

ECOLOGICAL FAUNA HABITAT SURVEY

**GROOTVLEI POWERSTATION PHOTOVOLTAIC
DEVELOPMENT**



Anax imperator, the blue emperor dragonfly, in flight looking for prey at a pool of water at a drainage ditch at the site.

Photo: September 2012, R.F. Terblanche.

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ANTHENE ECOLOGICAL CC

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1 INTRODUCTION

An ecological habitat survey of flora and fauna was required for the Grootvlei Power station Photovoltaic (PV) development. Four pre-identified alternative sites (hereafter referred to as the site) were identified on the power station property. The survey focused on the possibility that threatened fauna known from Mpumalanga Province are likely to occur within the proposed development site or not. Species of high conservation priority that do not qualify for threatened status also received attention in the survey. Areas adjacent to the site have also been investigated with the focus especially on whether threatened species are present or not.

1.1 OBJECTIVES OF THE HABITAT STUDY

The objectives of the habitat study are to provide:

- A detailed fauna habitat survey;
- A detailed habitat survey of possible threatened or localised animal species;
- 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 that could occur as a result of the development; and
- Make recommendations to reduce or minimise impacts, should the development be approved.

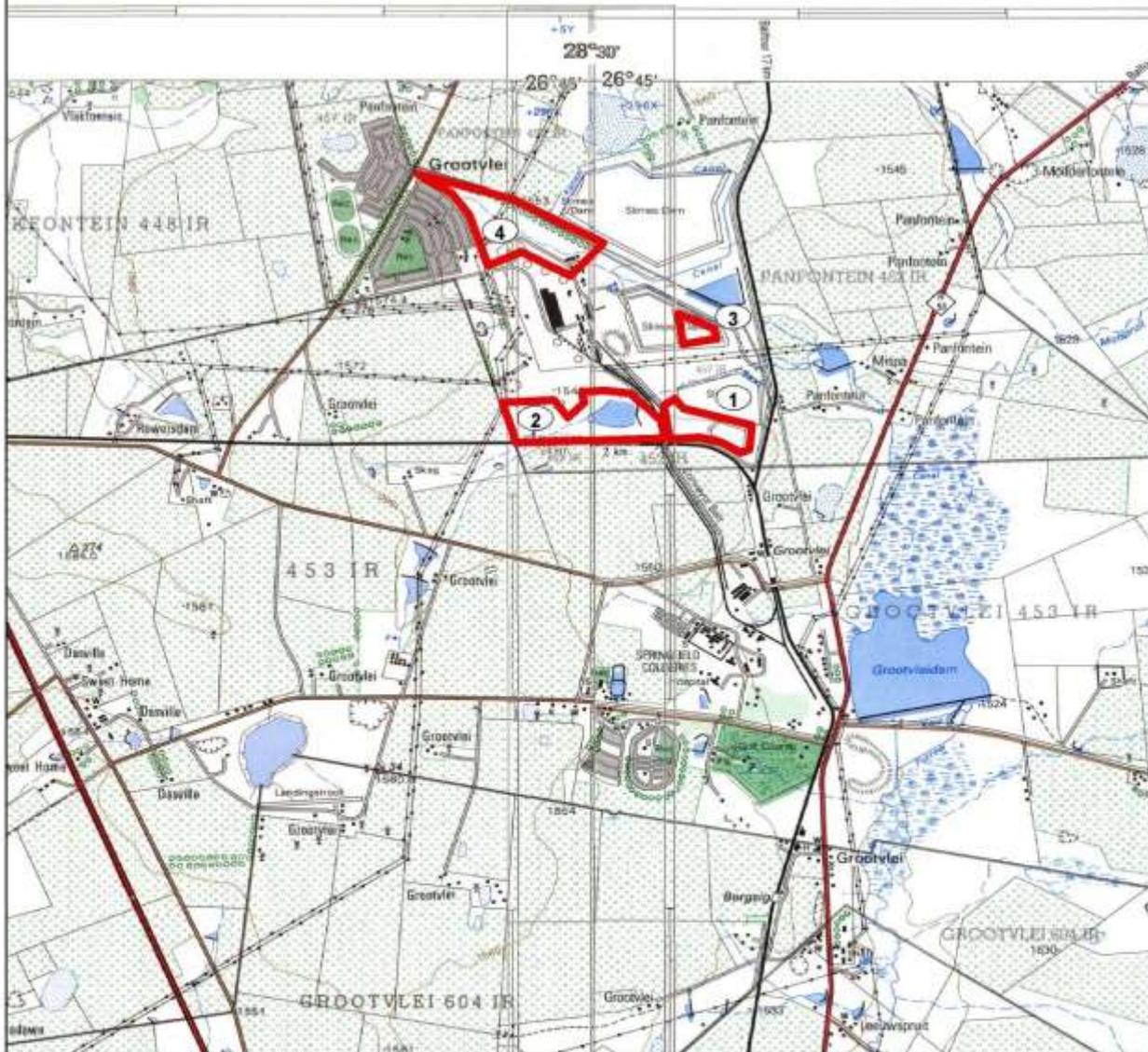
1.2 SCOPE OF STUDY

- A survey consisting of two visits to investigate key elements of habitats on the site, relevant to the conservation of fauna.
- Recording of any sightings and/or evidence of existing fauna.
- An evaluation of the conservation importance and significance of the site with special emphasis on the current status of threatened species.
- 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 South South East of the town Balfour, in the Mpumalanga Province. The study site is situated at the Grassland Biome which is represented by Soweto Highveld Grassland (Mucina & Rutherford 2006). The Soweto Highveld Grassland vegetation type on the whole is situated on a gently to moderately undulating landscape on the Highveld plateau which supports short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra* and accompanied by a variety of other grasses such as *Elyonurus muticus*, *Eragrostis racemosa*, *Heteropogon contortus* and *Tristachya leucothrix*. In general in the Soweto Highveld vegetation type, in areas that are not disturbed, only scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover. Very little of the study area and 4 alternative sites are undisturbed in some form or another. Climate is characterized by summer-rainfall with a mean annual precipitation of 662 mm. Frequent occurrence of frost and large thermic diurnal differences are recorded (Mucina & Rutherford 2006). See map 1 for a map of the study area location and arrangement of the four alternatives that comprise the study area.

1:50 000 SUID-AFRIKA SOUTH AFRICA 2628DC GROOTVLEI



**Grootvlei Powerplant
Alternative sites for Photovoltaic site development**

 Alternative sites

0 250 500 1,000 1,500 2,000
 Meters



Map 1. Grootvlei Power Station study area and alternative sites

3 METHODS

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

Surveys by R.F. Terblanche took place on 26 September 2012, 10 November 2012 and 11 November 2012 to note key elements of habitats on the site, relevant to the conservation of fauna. The main purpose of the site visit was ultimately to serve as a habitat survey 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. Field guides such as those by Germishuizen (2003), Manning (2003), Manning (2009), Van Oudtshoorn (1999), Van Wyk (2000), Van Wyk & Malan (1998) and Van Wyk & Van Wyk (1997) were used to confirm the taxonomy of the species. Works on specific plant groups (often genera) such as those by Goldblatt (1986), Goldblatt & Manning (1998), Jacobsen (1983), McMurtry, Grobler, Grobler & Burns (2008), Smit (2008), Van Jaarsveld (2006) and Van Wyk & Smith (2003) were also consulted to confirm the identification of species. In this case no plant specimens were needed to be collected as voucher specimens or to be send to a herbarium for identification. For the most recent treatise of scientific plant names and broad distributions, Germishuizen, Meyer & Steenkamp (2006) were followed to compile the lists of species.

3.2 MAMMALS

Mammal sightings would be noted as sight records together with animal signs of presence. 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 spoor and signs. Trapping was not done since it proved not necessary in the case of this study. Habitat characteristics were also surveyed to note potential occurrences of mammals. 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

Bird sightings would be noted as sight records, mainly with the aid of binoculars (10x30). Nearby bird calls of which the observer was sure of the identity were also recorded. For practical skills of noting diagnostic characteristics, the identification of species and observation techniques Ryan (2001) is followed. For information on identification, biogeography and ecology Barnes (2000), Hockey, Dean & Ryan, P.G. (2005), Cillié, Oberprieler & Joubert (2004), Tarboton & Erasmus (1998) and Chittenden (2007) were consulted. Ringing of birds fell beyond the scope of this survey and was not deemed necessary. Sites have been walked, covering as many habitats as possible. Signs of the presence of bird species such as spoor and nests have additionally been recorded. Habitat characteristics were surveyed to note potential occurrences of birds.

3.4 REPTILES

Reptile sightings would be 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. 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 were surveyed to note potential occurrences of reptiles.

3.5 AMPHIBIANS

Frogs and toads are usually 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*, *Chrysoritis*, *Erikssonia*, *Lepidochrysops* and *Orachrysops* species (Lepidoptera: Lycaenidae), which live in association with a specific ant species, require a unique ecosystem for their survival (Deutschländer & Bredenkamp, 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 is on a habitat survey.

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 LIMITATIONS

For each study area 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 constraints. The on-site invertebrate survey was conducted during September and November 2012 which is an optimal time of the year to find animal species of high conservation priority. Weather conditions during the survey were favourable for recording fauna. The focus of the 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 more surveys would alter the outcome of this study.

4 RESULTS

4.1 HABITAT AND VEGETATION CHARACTERISTICS

Table 4.1 Outline of main landscape and habitat characteristics of the Study area. This is a discussion to outline the original habitat and its present modifications as it serves as habitat for the faunal complement. This overview relates only to the intactness of the faunal habitat and is not intended to replace the vegetation and wetland report, which discuss the vegetation in more detail.

HABITAT FEATURE	DESCRIPTION
Topography	The study area, within which the alternative sites are located for the proposed development is on gentle slopes. The anthropogenic disturbance in the four alternatives influenced the current topography to a varying degree, The modifications vary from micro-topographic changes, such as historical ploughing, to macro-topographic changes that has altered the landscape on a scale local to the study area, such as ash disposal facilities.
Rockiness	No rocky ridges are present.
Presence of wetlands	Wetlands ranging from semi-natural to conspicuously artificial or modified are present at the site.
Vegetation	The Grassland habitat (which dominates the four sites) is degraded (ploughed or lightly mechanically disturbed) or transformed (converted to revegetated ash disposal facilities) at most of the site. Patches of exotic Australian <i>Acacia</i> trees and <i>Eucalyptus</i> species are present at, and adjacent the site to the North, North East and West of Alternative four. Conspicuous grass species at alternative 3, 2 and 1 include <i>Eragrostis curvula</i> , <i>Hyparrhenia hirta</i> , <i>Sporobolus africanus</i> , <i>Cymbopogon pospischilli</i> and <i>Eragrostis chloromelas</i> . Various exotic weeds are present at these sections at the site. Most notably at areas that have been cleared, where soil or sediment has been topped up and along dirt tracks at the site. These exotic weeds include <i>Datura</i> species, <i>Amaranthus</i> species, exotic <i>Conyza</i> species, <i>Bidens</i> species, <i>Tagetes minuta</i> and <i>Cosmos bipinnatus</i> . A number of alien invasive trees are present at the site including exotic Australian <i>Acacia</i> species, <i>Eucalyptus camaldulensis</i> , <i>Melia azedarach</i> and <i>Solanum mauritianum</i> . Isolated patches of more natural grassland in appearance are present at

Signs of disturbances	<p>alternative 4 at the northern section of the site. A number of indigenous herbaceous species are also present among the grassland at this including <i>Hermannia</i> species, <i>Gazania</i> species and <i>Columbaria scabiosa</i>. (The vegetation and wetland report has a more thorough description of the vegetation and wetland condition in the study area)</p> <p>Most of the site is extensively or completely transformed in terms of natural vegetation and habitat available for fauna. A diversity of exotic trees and weeds reflect the amount of disturbances. Numerous bare interpatches are visible at most sections of the site..</p>
Connectivity of natural vegetation in the site and between the site and surrounding areas	<p>There is little scope for most sections of to be part of a corridor of particular conservation importance. A corridor at the north-eastern section of the study area, which comprises alternative 4 and adjacent wetlands is a viable option that could link patches of natural grassland and wetland areas in a stepping stone corridor to important wetland areas outside and downstream from the site. The Southern portion ,which encompasses alternative 1 and 2, of the study area has little or no primary vegetation left and whilst better connected, are not of any specific biodiversity conservation importance, insofar as rare and threatened fauna species are concerned, outside of the natural ecosystem processes, due to the wetland system and nutrient cycling.</p>



Figure 1 Much of the area that surrounds Grootvlei consists of cultivated fields.
Photo: November 2012, R.F. Terblanche.



Figure 2 Burnt veld at a remaining patch of natural/ semi-natural grassland at Alternative 4. Exotic *Eucalyptus* trees are present in the background.
Photo: September 2012, R.F. Terblanche.



Figure 3 Overlapping footprints of the water mongoose, *Atilax paludinosus* at alternative 2 of the study area. On rare occasion a five toe-pad print is visible (normally only four toe-pads are printed in the substrate).
Photo: September 2012, R.F. Terblanche.



Figure 4 *Spialia asterrodia* (asteroid sandman) nectaring on *Hermannia* species at alternative site 4.
Photo: September 2012, R.F. Terblanche.



Figure 5 Alternative 1 from the vantage point of the ash disposal facility towards the West, depicting secondary grassland

4.3 VERTEBRATE SPECIES OF PARTICULAR CONSERVATION PRIORITY

Table 4.2 Threatened **mammal** species of the Mpumalanga Province.

Species	Red Listed Status	Recorded at site during survey	Likelihood of being resident at the Study area
<i>Acinonyx jubatus</i> Cheetah	Vulnerable	No	Unlikely to be resident
<i>Amblysomus robustus</i> Robust Golden Mole	Vulnerable	No	Unlikely to be resident
<i>Chlorotalpa sclateri</i> Sclater's Golden Mole	Vulnerable	No	Unlikely to be resident
<i>Chrysospalax villosus</i> Rough-haired Golden Mole	Vulnerable	No	Unlikely to be resident
<i>Cistugo lesueuri</i> Lesueur's hairy bat	Vulnerable	No	Unlikely to be resident
<i>Felis nigripes</i> Black-footed cat	Vulnerable	No	Unlikely to be resident
<i>Hippopotamus amphibius</i> Hippopotamus	Vulnerable	No	Unlikely to be resident
<i>Loxodonta africana</i> African Elephant	Vulnerable	No	Unlikely to be resident
<i>Panthera leo</i> Lion	Vulnerable	No	Unlikely to be resident
<i>Lycaon pictus</i> Wild Dog	Endangered	No	Unlikely to be resident

<i>Mystromys albicaudatus</i> White-tailed mouse	Endangered	No	Unlikely to be resident
<i>Neamblysomus julianae</i> Juliana's Golden Mole	Endangered	No	Unlikely to be resident

Literature sources: Friedman & Daly, (2004), Skinner & Chimimba (2005), Wilson & Reeder (2005); IUCN: www.iucnredlist.org. No = Not recorded at site/ Unlikely to be resident at the site. Yes: Recorded at the site/ Likely to be resident at the site.

Table 4.3 Near Threatened **mammal** species known to occur in the Mpumalanga Province.

Species	Red Listed Status	Recorded at site during survey	Likelihood of being resident at the site
<i>Amblysomus septentrionalis</i> Highveld Golden Mole	Near Threatened	No	Unlikely to be resident
<i>Ceratotherium simum</i> White Rhinoceros	Near Threatened	No	Unlikely to be resident
<i>Manis temminckii</i> Ground Pangolin	Lower risk/ Near Threatened	No	Unlikely to be resident
<i>Rhinolaphus blasii</i> Blasius's horseshoe bat	Near Threatened	No	Unlikely to be resident

Literature sources: Skinner & Chimimba (2005), IUCN: www.iucnredlist.org. No = Not recorded at site/ unlikely to be resident at the site. Yes: Recorded at the site/ Likely to be resident at the site.

Table 4.4 Data deficient (or uncertain) **mammal** species of the Mpumalanga Province.

Species	Red Listed Status	Recorded at site during survey	Likelihood of being resident at the site
<i>Mus naevei</i> Neave's Pygmy Mouse	Data Deficient	No	Unlikely to be resident

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

4.3.2 Birds of particular high conservation priority

Table 4.5 Bird species of particular conservation concern in the Mpumalanga Province. Literature sources Barnes (2000), Hockey, Dean & Ryan, P.G. (2005) and Chittenden (2007). No = Bird species is not a resident at the site. Yes = Bird species is a resident at the site.

Species	Common name	Red Listed Status	Recorded at site during survey	Likely to be resident at the site based on habitat assessments or observation
<i>Aegypius occipitalis</i>	White-headed Vulture	Vulnerable	No	No
<i>Aegypius tracheliotos</i>	Lappet-faced Vulture	Vulnerable	No	No
<i>Alcedo semitorquata</i>	Half-collared Kingfisher	Near-threatened	No	No

<i>Anastomus lamelligerus</i>	African Openbill	Near-threatened	No	No
<i>Anthropoides paradiseus</i>	Blue Crane	Vulnerable	No	No
<i>Anthus chloris</i>	Yellow-breasted Pipit	Vulnerable (Globally)	No	No
<i>Apalis ruddi</i>	Rudd's Apalis	Near-threatened	No	No
<i>Aquila ayresii</i>	Ayres's Hawk-Eagle	Near-threatened	No	No
<i>Aquila rapax</i>	Tawny Eagle	Vulnerable	No	No
<i>Ardeotis kori</i>	Kori Bustard	Vulnerable	No	No
<i>Balearica regulorum</i>	Grey Crowned Crane (Mahem)	Vulnerable	No	No
<i>Botaurus stellaris</i>	Eurasian Bittern	Critically Endangered	No	No
<i>Bucorvis leadbeateri</i>	Southern Ground-hornbill	Vulnerable (in South Africa)	No	No
<i>Bugeranus carunculatus</i>	Wattled Crane	Vulnerable (Globally) Critically Endangered (RSA)	No	No
<i>Buphagus africanus</i>	Yellow-billed Oxpecker	Vulnerable	No	No
<i>Buphagus erythrorhynchus</i>	Red-Billed Oxpecker	Near-threatened	No	No
<i>Centropus grillii</i>	Black Coucal	Near-threatened	No	No
<i>Charadrius pallidus</i>	Chestnut-banded Plover	Near-threatened	No	No
<i>Ciconia nigra</i>	Black Stork	Near-threatened	No	No
<i>Circus macrourus</i>	Pallid Harrier	Near-threatened	No	No
<i>Circus ranivorus</i>	African Marsh- Harrier	Vulnerable	No	No
<i>Crex crex</i>	Corn Crane	Vulnerable	No	No
<i>Ephippiorynchus senegalensis</i>	Saddle-billed Stork	Endangered (in RSA)	No	No
<i>Eupodotis caerulea</i>	Blue Korhaan	Near-threatened	No	No

<i>Eupodotis senegalensis</i>	White-bellied Korhaan	Vulnerable	No	No
<i>Falco biarmicus</i>	Lanner Falcon	Near-threatened	No	No
<i>Falco naumanni</i>	Lesser Kestrel	Vulnerable	No	No
<i>Falco peregrinus</i>	Peregrine Falcon	Near-threatened	No	No
<i>Geronticus calvus</i>	Southern Bald Ibis	Vulnerable	No	No
<i>Glareola nordmanni</i>	Black-winged Pratincole	Near-threatened	No	No
<i>Glareola pranticola</i>	Collared Pranticole	Near-threatened	No	No
<i>Gorsachius leuconotus</i>	White-backed Night-heron	Vulnerable	No	No
<i>Gyps africanus</i>	White-backed Vulture	Vulnerable	No	No
<i>Gyps coprotheres</i>	Cape Vulture	Vulnerable	No	No
<i>Heteromirafra ruddi</i>	Rudd's Lark	Critically Endangered (Globally)	No	No
<i>Hirundo atrocaerulea</i>	Blue Swallow	Critically Endangered (in RSA)	No	No
<i>Hypargos margaritatus</i>	Pink-throated Twinspot	Near-threatened	No	No
<i>Leptoptilos crumeniferus</i>	Marabou Stork	Near-threatened	No	No
<i>Lioptilus nigricapillus</i>	Bush Blackcap	Near-threatened	No	No
<i>Lissotis melanogaster</i>	Black-bellied Bustard	Near-threatened	No	No
<i>Macheiramphus alcinus</i>	Bat Hawk	Near-threatened	No	No
<i>Mirafra cheniana</i>	Melodious lark	Near-threatened	No	No
<i>Mycteria ibis</i>	Yellow-billed Stork	Near-threatened	No	No
<i>Neophron percnopterus</i>	Egyptian Vulture	Regionally almost extinct	No	No
<i>Neotis denhami</i>	Denham's Bustard	Vulnerable	No	No

<i>Nettapus auritus</i>	African Pygmy-goose	Near-threatened	No	No
<i>Pelecanus onocrotalus</i>	Great White Pelican	Near-threatened	No	No
<i>Pelecanus rufescens</i>	Pink-backed Pelican	Vulnerable	No	No
<i>Phoenicopterus minor</i>	Lesser Flamingo	Near-threatened	No	No
<i>Phoenicopterus ruber</i>	Greater Flamingo	Near-threatened	No	No
<i>Platysteira peltata</i>	Black-throated Wattle-eye	Near-threatened	No	No
<i>Polemaetus bellicosus</i>	Martial Eagle	Vulnerable	No	No
<i>Rostratula benghalensis</i>	Greater Painted-snipe	Near-threatened	No	No
<i>Rhynchops flavirostris</i>	African Skimmer	Endangered	No	No
<i>Sagittarius serpentarius</i>	Secretarybird	Near-threatened	No	No
<i>Sarothrura affinis</i>	Striped Flufftail	Vulnerable	No	No
<i>Sarothrura ayresi</i>	White-winged Flufftail	Critically Endangered	No	No
<i>Schoenicola brevirostris</i>	Broad-tailed Warbler	Near-threatened	No	No
<i>Scotopelia peli</i>	Pel's Fishing-Owl	Vulnerable	No	No
<i>Spermestes fringilloides</i>	Magpie Mannikin	Near-threatened	No	No
<i>Spizocorys fringillaris</i>	Botha's Lark	Endangered (Globally)	No	No
<i>Stephanoaetus coronatus</i>	African Crowned Eagle	Near-threatened	No	No
<i>Sterna caspia</i>	Caspian Tern	Near-threatened	No	No
<i>Therathopius ecaudatus</i>	Bateleur	Vulnerable (in southern Africa)	No	No
<i>Turnix nanus</i>	Black-rumped Buttonquail	Endangered	No	No
<i>Tyto capensis</i>	African Grass-Owl	Vulnerable	No	No (Could not be totally excluded but no ideal habitat present)

<i>Vanellus albiceps</i>	White-crowned Lapwing	Near-threatened	No	No
<i>Vanellus melanopterus</i>	Black-winged lapwing	Near-threatened	No	No
<i>Zoothera gurneyi</i>	Orange ground-thrush	Near-threatened	No	No

4.3.3 Assessments of reptiles of particular high conservation concern in Mpumalanga Province

The following tables list possible presence or absence of threatened reptile or Near Threatened reptile species in the study area. 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 in the near future (Branch *et al.*, 2006). A full up-dated conservation assessment of reptiles, taking into account the recent IUCN (2001) criteria, can only be used once it becomes available. Alexander & Marais (2007) and Tolley & Burger (2007) give useful indications of present conservation statuses as well as possible red listings of reptile species and subspecies in the near future.

Table 4.6 Threatened **reptile** species of the Mpumalanga Province that are listed in the vulnerable category. Note the reptile atlas with revised conservation assessment is only likely to be available by the end of 2009. Sources: Alexander & Marais (2007), Branch (1998), Tolley & Burger (2007). No = Reptile species is not a resident on the site; Yes = Reptile species is found to be resident on the site.

Species	Common name	Conservation status	Recorded at site during survey	Likelihood of being resident at the site
<i>Smaug (Cordylus) giganteus*</i>	Sungazer	Vulnerable	No	Unlikely to be resident
<i>Python natalensis**</i>	Southern African Python	Vulnerable	No	Unlikely to be resident

* *Smaug (Cordylus) giganteus* is classified by the IUCN as Vulnerable and numbers are declining (Alexander & Marais 2007)

** Although declining in some areas *Python natalensis* is unlikely to retain threatened status when reassessed according to the latest IUCN criteria (Alexander & Marais 2007)

Table 4.7 Near Threatened **reptile** species of the Mpumalanga Province.

Species	Common name	Conservation status	Recorded at site during survey	Likelihood to be resident at the site
<i>Homoroselaps dorsalis</i>	Striped Harlequin Snake	Near Threatened	No	Unlikely to be resident

<i>Kinixys natalensis</i>	Natal Hinged Tortoise	Near Threatened	No	Unlikely to be resident
<i>Lamprophis swazicus</i>	Swazi Rock Snake	Near Threatened	No	Unlikely to be resident

Note the reptile atlas with revised conservation assessment is only likely to be available by the end of 2009. Sources: Alexander & Marais (2007), Branch (1998), Tolley & Burger (2007). No = Reptile species is not a resident on the site; Yes = Reptile species is found to be resident on the site.

Table 4.8 Reptile species of the Mpumalanga Province of which the conservation status is uncertain owing to a lack of information and which are listed in the Data Deficient category.

Species	Common name	Conservation status	Recorded at site during survey	Likely to be resident at the site
<i>Xencocalamus transvaalensis</i>	Transvaal Quill-snouted Snake	Data Deficient	No	Unlikely to be resident

Sources: Alexander & Marais (2007), Branch (1998), Tolley & Burger (2007). No = Reptile species is not a resident on the site; Yes = Reptile species is found to be resident on the site.

4.3.4 Amphibian species of particular high conservation priority

Table 4.9 Threatened amphibian species of the Mpumalanga Province which are listed in the Vulnerable category. Sources: Minter et al. (2004), Du Preez & Carruthers (2009). No = Amphibian species is unlikely to be resident at the site; Yes = Amphibian species is likely to be resident at the site.

Species	Common name	Conservation status	Recorded at site during survey	Likelihood to be resident at the site
<i>Hemisus guttatus</i>	Spotted Shovel-nosed Frog	Vulnerable	No	Unlikely to be resident

Table 4.10 Near Threatened amphibian species in Mpumalanga Province. Sources: Minter et al. (2004), Du Preez & Carruthers (2009). No = Amphibian species is unlikely to be resident at the site; Yes = Amphibian species is likely to be resident at the site.

Species	Common name	Conservation status	Recorded at site during survey	Likelihood to be resident at the site
<i>Strongylopus wageri</i>	Plain Stream Frog	Near Threatened	No	Unlikely to be resident

Table 4.11 Amphibian species of the Mpumalanga Province of which the conservation status is uncertain owing to a lack of information and which are listed in the Data Deficient category.

Species	Common name	Conservation status	Recorded at site during	Likelihood to be
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			survey	resident at the site
<i>Breviceps sopranus</i>	Whistling Rain Frog	Data Deficient	No	Unlikely to be resident

Sources: Minter *et al.* (2004), Du Preez & Carruthers (2009). No = Amphibian species is unlikely to be resident at the site; Yes = Amphibian species is likely to be resident at the site.

4.4 INVERTEBRATE SPECIES OF PARTICULAR HIGH CONSERVATION PRIORITY

4.4.1 Butterfly species of particular high conservation priority

Table 4.12 Threatened **butterfly** species in Mpumalanga Province which appear in the present revised South African red data book of butterflies (Henning, Terblanche & Ball, 2009). Invertebrates such as threatened butterfly species are often very habitat specific and residential status imply a unique ecosystem that is at stake.

Species	Common name	Conservation Status	Recorded at site during survey	Likely to be resident based on habitat assessment
<i>Aloeides barbara</i>	Barbara's Copper	Endangered	No	No
<i>Aloeides nubilus</i>	Cloud Copper	Endangered	No	No
<i>Aloeides rossouwi</i>	Rossouw's Copper	Endangered	No	No
<i>Chrysoritis aureus</i>	Golden Opal	Vulnerable	No	No
<i>Dingana fraterna</i>	Fraternal Widow	Endangered	No	No
<i>Lepidochrysops irvingi</i>	Irving's Blue	Vulnerable	No	No
<i>Lepidochrysops jefferyi</i>	Jeffery's Blue	Endangered	No	No
<i>Lepidochrysops rossouwi</i>	Rossouw's Blue	Vulnerable	No	No
<i>Lepidochrysops swanepoeli</i>	Swanepoel's Blue	Vulnerable	No	No

Table 4.13 Butterfly species of the Mpumalanga Province which are not threatened and not near threatened but of which are of particular conservation concern and listed in the **Rare** category (Mecenero *et al.* In prep.). No = Butterfly species is unlikely to be a resident at the study area; Yes = Butterfly species is a resident at the study area.

Species	Threatened Status	Recorded at study area during survey	Resident at the study area
<i>Metisella meninx</i> Marsh Sylph	Rare (habitat specialist)	No	No (though some individuals may visit/ small population may exist) This butterfly could be present but possible available habitat is marginal rather than ideal.

<i>Platylesches dolomitica</i> Hilltop Hopper	Rare (low density)	No	No
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4.4.2 Fruit chafer beetle species of particular high conservation priority

Table 4.14 Fruit chafer beetle species of the Mpumalanga Province of which the conservation status is uncertain (not a formal category) owing to a lack of information. Sources: Holm & Marais (1992). No = Fruit chafer beetle species is unlikely to be resident at the site; Yes = Fruit chafer beetle species is likely to be resident at the site.

Species	Common name	Conservation Status	Recorded at site during survey	Likely to be resident based on habitat assessment
<i>Discopeltis barbertonensis</i>	-	Uncertain/ Restricted range	No	No
<i>Trichocephala brincki</i>	-	Uncertain/ Data Deficient	No	No

5 DISCUSSION

5.1 HABITAT AND VEGETATION CHARACTERISTICS

An outline of the habitat and vegetation characteristics is given in Table 4.1. This habitat outline serves as an important reference to presence or absence of particular biodiversity and habitat specialist species.

From the perspective of potential habitat for fauna species in threat categories of Red Data Lists, none of the site is worth conserving. The only alternative site worth mentioning is alternative 4, due to the presence of primary vegetation and the associated food plants for a variety of butterflies, none of which are listed in threat categories in Mpumalanga. *Aloeides dentata* could potentially visit alternative 4 due to the foodplant availability; however the closest hills are quite distant and the butterfly is in a threat category in Gauteng, not Mpumalanga.

5.2 VERTEBRATES

5.2.1 Mammals

Table 4.2, Table 4.3 and Table 4.4 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 study area as well.

5.2.2 Birds

Table 4.5 lists the possible presence or absence of threatened bird species and near threatened bird species at the site. Literature sources that were mainly consulted are Barnes (2000), Hockey, Dean & Ryan, P.G. (2005) and Chittenden (2007). The study area does not appear to form part of any habitat of particular importance for any threatened bird species or any other bird species of particular conservation importance.

5.2.3 Reptiles

Table 4.6, Table 4.7 and Table 4.8 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 which should be produced in the near future (Branch *et al.*, 2006). Therefore a full up-dated 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 any part of the study area is developed.

5.2.4 Amphibians

Threatened and Near Threatened amphibian species that occur in the Mpumalanga Province are listed in Table 4.9, Table 4.10 and Table 4.11. Minter, Burger, Harrison, Braack, Bishop and Kloepfer (2004) as well as Du Preez & Carruthers (2009) are followed for compiling these tables. There is no suitable habitat for threatened or near threatened amphibians at the site and it is unlikely that any amphibian species of particular high conservation importance would be threatened if any part of the study area is developed.

5.3 INVERTEBRATES

5.3.1 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 (Deutschländer 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.

There appears to be no threat to any threatened butterfly species if any part of the study area is developed (Tables 4.12, 4.13).

5.3.2 Fruit chafer beetles

Table 4.14 lists the fruit chafer beetle species (Coleoptera: Scarabaeidae: Cetoninae) that are of possible high conservation priority in the Mpumalanga Province. There appears to be no threat to any of the fruit chafer beetles of particular high conservation priority if the site is developed.

6 IMPACT ASSESSMENT AND MITIGATION MEASURES

The proposed development presents a short term construction impact, with a semi-permanent operational phase impact. This is due to the low impact construction methodology selected

The construction related impacts expected on the faunal community is mostly disturbance of shy species during the construction activities and a small footprint of the supports for the photovoltaic arrays.

The operational phase impacts centre on the exclusion of fire from the site – which could potentially affect the plant species composition and therefore the faunal communities supported on the chosen site. Please refer to the vegetation survey for more on this. The shading of large parts of the site due to the photo-voltaic panels will affect the faunal assemblages on the preferred site to an unknown degree; it is likely that a slight compositional change in these assemblages will take place, from those species that are less adaptive to those that are hardier. In some cases insects and other species might be attracted to the reflection off the photo-voltaic panels, they may then succumb to heat when they alight on the panels, this will lead to a population sink for the area, this impact is similar to tin unpainted tin roofs or swimming pools.

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). Furthermore corridors and linkages may play a significant role in insect conservation (Pryke & Samways, 2003, Samways, 2005).

The conservation of habitats is the key to invertebrate conservation, especially for those red listed species that are very habitat specific. This is also true for any detailed planning of corridors and buffer zones for invertebrates. 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.

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). 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.

To summarise: In practice, as far as development planning is concerned, the key would be to prioritise and plan according to sensitive species and special ecosystems. In the case of the Grootvlei PV development, the key to conserving the habitat and minimising the impact on sensitive fauna species would be to avoid the primary grassland alternative 4, and maintain ecosystem processes and rather locate the PV development on other more disturbed alternative sites, such as alternative 1, 2 or 3. By not impacting directly on Alternative 3, many fauna related impacts would be minimised.

In the case of the proposed alternative sites the condition of indigenous vegetation appears to be moderate to very low. There appears to be no loss of any particular unique ecosystems, if the site is developed. There appears to be no loss of any particular sensitive species, if the site is developed.

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 for the current proposed alternative (Alternative 1) as identified by the wetland and vegetation study. The proposed alternative site consists of secondary vegetation and the impacts range from historical ploughing to a re-vegetated Ash disposal facility. It is not expected that sensitive fauna species will occur on 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 low without mitigation and low with mitigation.

Impact summary matrix:

Phase	Significance of Impact				
	None	Low	Moderate	High	With mitigation

Operational		X			Low
Construction			Moderate		Moderate

Mitigation measures:

- Present exotic and invasive plant species should be controlled at the site to be (which was) developed.
- Habitat quality must be ensured through ecological management

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 fauna and flora species that are red listed or of known particular high conservation importance. It is unlikely that the any fauna species and flora species of particular high conservation priority occur on the site. No particular mitigation measures for sensitive species could apply since it is unlikely that any such species occur on the site.

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 low 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:

- Present exotic and invasive plant species should be eradicated where appropriate.

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 short duration, of high intensity (because the continued activity at the site will be a significant deterrent to shy faunal species accessing the site) 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

Mitigation measures:

- No exotic invasive plant species should be planted in the areas to be developed, if the development is approved.
- Present exotic and invasive plant species should be eradicated at the section of the site to be developed, if the development is approved.

7 RECOMMENDATION

- If the development is approved, alien invasive weeds (mostly trees and shrubs) that occur at the proposed site will be eradicated, to avoid shading of the panels, this would be positive.
- It is recommended that the northern section or alternative 4 of the site be noted as higher conservation priority owing to its potential as part of a conservation corridor and owing to patches of more natural grassland as well as wetland areas that are present.
- This means that based on general faunal diversity and available habitat and connectivity of habitat the northeastern section (alternative 3), the southwestern section (alternative 2) and the southeastern sections (alternative 1) as alternatives should be favoured for development and the northern section (alternative 4) should be avoided as an alternative.

8 CONCLUSION

Ecologically indigenous vegetation at the site appears to be considerably transformed at most of the site which has an impact on animal biodiversity. Primary Grassland remained in some areas

such as alternative 4 and in the permanent wetland sections but has relatively poor microhabitat diversity.

Small patches of natural grassland in alternative 4 that could be suitable for the rare and localised butterfly, *Aloeides dentatis* (Roodepoort Copper) have been revisited and it could be concluded that it is highly unlikely that this butterfly species is a resident at the site. Small patches that may have been suitable for mammals of particular conservation concern such as *Mystromys albicaudatus* have been given special attention in the habitat survey but no signs of this species could be observed and based on the isolated and often degraded nature of the habitat it is unlikely that this rare species is present at the site.

No loss of particular habitat or connectivity is foreseen if the development is approved, though the alternative 4 site is least favoured for development in terms of faunal habitat conservation, purely because it contains primary vegetation, and as such is more likely able to support sensitive species in future. In the larger faunal biodiversity conservation this study area will not have a high priority. It is unlikely that there are any threatened animal species or any animal species of particular conservation importance at the study area. It is therefore concluded that if any of the alternative sections at the site is developed, there would be no threat to any threatened or near threatened animal species.

Despite disturbances, signs of mammal species such as caracal (*Caracal caracal*) and water mongoose, *Atilax paludinosus* are found in the study area, mostly alternative 2 a number of butterfly species are also present across the study area. This means that opportunities exist for the site to make contributions towards the conservation of indigenous fauna at the site and in the context of the larger area. Although no threat category species are affected by any of the alternatives, it is worthwhile to protect the natural species remaining on the site, along with the prevalent ecosystem processes. This is accomplished by normal landowner compliance to the National Water Act, the Care for Agricultural Resources Act and National Environmental Management Act. On the study area, this may be practically accomplished by the control of alien invasive species, prevention of overgrazing and, judicious use of fire as a management tool, prevention of pollution as well as wetland conservation practices. The landowner may already be compliant in these aspects and no further action may be necessary.

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