

## ECOLOGICAL FAUNA AND FLORA HABITAT SURVEY

**Portion 3 of the Farm Middel Pan 605, situated in the division of Vryburg, IN Registration Division, Province of the North-West, measuring 664,8825 (six hundred and sixty four comma eight eight two five) hectares, Title Deed No.: 76/1992**



Steenbok, *Raphiceros campestris* at the site.  
Photo: November 2015, R.F. Terblanche.

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ANTHENE ECOLOGICAL CC

# TABLE OF CONTENTS

<b>1. INTRODUCTION</b>	<b>1</b>
.....	
<b>2. STUDY AREA</b>	<b>2</b>
.....	
<b>3. METHODS</b>	<b>4</b>
.....	
<b>4. RESULTS</b>	<b>9</b>
.....	
<b>5. DISCUSSION</b>	<b>24</b>
.....	
<b>6. IMPACT ASSESSMENT AND MITIGATION MEASURES</b>	<b>33</b>
.....	
<b>7. CONCLUSION</b>	<b>41</b>
.....	
<b>8. REFERENCES</b>	<b>44</b>
.....	
<b>9. ANNEXURE 1 LIST OF PLANT SPECIES</b> .....	<b>56</b>



# 1 INTRODUCTION

An ecological habitat survey was required for a proposed solar power plant development at Portion 3 of the Farm Middel Pan 605, situated in the division of Vryburg, IN Registration Division, Province of the North-West, measuring 664,8825 (six hundred and sixty four comma eight eight two five) hectares, Title Deed No.: 76/1992, 30 km west of Vryburg in the North West Province (elsewhere referred to as the site). The survey focused on the possibility that threatened fauna or flora known to occur in North West Province are likely to occur within the proposed footprint. Species of known high conservation priority that do not qualify for threatened status also received attention in the survey.

## 1.1 OBJECTIVES OF THE HABITAT STUDY

The objectives of the habitat study are to provide:

- A detailed fauna and flora habitat survey;
- A detailed habitat survey of possible threatened or localised plant species, vertebrates and invertebrates;
- Recording of possible host plants or foodplants of fauna such as butterflies.
- Evaluate the conservation importance and significance of the site with special emphasis on the current status of threatened species;
- Literature investigation of possible species that may occur on site;
- Identification of potential ecological impacts on fauna and flora that could occur as a result of the development; and
- Make recommendations to reduce or minimise impacts, should the development be approved.

## 1.2 SCOPE OF STUDY

- Surveys to investigate key elements of habitats on the site, relevant to the conservation of fauna and flora.
- Recording of any sightings and/or evidence of existing fauna and flora.
- The selective and careful collecting of voucher specimens of invertebrates where deemed necessary.
- An evaluation of the conservation importance and significance of the site with special emphasis on the current status of threatened species.
- Recording of possible host plants or foodplants of fauna such as butterflies.
- Literature investigation of possible species that might occur on site.
- Integration of the literature investigation and field observations to identify potential ecological impacts that could occur as a result of the development.
- Integration of literature investigation and field observations to make recommendations to reduce or minimise impacts, should the development be approved.

## 2 STUDY AREA

The study area is 30 km west of Vryburg in the North West Province. The site is situated at the Savanna Biome which is represented by the Mafikeng Bushveld vegetation type (Mucina & Rutherford 2006). A brief overview of SVk 1, the Mafikeng Bushveld vegetation type in which the site is located, follows:

### SVk 1 Mafikeng Bushveld

Distribution: In South Africa the Mafikeng Bushveld is found in the North West Province to the west of Mafikeng and south of the Botswana border westwards to around Vergeleë, south-wards to Piet Plessis and Setlagole at an altitude that ranges from 1100 – 1400 m (Mucina & Rutherford, 2006).

Vegetation and landscape features comprise well developed tree and shrub layers, dense stands of *Terminalia sericea*, *Acacia luederitzii* and *Acacia erioloba* in certain areas. Shrubs include *Acacia karroo*, *Acacia hebeclada* and *Acacia mellifera*, *Dichrostachys cinerea*, *Grewia flava*, *Grewia retinervis*, *Searsia tenuinervis* and *Ziziphus mucronata*. Grass layer is also well-developed.

Geology & Soils: Aeolian Kalahari sand of the Tertiary to Recent age on flat sandy plains, soils deep (>1.2 m). Clovelly and Hutton soil forms. Land types Ah, Ai and Ae.

Climate is summer rainfall with very dry winters. Mean annual precipitation (MAP) from about 350 mm in the west to about 520 mm in the east. Frost frequent in winter (Mucina & Rutherford, 2006).

Important taxa noted for the Mafikeng Bushveld are: Tall Tree: *Acacia erioloba*. Small Trees: *Acacia karroo*, *Acacia mellifera* subsp. *detinens*, *Terminalia sericea*, *Ziziphus mucronata*. Tall Shrubs: *Dichrostachys cinerea*, *Grewia flava*, *Searsia tenuinervis*, *Diospyros austro-africana*, *Ehretia rigida* subsp. *rigida*, *Rhigozum obovatum*, *Tarchonanthus camphoratus*. Low Shrubs: *Acacia hebeclada* subsp. *hebeclada*, *Grewia retinervis*, *Aptosimum procumbens*, *Felicia muricata*, *Gnidia polycephala*, *Helichrysum zeyheri*, *Hoffmannseggia burchellii*, *Lantana rugosa*, *Talinum arnotii*. Geoxylic Suffrutex: *Elephantorrhiza elephantina*. Succulent Shrub: *Lycium cinereum*. Woody Climber: *Asparagus africanus*. Graminoids: *Anthephora pubescens*, *Cymbopogon pospischilii*,

*Digitaria eriantha* subsp. *eriantha*, *Eragrostis lehmanniana*, *Eragrostis pallens*, *Schmidtia pappophoroides*, *Stipagrostis uniplumis*, *Aristida congesta*, *Aristida meridionalis*, *Aristida mollissima* subsp. *argentea*, *Aristida stipitata* subsp. *stipitata*, *Brachiaria nigropedata*, *Brachiaria serrata*, *Cynodon dactylon*, *Digitaria argyrograpta*, *Eragrostis superba*, *Eragrostis trichophora*, *Melinis repens*, *Tragus racemosus*, *Urochloa panicoides*. Herbs: *Barleria macrostegia*, *Erlangea misera*, *Harpagophytum procumbens* subsp. *procumbens*, *Hermannia tomentosa*, *Hermibstaedtia odorata*, *Indigofera daleioides*, *Limeum fenestratum*, *Nidorella resedifolia*, *Oxygonum dregeanum* subsp. *canescens* var. *canescens*, *Senna italica* subsp. *arachoides*. Geophytic Herb: *Ledebouria marginata*.

**Note:** Though many of the above plant species occurs at the site, not all of them necessarily occur at the site.

Mafikeng Vaalbosveld is listed as threatened, Vulnerable, according to the National List of Threatened Ecosystems (2011).

### **3 METHODS**

A desktop study comprised not only an initial phase, but also it was used throughout the study to accommodate and integrate all the data that become available during the field observations.

Surveys of a number of study areas in the vicinity of Vryburg, including the site, were conducted from 10 – 16 November 2015, December 2015 and 23 – 31 January 2016 to note key elements of habitats on the site, relevant to the conservation of fauna and flora. Notes and experience from earlier surveys at the larger study area of the Taung-Vryburg area by R.F. Terblanche that had taken place in July 2011, November 2011, January 2012, February 2012, August 2013, December 2013, January 2014 and November 2014 were also taken into account where applicable. The main purpose of the site visits was ultimately to serve as habitat surveys that concentrated on the possible presence or not of threatened species and other species of high conservation priority.

The following sections highlight the materials and methods applicable to different aspects that were observed.

#### **3.1 HABITAT CHARACTERISTICS AND VEGETATION**

The habitat was investigated by noting habitat structure (rockiness, slope, plant structure/physiognomy) as well as floristic composition. Voucher specimens of plant species were only taken where the taxonomy was in doubt and where the plant specimens were of significant relevance for invertebrate conservation. In this case no plant specimens were needed to be collected as voucher specimens or to be send to a herbarium for identification. A wealth of guides and detailed works of plant identifications, ecology and conservation is fortunately available and very useful. Field guides, biogeographic works, species lists, diagnostic outlines, conservation statuses and detail on specific plant groups were sourced from Court (2010), Germishuizen (2003), Germishuizen, Meyer & Steenkamp (2006), Goldblatt (1986), Goldblatt & Manning (1998), Jacobsen (1983), Manning (2003), Manning (2009), McMurtry, Grobler, Grobler & Burns (2008), Pooley (1998), Retief & Herman (1997), Smit (2008), Van Ginkel, Glen, Gordon-Gray, Cilliers, Muasya & Van Deventer (2011), Van Jaarsveld (2006), Van Oudtshoorn (1999), Van Wyk (2000), Van Wyk & Smith (2001), Van Wyk & Smith (2003), Van Wyk & Malan (1998) and Van Wyk & Van Wyk (2013). Lists of species, species names and the conservation status of species were mainly sourced from Raimondo, von Staden, Victor, Helme, Turner, Kamundi & Manyama (2009) and updated versions

of red lists and species from the Threatened Species Programme of SANBI and the Red List of South African Plants (sanbi.org.za).

Indications of abundance and distribution of *Vachellia erioloba* (= *Acacia erioloba*), the Camel Thorn. For areas with where Camel Thorn trees are sparse direct count and positioning of all the individual trees are conducted at the proposed footprint by carefully walking in zigzag fashion through the site. For areas where direct counting become impractical within time and cost limits, counts of individual trees within 50 m x 50 m plots are conducted at zones where higher number of individuals is conspicuous. *Vachellia erioloba* trees sometimes occur in clumps with a number of tree trunks in close proximation which makes the number of individuals difficult to count if the separation of individuals is concerned. As far as possible it was ascertained whether two trunks in close proximation represent different individuals (often the case) or the same individual (when two or more trunks are likely to be part of same tree). Height classes of the trees are taken during the counts.

### **3.2 MAMMALS**

Mammals were noted as sight records by day. For the identification of species and observation of diagnostic characteristics Smithers (1986), Skinner & Chimimba (2005), Cillié, Oberprieler and Joubert (2004) and Apps (2000) are consulted. Sites have been walked, covering as many habitats as possible. Signs of the presence of mammal species, such as calls of animals, animal tracks (spoor), burrows, runways, nests and faeces were recorded. Walker (1996), Stuart & Stuart (2000) and Liebenberg (1990) were consulted for additional information and for the identification of tracks and signs. Because of the type of threatened mammals that are assessed in the local area such as the blackfooted cat and golden moles or rough-haired golden moles which are not to be trapped in normal way, the poor trapping records of species in question such as the White-tailed Mouse as well as the similarity of terrestrial habitats and lack of unique habitats at the sites, trapping was not done since it was not deemed necessary in the case of this study. The focus has been on signs and surveying habitat characteristics to note potential occurrences of mammals of particular conservation concern. Many mammals can be identified from field sightings but, with a few exceptions bats, rodents and shrews can only be reliably identified in the hand, and even then some species needs examination of skulls, or even chromosomes (Apps, 2000).



### **3.3 BIRDS**

A specific avifaunal study has been conducted for the assessment of birds at the site (see avifaunal study).

### **3.4 REPTILES**

Reptiles were noted as sight records in the field. Binoculars (10x30) can also be used for identifying reptiles of which some are wary. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques, Branch (1998), Marais (2004), Alexander & Marais (2007) and Cillié, Oberprieler and Joubert (2004) were followed. The Atlas and Red List of Reptiles of South Africa, Lesotho and South Africa (Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers, 2014) has been used as the main source to compile the list for assessment. Sites were walked, covering as many habitats as possible. Smaller reptiles are sometimes collected for identification, but this practice was not necessary in the case of this study. Habitat characteristics are surveyed to note potential occurrences of reptiles.

### **3.5 AMPHIBIANS**

Frogs and toads are noted as sight records in the field or by their calls. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques Carruthers (2001), Du Preez (1996), Conradie, Du Preez, Smith & Weldon (2006) and the recent complete guide by Du Preez & Carruthers (2009) are consulted. CD's with frog calls by Carruthers (2001) and Du Preez & Carruthers (2009) are used to identify species by their calls when applicable. Sites are walked, covering as many habitats as possible. Smaller frogs are often collected by pitfall traps put out for epigeal invertebrates (on the soil), but this practice falls beyond the scope of this survey. Habitat characteristics are also surveyed to note potential occurrences of amphibians.

### **3.6 BUTTERFLIES**

Butterflies were noted as sight records or voucher specimens. Voucher specimens are mostly taken of those species of which the taxa warrant collecting due to taxonomic difficulties or in the cases where species can look similar in the veldt. Many butterflies use only one species or a limited number of plant species as host plants for their larvae. Myrmecophilous (ant-loving) butterflies such

as the *Aloeides*, *Chrysochrysis*, *Erikssonina*, *Lepidochrysis* and *Orachrysis* species (Lepidoptera: Lycaenidae), which live in association with a specific ant species, require a unique ecosystem for their survival (Deutschländer & Breckenkamp, 1999; Terblanche, Morgenthal & Cilliers, 2003; Edge, Cilliers & Terblanche, 2008; Gardiner & Terblanche, 2010). Known food plants of butterflies were therefore also recorded. After the visits to the site and the identification of the butterflies found there, a list was also compiled of butterflies that will most probably be found in the area in all the other seasons because of suitable habitat. The emphasis of this study remains a habitat survey that focuses on the likelihood of occurrence of threatened, near threatened or rare butterfly species.

### **3.7 FRUIT CHAFER BEETLES**

Different habitat types in the areas were explored for any sensitive or special fruit chafer species. Selection of methods to find fruit chafers depends on the different types of habitat present and the species that may be present. Fruit bait traps would probably not be successful for capturing *Ichneustoma* species in a grassland patch (Holm & Marais 1992). Possible chafer beetles of high conservation priority were noted as sight records accompanied by the collecting of voucher specimens with grass nets or containers where deemed necessary.

### **3.8 ROCK SCORPIONS**

Relatively homogenous habitat / vegetation areas were identified and explored to identify any sensitive or special species. Selected stones that were lifted to search for Arachnids were put back very carefully resulting in the least disturbance possible. All the above actions were accompanied by the least disturbance possible.

### **3.9 LIMITATIONS**

For each site visited, it should be emphasized that surveys can by no means result in an exhaustive list of the plants and animals present on the site, because of the time constraint. Counts of trees are limited by time constraints but its aim to give good indications of certain tree numbers meets the aims of the impact assessment. There are many invertebrate groups with huge taxonomic and biogeographic impediments which further add to limitations of present surveys.

The on site survey was conducted during November 2015 and January 2016 which fall within an optimal time of the season to find sensitive plant and animal species of high conservation priority. Weather conditions during the surveys were favourable for recording fauna and flora. Notes and experience from earlier surveys at the Taung-Vryburg area by R.F. Terblanche that had taken place on July 2011, November 2011, January 2012, February 2012, August 2013, December 2013, January 2014 and November 2014 were also taken into account where applicable, these cover a vast range of conditions including optimal conditions for surveys. The focus of the present survey remains a habitat survey that concentrates on the possibility that species of particular conservation priority occur on the site or not. It is unlikely that any more visits would reveal information that would change the outcome of this assessment both in terms of ecosystems of special conservation concern or suitable habitats of species of particular conservation concern. Visits that were conducted therefore appear to be sufficient to address the objectives of this study.

## **4 RESULTS**

### **4.1 HABITAT AND VEGETATION CHARACTERISTICS**

**Table 4.1** Outline of main landscape and habitat characteristics of the site.

HABITAT FEATURE	DESCRIPTION
Topography	The site proposed for the developments is on gentle to very gentle slopes (flat plateau, plain).
Rockiness	No rocky ridges are present at the site.
Presence of wetlands	Wetlands appear to be absent at the proposed footprint.
Vegetation	Vegetation is a well-developed grass layer with shrubs and small trees that dot the landscape. Grass species such as <i>Eragrostis pallens</i> , <i>Eragrostis lehmanniana</i> , <i>Schmidtia pappophoroides</i> , <i>Stipagrostis uniplumis</i> , <i>Aristida congesta</i> , <i>Aristida meridionalis</i> are conspicuous at the site. Indigenous shrubs and trees include <i>Vachellia erioloba</i> (Camel Thorn tree), <i>Vachellia tortilis</i> subsp. <i>heteracantha</i> (Umbrella Thorn), <i>Searsia lancea</i> (Karee), <i>Diospyros lycioides</i> subsp. <i>lycioides</i> (Karoo Bluebush), <i>Diospyros austro-africana</i> , <i>Ehretia alba</i> (White Puzzlebush), <i>Ziziphus mucronata</i> (Buffalothorn), <i>Vachellia hebeclada</i> subsp. <i>hebeclada</i> (Candlepod Thorn), <i>Senegalia mellifera</i> subsp. <i>detinens</i> (Black Thorn), <i>Searsia tridactyla</i> , <i>Tarchonanthus camphoratus</i> (Camphor Bush), <i>Grewia flava</i> (Wild Raisin) and <i>Terminalia sericea</i> (Silver Clusterleaf). Shrublet <i>Gnidia</i> cf. <i>burchellii</i> is present at the site. Indigenous herbaceous plant species at the site include <i>Indigofera daleioides</i> , <i>Senna italica</i> subsp. <i>arachoides</i> , <i>Melania prostrata</i> and <i>Barleria macrostegia</i> . Sand-loving prostrate or decumbent herbaceous species such as <i>Hermannia tomentosa</i> and <i>Tephrosia lupinifolia</i> are visible in many open sandy areas between and at tufts of grass.
Signs of disturbances	Overall fairly natural vegetation with visible relative high cover of indigenous species is present.
Connectivity of natural vegetation in the site and between the site and surrounding areas	The footprint proposed for the proposed development is not part of a corridor of particular conservation importance.



**Photo 1** View of site with open sandy areas covered with flat growing (prostrate) herbs in the foreground, *Gnidia* cf. *burchellii* shrublets in the middle ground and grasslayer with dotted distribution of thorn trees in the background. Photo: November 2015, R.F. Terblanche.



**Photo 2** *Acacia erioloba* (Camel Thorn tree), at the proposed footprint, stripped of foliage, in part at least, by caterpillars of *Gonometa postica* (Wild African Silk Moth).  
Photo: November 2015, R. F. Terblanche.





**Photo 3** Water point for cattle at the site, with round concrete farm dam just visible behind the cattle. Such drinking points are part of many farms in the Vryburg area.  
Photo: November 2015, R.F. Terblanche.



**Photo 4** *Diospyros lycioides* subsp. *lycioides* at the proposed footprint.  
Photo: November 2015, R.F. Terblanche.





**Photo 5** *Senna italica* subsp. *arachoides* (Wild Senna) at open sandy area at the proposed footprint area.  
Photo: November 2015, R.F. Terblanche.



**Photo 6** Steenbok, *Raphicerus campestris* at the site.  
Photo: November 2015, R.F. Terblanche.

## 4.2 ASSESSMENT OF PLANT SPECIES OF PARTICULAR CONSERVATION PRIORITY

### 4.2.1 Plant species of particular conservation concern according to the red list of plants

**Table 4.2** Threatened plant species of the North West Province which are listed in the **Critically Endangered** category. The list here follows the most recent updated red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Status: Global status or national status indicated	Resident at the site
<i>Brachystelma canum</i>	Critically Endangered	No
<i>Brachystelma gracillimum</i>	Critically Endangered	No

**Table 4.3** Threatened plant species of the North West Province which are listed in the **Endangered** category. The list here follows the most recent updated red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Status: Global status or national status indicated	Resident at the site
<i>Aloe peglerae</i>	Endangered	No
<i>Brachystelma discoideum</i>	Endangered	No

**Table 4.4** Threatened plant species of the North West Province which are listed in the **Vulnerable** category. The list here follows the most recent updated red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.



<b>Species</b>	<b>Status:</b> Global status or national status indicated	<b>Resident at the site</b>
<i>Brachycorythis conica</i> subsp. <i>transvaalensis</i>	Vulnerable	No
<i>Brachystelma incanum</i>	Vulnerable	No
<i>Ceropegia decidua</i> subsp. <i>pretoriensis</i>	Vulnerable	No
<i>Ceropegia stentiae</i>	Vulnerable	No
<i>Ledebouria atrobrunnea</i>	Vulnerable	No
<i>Marsilea farinosa</i>	Vulnerable	No
<i>Melolobium subspicatum</i>	Vulnerable	No
<i>Prunus africana</i>	Vulnerable	No
<i>Rennera stellata</i>	Vulnerable	No
<i>Searsia maricoan</i>	Vulnerable	No

**Table 4.5** Near Threatened plant species of the North West Province. The list here follows the most recent updated red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

<b>Species</b>	<b>Status:</b> Global status or national status indicated	<b>Resident at the site</b>
<i>Adromischus umbraticola</i> subsp. <i>umbraticola</i>	Near Threatened	No
<i>Ceropegia turricula</i>	Near Threatened	No
<i>Cineraria austrotransvaalensis</i>	Near Threatened	No
<i>Cleome conrathii</i>	Near Threatened	No
<i>Delosperma leendertziae</i>	Near Threatened	No
<i>Drimia sanguinea</i>	Near Threatened	No
<i>Elaeodendron transvaalense</i>	Near Threatened	No
<i>Kniphofia typhoides</i>	Near Threatened	No
<i>Lithops leslei</i> subsp. <i>leslei</i>	Near Threatened	No
<i>Nerine gracilis</i>	Near Threatened	No
<i>Sporobolus oxyphyllus</i>	Near Threatened	No
<i>Stenostelma umbelluliferum</i>	Near Threatened	No

**Table 4.6** Plant species of the North West Province which are not threatened and not near threatened but which are of particular conservation concern and listed in the **Critically Rare** category (Raimondo *et al.* 2009).

The list here follows the most recent red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Conservation status	Resident at the site
<i>Gladiolus filiformis</i>	Critically Rare	No

**Table 4.7** Plant species of the North West Province which are not threatened and not near threatened but of which are of particular conservation concern and listed in the **Rare** category (Raimondo *et al.* 2009). The list here follows the most recent red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Status: Global status or national status indicated	Resident at the site
<i>Brachystelma dimorphum</i> subsp. <i>gratum</i>	Rare	No
<i>Ceropegia insignis</i>	Rare	No
<i>Frithia pulchra</i>	Rare	No
<i>Gnaphalium nelsonii</i>	Rare	No
<i>Habenaria culveri</i>	Rare	No

**Table 4.8** Plant species of the North West Province which are not threatened and not near threatened but which are of particular conservation concern and listed in the **Declining** category (Raimondo *et al.* 2009). The list here follows the most recent red list of South African plant species (Raimondo *et al.* 2009). No = Plant species is unlikely to be a resident at the site; Yes = Plant species is a resident at the site.

Species	Status: Global status or national status indicated	Resident at the site
<i>Boophone disticha</i>	Declining	No
<i>Crinum bulbispermum</i>	Declining	No
<i>Crinum macowanii</i>	Declining	No
<i>Drimia altissima</i>	Declining	No
<i>Eucomis autumnalis</i>	Declining	No
<i>Gunnera perpensa</i>	Declining	No
<i>Hypoxis hemerocallidea</i>	Declining	No
<i>Ilex mitis</i>	Declining	No
<i>Pelargonium sidoides</i>	Declining	No
<i>Vachellia erioloba</i> (= <i>Acacia erioloba</i> )	<b>Declining</b>	<b>Yes</b>

#### 4.2.2 Plant species of particular conservation concern: protected species

**Table 4.9** Tree species of the North West Province which are listed as **Protected Species** under the National Forests Act No. 84 of 1998, Section 51(1). No = Plant species is not a resident on the site; Yes = Plant species is a resident at the site.

Species	Conservation status	Resident at the site
<i>Boscia albitrunca</i> (Shepherd's Tree)	Protected	No
<i>Sclerocarya birrea</i> (Marula)	Protected	No
<i>Vachellia erioloba</i> (= <i>Acacia erioloba</i> ) (Camel Thorn Tree)	<b>Protected</b>	<b>Yes</b>

### 4.3 ASSESSMENT OF VERTEBRATE SPECIES OF PARTICULAR HIGH CONSERVATION PRIORITY

#### 4.3.1 Mammals of particular high conservation priority

**Table 4.10** Threatened mammal species of the North West Province. Literature sources: Friedman & Daly, (2004), Skinner & Chimimba (2005), Wilson & Reeder (2005). With mammal species which normally needs a large range their residential status does not implicate that they are exclusively dependent on the site or use the site as important shelter or for reproduction. No = Not recorded at site/ Unlikely to be resident at the site. Yes: Recorded at the site/ Likely to be resident at the site.

Species	Threatened Status	Site is part of range	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Chrysoxalax villosus</i> Rough-haired golden mole	Vulnerable	No	No	No
<i>Cloeotis percivali</i> Short-eared Trident Bat	Vulnerable/ Near-threatened	No	No	No
<i>Diceros bicornis</i> Black rhinoceros	Critically Endangered	No	No	No
<i>Lycaon pictus</i> African wild dog	Endangered	No	No	No
<i>Loxodonta africana</i> African elephant	Vulnerable	No	No	No

<b><i>Mystromys albicaudatus</i></b> White-tailed mouse	Endangered	Yes	No	No
<b><i>Neamblysomus julianae</i></b> Juliana's Golden Mole	Critically Endangered	No	No	No
<b><i>Panthera leo</i></b> Lion	Vulnerable	No	No	No
<b><i>Rhinolophus blasii</i></b> Blasi's Horseshoe Bat	Vulnerable	No	No	No

**Table 4.11 Near threatened** mammal species known to occur in the North West Province. Literature sources: Skinner & Chimimba (2005). No = Not recorded at site/ unlikely to be resident at the site. Yes: Recorded at the site/ Likely to be resident at the site.

Species	Threatened Status	Site is part of range	Recorded at site during survey	Likely to be found based on habitat assessment
<b><i>Ceratotherium simum</i></b> White Rhinoceros	Near threatened	No	No	No
<b><i>Manis temminckii</i></b> Ground Pangolin	Near threatened	No	No	No

**Table 4.12 Data deficient (or uncertain)** mammal species of the North West Province. Literature sources: Skinner & Chimimba (2005). No = Not recorded at site/ unlikely to be resident at the site. Yes: Recorded at the site/ Likely to be resident at the site.

Species	Threatened Status	Recorded at site during survey	Likely be a resident at the site
<b><i>Myosorex varius</i></b> Forest shrew	Uncertain	No	No

### 4.3.2 Birds of particular high conservation priority

See separate avifaunal report.

### 4.3.3 Reptiles of particular high conservation priority

The following tables list possible presence or absence of threatened reptile or near threatened reptile species in the study area. The Atlas and Red List of Reptiles of South Africa, Lesotho and South Africa (Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers, 2014) has been used as the main source to compile the list for assessment.

**Table 4.13** Threatened reptile species in North West Province. Main Source: (Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers, 2014). No = Reptile species is not a resident on the site; Yes = Reptile species is found to be resident on the site.

Species	Threatened Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Crocodylus niloticus</i> Nile Crocodile	Vulnerable	No	No	No

**Table 4.14** Near threatened reptile species in North West Province. Main Source: Bates, Branch, Bauer, Burger, Marais, Alexander & de Villiers (2014). Though *Homoroselaps dorsalis* has not yet been recorded from the North West Province, its presence in some areas of the Province is anticipated. No = Reptile species is not a resident on the site; Yes = Reptile species is found to be resident on the site.

Species	Threatened Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Homoroselaps dorsalis</i> Striped Harlequin Snake	Near threatened	No	No	No

#### 4.3.4 Amphibian species of particular high conservation priority

**Table 4.15** Near threatened amphibian species in North West Province. No = Amphibian species is not a resident on the site; Yes = Amphibian species is found to be resident on the site.

Species	Threatened Status	Resident at site	Recorded at site during survey	Likely to be found based on habitat assessment
<i>Pyxicephalus adspersus</i> Giant Bullfrog	Near threatened (Currently Least Concern)	No	No	No

#### 4.4 ASSESSMENT OF INVERTEBRATE SPECIES OF PARTICULAR HIGH CONSERVATION PRIORITY

##### 4.4.1 Butterflies of particular conservation priority

**Table 4.16** Threatened butterfly species in North West Province, northeastern parts of the Northern Cape Province and Gauteng Province. Sources: Henning, Terblanche & Ball (2009), Mecenero *et al.* (2013). Invertebrates such as threatened butterfly species are often very habitat specific and residential status imply a unique ecosystem that is at stake.

Species	Threatened Status	Recorded at site during survey	Residential status at the site: Yes confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely
<i>Aloeides dentatis dentatis</i> Roodepoort Copper	Endangered	No	Highly unlikely
<i>Anthene lindae</i> Kalahari Hairtail	Vulnerable	No	Unlikely
<i>Chrysochrysis aureus</i> Golden Copper	Endangered	No	Highly unlikely
<i>Lepidochrysis praeterita</i> Highveld Blue	Endangered	No	Highly unlikely
<i>Orachrysis mijburghii</i> Mijburgh's Blue	Endangered	No	Highly unlikely

**Table 4.17** Butterfly species of the North West Province and Gauteng Province that are not threatened and not near threatened but of which are of particular conservation concern and listed in the **Rare** category (Mecenero *et al.*, 2013). No = Butterfly species is unlikely to be a resident at the study area; Yes = Butterfly species is a resident at the study area.

<b>Species</b>	<b>Threatened Status</b>	<b>Recorded at site during survey</b>	<b>Residential status at the site: Yes confirmed, Highly likely, Likely, Medium possibility, Unlikely, Highly unlikely</b>
<i>Colotis celimene amina</i> Lilac Tip	Rare (Low density)	No	Highly unlikely
<i>Lepidochrysops procera</i> Savanna Blue	Rare (Habitat specialist)	No	Highly unlikely
<i>Metisella meninx</i> Marsh Sylph	Rare (Habitat specialist)	No	Highly unlikely
<i>Platylesches dolomitica</i> Hilltop Hopper	Rare (low density)	No	Highly unlikely

#### 4.4.2 Beetles of particular conservation priority

**Table 4.18** Fruit chafer species (Coleoptera: Scarabaeidae: Cetoninae) in the Gauteng Province and North-West Province which are of known high conservation priority.

<b>Species</b>	<b>Threatened Status</b>	<b>Recorded at site during survey</b>	<b>Likely to be resident based on habitat assessment</b>
<i>Ichnestoma stobbiai</i>	Uncertain	No	No
<i>Trichocephala brincki</i>	Uncertain	No	No

### 4.4.3 Scorpion species of particular conservation priority

**Table 4.19** Rock scorpion species (Scorpiones: Ischnuridae) species that are of known high conservation priority in the Gauteng Province and North-West Province.

Species	Threatened Status	Recorded at site during survey	Likely to be resident at site based on habitat assessment
<i>Hadogenes gracilis</i>	Uncertain	No	No
<i>Hadogenes gunningi</i>	Uncertain	No	No

### 4.5 ASSESSMENT OF CAMEL THORN TREES AT THE PROPOSED FOOTPRINT

During the initial surveys it was found that *Vachellia erioloba* (= *Acacia erioloba*), Camel Thorn trees, are present at the site. Additional surveys were conducted to indicate the distribution and abundance of Camel Thorn trees at the site. A high number of *Vachellia erioloba* is present at the central-northern parts of the proposed footprint.

**Table 4.20** Indication of attributes of population of Camel Thorn tree, *Vachellia erioloba* (= *Acacia erioloba*) at the proposed footprint.

Part of proposed footprint	Approximate estimation of number of <i>Vachellia erioloba</i> taller than 2 m, per hectare at the conspicuous high density zones at proposed footprint.	Likelihood of presence of individuals taller than 10 m	Notes on individuals less than 2	Presence or absence of particular old and remarkable Camel Thorn trees at proposed footprint	Presence or absence of Camel Thorn Forest of note
Central-northern parts of the site	Up to 60/ ha. Numbers at three sample plots of 50 m x 50 m each: 19, 12, 15.	Highly unlikely	Many have been found, up to 11 per 50 m x 50 m sample plot. High recruitment in some areas. .	No particularly old or remarkable trees found at proposed footprint.	Absent.



#### 4.6 ASSESSMENT OF ALIEN INVASIVE SPECIES WITH PARTICULAR REFERENCE TO *PROSOPIS GLANDULOSA* (HONEY MESQUITE)

Exotic weeds at the site include *Agremone ochroleuca* (White-flowered Mexican Poppy), *Chenopodium album* (Goosefoot), *Opuntia ficus-indica* (Prickly Pear) and *Schkuhria pinnata* (Dwarf Marigold). Though these exotic weeds easily spring up where disturbances such as overgrazing, scraping of an area and diggings are found, at the present study area no severe infestations such as could often be observed in larger urban areas and surrounds in the North West and Gauteng Provinces, are found.

During the initial surveys it was found that *Prosopis glandulosa* (Honey Mesquite tree) thickets occur in some parts of the Naledi Local Municipality and particular consideration has been given to this highly invasive tree species at and near the proposed footprint. *Prosopis glandulosa* appears to be absent at the site (or if present very few).

**Table 4.21** Summary of assessment of the highly alien invasive *Prosopis glandulosa* (Honey Mesquite tree) at the proposed footprint.

Part of the proposed footprint	Approximate estimation of number of <i>Prosopis glandulosa</i> taller than 2 m	Notes on <i>Prosopis glandulosa</i> individuals of height less than 2 m	Presence or absence of severe invasion by <i>Prosopis glandulosa</i> .
Entire area of proposed footprint	Absent (or if present very few)	Absent (or if present very few)	Absent. No trees (or very few if present at all). Therefore no invasion at the proposed footprint.

## **5 DISCUSSION**

### **5.1 HABITAT AND VEGETATION CHARACTERISTICS**

An outline of the habitat and vegetation characteristics is given in Table 4.1.

### **5.2 PLANT SPECIES**

Extinct, threatened, near threatened and other plant species of high conservation priority in North West Province are listed in Tables 4.2 – 4.8. Protected tree species are listed in Table 4.9. The presence or not of all the species listed in the tables were investigated during the survey. None of the threatened and near-threatened plant species are likely to occur on the site. *Vachellia erioloba*, a Declining species that occurs at the site, is also a Protected Tree species. Protected tree species under the National Forests Act No. 84 of 1998 are listed in Table 4.9. In terms of a part of section 51(1) of Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister. See section 5.5 for a more detailed discussion of the Camel Thorn tree at the proposed footprint.

### **5.3 VERTEBRATES**

#### **5.3.1 Mammals**

Table 4.10, Table 4.11 and Table 4.12 list the possible presence or absence of threatened mammal species, near threatened mammal species and mammal species of which the status is uncertain, respectively, at the site. Literature sources that were used are Friedman & Daly (2004), Skinner & Chimimba (2005) and Wilson & Reeder (2005). Since the site falls outside reserves, threatened species such as the black rhinoceros (*Diceros bicornis*) and the African wild dog (*Lycaon pictus*) are obviously not present. No smaller mammals of particular high conservation significance are likely to be found on the site as well.

### 5.3.2 Birds

See separate avifaunal report for assessment of birds.

### 5.3.3 Reptiles

Table 4.13 and Table 4.14 list the possible presence or absence of threatened and near threatened reptile species on the site. The Southern African Reptile Conservation Assessment (SARCA) was launched in May 2005 (Branch, Tolley, Cunningham, Bauer, Alexander, Harrison, Turner & Bates, 2006). Its primary aim is to produce a conservation assessment for reptiles of South Africa, Lesotho and Swaziland within a four year period, ending 2009 (Branch *et al.*, 2006). Therefore a full updated conservation assessment of reptiles, taking into account the recent IUCN (2001) criteria, will only be available in the near future. While the conservation statuses of reptile species are under revision Alexander & Marais (2007) as well as Tolley & Burger (2007) give useful indications of possible red listings in the near future. There appears to be no threat to any reptile species of particular high conservation importance if the site is developed.

### 5.3.4 Amphibians

No frog species that occur in the North West are threatened as threatened species (vulnerable, endangered or critically endangered) according to Minter, Burger, Harrison, Braack, Bishop and Kloepfer (2004) as well as Du Preez & Carruthers (2009). Table 4.15 lists *Pyxicephalus adspersus* (Giant Bullfrog) as near threatened (Minter *et al.*, 2004; Du Preez & Carruthers, 2009). There is no suitable habitat for *Pyxicephalus adspersus* (Giant Bullfrog) at the site. There appears to be no threat to any amphibian species of particular high conservation importance if the site is developed.

## 5.4 INVERTEBRATES

### 5.4.1 Butterflies

Studies about the vegetation and habitat of threatened butterfly species in South Africa showed that ecosystems with a unique combination of features are selected by these often localised threatened butterfly species (Deuschländer and Bredenkamp 1999; Edge 2002, 2005; Terblanche, Morgenthal & Cilliers 2003; Lubke, Hoare, Victor & Ketelaar 2003; Edge, Cilliers & Terblanche, 2008). Threatened butterfly species in South Africa can then be regarded as bio-indicators of rare ecosystems.

Five species of butterfly in Gauteng Province, northeastern parts of the Northern Cape Province and North West Province combined are listed as threatened in the recent butterfly conservation assessment of South Africa (Mecenero *et al.*, 2013). The expected presence or not of these threatened butterfly species as well as species of high conservation priority that are not threatened, at the site (Table 4.16 and Table 4.17) follows.

#### **5.4.1.1 Assessment of threatened butterfly species**

##### ***Aloeides dentatis dentatis* (Roodepoort Copper)**

The proposed global red list status for *Aloeides dentatis dentatis* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.*, 2013). *Aloeides dentatis dentatis* colonies are found where one of its host plants *Hermannia depressa* or *Lotononis eriantha* is present. Larval ant association is with *Lepisiota capensis* (S.F. Henning 1983; S.F. Henning & G.A. Henning 1989). The habitat requirements of *Aloeides dentatis dentatis* are complex and not fully understood yet. See Deuschländer and Bredenkamp (1999) for the description of the vegetation and habitat characteristics of one locality of *Aloeides dentatis* subsp. *dentatis* at Ruimsig, Roodepoort, Gauteng Province. There is not an ideal habitat of *Aloeides dentatis* subsp. *dentatis* on the site and it is unlikely that the butterfly is present at the site.

##### ***Anthene lindae* (Kalahari Hairtail)**

Small but distinct butterfly species discovered by R.F. Terblanche in 1990 at the present Witsand Nature Reserve in the Northern Cape. Recent red listing and extinction risk assessments list *Anthene lindae* as Vulnerable (Henning, Terblanche & Ball, 2009; Mecenero *et al.*, 2013). Because

*Acacia erioloba* occurs on the site, the presence or not of *Anthene lindae* (Kalahari hairtail butterfly, Vulnerable) has bearing. The butterfly is intimately associated with *Acacia erioloba* which may prove to be the larval food plant (Terblanche, 1994). Present observations by V. Jessnitz confirmed egg-laying of females of *Anthene lindae* on *Vachellia erioloba* (unpublished). However, all the localities for this butterfly species have been found on what appears to be a unique catchment area and basins with particular high water tables on the western side of the Langberg mountain chain, Northern Cape Province (Terblanche & Taylor, 2000). According to Henning *et al.* (2009) *Anthene lindae* has up to date only been found at an ecotone between Gordonia Plains Shrubland and Olifantshoek Plains Thornveld (Mucina & Rutherford, 2006). *Anthene lindae* is not found everywhere where *Vachellia erioloba* trees are present and based on the present knowledge and the surveys at the site, presence of the butterfly at the site is unlikely.

#### ***Chrysochrysis aureus* (Golden Highveld Opal/ Heidelberg Copper)**

The proposed global red list status for *Chrysochrysis aureus* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.*, 2013) *Chrysochrysis aureus* (Golden Opal/ Heidelberg Copper) is a resident where the larval host plant, *Clusia pulchella* is present. However, the distribution of the butterfly is much more restricted than that of the larval host plant (S.F. Henning 1983; Terblanche, Morgenthal & Cilliers 2003). One of the reasons for the localised distribution of *Chrysochrysis aureus* is that a specific host ant *Crematogaster liengmei* must also be present at the habitat. Fire appears to be an essential factor for the maintenance of suitable habitat (Terblanche, Morgenthal & Cilliers 2003). Research revealed that *Chrysochrysis aureus* (Golden Opal/ Heidelberg Copper) has very specific habitat requirements, which include rocky ridges with a steep slope and a southern aspect (Terblanche, Morgenthal & Cilliers 2003). Owing to a lack of habitat requirements and ideal habitat the presence of the taxon is highly unlikely.

#### ***Lepidochrysis praeterita* (Highveld Blue)**

The proposed global red list status for *Lepidochrysis praeterita* according to the most recent IUCN criteria and categories is Endangered (G.A. Henning, Terblanche & Ball, 2009; Mecenero *et al.*, 2013). *Lepidochrysis praeterita* is a butterfly that occurs where the larval host plant *Ocimum obovatum* (= *Becium obovatum*) is present (Pringle, G.A. Henning & Ball, 1994), but the distribution of the butterfly is much more restricted than the distribution of the host plant. *Lepidochrysis praeterita* is found on selected rocky ridges and rocky hillsides in parts of Gauteng, the extreme northern Free State and the south-eastern Gauteng Province. No ideal habitat appears to be

present for the butterfly on the site. It is unlikely that *Lepidochrysops praeterita* would be present on the site and at the footprint proposed for the development.

#### ***Orachrysops mijburghi* (Mijburgh's Blue)**

The proposed global red status for *Orachrysops mijburghi* according to the most recent IUCN criteria and categories is Endangered (Mecenero *et al.*, 2013). *Orachrysops mijburghi* favours grassland depressions where specific *Indigofera* plant species occur (Terblanche & Edge 2007). The Heilbron population of *Orachrysops mijburghi* in the Free State uses *Indigofera evansiana* as a larval host plant (Edge, 2005) while the Suikerbosrand population in Gauteng uses *Indigofera dimidiata* as a larval host plant (Terblanche & Edge 2007). There is no suitable habitat for *Orachrysops mijburghi* on the site and it is unlikely that *Orachrysops mijburghi* would be present on the site.

#### **Conclusion on threatened butterfly species**

There appears to be no threat to any threatened butterfly species if the site is developed.

#### **5.4.1.2 Assessment of butterfly species that are not threatened but also of high conservation priority**

##### ***Colotis celimene amina* (Lilac tip)**

*Colotis celimene amina* is listed as Rare (Low density) by Mecenero *et al.* (2013). In South Africa *Colotis celimene amina* is present from Pietermaritzburg in the south and northwards into parts of Kwa-Zulu Natal, Gauteng, Limpopo, Mpumalanga and the North West Provinces (Mecenero *et al.* In press.). Reasons for its rarity are poorly understood. It is highly unlikely that *Colotis celimene amina* would be present at the site or make use of the site as a particular habitat.

##### ***Lepidochrysops procera* (Savanna Blue)**

*Lepidochrysops procera* is listed as Rare (Habitat specialist) by Mecenero *et al.* (2013). *Lepidochrysops procera* is endemic to South Africa and found in Gauteng, KwaZulu-Natal, Mpumalanga and North West (Mecenero *et al.*, 2013). Owing to a lack of habitat requirements and ideal habitat the presence of the taxon at the site is highly unlikely.

##### ***Metisella meninx* (Marsh Sylph)**

Henning and Henning (1989) in the first South African Red Data Book of Butterflies, listed *Metisella meninx* as threatened under the former IUCN category Indeterminate. Even earlier in the 20<sup>th</sup> century Swanepoel (1953) raised concern about vanishing wetlands leading to habitat loss and loss of populations of *Metisella meninx*. According to the second South African Red Data Book of butterflies (Henning, Terblanche & Ball, 2009) the proposed global red list status of *Metisella meninx* has been Vulnerable. During a recent large scale atlassing project the *Conservation Assessment of Butterflies of South Africa, Lesotho and Swaziland: Red List and Atlas* (Mecenero *et al.*, 2013) it was found that more *Metisella meninx* populations are present than thought before. Based on this valid new information, the conservation status of *Metisella meninx* is now regarded as Rare (Habitat specialist) (Mecenero *et al.*, 2013). Though *Metisella meninx* is more widespread and less threatened than perceived before, it should be regarded as a localised rare habitat specialist of conservation priority, which is dependent on wetlands with suitable patches of grass at wetlands (Terblanche *In prep.*). Another important factor to keep in mind for the conservation of *Metisella meninx* is that based on very recent discoveries of new taxa in the group the present *Metisella meninx* is species complex consisting of at least three taxa (Terblanche *In prep.*, Terblanche & Henning *In prep.*). The ideal habitat of *Metisella meninx* is treeless marshy areas where *Leersia hexandra* (rice grass) is abundant (Terblanche *In prep.*). The larval host plant of *Metisella meninx* is wild rice grass, *Leersia hexandra* (G.A. Henning & Roos, 2001). Owing to a lack of habitat requirements and ideal habitat the presence of the taxon at the site is highly unlikely.

***Platylesches dolomitica*** (Hilltop Hopper)

*Platylesches dolomitica* is listed as Rare (Low density) by Mecenero *et al.* (2013). Historically the conservation status of *Platylesches dolomitica* was proposed to be Vulnerable (Henning, Terblanche & Ball 2009). However this butterfly which is easily overlooked and has a wider distribution than perceived before. *Platylesches dolomitica* has a patchy distribution and is found on rocky ledges where *Parinari capensis* occurs, between 1300 m and 1800m (Mecenero *et al.* 2013, Dobson Pers comm.). Owing to a lack of habitat requirements and ideal habitat the presence of the taxon at the site is highly unlikely.

#### 5.4.2 Fruit chafer beetles

Table 4.18 lists the fruit chafer beetle species (Coleoptera: Scarabaeidae: Cetoninae) that are of known high conservation priority in the North West Province. No *Ichneustoma stobbiai* or *Trichocephala brincki* were found during the surveys. There appears to be no suitable habitat for *Ichneustoma stobbiai* or *Trichocephala brincki* at the site. There appears to be no threat to any of the fruit chafer beetles of particular high conservation priority if the site were developed.

#### 5.4.3 Scorpions

Table 4.19 lists the rock scorpion species (Scorpiones: Ischnuridae) that are of known high conservation priority in the North West Province. None of these rock scorpions have been found at the site and the habitat does not appear to be optimal.

### 5.5 CAMEL THORN TREES, *VACHELLIA ERIOLOBA* (= *ACACIA ERIOLOBA*)

Camel Thorn trees (*Vachellia erioloba* = *Acacia erioloba*) are found at the proposed footprint. Recent research reinforces the recognition of two genera *Vachellia* and *Senegalia* for hitherto *Acacia* in South Africa (see Kyalangalilwa *et al.*, 2013) hence the name *Vachellia erioloba*. Camel Thorn trees can be described as trees of “great value, beauty and apparent ecological importance” (Anderson & Anderson, 2001).

Table 4.20 gives an indication of attributes of population of Camel Thorn tree, *Vachellia erioloba* (= *Acacia erioloba*) at the proposed footprint. Camel Thorn trees at the site are not particularly large (none taller than 10 m) and are not part of a camel thorn forest of note, even though in the central-northern parts of the proposed footprint a relatively high density of Camel Thorn trees are present; up to 60 individuals taller than 2 m per hectare area were counted (based on average of three sample plots of 50 m by 50 m). The zone of high density of Camel Thorn trees at the site is at least 40 ha. If conservative estimate of 40 individuals taller than 2 m/ hectare for this zone is made at least a 1500 individuals taller than 2 m is present at the central-northern parts of the site.



It is recommended that a permit at the relevant authorities should be applied for in case of any damage or removal of individual trees and that *Vachellia erioloba* trees (from a nursery or being cultivated) could be planted on site outside the present footprint. These strategies and actions can only be applied in liason and with the permission of government as outlined above.

## **5.5 ALIEN INVASIVE SPECIES WITH PARTICULAR REFERENCE TO *PROSOPIS GLANDULOSA* (HONEY MESQUITE)**

Exotic weeds at the site are typical for those that are found at disturbed areas at farms in the North West Province. Though these exotic weeds easily spring up where disturbances such as overgrazing, scraping of an area and diggings are found, at the present study area no severe infestations such as could often be observed in larger urban areas and surrounds in the North West and Gauteng Provinces, are found.

No *Prosopis glandulosa* have been observed at the proposed footprint and it is likely that this highly invasive tree is absent (or if present in very low numbers) at the site.

*Prosopis* should not be allowed to establish at the site from adjacent areas and continuously monitored/ controlled. Many *Prosopis* species have been introduced to South Africa; some taxa and their hybrids have naturalised and become widespread invasive trees. *Prosopis* was introduced to South Africa and has become the second most widespread invasive alien plant taxon in the country (Shackleton et al., 2015c). These invasions have detrimental effects on biodiversity, ecosystem services and human livelihoods Shakleton et al., 2015a). In South Africa it was found that native woody species density, basal area, richness and diversity all decreased significantly as the basal area of *Prosopis* stands increased (Shackleton et al., 2015a). The cover of native perennial grasses and herbaceous plants declined from 15–20% where the basal area of *Prosopis* was < 2 m<sup>2</sup>/ha to zero where the basal area of *Prosopis* was > 4.5 m<sup>2</sup>/ha (Shackleton et al., 2015a). *Prosopis* in South Africa also has higher recruitment (% juvenile plants) than in other areas like Australia. *Prosopis* invasions are having a negative effect on the stability of native tree populations in South Africa, and are linked to increased mortality of native trees. Improved management of *Prosopis* is needed Shackleton et al., 2015c).

Invasive alien trees impact the environment and human livelihoods. Costs associated with *Prosopis* were perceived to exceed benefits, and most stakeholders wanted to see a reduction in the abundance of *Prosopis* stands (Shackleton *et al.*, 2015b). The mean total cost for the management of *Prosopis* was US\$ 1914 year<sup>-1</sup> per farm, where costs ranged from under US\$ 10 to over US\$ 500 per ha based on invasion densities and objectives for control (Shackleton *et al.*, 2015b).

## 6 IMPACT ASSESSMENT AND MITIGATION MEASURES

The primary cause of loss of biological diversity is habitat degradation and loss (IUCN, 2004; Primack, 2006). Habitats of threatened plants are in danger most often due to urban developments such as is the case for the Gauteng Province (Pfab & Victor, 2002). Habitat conservation is the key to the conservation of invertebrates such as threatened butterflies (Deutschländer and Bredenkamp 1999; Edge 2002, 2005; Terblanche, Morgenthal & Cilliers 2003; Lubke, Hoare, Victor & Ketelaar 2003; Edge, Cilliers & Terblanche, 2008). Though human impacts in few cases have improved the habitat for mammalian species such as greater cane rats, that prosper in sugar cane and maize fields (Apps 2000), for many mammalian habitat specialist species, human impacts has lead to habitat loss. Some mammal species, especially many of the larger species, could adapt to a wide range of habitat types, but then need a large range. Some animals and plants are rare and occupy only one or a few specialised habitats (Primack 2006). Habitat conservation, either as large available land or as specialised habitats is therefore key to the conservation of many threatened plant species and animal species or any other species of high conservation priority (i.e. rare, near threatened species). In addition corridors and linkages may play a significant role in conservation of fauna.

Corridors are important to link ecosystems of high conservation priority. Such corridors or linkages are there to improve the chances of survival of otherwise isolated populations (Samways, 2005). How wide should corridors be? The answer to this question depends on the conservation goal and the focal species (Samways, 2005). Corridors for mammalian species are especially important for migratory species (Mwalyosi, 1991, Pullin 2002). For an African butterfly assemblage this is about 250m when the corridor is for movement as well as being a habitat source (Pryke and Samways 2003). Hill (1995) found a figure of 200m for dung beetles in tropical Australian forest. In the agricultural context, and at least for some common insects, even small corridors can play a valuable role (Samways, 2005). Much more research remains to be done to find refined answers to the width of grassland corridors in South Africa. The width of corridors will also depend on the type of development, for instance the effects of the shade of multiple story buildings will be quite different from that of small houses. Corridors have a number of advantages related to dispersal and gene flow by avoiding isolation of ecological patches. However, corridors could also have potential drawbacks, for example creating gene flow where none has occurred naturally in the past and also as reservoirs for pathogens or introduced species (Pullin, 2002). Perhault and Lomolino (2000)

studied corridors and mammal community structure in an old-growth forest landscape in the United States of America and their data suggest that each corridor should be valued individually. A lot of research remains to be conducted to have a better idea of the value of corridors, but in general corridors would be of considerable value. It appears that a network of wetland corridors and rocky ridges is highly likely to be of considerable benefit in environmental management and planning. Though proper management plans for habitats are not in place, setting aside special ecosystems is in line with the recent Biodiversity Act (2004) of the Republic of South Africa.

To summarise: In practice, as far as any developments are concerned, the key would be to prioritise and plan according to sensitive species and special ecosystems.

In the case of this study vegetation appear to be disturbed in areas but a relatively high cover of indigenous plant species in a fairly natural area is present. If the development is approved, it is unlikely that there will be a loss of any particular ecosystem or corridor of special conservation concern according to the planned footprint. There appears to be no loss of any particular sensitive species, if the site is developed according to the proposed footprint. Mitigation measures for *Vachellia erioloba* (Declining, Protected Tree) apply.

The following potential impacts and mitigation measures with a view to the proposed developments apply:

### **6.1 Anticipated risks or impacts to the loss of habitat**

The following impacts on the loss of habitat apply at the site.

Potential impacts on the available habitat will be of local extent, of permanent duration, of medium intensity and high probability. The significance of loss of habitat is expected to be moderate without mitigation and moderate-low with mitigation.

Impact summary matrix:

Phase	Significance of Impact				
	None	Low	Moderate	High	With mitigation
Operational			X		Moderate-low

Mitigation measures:

- Exotic and invasive plant species should not be allowed to establish, if the development is approved, especially an alien invasive tree species such as *Prosopis*.

## 6.2 Anticipated risks or impacts to the loss of sensitive species

Sensitive species are regarded here as those listed in section 5 and constitutes the flora and fauna that are threatened or of other particular high conservation importance. The presence or not of all the species listed in the tables were investigated during the survey. None of the threatened and near-threatened plant species are likely to occur on the site. Apart from one Protected Tree species (also listed as Declining), none of the other plant species of particular conservation priority are likely to occur on the footprint proposed for development.

A Protected Tree species, *Vachellia erioloba* (also listed as Declining) is found sparsely at the site. Protected Tree species under the National Forests Act No. 84 of 1998 are listed in Table 4.9. In terms of a part of section 51(1) of Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.

Recommendation for *Vachellia erioloba*:

*Acacia erioloba* individuals at the site are not particularly large and are not part of a camel thorn forest of note. It is recommended that a permit at the relevant authorities should be applied for in case of any damage or removal of individual trees and that *Vachellia erioloba* (= *Acacia erioloba*) trees (from a nursery) could be planted on site outside the present footprint.

### 6.3 Anticipated risks or impacts to habitat connectivity and open space

Potential impacts on connectivity will be of local extent, of permanent duration, of medium intensity and high probability. The significance of the impacts on loss of connectivity is expected to be low without mitigation and low with mitigation.

Impact summary matrix: habitat connectivity

Phase	Significance of Impact				
	None	Low	Moderate	High	With mitigation
Construction		X			Low
Operational		X			Low

Mitigation measures:

- If the development is approved, establishment of exotic and invasive plant species should be avoided and where these have been found at the site continuous eradication should take place.
- It is in particular declared alien invasive species such as *Prosopis glandulosa* (Mesquite) that should not be allowed to establish.

### 6.4 Anticipated risks or impacts associated with construction activities

Overall construction activities associated with the development if approved will be of local extent, of medium duration, of medium intensity and high probability. During the construction phase, the significance of the impacts associated with the construction phase is likely to be moderate without and low with mitigation.

Impact summary matrix:

Phase	Significance of Impact				
	None	Low	Moderate	High	With mitigation
Construction			X		Low
Operational			X		Low

Mitigation measures:

- If the development is approved, contractors must ensure that no animal species are disturbed, trapped, hunted or killed during the construction phase.
- Rubble or waste that could accompany the construction effort, if the development is approved, should be removed during and after construction.
- If the development is approved, measures should be taken to avoid any spills and infiltration of petroleum fuels or any chemical pollutants into the soil during construction phase.

## 6.5 Cumulative impacts

Cumulative impacts could arise as other similar projects are constructed in the area.

According to the Energy Blog's database only one other solar PV plant has been granted preferred bidders status within close proximity to the proposed Khubu PV plant:

- *Waterloo Solar Park with a capacity of 75MW near Vryburg, North West Province (Approvals, planning and financing phase) – refer to Figure 10.*

According to the Department's database numerous other solar plants have been proposed in relative close proximity to the proposed activity, namely:

- *The proposed Carocraft Solar Park near Vryburg, North West Province (14/12/16/3/3/2/374);*
- *Construction of the 75MW Photovoltaic facility and associated infrastructure in Naledi (14/12/16/3/3/2/390).*
- *The proposed Tiger Kloof Solar Photovoltaic energy facility near Vryburg, North West Province (14/12/16/3/3/2/535).*
- *The proposed Keren Energy Bosh Pan Solar Plant, Northern Cape Province (14/12/16/3/3/1/563);*
- *The proposed renewable energy generation project. Carocraft Solar Park in North West Province (14/12/16/3/3/2/699);*
- *The proposed Renewable Energy Generation Project rem farm Elda, North West (14/12/16/3/3/2/750);*
- *The proposed Renewable Energy Project on Farm Doornbult 29 and Doornbult 33, North West (14/12/16/3/3/2/751);*

Environamics and other environmental consultants are also in the process of applying for Environmental Authorisation for other PV projects in the area, namely:

- *The proposed Protea Solar Power Plant near Vryburg, North West Province.*
- *The proposed Gamma Solar Power Plant near Vryburg, North West Province.*
- *The proposed Alpha Solar Power Plant near Vryburg, North West Province.*
- *The proposed Meerkat Solar Power Plant near Vryburg, North West Province.*
- *The proposed Sonbesie Solar Power Plant near Vryburg, North West Province.*
- *Three PV Solar Energy facilities on the farm Klondike - AMDA Developments*

The potential for cumulative impacts therefore exists. In the Naledi Local Municipality a number of solar power plants are planned and their cumulative impacts to ecosystem and biodiversity need consideration. Several characteristics and development strategies of utility-scale solar energy systems have low environmental impacts relative to other energy systems, including other renewables (Hernandez *et al.*, 2015) so that their cumulative effects may be relatively lower. Cumulative effects of solar power plants to habitat loss and fragmentation should receive much of the attention. Habitat loss and fragmentation are known to be the main threats to biodiversity (Fahrig, 2003; Wilcove *et al.*, 1998; IUCN, 2004; Primack, 2006). Because some fragmentation will take place if the developments are approved the focus of assessing cumulative effects of solar power plants could be on how the different projects allow for enough corridors and linkages in between the locations of solar power plants to enhance connectivity of biodiversity. An outline of possible cumulative impacts follows.

Possible cumulative effects and mitigation/ avoidance thereof:

1) Cumulative impacts on unique or sensitive habitats:

At the study area cumulative effects on the loss of sensitive habitats are kept to a minimum because such habitats are avoided at large.

2) Cumulative impacts on habitat fragmentation:

Regionally landscape fragmentation could create barriers to the movement of species and their genes (Saunders *et al.*, 1991). The answer to the width and extent of corridors depends on the conservation goal and the focal species (Samways, 2005). Corridors for mammalian species are especially important for migratory species (Mwalyosi, 1991, Pullin 2002). For an



African butterfly assemblage this is about 250m when the corridor is for movement as well as being a habitat source (Pryke and Samways 2003). Hill (1995) found a figure of 200m for dung beetles in tropical Australian forest. In the agricultural context, and at least for some common insects, even small corridors can play a valuable role (Samways, 2005).

*At the study area of which the site is part:*

Corridors and linkages of areas with similar habitat are present in the local district where a number of solar power plants are planned. Watercourses and wetlands are avoided by the proposed footprint so that stepping stone corridors (pans) and a network of linked corridors (active channels with riparian zones) remain. No particular habitats of threatened species that are easily isolated (e.g. beetles with flightless females) are known to be impacted locally in the larger study area where a number of solar power plants are planned to be developed.

### 3) Emissions and pollutants into the air, soil and water:

Overall because of the restricted nature of power plants and few or no emissions and pollutants into air when operational, soil and water cumulative impacts to the environment are limited (if compared for example to emissions from fossil fuel burning). Ultimately power plants could relieve the pressures to use fossil fuels that are associated with numerous cumulative impacts and habitat losses.

Therefore in the bigger regional context, the vast tracks of relatively similar habitat in the interior are ideal for such power generating facilities. Current developments of solar power plants could therefore not be seen in the same context as many other more developed parts of the world where natural habitats are often severely fragmented. Some fragmentation of habitats will take place and the key issue would be to avoid sensitive habitats and to allow for enough corridors and linkages between habitats such as in the present proposed planned footprints.

The Environmental Impact Assessment (EIA) Report will include a detailed assessment of the potential cumulative impacts associated with the proposed development.

## 7 CONCLUSION

- Vegetation at the site is in fairly natural condition for the vegetation type, with some bare areas but in general a relatively high cover of indigenous plant versus alien species. Vegetation at the site is a savanna with well-developed grass layer with indigenous shrubs and small trees that dot the landscape. Sand-loving plant species such as the grass species *Eragrostis pallens*, herbaceous plant species with trailing stems *Hermannia tomentosa* and

*Tephrosia lupinifolia* as well as the tree species *Vachellia erioloba* and *Terminalia sericea* are all reflections of the sandy soils at the site. *Terminalia sericea* that prefers deep sandy soils are distributed only sporadically at the proposed footprint.

- The vegetation type to which the site belongs, Mafikeng Bushveld (SVk 1) is listed as threatened ecosystem according to the National List of Threatened Ecosystems (2011). The development if approved should therefore be planned carefully and the footprint restricted to the area allocated as such.
- Establishment of exotic weeds should be monitored, during construction, if the development is approved, and exotic weeds at the site should be eradicated.
- *Prosopis* has become the second most widespread invasive alien plant taxon in the country (Shackleton et al., 2015c). These invasions have detrimental effects on biodiversity, ecosystem services and human livelihoods (Shackleton et al., 2015a). In South Africa it was found that native woody species density, basal area, richness and diversity all decreased significantly as the basal area of *Prosopis* stands increased (Shackleton et al., 2015a). Therefore a declared invader such as the mesquite tree (*Prosopis* species), should not be planted and should not be allowed to establish and spread from nearby areas to the proposed footprint.
- No wetlands appear to be present at the proposed footprint.
- No loss of particularly sensitive or localised habitat type of particular conservation importance is anticipated if the site is developed.
- No loss of corridors or connectivity of ecosystems is anticipated if the sites are developed.
- Ecological sensitivity at the site is medium: There are no indications of any particular ecosystems of conservation importance, any particular conservation corridors or a significant impact on any plant, mammal, reptile, amphibian or invertebrate species of particular conservation concern if the site is developed.
- A Protected Tree species, *Vachellia erioloba* (= *Acacia erioloba*), the Camel Thorn tree (also listed as a Declining species), is found at the site. Protected Tree species are listed under the National Forests Act No. 84 of 1998. In terms of a part of section 51(1) of Act No. 84 of 1998, no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister.
- At the zone of conspicuous high density of Camel Thorn trees at the south western parts of the proposed footprint an average of 15 individuals were counted at three sample plots of

50 m x 50 m each. This means that for this high density zone (over 40 ha) of Camel Thorn trees more than a 1500 individuals taller than 2 m would be present.

- No Camel Thorn trees taller than 10 m are present at the proposed footprint and also no remarkable old trees. Camel Thorn tree population at the site would not be regarded as a Camel Thorn tree forest. Reference sites for Camel Thorn forests: Large Camel Thorn forest at Kathu and smaller Camel Thorn forest at Witsand in the Northern Cape visited by R.F. Terblanche during the time span of the surveys.
- Recommendation for Camel Thorn trees at the site if the development is approved. It is recommended that a permit should be applied for at the relevant authorities in case any removal or damage of Camel Thorn trees. If *Vachellia erioloba* is impacted upon it is also recommended that new (from nursery) Camel Thorn trees could be planted on site outside the present footprint.
- Cumulative effects of solar power plants are considered with special reference to habitat loss and fragmentation. Habitat loss and fragmentation are known to be the main threats to biodiversity (Fahrig, 2003; Wilcove *et al.*, 1998; IUCN, 2004; Primack, 2006). Because some fragmentation will take place if the developments are approved the focus of assessing cumulative effects of solar power plants could be on how the different projects allow for enough corridors and linkages in between the locations of solar power plants to enhance connectivity of biodiversity.
- There is no distinct reason why this relatively small footprint allocated for the development, in the vast countryside of the North West Province is of particular conservation concern for any threatened vertebrate species, including those that roam large areas and which may occasionally or coincidentally visit the site.
- It is unlikely that there will be a loss of any known plant, mammal, reptile, amphibian or invertebrate species that are threatened or near threatened, if the site is developed.

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## **ANNEXURE 1: Plant species list**

Plant species recorded or likely to occur at the site.

Plant species are listed alphabetically under life forms that are generally recognizable.

Plant species marked with an asterisk (\*) are exotic.

Sources: Germishuizen (2003), Manning (2003), Manning (2009), Van Oudtshoorn (1999), Van Wyk (2000), Van Wyk & Malan (1998), Van Wyk & Van Wyk (2013), Crouch, Klopper, Burrows & Burrows (2011), Goldblatt (1986), Goldblatt & Manning (1998), Jacobsen (1983), McMurtry, Grobler, Grobler & Burns (2008), Smit (2008), Van Ginkel *et al.* (2011), Van Jaarsveld (2006), Van Wyk & Smith (2003).



TAXON	COMMON NAMES	FAMILY
<b>ANGIOSPERMAE: MONOCOTYLEDONS</b>		
<i>Albuca setosa</i>	Fibrous Slime Lily	HYACINTHACEAE
<i>Antheophora pubescens</i>	Wool Grass	POACEAE
<i>Aristida adscensionis</i>	Annual Three-awn	POACEAE
<i>Aristida congesta</i> subsp. <i>congesta</i>	Tassel Three-awn	POACEAE
<i>Aristida meridionalis</i>	Giant Three-awn	POACEAE
<i>Asparagus africanus</i>		ASPARAGACEAE
<i>Bulbine narcissifolia</i>		ASPHODELACEAE
<i>Cenchrus ciliaris</i>	Foxtail Buffalo Grass	POACEAE
<i>Chloris virgata</i>	Feather-top Chloris	POACEAE
<i>Chlorophytum fasciculatum</i>		ANTHERICACEAE
<i>Commelina africana</i>		COMMELINACEAE
<i>Cymbopogon pospischilii</i>	Narrow-leaved Turpentine Grass	POACEAE
<i>Cynodon dactylon</i>	Couch Grass	POACEAE
<i>Digitaria eriantha</i>	Common Finger Grass	POACEAE
<i>Elionurus muticus</i>	Wire Grass	POACEAE
<i>Enneapogon cenchroides</i>	Nine-awned Grass	POACEAE
<i>Eragrostis curvula</i>	Weeping Love Grass	POACEAE
<i>Eragrostis lehmanniana</i>	Lehmann's Love Grass	POACEAE
<i>Eragrostis pallens</i>	Broom Love Grass	POACEAE
<i>Eragrostis superba</i>	Saw-toothed Love Grass	POACEAE
<i>Fingerhuthia africana</i>	Thimble Grass	POACEAE
<i>Ledebouria marginata</i>		HYACINTHACEAE
<i>Melinis repens</i>	Natal Red Top	POACEAE
<i>Pogonarthria squarrosa</i>	Herringbone Grass	POACEAE
<i>Schmidtia pappophoroides</i>	Sand Quick	POACEAE
<i>Setaria sphacelata</i> var. <i>torta</i>	Creeping Bristle Grass	POACEAE
<i>Stipagrostis uniplumis</i>	Silky Bushman Grass	POACEAE
<i>Themeda triandra</i>	Red Grass	POACEAE
<i>Trachyandra laxa</i>		ASPHODELACEAE
<i>Tragus racemosus</i>		POACEAE
<i>Trichoneura grandiglumis</i>	Small Rolling Grass	POACEAE
<b>ANGIOSPERMS: DICOTYLEDONS</b>		
<i>Acacia</i> indigenous species: see <i>Senegalia</i> and <i>Vachellia</i> below		

<i>Acacia erioloba</i>	Camel Thorn	MIMOSACEAE
<i>Acacia hebeclada</i> subsp. <i>hebeclada</i>	Candlepod Thorn	MIMOSACEAE
<i>Acacia karroo</i>	Sweet Thorn	MIMOSACEAE
<i>Acacia mellifera</i> subsp. <i>detinens</i>	Black Thorn	MIMOSACEAE
<i>Acacia tortilis</i> subsp. <i>heteracantha</i>	Umbrella Thorn	MIMOSACEAE
<i>Acrotome inflata</i>		LAMIACEAE
<i>Aptosimum procumbens</i>	Karoo Violet	SCROPHULARIACEAE
* <i>Argemone ochroleuca</i>	White-flowered Mexican poppy	PAPAVERACEAE
<i>Barleria macrostegia</i>		ACANTHACEAE
<i>Ceratotheca triloba</i>	Wild Foxglove	PEDALIACEAE
<i>Chamaecrista</i> species	Cassia	CAESALPINIACEAE
<i>Chamaesyce hirta</i>	Red Milkweed	EUPHORBIACEAE
<i>Chrysocoma ciliata</i>	Bitterbush	ASTERACEAE
<i>Citrullus lanatus</i>	Wild Waterlemon	CUCURBITACEAE
<i>Cleome angustifolia</i>	Yellow Mouse-whiskers	BRASSICACEAE (or Capparaceae)
<i>Convolvulus sagittatus</i>	Wild Bindweed	CONVOLVULACEAE
<i>Cucumis zeyheri</i>		CUCURBITACEAE
<i>Deverra denudata</i> subsp. <i>aphylla</i>	Wild Celery	APIACEAE
<i>Diospyros austro-africana</i>		EBENACEAE
<i>Diospyros lycioides</i> subsp. <i>lycioides</i>	Karoo Bluebush	EBENACEAE
<i>Ehretia alba</i>	White Puzzle Bush	BORAGINACEAE
<i>Elephantorrhiza elephantina</i>	Eland's Bean	MIMOSACEAE
<i>Felicia muricata</i>		ASTERACEAE
<i>Gazania krebsiana</i> subsp. <i>krebsiana</i>		ASTERACEAE
<i>Geigeria filifolia</i>		ASTERACEAE
<i>Geigeria ornativa</i>		ASTERACEAE
<i>Gisekia africana</i>		GISEKIACEAE
<i>Gnidia</i> cf. <i>burchellii</i>		THYMELAEACEAE
<i>Gnidia polycephala</i>		THYMELAEACEAE
* <i>Gomphrena celosioides</i>	Bachelor's Button	AMARANTHACEAE
<i>Grewia flava</i>	Velvet Raisin	SPARRMANNIACEAE
<i>Helichrysum argyrosphaerum</i>		ASTERACEAE
<i>Helichrysum zeyheri</i>		ASTERACEAE
<i>Heliotropium ciliatum</i>		BORAGINACEAE
<i>Hermibstaedtia odorata</i>	Wild Cockscorn	AMARANTHACEAE
<i>Hermannia tomentosa</i>		MALVACEAE

<i>Indigofera daleoides</i>		FABACEAE
<i>Ipomoea bolusiana</i>		CONVOLVULACEAE
<i>Jamesbrittenia aurantiaca</i>	Cape Saffron	SCROPHULARIACEAE
<i>Limeum fenestratum</i>		
<i>Lycium horridum</i>		SOLANACEAE
<i>Melhania prostrata</i>		STERCULIACEAE
<i>Melolobium microphyllum</i>		FABACEAE
<i>Monsonia angustifolia</i>	Crane's Bill	GERANIACEAE
* <i>Opuntia ficus-indica</i>	Sweet Prickly Pear	CACTACEAE
<i>Pentzia calcarea</i>		ASTERACEAE
<i>Pollichia campestris</i>	Waxberry	ILLECEBRACEAE
<i>Salvia disermas</i>	Large Blue Sage	LAMIACEAE
<i>Scabiosa columbaria</i>	Wild Scabious, Morning Bride	DIPSACACEAE
* <i>Schkuhria pinnata</i>	Dwarf Marigold	ASTERACEAE
<i>Searsia lancea</i>	Karee	ANACARDIACEAE
<i>Searsia tridactyla</i>		ANACARDIACEAE
<i>Selago densiflora</i>		SCROPHULARIACEAE
<i>Senecio coronatus</i>	Sybossie	ASTERACEAE
<i>Senecio consanguineus</i>	Starvation Senecio	ASTERACEAE
<i>Senegalia mellifera</i> subsp. <i>detinens</i>	Black Thorn	MIMOSACEAE
<i>Senna italica</i> subsp. <i>arachoides</i>	Wild Senna	CAESALPINIACEAE
<i>Solanum incanum</i>	Bitter Apple	SOLANACEAE
<i>Tarchonanthus camphoratus</i>	Wild Camphor Bush	ASTERACEAE
<i>Tephrosia lupinifolia</i>		FABACEAE
<i>Terminalia sericea</i>	Silver Clusterleaf	COMBRETACEAE
<i>Trichodesma angustifolium</i>	Hairy Blue Bells	BORAGINACEAE
<i>Thesium</i> sp.		SANTALACEAE
<i>Tribulus terrestris</i>	Devil's Thorn	ZYGOPHYLLACEAE
<i>Vachellia erioloba</i> (= <i>Acacia erioloba</i> )	Camel Thorn	MIMOSACEAE
<i>Vachellia hebeclada</i> subsp. <i>hebeclada</i>	Candlepod Thorn	MIMOSACEAE
<i>Vachellia karroo</i>	Sweet Thorn	MIMOSACEAE
<i>Vachellia tortilis</i> subsp. <i>heteracantha</i>	Umbrella Thorn	MIMOSACEAE
<i>Viscum rotundifolium</i>	Round-leaved Mistletoe	VISCACEAE
<i>Ziziphus mucronata</i>	Buffalo-thorn	RHAMNACEAE
<i>Ziziphus zeyheriana</i>	Dwarf Buffalo-thorn	RHAMNACEAE

