynodon</i> Semi-transformed Grassland	<i>Imperata cylindrica</i> Untransformed Valley-bottom Wetland	<i>Helichrysum - Leersia</i> Semi-transformed Valley-bottom Wetland	<i>Leersia hexandra</i> Endorheic Pan	Development
Dicotyledons											
<i>Barleria ovata</i>	Acanthaceae	dwarf shrub				1					
<i>Chaetacanthus setiger</i>	Acanthaceae	dwarf shrub				1					
<i>Crabbea acaulis</i>	Acanthaceae	herb				1					
<i>Searsia discolor</i>	Anacardiaceae	dwarf shrub				1					
<i>Centella asiatica</i> *	Apiaceae	herb						1			
<i>Asclepias gibba</i>	Apocynaceae	herb				+					
<i>Berkheya cf.echinacea</i>	Asteraceae	herb				+					
<i>Berkheya insignis</i>	Asteraceae	herb				+					
<i>Berkheya radula</i>	Asteraceae	herb						+			
<i>Berkheya radulosa</i>	Asteraceae	herb							1		
<i>Berkheya speciosa</i>	Asteraceae	herb				+					
<i>Bidens pilosa</i> *	Asteraceae	herb									1
<i>Campuloclinium macrocephalum</i> *	Asteraceae	herb			1						
<i>Cirsium vulgare</i> *	Asteraceae	herb			1			+	+		

<i>Conyza albida</i> *	Asteraceae	herb					1	1	1	1	1
<i>Conyza podocephala</i> *	Asteraceae	herb				+	+	1			
<i>Cosmos bipinnatus</i> *	Asteraceae	herb									1
<i>Dicoma zeyheri</i>	Asteraceae	herb				1					
<i>Felicia muricata</i>	Asteraceae	herb				1					
<i>Haplocarpa nervosa</i>	Asteraceae	herb				1					
<i>Haplocarpa scaposa</i>	Asteraceae	herb				1					
<i>Helichrysum cf. difficile</i>	Asteraceae	herb							3		
<i>Helichrysum coriaceum</i>	Asteraceae	herb				1	1	+		1	
<i>Helichrysum nudifolium</i>	Asteraceae	herb						+			
<i>Helichrysum pilosellum</i>	Asteraceae	herb				1					
<i>Helichrysum rugulosum</i>	Asteraceae	herb				1		2	2	1	
<i>Hypochaeris radicata</i> *	Asteraceae	herb						+			
<i>Nidorella auriculata</i>	Asteraceae	herb				+		+	1		
<i>Nidorella hottentota</i>	Asteraceae	herb					1				
<i>Pseudogrophalium undulatum</i>	Asteraceae	herb					+		1		
<i>Schkurgia pinnata</i> *	Asteraceae	herb									+
<i>Senecio consanguineus</i>	Asteraceae	herb									
<i>Senecio coronatus</i>	Asteraceae	herb				+					
<i>Senecio erubescens</i>	Asteraceae	herb				1	+	1	1		
<i>Senecio inornatus</i>	Asteraceae	herb						1			
<i>Senecio polyanthemoides</i>	Asteraceae	herb					1				
<i>Senecio scitius</i>	Asteraceae	herb				+					
<i>Senecio sp. (no flowers)</i>	Asteraceae	herb					+	+	1		
<i>Stoebe vulgaris</i>	Asteraceae	dwarf shrub				+	1				
<i>Tagetes minuta</i> *	Asteraceae	herb				+	1				1
<i>Vernonia natalensis</i>	Asteraceae	herb				1					
<i>Xanthium spinosum</i> *	Asteraceae	herb			1						+
<i>Wahlenbergia sp.</i>	Campanulaceae	herb						+	+		
<i>Ipomoea crassipes</i>	Convolvulaceae	creeper				1	1				

<i>Turbina oblongata</i>	Convolvulaceae	creeper					+				
<i>Crassula capitella</i>	Crassulaceae	succulent					+				
<i>Cucumis hirsutus</i>	Cucurbitaceae	creeper					+	+			
<i>Scabiosa columbaria</i>	Dipsacaceae	herb					1				
<i>Diospyros lycioides</i> <i>subsp.guerkei</i>	Ebenaceae	shrub					+				
<i>Acalypha angustifolia</i>	Euphorbiaceae	herb					+				
<i>Acalypha punctata</i>	Euphorbiaceae	herb					1				
<i>Acacia mearnsii</i> *	Fabaceae	tree			2		+				
<i>Chamaecrista mimosoides</i>	Fabaceae	dwarf shrub					+	+			
<i>Elephantorrhiza elephantina</i>	Fabaceae	dwarf shrub						+			
<i>Eriosema sp. (no flowers)</i>	Fabaceae	herb					+				
<i>Indigofera cf.melanadenia</i>	Fabaceae	herb					+				
<i>Indigofera sanguinea</i>	Fabaceae	herb						1			
<i>Rhynchosia adenoides</i>	Fabaceae	herb					1				
<i>Tephrosia capensis</i>	Fabaceae	herb					1				
<i>Chironia palustris</i>	Gentianaceae	herb							+		
<i>Chironia sp.</i>	Gentianaceae	herb					+				
<i>Sebaea grandis</i>	Gentianaceae	herb					+	+			
<i>Sebaea leiostyla</i>	Gentianaceae	herb							+	1	+
<i>Pelargonium luridum</i>	Geraniaceae	herb					1	+			
<i>Lobelia erinus</i>	Lobeliaceae	herb									+
<i>Monopsis decipiens</i>	Lobeliaceae	herb							+	+	
<i>Hibiscus aethiopicus</i>	Malvaceae	herb					+				
<i>Sida alba</i>	Malvaceae	dwarf shrub					+				
<i>Eucalyptus cf.camaldulensis</i> *	Myrtaceae	tree			2						1
<i>Oenothera rosea</i> *	Onagraceae	herb							1	+	
<i>Cycnium tuberosum</i>	Orobanchaceae	herb									+
<i>Polygala hottentota</i>	Polygalaceae	herb					+				

<i>Persicaria attenuata*</i>	Polygonaceae	herb								2	
<i>Persicaria lapathifolia*</i>	Polygonaceae	herb									+
<i>Anthospermum hispidulum</i>	Rubiaceae	herb				1					
<i>Pentanisia angustifolia</i>	Rubiaceae	herb				1	+				
<i>Pygmaeothamnus chamaedendrum</i>	Rubiaceae	herb					+				
<i>Thesium sp.</i>	Santalaceae	herb				+					
<i>Selago densiflora</i>	Scrophulariaceae	herb					+				
<i>Striga asiatica</i>	Scrophulariaceae	herb				+					
<i>Walafriida densiflora</i>	Scrophulariaceae	herb				+					
<i>Solanum elaeagnifolium*</i>	Solanaceae	herb			1		1				
<i>Solanum nigrum</i>	Solanaceae	herb					+				
<i>Solanum panduriforme</i>	Solanaceae	herb				+					
<i>Hermannia depressa</i>	Sterculiaceae	herb				1					
<i>Gnidia kraussiana</i>	Thymelaeaceae	herb				+					
<i>Verbena bonariense*</i>	Verbenaceae	herb					1	1	1	1	1
<i>Verbena brasiliense*</i>	Verbenaceae	herb									+
Subtotal		88	0	0	6	50	24	19	14	8	10
Monocotyledons											
<i>Boophane disticha</i>	Amaryllidaceae	bulb	Declining	MNCA		+					
<i>Agave sisalana*</i>	Agavaceae	succulent				+					
<i>Chlorophytum fasciculatum</i>	Anthericaceae	bulb					+				
<i>Commelina africana</i>	Commelinaceae	herb					+	+	+		
<i>Bulbostylis sp.</i>	Cyperaceae	sedge							1		
<i>Cyperaceae sp. 2</i>	Cyperaceae	sedge						2			
<i>Cyperus sp. 1</i>	Cyperaceae	sedge					1	1			
<i>Kyllinga pulchella</i>	Cyperaceae	sedge						1	+	1	
<i>Schoenoplectus muriculatus</i>	Cyperaceae	sedge							1		
<i>Eucomis autumnalis</i>	Hyacinthaceae	bulb	Declining	MNCA		+					
<i>Ledebouria ovatifolia</i>	Hyacinthaceae	bulb				+					
<i>Hypoxis costata</i>	Hypoxidaceae	bulb				1	+				

<i>Hypoxis obtusa</i>	Hypoxidaceae	bulb				+	1		+		
<i>Hypoxis rigidula</i>	Hypoxidaceae	bulb				1	+				
<i>Gladiolus crassifolius</i>	Iridaceae	bulb		MNCA		+					
<i>Juncus oxycarpus</i>	Juncaceae	sedge								1	
<i>Habenaria sp.</i>	Orchidaceae	herb		MNCA					+		
<i>Bothriochloa insculpta</i>	Poaceae	grass					+				
<i>Brachiaria serrata</i>	Poaceae	grass				1					
<i>Cymbopogon excavatus</i>	Poaceae	grass				+					
<i>Cynodon dactylon</i>	Poaceae	grass					2				1
<i>Diheteropogon amplexans</i>	Poaceae	grass				1					
<i>Eleusine coracana</i>	Poaceae	grass									+
<i>Eragrostis cf. biflora</i>	Poaceae	grass					2				
<i>Eragrostis chloromelas</i>	Poaceae	grass					1				+
<i>Eragrostis curvula</i>	Poaceae	grass							2		1
<i>Eragrostis plana</i>	Poaceae	grass					1				1
<i>Eragrostis racemosa</i>	Poaceae	grass				1	+				
<i>Helictotrichon turgidulum</i>	Poaceae	grass						1	+	1	
<i>Hyparrhenia cf. anamesa</i>	Poaceae	grass						1			
<i>Hyparrhenia hirta</i>	Poaceae	grass				2			+		
<i>Hyparrhenia tamba</i>	Poaceae	grass									+
<i>Imperata cylindrica</i>	Poaceae	grass						4	2		
<i>Leersia hexandra</i>	Poaceae	grass						1	3	4	
<i>Melinis nervigulumis</i>	Poaceae	grass				+					
<i>Melinis repens</i>	Poaceae	grass					+				+
<i>Panicum natalense</i>	Poaceae	grass				1					
<i>Panicum schinzii</i>	Poaceae	grass									+
<i>Paspalum notatum</i>	Poaceae	grass							1		
<i>Paspalum urvillei</i> *	Poaceae	grass							1	1	
<i>Setaria pallide-fusca</i>	Poaceae	grass									+
<i>Setaria sphacelata</i>	Poaceae	grass				1	1				
<i>Sporobolus fimbriatus</i>	Poaceae	grass									+

<i>Themeda triandra</i>	Poaceae	grass				3	2		+		
<i>Trachypogon spicatus</i>	Poaceae	grass				2					
<i>Urelytrum agropyroides</i>	Poaceae	grass				+					
<i>Urochloa panicoides</i>	Poaceae	grass					1				+
<i>Zea mays</i> *	Poaceae	grass									4
Subtotal		47	2	4	0	19	16	8	14	5	11
TOTAL		135	2	4	6	69	40	27	28	13	21

MNCA = Mpumalanga Nature Conservation Act
* = alien plant sp.
CARA categories:
1 = prohibited plants
2 = commercial plants
3 = ornamental plants

APPENDIX 2: Summary of Quadrat Data

Species	Vegetation Communities					Species Frequency
	<i>Themeda triandra</i> Untransformed Grassland Quadrat SC05	<i>Eragrostis - Cynodon</i> Semi- transformed Grassland Quadrat SC01	<i>Imperata cylindrica</i> Untransformed Valley- bottom Wetland Quadrat SC04	<i>Helichrysum - Leersia</i> Semi- transformed Valley-bottom Wetland Quadrat SC02	<i>Leersia hexandra</i> Endorheic Pan Quadrat SC03	
<i>Acalypha angustifolia</i>	+					1
<i>Acalypha punctata</i>	2					1
<i>Anthospermum hispidulum</i>	1					1
<i>Barleria ovata</i>	1					1
<i>Berkheya insignis</i>	+					1
<i>Berkheya radula</i>			+			1
<i>Bothriochloa insculpta</i>		+				1
<i>Brachiaria serrata</i>	1					1
<i>Bulbostylis sp.</i>				1		1
<i>Chaetacanthus setiger</i>	1					1
<i>Chamaecrista mimosoides</i>		+				1
<i>Chlorophytum fasciculatum</i>		+				1
<i>Cirsium vulgare*</i>			+	+		2
<i>Commelina africana</i>		+				1

<i>Conyza albida*</i>				1	1	2
<i>Conyza podocephala*</i>			1			1
<i>Cucumis hirsutus</i>		+				1
<i>Cynodon dactylon</i>		2				1
<i>Cyperaceae sp.</i>			2			1
<i>Cyperus sp. 1</i>		1	1			2
<i>Dicoma zeyheri</i>	1					1
<i>Diheteropogon amplexans</i>	1					1
<i>Elephantorrhiza elephantina</i>		+				1
<i>Eragrostis cf. biflora</i>		2				1
<i>Eragrostis chloromelas</i>		1				1
<i>Eragrostis curvula</i>				2		1
<i>Eragrostis plana</i>		1				1
<i>Eragrostis racemosa</i>	1	+				2
<i>Eriosema sp. (no flowers)</i>	+					1
<i>Eucomis autumnalis</i>	+					1
<i>Felicia muricata</i>	+					1
<i>Helichrysum cf. difficile</i>				3		1
<i>Helichrysum coriaceum</i>	1					1
<i>Helichrysum rugulosum</i>	1			2	1	3
<i>Helictotrichon turgidulum</i>			1	+	1	3
<i>Hyparrhenia hirta</i>	2			+		2
<i>Hypoxis costata</i>	1	+				2
<i>Hypoxis obtusa</i>		1				1
<i>Hypoxis rigidula</i>	1	+				2
<i>Imperata cylindrica</i>			4	2		2
<i>Kyllinga pulchella</i>				+	1	2
<i>Leersia hexandra</i>					4	1
<i>Melinis nerviglumis</i>	+					1
<i>Nidorella auriculata</i>			+	1		2
<i>Oenothera rosea*</i>			1			1

<i>Panicum natalense</i>	1					1
<i>Paspalum notatum</i>				1		1
<i>Paspalum urvillei</i> *					1	1
<i>Pelargonium luridum</i>		+				1
<i>Pentanisia angustifolia</i>	1	+				2
<i>Persicaria attenuata</i>					2	1
<i>Polygala hottentota</i>	+					1
<i>Pseudoglyphalium undulatum</i>				1		1
<i>Pygmaeothamnus chamaedendrum</i>		+				1
<i>Schoenoplectus muriculatus</i>				1		1
<i>Sebaea grandis</i>	+	+				2
<i>Sebaea leiostyla</i>				1		1
<i>Selago densiflora</i>		+				1
<i>Senecio coronatus</i>	+					1
<i>Senecio erubescens</i>	1	+				2
<i>Senecio inornatus</i>			1			1
<i>Senecio scitus</i>	1					1
<i>Senecio sp. (no flower)</i>		+	+	1		3
<i>Setaria sphacelata</i>	1	1				2
<i>Solanum elaeagnifolium</i>		1				1
<i>Tephrosia capensis</i>	1					1
<i>Themeda triandra</i>		3				1
<i>Trachypogon spicatus</i>	2					1
<i>Turbina oblongata</i>		+				1
<i>Urelytrum agropyroides</i>	+					1
<i>Verbena bonariense</i> *			1	1	1	3
QUADRAT TOTALS	30	26	12	17	8	
Mean richness per veg comm	30	26	12	17	8	

APPENDIX 3: Photographs of Vegetation Units



A. *Themeda triandra* Untransformed Grassland



B. *Eragrostis* – *Cynodon* Semi-transformed Grassland



***C. Imperata cylindrica* Untransformed Valley-bottom Wetland**



***D. Helichrysum – Leersia* Semi-transformed Valley-bottom Wetland**



***E. Leersia hexandra* Endorheic Pan**

APPENDIX 4: Checklist of fauna recorded within the project area

Common Name	Scientific Name	Red Data	Endemic	Protected	Vegetation Communities					
					<i>Themeda triandra</i> Untransformed Grassland	<i>Eragrostis - Cynodon</i> Semi-transformed Grassland	<i>Imperata cylindrica</i> Untransformed Valley-bottom Wetland	<i>Helichrysum - Leersia</i> Semi-transformed Valley-bottom Wetland	<i>Leersia hexandra</i> Endorheic Pan	Transformed Areas
Mammals										
Yellow Mongoose	<i>Cynictis penicillata</i>									
Serval	<i>Leptailurus serval</i>	NT		NEMBA		x	x	x	x	
Scrub Hare	<i>Lepus saxatilis</i>					x		x		
Common Duiker	<i>Sylvicapra grimmia</i>				x	x	x	x	x	
Subtotal	3	1	0	1	1	3	2	3	2	0
Birds										
Lesser Swamp-Warbler	<i>Acrocephalus gracilirostris</i>								x	
Egyptian Goose	<i>Alopochen aegyptiaca</i>								x	x
African Black Duck	<i>Anas sparsa</i>								x	x
African Pipit	<i>Anthus cinnamomeus</i>				x	x				
Grey Heron	<i>Ardea cinerea</i>						x		x	x
Black-headed Heron	<i>Ardea melanocephala</i>					x		x	x	x
Marsh Owl	<i>Asio capensis</i>						x	x		
Hadeda Ibis	<i>Bostrychia hagedash</i>									x
Little Rush Warbler	<i>Bradypterus baboecala</i>						x	x	x	
Cattle Egret	<i>Bubulcus ibis</i>				x	x				x
Spotted Thick-knee	<i>Burhinus capensis</i>				x					

Steppe Buzzard	<i>Buteo vulpinus</i>					X	X	X	X		X
Three-banded Plover	<i>Charadrius tricollaris</i>									X	
Spike-heeled Lark	<i>Chersomanes albofasciata</i>					X					
Diderick Cuckoo	<i>Chrysococcyx caprius</i>								X		X
Montagu's Harrier	<i>Circus pygargus</i>					X	X	X	X	X	
Zitting Cisticola	<i>Cisticola juncidis</i>					X	X				
Levaillant's Cisticola	<i>Cisticola tinniens</i>							X	X	X	
Black-throated Canary	<i>Crithagrus atrogularis</i>					X	X				X
Black-shouldered Kite	<i>Elanus caeruleus</i>					X	X	X	X	X	X
Common Waxbill	<i>Estrilda astrild</i>							X	X	X	X
Yellow-crowned Bishop	<i>Euplectes afer</i>							X	X	X	
Fan-tailed Widowbird	<i>Euplectes axillaris</i>							X	X	X	
Southern Red Bishop	<i>Euplectes orix</i>							X	X	X	X
Long-tailed Widowbird	<i>Euplectes progne</i>					X	X				
Amur Falcon	<i>Falco amurensis</i>					X	X	X	X	X	
Red-knobbed Coot	<i>Fulica cristata</i>									X	X
Common Moorhen	<i>Gallinula chloropus</i>									X	X
Greater Striped Swallow	<i>Hirundo cucullata</i>					X	X	X	X	X	X
Barn Swallow	<i>Hirundo rustica</i>					X	X	X	X	X	X
South African Cliff-Swallow	<i>Hirundo spilodera</i>					X	X	X	X	X	X
Cape Glossy Starling	<i>Lamprotornis nitens</i>										X
Cape Longclaw	<i>Macronyx capensis</i>					X	X				
Rufous-naped Lark	<i>Mirafra africana</i>					X	X				
Helmeted Guineafowl	<i>Numida meleagris</i>					X	X				X
African Quailfinch	<i>Ortygospiza atricollis</i>					X	X				
Cape Sparrow	<i>Passer melanurus</i>					X	X				X
Spur-winged Goose	<i>Plectropterus gambensis</i>					X	X	X	X	X	X
Glossy Ibis	<i>Plegadis falcinellus</i>									X	X
Southern Masked-Weaver	<i>Ploceus velatus</i>							X	X	X	X
Black-chested Prinia	<i>Prinia flavicans</i>					X	X				
Swainson's Spurfowl	<i>Pternistis swainsonii</i>					X	X				X
Brown-throated Martin	<i>Riparia paludicola</i>							X	X	X	X
Red-chested Flufftail	<i>Sarothrura rufa</i>							X			
African Stonechat	<i>Saxicola torquatus</i>					X	X	X	X	X	

Orange-breasted Waxbill	<i>Sporaeginthus subflavus</i>						x	x	x	
Cape Turtle-Dove	<i>Streptopelia capicola</i>				x	x				x
Red-eyed Dove	<i>Streptopelia semitorquata</i>									x
Laughing Dove	<i>Streptopelia senegalensis</i>				x	x				x
Blacksmith Lapwing	<i>Vanellus armatus</i>						x	x	x	x
Pin-tailed Whydah	<i>Vidua macroura</i>				x	x	x	x		x
Subtotal	51	0	0	0	26	25	23	23	27	30
TOTAL	54	1	0	1	27	28	25	26	29	30

NT = Near Threatened

NEMBA = National Environmental Management: Biodiversity Act

APPENDIX 5: Conservation-important Fauna potentially occurring within the Project Area

Common Name	Scientific Name	Red Data	Endemic	Protected	Vegetation Communities					
					<i>Themeda triandra</i> Untransformed Grassland	<i>Eragrostis - Cynodon</i> Semi-transformed Grassland	<i>Imperata cylindrica</i> Untransformed Valley-bottom Wetland	<i>Helichrysum - Leersia</i> Semi-transformed Valley-bottom Wetland	<i>Leersia hexandra</i> Endorheic Pan	Development
Mammals										
Highveld Golden Mole	<i>Amblysomus septentrionalis</i>	NT	x		x	x				
African Clawless Otter	<i>Aonyx capensis</i>			NEMBA			x	x	x	
Southern African Hedgehog	<i>Atelerix frontalis</i>	NT		NEMBA	x	x				
Reddish-grey Musk Shrew	<i>Crocidura cyanea</i>	DD			x	x	x	x	x	
Swamp Musk Shrew	<i>Crocidura mariquensis</i>	DD					x	x	x	
Peters' Musk Shrew	<i>Crocidura silacea</i>	DD			x	x	x	x	x	
Serval	<i>Leptailurus serval</i>	NT		NEMBA	x	x	x	x	x	
Forest Shrew	<i>Myosorex varius</i>	DD	x				x	x	x	
White-tailed Mouse	<i>Mystromys albicaudatus</i>	EN	x		x	x				
Aardvark	<i>Orycteropus afer</i>			MNCA	x	x	x	x	x	
Brown Hyaena	<i>Parahyaena brunnea</i>	NT		NEMBA	x	x	x	x	x	
African Weasel	<i>Poecilogale albinucha</i>	DD			x	x	x	x	x	
Aardwolf	<i>Proteles cristatus</i>			MNCA	x	x	x	x	x	
Steenbok	<i>Raphicerus campestris</i>			MNCA	x	x	x	x	x	
Least Dwarf Shrew	<i>Suncus infinitesimus</i>	DD			x	x	x	x	x	
Lesser Dwarf Shrew	<i>Suncus varilla</i>	DD			x	x	x	x	x	
Subtotal	16	12	3	7	13	13	13	13	13	0
Birds										
Blue Crane	<i>Anthropoides paradiseus</i>	VU		NEMBA	x	x	x	x	x	

Pallid Harrier	<i>Circus macrourus</i>	NT			x	x	x	x	x	
African Marsh Harrier	<i>Circus ranivorus</i>	VU					x	x	x	
Greater Flamingo	<i>Phoenicopterus ruber</i>	NT							x	
Lesser Flamingo	<i>Phoenicopterus minor</i>	NT							x	
Blue Korhaan	<i>Eupodotis caerulescens</i>	NT	x	NEMBA	x	x				
White-bellied Korhaan	<i>Eupodotis senegalensis</i>	VU	x	NEMBA	x	x				
Lanner Falcon	<i>Falco biarmicus</i>	NT			x	x	x	x	x	x
Lesser Kestrel	<i>Falco naumanni</i>	VU		NEMBA	x	x				
Black-winged Pratincole	<i>Glareola nordmanni</i>	NT			x	x	x	x	x	x
Yellow-billed Stork	<i>Mycteria ibis</i>	NT							x	
Caspian Tern	<i>Sterna caspia</i>	NT							x	
Secretarybird	<i>Sagittarius serpentarius</i>	NT			x	x	x	x	x	
Pied Starling	<i>Spreo bicolor</i>		x		x	x	x	x	x	x
Karoo Thrush	<i>Turdus smithii</i>		x							x
African Grass-Owl	<i>Tyto capensis</i>	VU		NEMBA	x	x	x	x	x	
Cape White-eye	<i>Zosterops virens</i>		x							x
Subtotal	17	14	5	5	10	10	8	8	12	5
Reptiles										
Transvaal Grass Lizard	<i>Chamaesaura aenea</i>		x		x	x				
Transvaal Girdled Lizard	<i>Cordylus vittifer</i>				x	x				
Spotted Harlequin Snake	<i>Homoroselaps lacteus</i>		x		x	x				
Aurora House Snake	<i>Lamprophis aurora</i>		x		x	x	x	x	x	
Cape Thread Snake	<i>Leptotyphlops conjunctus</i>		x		x	x	x	x	x	
Distant's Thread Snake	<i>Leptotyphlops distanti</i>		x		x	x	x	x	x	
Dusky-bellied Water Snake	<i>Lycodonomorphus laevisissimus</i>		x				x	x	x	
Delalande's Sandveld Lizard	<i>Nucras lalandii</i>		x		x					
Subtotal	8	0	7	0	7	6	4	4	4	0
Frogs										
Rattling Frog	<i>Semnodactylus wealii</i>		x				x	x	x	
Giant Bullfrog	<i>Pyxicephalus edulis</i>	NT		NEMBA					x	
Cape River Frog	<i>Afrana fuscigula</i>		x				x	x	x	
Subtotal	3	1	2	1	0	0	2	2	3	0
TOTAL	44	27	17	13	30	29	27	27	32	5

E = Endangered

VU = Vulnerable

DD = Data Deficient

NT = Near Threatened

MNCA = Mpumalanga Nature Conservation Act

NEMBA = National Environmental Management: Biodiversity Act