GALAGO ENVIRONMENTAL
Biodiversity & Aquatic Specialists
638 Turf Street
Wingate Park, 0180
Tel: 012-345 4891
Fax: 086 675 6136
Cell: 082 322 5688
vanessam@lantic.net
www.galagoenvironmental.co.za

Avifaunal Habitat Assessment

of

PROPOSED 50MW PV SOLAR FARM ON PORTIONS 26-28, 106, 107 AND THE REMAINDER OF PORTION 15 OF THE FARM SCHIETFONTEIN 437 JQ

May 2016

Report author: Mr. Rihann F. Geyser
Report verified/reviewed by: Dr. A.C. Kemp (Ph.D., Pr.Sci. Nat. (Zoology & Ecology))

DECLARATION OF INDEPENDENCE:

I, Rihann Frans Geyser (690304 5248 084), declare that I:

- am committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas I appreciate the opportunity to also learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them
- act as an independent specialist consultant in the field of ornithology
- am subcontracted as specialist consultant by Galago Environmental CC for the proposed 50MW PV Solar Park and associated Infrastructures on Portions 26 – 28, 106, 107 and the Remainder of Portion 15 of the farm Schietfontein 437 JQ development described in this report
- have no financial interest in the proposed development other than remuneration for work performed
- neither have nor will have any vested or conflicting interests in the proposed development
- undertake to disclose to Galago Environmental CC and its client, and the competent authority, any material information that has or may have the potential to influence decisions by the competent authority as required in terms of the Environmental Impact Assessment Regulations, 2014.

Rihann F. Geyser

VERIFICATION STATEMENT

Mr Rihann F. Geyser is not registered as a Professional Natural Scientist with the S.A. Council for Natural Scientific Professions. This communication serves to verify that the avifaunal report compiled by Mr Rihann F. Geyser has been prepared under my supervision, and I have verified the contents thereof.

Declaration of Independence: I, Alan Charles Kemp (4405075033081), declare that I:

- am committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas I appreciate the opportunity to also learn through the processes of constructive criticism and debate, I reserve the right to form and hold my own opinions and therefore will not willingly submit to the interests of other parties or change my statements to appease them
- abide by the Code of Ethics of the S.A. Council for Natural Scientific Professions
- act as an independent specialist consultant in the fields of zoology and ecology
- am subcontracted as specialist consultant by Galago Environmental CC for the proposed 50MW PV Solar Park and associated Infrastructures on Portions 26 – 28, 106, 107 and the Remainder of Portion 15 of the farm Schietfontein 437 JQ described in this report
- have no financial interest in the proposed development other than remuneration for work performed
- neither have nor will have any vested or conflicting interests in the proposed development
- undertake to disclose to Galago Environmental CC and its client, and the competent authority, any material information that has or may have the potential to influence decisions by the competent authority as required in terms of the Environmental Impact Assessment Regulations, 2014.

Dr. A.C. Kemp

TABLE OF CONTENTS

1. INTRODUCTION 5
2. SCOPE AND OBJECTIVES OF THE STUDY 5
3. STUDY AREA 5
3.1 Locality 5
3.2 Land Use 6
5. RESULTS 9
5.1 Avifaunal Habitat Assessment 9
5.2 Observed and Expected Species Richness 14
5.3 Threatened and Red Listed Bird Species 19
5.4 SUMMARY OF THE RED DATA AVIFAUNAL SPECIES 20
6. FINDINGS AND POTENTIAL IMPLICATIONS 25
7. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE 28
8. RECOMMENDED MITIGATION MEASURES 29
9. CONCLUSIONS 33
10. LITERATURE SOURCES 34

FIGURES:

Figure 1: Locality map of the study area 6
Figure 2: Livestock on the study site 6
Figure 3: The 2527DB q.d.g.c. 8
Figure 4: Avifaunal species habitat systems identified on the study site and within the study area. 10
Figure 5: Dense stands of *Acacia* dominated woodland on the left of the main access road to the study site 11
Figure 6: Open savanna habitat 11
Figure 7: Mixture of *Acacia* dominated trees and grass density 12
Figure 8: *Acacia caffra*, dominant on the study site 12
Figure 9: Drainage area with dense vegetation dominated by *Searsia lancea* trees 13
Figure 10: Water filled quarry in the north-western corner of the study site 14
Figure 11: Avifaunal Sensitivity Map 33

TABLES:

Table 1: Avifaunal habitat composition of the study area 10
Table 2: Avifaunal species observed, that are likely to occur in the study area. 15
Table 3: Red Data avifaunal species recorded for the 2527DB q.d.g.c. 19
Table 4: Red Data avifaunal species assessment for the study site and study area according to the SABAP1 and SABAP2 data for the 2527DB q.d.g.c. 20

1. INTRODUCTION

Galago Environmental CC. was appointed to undertake an avifaunal habitat survey for the proposed 50MW PV Solar Park and associated Infrastructures on Portions 26 – 28, 106, 107 and the Remainder of Portion 15 of the farm Schietfontein 437 JQ (hereinafter referred to as the study site). This is in accordance with the 2014 EIA Regulations emanating from Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998). The study site and the 500 m extended study area (e.s.a.) are hereafter referred to as the study area.

The primary objective was to determine the presence of Red Data avifaunal species and to identify suitable habitat for these species. Direct observations and published data apart, qualitative and quantitative habitat assessments were used to derive the presence / absence of Red Data avifaunal species. A list of avifaunal species likely to be affected by the new development is compiled.

2. SCOPE AND OBJECTIVES OF THE STUDY

- To qualitatively and quantitatively assess the significance of the avifaunal habitat components, and current general conservation status of the property;
- To comment on ecologically sensitive areas;
- To comment on connectivity with natural vegetation and habitats on adjacent sites;
- To provide a list of avifauna that occur or that are likely to occur, and to identify species of conservation importance;
- To highlight potential impacts of the proposed development on the avifauna of the study site, and
- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.

3. STUDY AREA

3.1 Locality

The study site, ±170.8040 ha in extent, is situated south-west of Ga-Rankuwa between the R556 and the N3 Bakwena Highway and west of the M21 (25º38’19.2563”S 27º56’4.359” E) within the Northwest province (Figure 1).

Furthermore the study area is situated within the 2527DB quarter degree grid cell (q.d.g.c.) and more specifically within the 2535_2755 pentad (SABAP2 protocol)(Figure 3). The study site is situated at an altitude of between 1 220 and 1 240 metres above sea level (m a.s.l.).

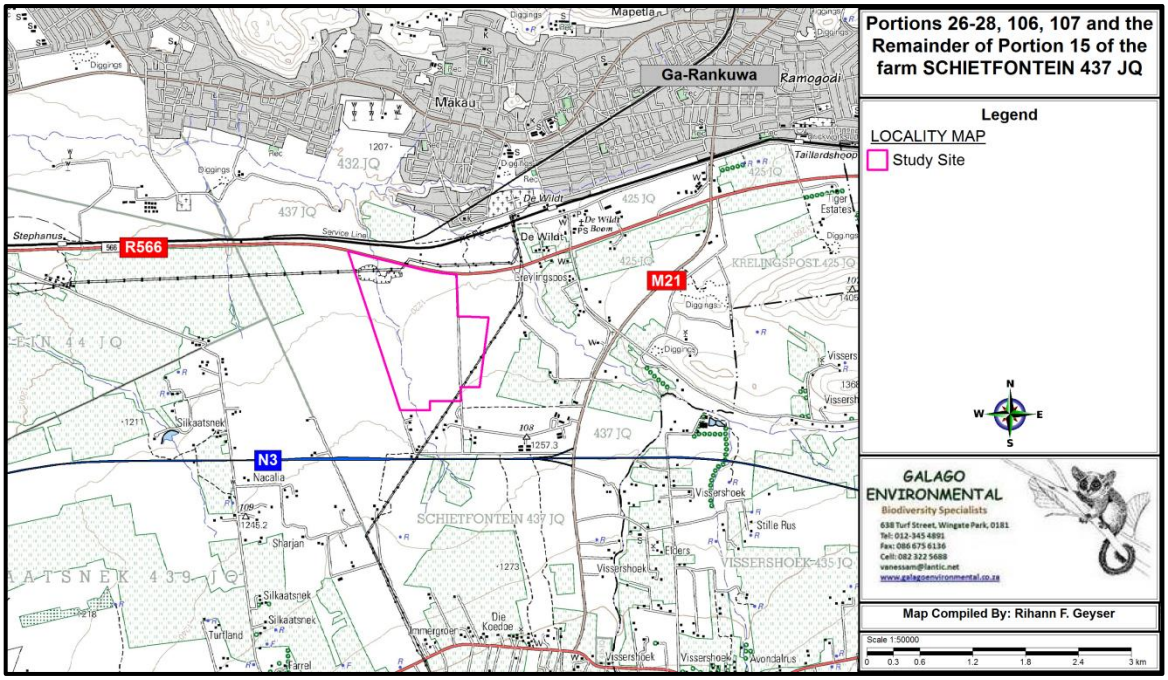

Figure 1: Locality map of the study area

3.2 Land Use

The study site is vacant and being used for grazing by livestock, both sheep and cattle (Figure 2). No large game was observed on the study site. The general area surrounding the study site consists of farms and small holdings with natural Marikana Thornveld and areas in-between where the natural thornveld vegetation has been removed for agricultural croplands with access roads and farm buildings. The area north of the study site and north of the R566 is represented by the Ga-Rankuwa township and is largely disturbed and transformed.

Figure 2: Livestock on the study site

3.3 Biophysical Information

3.3.1 ***Vegetation type and landscape***

The entire study area is situated within the Central Bushveld Bioregion of the Savanna Biome and more specifically within the **Marikana Thornveld** (SVcb 6) vegetation type according to Mucina and Rutherford (2006).

The Marikana Thornveld consists of open *Acacia karroo* dominated woodland growing in valleys and on slightly undulating plains, and some lowland hills. Shrubs are denser along drainage lines, and on termitaria and rocky outcrops or other areas that are protected by fire (Mucina and Rutherford, 2006).

3.3.2 ***Climate***

The study site is situated in a summer rainfall region with very dry winters. The rainfall varies between 600 and 750 mm. Frost occurs frequently in winter but less commonly on the ridges and hills. Temperatures vary between 32.8°C in summer (January) and -1.8°C in winter (July) (Mucina and Rutherford 2006).

3.3.3 ***Conservation status of habitat***

Marikana Thornveld is considered endangered (Mucina and Rutherford, 2006).

4. METHODS

An eight-hour site visit was conducted on 21 April 2016 to record the presence of avifaunal species associated with the habitat systems on the study site and within the study area and to identify possible sensitive areas. During this visit the observed and derived presence of avifaunal species associated with the recognized habitat types of the study site, were recorded. This was done with due regard to the well recorded global distributions of Southern African avifauna, coupled to the qualitative and quantitative nature of recognized habitats.

4.1 Field Surveys

Avifaunal species were identified visually, using 10X42 Bushnell Legend binoculars and a 20X-60X Pentax spotting scope, and by call, and where necessary were verified from Sasol Birds of Southern Africa (Sinclair *et al*., 2011) and Southern African Bird Sounds (Gibbon, 1991).

The 500 m of adjoining properties or extended study area was scanned or surveyed for important avifaunal species and habitats.

During the site visit, avifaunal species were identified by visual sightings or aural records along random transect walks. No trapping or mist netting was conducted, since the terms of reference did not require such intensive work. In addition, avifaunal species were also identified by means of feathers, nests, signs, droppings, burrows or roosting sites. Locals were interviewed to confirm occurrences or absences of species.

4.2 Desktop Surveys

The presence of suitable habitats was used to deduce the likelihood of presence or absence of avifaunal species, based on authoritative tomes, scientific literature, field guides, atlases and databases. This can be done irrespective of season.

The likely occurrence of key avifaunal species was verified according to distribution records obtained during the Southern African Bird Atlas Project 1 (SABAP1) period from 1981 to 1993 (Harrison *et al.* 1997) and the most recent avifaunal distribution data were obtained from the current SABAP2 project which commenced on 1 July 2007.

The occurrence and historic distribution of likely avifaunal species, especially all Red Data avifaunal species recorded for the q.d.g.c. 2527DB, were verified from SABAP1 (southern Africa Bird Atlas Project 1) data (Harrison *et al.* 1997) and the current SABAP2 project (SABAP2 data for the 2527DB q.d.g.c. and for the 2535_2755 pentad). The reporting rate for each avifaunal species likely to occur on the study site, based on Harrison *et al*. (1997), was scored between 0 – 100% and was calculated as follows: Total number of cards on which a species was reported during the Southern African Bird Atlas SABAP1 and, Red Data species only, the current SABAP2 project period X 100 ÷ total number of cards for the particular q.d.g.c. (Harrison *et al*., 1997) and pentad(s) (SABAP2). It is important to note that a q.d.g.c. (SABAP1 Protocol) covers a large area: for example, q.d.g.c. 2527DB covers an area of ±27 X 25 km (±693 km²) (15 minutes of latitude by 15 minutes of longitude, 15' x 15') and a pentad (SABAP2 Protocol) and area of ±8 X 7.6 km (5 minutes of latitude by 5 minutes of longitude, 5' x 5') (Figure 3) and it is possible that suitable habitat will exist for a certain Red Data avifaunal species within this wider area surrounding the study site. However, the specific habitat(s) found on site may not suit the particular Red Data species, even though it has been recorded for the q.d.g.c. or pentad. For example, the Cape Vulture occurs along the Magaliesberg but will not favour the habitat found within the Pretoria CBD, both of which are in the same q.d.g.c. Red Data bird species were selected and categorised according to Barnes (2000).

Figure 3: The 2527DB q.d.g.c. (15 minutes of latitude by 15 minutes of longitude, 15' x 15') is divided in nine smaller grids (5 minutes of latitude by 5 minutes of longitude, 5' x 5') of which each represent a pentad. The pentad in red represents the pentad in which the study site is situated.

An avifaunal biodiversity index (ABI), which gives an indication of the habitat system on the study site that will hold the richest avifaunal species diversity, was calculated as the sum of the probability of occurrence of bird species within a specific habitat system on site. For each species and habitat, the probability of occurrence was ranked as: 5 = present on site, 4 = not observed on site but has a high probability of occurring there, 3 = medium probability, 2 = low probability, 1 = very low probability and 0 = not likely to occur.

5. RESULTS

5.1 Avifaunal Habitat Assessment

One of the primary reasons for conserving avifaunal species is that they are environmental indicators. Being a very mobile fauna, they move from less favourable environments to more favourable ones and are the first to respond to any environmental change, whether positive or negative. One of the difficulties with human-induced environmental change is that it can often be many years before the full, long-term effects of a particular action become apparent. However, avifaunal species are quick to colonize optimal environments and to leave poor or degraded ones.

Some avifaunal species are habitat-specific or have very definite biological or ecological requirements such as specific breeding, roosting or foraging habitat systems. These avifaunal species may not be able to move on and so often become threatened species, especially of their preferred habitat continues to shrink or degrade due to various impacts, which could include change in land-use or water regimes, altered weather patterns, and impacts such as overgrazing, bush encroachment, afforestation, desertification, human development and the general transformation of natural vegetation due to urbanisation, mining and industrialisation. The number of threatened species in an area is therefore an indication of its general environmental health. Avifaunal species are very sensitive to environmental change and when deciding on whether a habitat is suitable, avifaunal species consider things such as the arrangement of vegetation, spaces between the foliage in trees and so on. Because of this sensitivity to their surroundings, avifaunal species can also be used as indicators to determine the health of existing areas. The presence or absence of certain avifaunal species (not only threatened species but also the more common grassland or wetland species) can give an immediate indication of the quality of the habitat system such as water quality depending on particular species individual requirements. This is however a long term process and the presence of these avifaunal species in a certain area can only be determined over a period of time and during different seasons. The availability of suitable habitat is just as important due to the rate that these habitats are being transformed not only for threatened avifaunal species but also species that are habitat specific such as endemic and near-endemic avifaunal species.

Some avifaunal species will favour a specific habitat type such as open grassland while other bird species will make use of more than one habitat system such as open grassland and woodland vegetation. Some avifaunal species are able to adapt to areas change by man while other are very sensitive to human disturbance and areas transformed by man.

Five major avifaunal habitat systems were identified within the study area. These habitat systems are as follow (Figure 4):

a. *Acacia caffra* dominated thornveld (Marikana Thornveld)
b. Drainage line thickets
c. Dams and water filled quarries
d. Fallow Fields and Pastures
e. Disturbed and Transformed Area

Table 1 indicates the habitat composition of the study area in terms of surface area and percentage.

Table 1: Avifaunal habitat composition of the study area

Avifaunal Habitat Systems	Area (ha)	%
Acacia caffra dominated thornveld	± 441.3450 ha	82
Drainage line thickets	± 10.7424 ha	2
Fallow Fields	± 39.1360 ha	7
Dams and water filled quarries	± 1.0151 ha	1
Disturbed and Transformed	± 41.1756 ha	8
Total surface Area:	± 533.4141 ha	

For purpose of this report, habitat systems a - c are combined as one habitat system under woodland vegetation, since the avifaunal biodiversity will not differ significantly from each other.

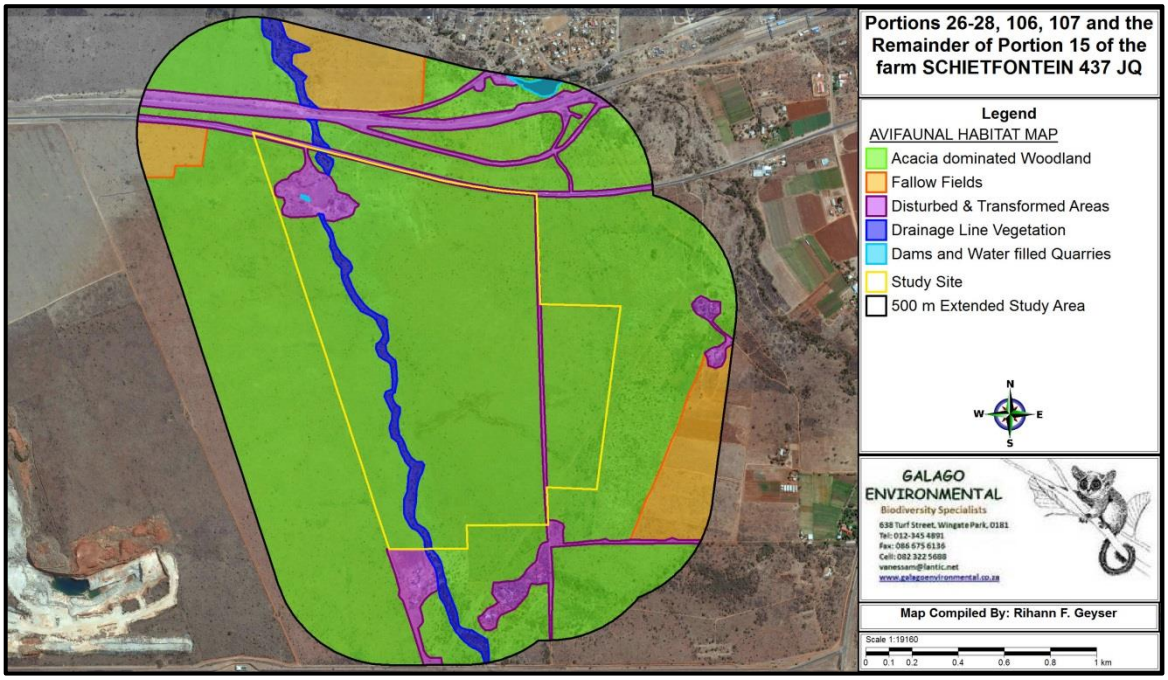

Figure 4: **Avifaunal species habitat systems identified on the study site and within the study area.**

A short description of each habitat system follows, ranked from most to least important.

Woodland Vegetation

82% of the total surface area of the study area consists of woodland vegetation that consists of *Acacia caffra* dominated woodland (90%), drainage line thickets (2%) and fallow fields (8%).

The largest surface area of the study area consists of *Acacia caffra* dominated thornveld represented by the Marikana Thornveld vegetation type. The woodland vegetation varies from dense stands of woodland (Figure 5) to open savanna habitat (Figure 6) and a mixture of vegetation in-between (Figure 7). Most of the trees on the study site consist of small shrubby *Acacia caffra* trees (Figure 8).

Figure 5: Dense stands of *Acacia* dominated woodland on the left of the main access road to the study site

Figure 6: Open savanna habitat

Figure 7: Mixture of *Acacia* dominated trees and grass density

Figure 8: *Acacia caffra*, dominant on the study site

A seasonal drainage line with denser tree cover dominated by *Searsia lancea* (Karee) trees (Figure 9) runs through the western section of the study site with a north-south orientation. This drainage line only holds water during bursts of heavy rain and probably dries up quickly and is subject to small flash floods.

Figure 9: Drainage area with dense vegetation dominated by *Searsia lancea* trees

There are no fallow fields within the boundary of the study site and are limited to within the 500 m e.s.a. These fallow fields are mostly undergoing secondary tree growth and resemble arid thornveld.

This habitat will favour species typically associated with a bushveld habitat and more specifically mixed *Acacia* savanna woodland. This area generally include a great variety of arboreal passerines such as drongos, warblers, flycatchers, shrikes, sunbirds, waxbills and weavers and arboreal non-passerines such as doves, cuckoos and woodpeckers. Many of these species make use of the thorny nature of these trees to build their nests. Acacia trees generally attract many insects and in turn attract a good diversity of typical “Bushveld” bird species. None of the Red Data species listed in the Eskom Red Data Book of Birds of Southern Africa, Lesotho and Swaziland (Taylor, 2015) is likely to make use of the proposed development site.

Dams and water filled quarries

± 1% of the total surface area of the study area consists of a small man-made impoundment outside the boundary of the study site on the northern border of the 500 m e.s.a. and a water filled quarry in the north-western corner of the study site (Figure 10).

Figure 10: Water filled quarry in the north-western corner of the study site

Only the more common aquatic and semi-aquatic avifaunal species are likely to make use of these open water systems and many of the woodland avifaunal species surrounding these dams and quarries will make use of these water sources for drinking and bathing purposes and serves as a water source for livestock grazing on the study area.

Disturbed and Transformed Areas:
The rest of the study area ±37% is disturbed and has been transformed by past and present human activities. These areas include quarries, roads, housing developments and farm houses and cattle kraals.

Only the more common avifaunal species that are able to adapt to areas changed by man will make use of this habitat system. None of these species that occur within these habitat systems are threatened.

5.2 Observed and Expected Species Richness

Of the 316 avifaunal species recorded for the 2527DB q.d.g.c. during the SABAP1 period (Harrison *et al.* 1997) and the current SABA2 period, 181 (57 %) are likely to occur on the study site and 33 (18 %) of these avifaunal species were actually observed within the study area during the time of the survey.

To date 194 avifaunal species were recorded for the q.d.g.c. during the current SABAP2 project compared with 316 species recorded during the SABAP1 period.

The avifaunal biodiversity index (ABI) indicates that the largest avifaunal species diversity are likely to occur within the *Acacia* dominated woodland habitat system, with an avifauna biodiversity index (ABI) of 533 of which 158 species are likely to occur within

this habitat system, followed by the disturbed and transformed areas (ABI 362) with 117 species and the dams and water filled quarries (ABI 272) with 95 species.

The avifaunal species listed in Table 1 are in the species order according to *Roberts - Birds of Southern Africa* VIIth edition (Hockey *et al*, 2005). These comprise the 181 species that are likely to occur within the specific habitat systems on and within 500 m extended study area, with those actually observed in **bold**. This does not include overflying birds or rare vagrants. The reporting rate for each species is the percentage for the q.d.g.c. according to the SABAP 1 atlas (Harrison *et al.* 1997) and is represented by colour codes as follows: Yellow = Very Low, Light Orange = Low, Dark Orange = Medium and Red = High. The colour codes of the SABAP2 reporting rate indicate the following; Red = decrease in reporting rate, Green = increase in reporting rate and Yellow = stable reporting rate compared to the SABAP1 data. The habitat preference scores for each species are shown under the recognised habitat types on site: **WV = Woodland Vegetation, DQ = Dams and Water filled Quarries** and **DT = Disturbed and Transformed,** with their possibility of occurrence in these specific habitats rated as 5 = present, 4 = High, 3 = Medium, 2 = Low, 1 = Very low, and 0 = Not likely to occur.

Table 2: Avifaunal species observed and that are likely to occur within the study area.

SCIENTIFIC NAMES	ENGLISH NAMES*	Reporting rate(%)**		HABITAT PREFERENCE		
		SABAP1	SABAP2	WV	DQ	DT
Peliperdix coqui	Coqui Francolin	**2**	**2**	2	0	0
Dendroperdix sephaena	Crested Francolin	**23**	**27**	4	2	0
Pternistis swainsonii	Swainson's Spurfowl	**54**	**26**	4	4	2
Numida meleagris	Helmeted Guineafowl	**57**	**55**	4	4	3
Dendrocygna viduata	White-faced Duck	**47**	**36**	0	2	0
Alopochen aegyptiaca	Egyptian Goose	**49**	**43**	0	2	0
Anas undulata	Yellow-billed Duck	**24**	**25**	0	3	0
Anas smithii	Cape Shoveler	**5**	**4**	0	1	0
Anas erythrorhyncha	Red-billed Teal	**8**	**11**	0	3	0
Indicator indicator	Greater Honeyguide	**<1**	**3**	1	0	0
Indicator minor	Lesser Honeyguide	**8**	**7**	3	0	0
Campethera abingoni	Golden-tailed Woodpecker	**7**	**22**	4	0	0
Dendropicos fuscescens	Cardinal Woodpecker	**29**	**10**	4	0	0
Dendropicos namaquus	Bearded Woodpecker	**2**	**2**	1	0	0
Pogoniulus chrysoconus	Yellow-fronted Tinkerbird	**13**	**39**	3	0	0
Tricholaema leucomelas	**Acacia Pied Barbet**	**29**	**10**	5	0	2
Lybius torquatus	Black-collared Barbet	**77**	**67**	4	0	4
Trachyphonus vaillantii	Crested Barbet	**87**	**79**	4	0	4
Tockus nasutus	**African Grey Hornbill**	**56**	**48**	5	0	4
Upupa africana	African Hoopoe	**69**	**42**	4	0	4
Phoeniculus purpureus	Green Wood-Hoopoe	**51**	**38**	4	0	4
Coracias garrulus	European Roller (**LC/NT**)	**<1**	**<1**	1	0	0
Coracias caudatus	Lilac-breasted Roller	**18**	**9**	2	0	0
Halcyon senegalensis	Woodland Kingfisher	**18**	**15**	4	0	3
Halcyon albiventris	Brown-hooded Kingfisher	**68**	**57**	4	0	4
Ceryle rudis	Pied Kingfisher	**57**	**25**	0	2	0
Merops pusillus	Little Bee-eater	**13**	**1**	2	1	0
Merops bullockoides	White-fronted Bee-eater	**9**	**31**	2	3	1
Merops apiaster	European Bee-eater	**13**	**17**	4	2	0
Colius colius	White-backed Mousebird	**10**	**2**	2	0	1
Colius striatus	Speckled Mousebird	**67**	**62**	4	0	4

SCIENTIFIC NAMES	ENGLISH NAMES*	Reporting rate(%)**		HABITAT PREFERENCE		
		SABAP1	SABAP2	WV	DQ	DT
Urocolius indicus	**Red-faced Mousebird**	**48**	**55**	5	5	4
Clamator jacobinus	Jacobin Cuckoo	**4**	**2**	2	0	1
Cuculus solitarius	Red-chested Cuckoo	**27**	**20**	2	0	2
Cuculus clamosus	Black Cuckoo	**3**	**9**	3	0	1
Chrysococcyx klaas	Klaas's Cuckoo	**1**	**5**	2	0	1
Chrysococcyx caprius	Diderick Cuckoo	**29**	**31**	4	4	3
Centropus burchellii	Burchell's Coucal	**63**	**29**	2	2	3
Cypsiurus parvus	African Palm-Swift	**21**	**65**	4	4	4
Apus barbatus	African Black Swift	**2**	**3**	2	1	0
Apus affinis	Little Swift	**26**	**42**	4	4	4
Apus caffer	White-rumped Swift	**4**	**24**	4	4	4
Corythaixoides concolor	**Grey Go-away-bird**	**77**	**84**	5	2	4
Tyto alba	Barn Owl	**35**	**4**	4	1	4
Ptilopsis granti	Southern White-faced Scops-Owl	**3**	**<1**	2	0	0
Bubo africanus	Spotted Eagle-Owl	**17**	**3**	3	1	3
Glaucidium perlatum	Pearl-spotted Owlet	**17**	**5**	4	0	1
Columba livia	Rock Dove	**26**	**28**	0	2	3
Columba guinea	**Speckled Pigeon**	**76**	**52**	4	5	5
Streptopelia senegalensis	**Laughing Dove**	**95**	**93**	5	4	5
Streptopelia capicola	**Cape Turtle-Dove**	**51**	**26**	5	4	5
Streptopelia semitorquata	**Red-eyed Dove**	**57**	**83**	5	4	4
Turtur chalcospilos	Emerald-spotted Wood-Dove	**3**	**2**	2	2	0
Oena capensis	Namaqua Dove	**38**	**8**	3	3	1
Treron calvus	African Green-Pigeon	**2**	**20**	1	0	2
Lophotis ruficrista	Red-crested Korhaan	**12**	**<1**	2	0	0
Gallinula chloropus	Common Moorhen	**16**	**31**	0	2	0
Fulica cristata	Red-knobbed Coot	**43**	**32**	0	3	0
Tringa glareola	Wood Sandpiper	**15**	**6**	0	2	0
Actitis hypoleucos	Common Sandpiper	**12**	**1**	0	2	0
Burhinus capensis	Spotted Thick-knee	**49**	**27**	4	1	3
Charadrius tricollaris	Three-banded Plover	**26**	**19**	0	3	0
Vanellus armatus	Blacksmith Lapwing	**66**	**64**	0	3	0
Vanellus senegallus	African Wattled Lapwing	**19**	**32**	1	1	0
Vanellus coronatus	**Crowned Lapwing**	**67**	**69**	5	0	2
Elanus caeruleus	**Black-shouldered Kite**	**59**	**51**	5	2	2
Gyps coprotheres	Cape Vulture (**VU/EN**)	**31**	**14**	1	0	0
Circaetus pectoralis	Black-chested Snake-Eagle	**9**	**5**	2	0	0
Polyboroides typus	African Harrier-Hawk	**5**	**3**	2	0	0
Melierax gabar	Gabar Goshawk	**8**	**2**	2	0	0
Accipiter minullus	Little Sparrowhawk	**2**	**4**	3	1	3
Buteo vulpinus	Steppe Buzzard	**11**	**6**	2	0	0
Falco amurensis	Amur Falcon	**1**	**10**	3	0	0
Falco biarmicus	Lanner Falcon (**NT/VU**)	**1**	**2**	1	0	0
Tachybaptus ruficollis	Little Grebe	**22**	**31**	0	3	0
Phalacrocorax africanus	Reed Cormorant	**43**	**47**	0	4	0
Ardea cinerea	Grey Heron	**67**	**32**	0	2	0
Ardea melanocephala	Black-headed Heron	**35**	**37**	4	2	0
Ardea purpurea	Purple Heron	**21**	**11**	0	2	0

SCIENTIFIC NAMES	ENGLISH NAMES*	Reporting rate(%)**		HABITAT PREFERENCE		
		SABAP1	SABAP2	WV	DQ	DT
Bubulcus ibis	Cattle Egret	76	72	4	4	4
Scopus umbretta	Hamerkop	62	15	0	4	0
Bostrychia hagedash	Hadeda Ibis	75	76	3	4	4
Threskiornis aethiopicus	African Sacred Ibis	46	51	0	2	0
Oriolus larvatus	Black-headed Oriole	19	10	4	2	4
Dicrurus adsimilis	Fork-tailed Drongo	55	43	4	1	4
Terpsiphone viridis	African Paradise-Flycatcher	35	27	4	0	4
Nilaus afer	Brubru	3	3	2	0	1
Dryoscopus cubla	Black-backed Puffback	38	31	4	0	4
Tchagra senegalus	Black-crowned Tchagra	24	12	3	0	0
Tchagra australis	Brown-crowned Tchagra	9	21	4	0	0
Laniarius ferrugineus	**Southern Boubou**	45	75	5	0	4
Laniarius atrococcineus	**Crimson-breasted Shrike**	22	18	5	0	4
Telophorus zeylonus	Bokmakierie	18	6	3	0	1
Malaconotus blanchoti	Grey-headed Bush-Shrike	3	14	3	0	3
Batis molitor	Chinspot Batis	29	26	4	0	4
Corvus albus	**Pied Crow**	63	36	5	4	5
Lanius collurio	Red-backed Shrike	14	10	4	0	1
Lanius minor	Lesser Grey Shrike	3	3	3	0	0
Lanius collaris	**Southern Fiscal**	87	60	5	4	4
Corvinella melanoleuca	Magpie Shrike	16	10	3	0	0
Parus niger	Southern Black Tit	5	2	4	0	2
Hirundo rustica	Barn Swallow	24	32	4	4	4
Hirundo albigularis	White-throated Swallow	25	34	2	3	2
Hirundo dimidiata	Pearl-breasted Swallow	1	4	3	1	0
Hirundo cucullata	Greater Striped Swallow	17	34	4	4	4
Hirundo abyssinica	Lesser Striped Swallow	41	51	4	4	4
Hirundo semirufa	Red-breasted Swallow	3	8	3	2	0
Hirundo fuligula	Rock Martin	22	34	2	2	2
Delichon urbicum	Common House-Martin	3	3	2	2	2
Pycnonotus tricolor	**Dark-capped Bulbul**	93	93	5	4	5
Stenostira scita	Fairy Flycatcher	3	1	4	0	3
Sylvietta rufescens	**Long-billed Crombec**	26	26	5	0	4
Phylloscopus trochilus	Willow Warbler	8	15	4	0	0
Turdoides jardineii	Arrow-marked Babbler	49	45	4	0	4
Parisoma subcaeruleum	**Chestnut-vented Tit-Babbler**	36	29	5	0	2
Zosterops virens	**Cape White-eye**	69	66	5	0	4
Cisticola chiniana	Rattling Cisticola	21	29	4	0	2
Cisticola fulvicapilla	**Neddicky**	12	30	5	2	4
Cisticola juncidis	Zitting Cisticola	7	31	2	0	0
Prinia subflava	Tawny-flanked Prinia	35	71	3	4	3
Prinia flavicans	**Black-chested Prinia**	28	31	5	0	0
Apalis thoracica	Bar-throated Apalis	12	31	3	0	3
Camaroptera brevicaudata	Grey-backed Camaroptera	2	16	4	0	2
Mirafra africana	Rufous-naped Lark	4	10	2	0	0
Calendulauda sabota	Sabota Lark	16	6	4	0	0
Psophocichla litsitsirupa	Groundscraper Thrush	20	20	2	0	3
Turdus libonyanus	Kurrichane Thrush	32	41	3	0	3
Turdus smithi	**Karoo Thrush**	64	65	5	4	4

SCIENTIFIC NAMES	ENGLISH NAMES*	Reporting rate(%)**		HABITAT PREFERENCE		
		SABAP1	SABAP2	WV	DQ	DT
Bradornis mariquensis	Marico Flycatcher	**8**	**7**	3	0	3
Melaenornis pammelaina	Southern Black Flycatcher	**8**	**7**	3	0	3
Sigelus silens	**Fiscal Flycatcher**	**44**	**21**	5	0	4
Muscicapa striata	Spotted Flycatcher	**5**	**18**	4	0	4
Cossypha caffra	Cape Robin-Chat	**56**	**60**	4	3	4
Cossypha humeralis	White-throated Robin-Chat	**15**	**21**	4	0	0
Cercotrichas leucophrys	**White-browed Scrub-Robin**	**30**	**22**	5	0	1
Cercotrichas paena	Kalahari Scrub-Robin	**5**	**9**	2	0	0
Saxicola torquatus	African Stonechat	**24**	**27**	1	2	0
Cercomela familiaris	Familiar Chat	**12**	**8**	2	1	1
Onychognathus morio	Red-winged Starling	**65**	**47**	0	0	2
Lamprotornis nitens	**Cape Glossy Starling**	**45**	**40**	5	4	5
Cinnyricinclus leucogaster	Violet-backed Starling	**12**	**7**	4	0	4
Creatophora cinerea	Wattled Starling	**<1**	**13**	3	0	2
Acridotheres tristis	**Common Myna**	**4**	**85**	2	3	5
Buphagus erythrorhynchus	Red-billed Oxpecker (**NT/LC**)	**1**	**1**	2	0	0
Chalcomitra amethystina	Amethyst Sunbird	**36**	**40**	4	0	4
Cinnyris talatala	**White-bellied Sunbird**	**69**	**76**	5	0	4
Cinnyris mariquensis	Marico Sunbird	**22**	**7**	3	0	2
Sporopipes squamifrons	Scaly-feathered Finch	**29**	**9**	4	2	1
Ploceus capensis	Cape Weaver	**6**	**5**	1	1	1
Ploceus velatus	**Southern Masked-Weaver**	**75**	**87**	5	5	5
Quelea quelea	Red-billed Quelea	**20**	**25**	4	3	2
Euplectes orix	Southern Red Bishop	**38**	**55**	2	3	2
Euplectes albonotatus	White-winged Widowbird	**32**	**48**	0	1	0
Euplectes ardens	Red-collared Widowbird	**8**	**6**	1	1	0
Ortygospiza atricollis	African Quailfinch	**3**	**2**	1	2	0
Amadina erythrocephala	Red-headed Finch	**21**	**11**	4	3	4
Amadina fasciata	Cut-throat Finch	**38**	**10**	4	3	2
Estrilda erythronotos	Black-faced Waxbill	**12**	**2**	4	0	2
Estrilda astrild	**Common Waxbill**	**18**	**18**	3	5	2
Granatina granatina	Violet-eared Waxbill	**14**	**3**	5	4	3
Uraeginthus angolensis	**Blue Waxbill**	**67**	**60**	5	4	4
Pytilia melba	Green-winged Pytilia	**8**	**6**	4	4	4
Lagonosticta senegala	Red-billed Firefinch	**11**	**12**	4	4	4
Lagonosticta rhodopareia	Jameson's Firefinch	**15**	**14**	4	4	4
Spermestes cucullatus	Bronze Mannikin	**41**	**38**	4	4	4
Vidua macroura	Pin-tailed Whydah	**28**	**26**	4	4	4
Vidua paradisaea	Long-tailed Paradise-Whydah	**20**	**4**	4	3	2
Vidua regia	Shaft-tailed Whydah	**5**	**1**	2	0	0
Vidua chalybeata	Village Indigobird	**3**	**4**	1	0	1
Vidua funerea	Dusky Indigobird	**2**	**1**	1	0	1
Vidua purpurascens	Purple Indigobird	**2**	**<1**	1	0	1
Passer domesticus	**House Sparrow**	**81**	**50**	0	0	5
Passer melanurus	Cape Sparrow	**77**	**60**	2	3	4
Passer diffusus	**Southern Grey-headed Sparrow**	**35**	**60**	5	4	5

SCIENTIFIC NAMES	ENGLISH NAMES*	Reporting rate(%)**		HABITAT PREFERENCE		
		SABAP1	SABAP2	WV	DQ	DT
Motacilla capensis	Cape Wagtail	**81**	**62**	0	3	2
Anthus cinnamomeus	African Pipit	**11**	**20**	2	0	0
Crithagra mozambicus	Yellow-fronted Canary	**32**	**29**	4	4	4
Crithagra atrogularis	**Black-throated Canary**	**35**	**50**	5	5	4
Crithagra gularis	Streaky-headed Seedeater	**8**	**18**	4	3	4
Emberiza tahapisi	**Cinnamon-breasted Bunting**	**10**	**14**	5	0	2
Emberiza flaviventris	Golden-breasted Bunting	**17**	**9**	4	2	0
	Avifaunal Biodiversity Index			**533**	**272**	**362**

*Red data status according to Barnes (2000)/Red Data status according to BirdLife SA 2014 Checklist of Birds – List of Threatened Species (www.birdlife.org.za) (Taylor *et al* 2015)

**The reporting rate of SABAP1 and SABAP2 is calculated as follows: Total number of cards on which a species was reported X 100 ÷ total number of cards for a particular quarter degree grid cell.

The reporting rate for each species is the percentage for the q.d.g.c. according to the SABAP 1 atlas (Harrison *et al.* 1997) and is represented by colour codes as follows: Yellow = Very Low, Light Orange = Low, Dark Orange = Medium and Red = High. The colour codes of the SABAP2 reporting rate indicate the following; Red = decrease in reporting rate, Green = increase in reporting rate and Yellow = stable reporting rate compared to the SABAP1 data.

Red Data Species Categories for the birds (according to BirdLife SA 2014 Checklist of Birds – List of Threatened Species – The 2014 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland Unpubl)
EX= Extinct (regionally), **CR** = Critically Endangered **EN** = Endangered, **VU** = Vulnerable, **NT** = Near-threatened, **LC** = Least Concern, **DD** = Data Deficient, **NR** = Not Recognised by BirdLife International, **NA** = Not Assessed.

5.3 Threatened and Red Listed Bird Species

The following Red Data avifaunal species were recorded for the 2527DB q.d.g.c. according to the SABAP1 data (Harrison *et al.* 1997) and the SABAP2 data for the 2527DB q.d.g.c. and more specifically the 2535_2755 pentad in which the study area is situated (sabap2.adu.org.za May 2016) (Table 2).

Table 3: Red Data avifaunal species recorded for the 2527DB q.d.g.c.

SCIENTIFIC NAMES	ENGLISH NAMES*	Reporting Rate (%)**		
		SABAP1	SABAP2	Pentad
Coracias garrulus	European Roller (**LC/NT**)	**0.4**	**0.4**	0
Alcedo semitorquata	Half-collared Kingfisher (**NT/NT**)	**1.2**	**0.4**	0
Tyto capensis	African Grass-Owl (**VU/VU**)	**1.2**	0	0
Anthropoides paradiseus	Blue Crane (**VU/NT**)	**1.2**	0	0
Pterocles gutturalis	Yellow-throated Sandgrouse (**NT/NT**)	**0.4**	0	0
Sterna caspia	Caspian Tern (**NT/VU**)	**0**	**1.5**	0
Gyps africanus	White-backed Vulture (**VU/EN**)	**10**	**0.8**	0
Gyps coprotheres	Cape Vulture (**VU/EN**)	**31**	**14**	0
Aquila verreauxii	Verreauxs' Eagle (**LC/VU**)	**28**	**8.6**	0
Aquila ayresii	Ayres's Hawk-Eagle (**NT/LC**)	**0.4**	0	0
Polemaetus bellicosus	Martial Eagle (**VU/EN**)	**1**	0	0
Sagittarius serpentarius	Secretarybird (**NT/VU**)	**13**	0	0
Falco vespertinus	Red-footed Falcon (**LC/NT**)	**0.4**	0	0
Falco biarmicus	Lanner Falcon (**NT/VU**)	**1**	**2.3**	0
Falco peregrinus	Peregrine Falcon (**NT/LC**)	**0**	**0.6**	0
Phoenicopterus ruber	Greater Flamingo (**NT/NT**)	**2**	**0.6**	0
Phoenicopterus minor	Lesser Flamingo (**NT/NT**)	**1**	0	0
Pelecanus rufescens	Pink-backed Pelican (**VU/VU**)	**0.4**	0	0
Mycteria ibis	Yellow-billed Stork (**NT/EN**)	**2**	**0.6**	**5**

SCIENTIFIC NAMES	ENGLISH NAMES*	Reporting Rate (%)**		
		SABAP1	SABAP2	Pentad
Ciconia nigra	Black Stork (**NT/VU**)	**9**	**0.4**	0
Ciconia abdimii	Abdim's Stork (**LC/NT**)	**8**	**0.2**	0
Buphagus erythrorhynchus	Red-billed Oxpecker (**NT/LC**)	**1**	**0.8**	0
	TOTAL:	**20**	**13**	**1**

*Red data status according to Barnes (2000)/Red Data status according to BirdLife SA 2014 Checklist of Birds – List of Threatened Species (www.birdlife.org.za) (Taylor *et al* 2015)

**The reporting rate of SABAP1 and SABAP2 is calculated as follows: Total number of cards on which a species was reported X 100 ÷ total number of cards for a particular quarter degree grid cell.

The reporting rate for each species is the percentage for the q.d.g.c. according to the SABAP 1 atlas (Harrison *et al.* 1997) and is represented by colour codes as follows: Yellow = Very Low, Light Orange = Low, Dark Orange = Medium and Red = High. The colour codes of the SABAP2 reporting rate indicate the following; Red = decrease in reporting rate, Green = increase in reporting rate and Blue= stable reporting rate compared to the SABAP1 data.

Red Data Species Categories for the birds (according to BirdLife SA 2014 Checklist of Birds – List of Threatened Species – The 2014 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland Unpubl)
EX= Extinct (regionally), **CR** = Critically Endangered **EN** = Endangered, **VU** = Vulnerable, **NT** = Near-threatened, **LC** = Least Concern, **DD** = Data Deficient, **NR** = Not Recognised by BirdLife International, **NA** = Not Assessed.

A total of 22 Red Data avifaunal species have been recorded within the 2527DB q.d.g.c. during the SABAP1 period and the current SABAP2 period, 20 during the SABAP1 period , 13 during the current SABAP2 period and 1 for the 2535_2755 pentad in which the study area in situated (sabap2.adu.org.za May 2016).

A total of 81% (n=18) of the Red Data Species recorded for the 2527DB q.d.g.c. indicate a decrease in reporting rate, 14% (n=3) an increase in reporting rate and 5% (n=1) remains stable.

5.4 SUMMARY OF THE RED DATA AVIFAUNAL SPECIES

Table 4 provides a list of the Red Data avifaunal species recorded for the 2527DB q.d.g.c. according to Harrison *et al.* (1997) and an indication of their likelihood of occurrence on the study site and within the study area based on actual sightings, habitat and food availability.

Table 4: Red Data avifaunal species assessment for the study site and study area according to the SABAP1 and SABAP2 data for the 2527DB q.d.g.c.

SPECIES NAME*	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE ON STUDY SITE
Coracias garrulus (European Roller) (**LC/NT**)	Closed to very open savanna. Most common in open, broadleaved and *Acacia* woodlands with grassy clearings; least common in areas with less-developed woody cover.	Unlikely Only Likely to move through the area on very rare occasions
Alcedo semitorquata (Half-collared Kingfisher) (**NT/NT**)	None on site: Requires fast-flowing streams, rivers and estuaries, usually with dense marginal vegetation (Maclean, 1993), especially perennial streams and smaller rivers with overhanging riparian vegetation on their banks. Nests in sand/earth banks (Tarboton *et al*. 1987) and requires riverbanks in which to excavate nest tunnels (Harrison *et al.* 1997a). Most typically occurs along fast-flowing streams with clear water and well-wooded riparian growth, often near rapids. It most frequently favours broken escarpment terrain and requires at least 1 km up and down stream of undisturbed river and riparian vegetation while breeding. It occurs from sea-level to	Highly unlikely Due to a lack of suitable mangrove habitat

SPECIES NAME*	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE ON STUDY SITE
	2000 m a.s.l. in southern Africa. Usually perches low down on the banks of rivers and streams, often on exposed roots, as well as exposed rock and low overhanging tree branches.	
Tyto capensis (African Grass-Owl) (**VU/VU**)	None on site: Occurs predominately in rank grass, typically but not always at fairly high altitudes. Breeds mainly in permanent and seasonal vleis, which it vacates while hunting or during post-breeding although it will sometimes breed in any area of long grass, sedges or even weeds (Van Rooyen, pers comm.) and not necessarily associated with wetlands (Tarboton *et al*. 1987) although this is more the exception than the rule. Foraging mainly confined to tall grassland next to their wetland vegetation and rarely hunts in short grassland, wetlands or croplands nearby (Barnes, 2000). Mainly restricted to wet areas (marshes and vleis) where tall dense grass and/or sedges occur. Prefers permanent or seasonal vleis and vacates the latter when these dried up or are burnt. Roosts and breeds in vleis but often hunt elsewhere e.g. old lands and disturbed grassland although this is suboptimal habitat conditions (Tarboton *et al*. 1987). May rarely occur in sparse *Acacia* woodland where patches of dense grass cover are present (Harrison *et al*. 1997a).	Highly unlikely Due to a lack of suitable mangrove habitat
Anthropoides paradiseus (Blue Crane) (**VU/NT**)	Yes/None on site: Midlands and highland grassland, edge of karoo, cultivated land and edges of vleis (Maclean, 1993). Nests in both moist situations in vleis which have short grass cover and in dry sites far from water, usually exposed places such as on hillsides; forages in grassland and cultivated and fallow lands; roosts communally in the shallow water of pans and dams (Tarboton *et al*. 1987). Short dry grassland, being more abundant and evenly disturbed in the eastern "sour" grassland, where natural grazing of livestock is the predominant land use. Prefers to nest in areas of open grassland (Barnes, 2000) In the fynbos biome it inhabit cereal croplands and cultivated pastures and avoids natural vegetation. By contrast, it is found in natural vegetation in the Karoo and grassland biomes, but it also feeds in crop fields (Harrison *et al*. 1997a).	Highly unlikely Due to a lack of suitable mangrove habitat. Localised but common in the south-eastern Gauteng (Marais & Peacock, 2008)
Sterna caspia (Caspian Tern) (**NT/VU**)	None on site: Occurs along coast, mostly in sheltered bays and estuaries. Inland, at large water bodies, both natural and man-made, with preference for saline pans and large impoundments. Coastal breeding habitat primarily offshore islands, but with increasing use of sandy beaches and islands in saltworks, where protection is offered. Inland, breeds on small, low islets in pans and dams (Hockey *et al*. 2005).	Highly unlikely Due to a lack of suitable mangrove habitat. Non-breeding winter visitor to large water bodies in Gauteng (Marais & Peacock, 2008)
Pterocles gutturalis (Yellow-throated Sandgrouse) (**NT/NT**)	Yes/None on site: Inhabits short, open grassy plains, particularly on relatively moist, black/cotton clay-like soils, usually near seasonal rivers or swamps, or on seasonal flood plains where pioneer plant communities provide an abundant source of seeds for food. Also, readily occupies fallow fields in	Highly unlikely Due to a lack of suitable mangrove habitat.

SPECIES NAME*	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE ON STUDY SITE
	cultivated areas and recently burnt ground (Hockey *et al*. 2005). Short open grassveld, fallow fields and recently burnt veld on black clay soils, but avoid coarser soils derived from quartzite, granite or felsite, and also avoids natural, pristine *Acacia* savanna, preferring agricultural fields (Tarboton, *et al.* 1999).	
Gyps africanus (White-backed Vulture) (**VU/EN**)	Yes/None on site: Their presence is dependent on the availability of food. Lightly wooded arid savanna, including Mopane *Colophospernum mopane* woodland; but absent from forest, true deserts, and the treeless grass- and shrubland of the south and central Karoo (Hockey *et al*. 2005).	Highly unlikely Due to a lack of suitable foraging and breeding habitat.
Gyps coprotheres (Cape Vulture) (**VU/EN**)	They mostly occur in mountainous country, or open county with inselbergs and escarpments; less commonly as visitors to savannah or desert (Maclean, 1993). Forage over open grassland, woodland and agricultural areas; usually roosts on cliffs, but will also roost on trees and pylons (Barnes, 2000). It is reliant on tall cliffs for breeding but it wanders widely away from these when foraging. It occurs and breeds from sea level to 3 100 m.a.s.l. Current distribution is closely associated with subsistence communal grazing areas characterised by high stock losses and low use of poisons and, to a lesser extent, with protected areas (Harrison *et al*. 1997a), but their presence is ultimately dependent on the availability of food.	Highly unlikely Due to a lack of suitable foraging and breeding habitat. Breeds in Magaliesberg; uncommon wanderer elsewhere; mostly SW & NW Gauteng (Marais & Peacock, 2008)
Aquila verreauxii (Verreauxs Eagle) (**LC/VU**)	Yes: Mountains and rocky areas with cliffs.	Highly unlikely Due to a lack of suitable mangrove habitat.
Aquila ayresii (Ayres's Hawk-Eagle) (**NT/LC**)	Yes/None on site: Non-breeding summer visitor to South Africa, favouring dense woodland and forest edge, often in hilly country. Regular in larger northern cities and towns (Johannesburg, Pretoria, Mokopane/Pietersburg), where it often roosts in *Eucalyptus* stands or other tall trees within its prime distribution range (Hockey *et al*. 2005).	Highly unlikely There is no suitable habitat for this species on the study site. Rare in Gauteng (Marais & Peacock, 2008)
Polemaetus bellicosus (Martial Eagle) (**VU/EN**)	Yes/None on site: Tolerates a wide range of vegetation types, being found in open grassland, scrub, Karoo, agricultural lands and woodland, It relies on large trees (or electricity pylons) to provide nest sites (Barnes, 2000) as well as windmills and even cliffs in treeless areas . It occurs mainly in flat country and is rarer in mountains, and it also avoids extreme desert, and densely wooded and forested areas (Harrison *et al*. 1997a & Barnes, 2000).	Highly unlikely Due to a lack of suitable mangrove habitat. Uncommon local resident (Marais & Peacock, 2008)
Sagittarius serpentarius (Secretarybird) (**NT/VU**)	None on site: Open grassland with scattered trees, shrubland, open *Acacia* and *Combretum* savanna (Hockey *et al*. 2005). Restricted to large conservation areas in the region. Avoids densely	Highly unlikely Due to a lack of suitable mangrove habitat.

SPECIES NAME*	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE ON STUDY SITE
	wooded areas, rocky hills and mountainous areas (Hockey *et al*. 2005 & Barnes, 2000). Requires small to medium-sized trees with a flat crown for nesting, and often roosts in similar locations. Nesting density only about 150 km^2/pair (n = 4, Kemp, 1995).	Uncommon in open areas within Gauteng (Marais & Peacock, 2008)
Falco vespertinus (Red-footed Falcon) (**VU/LC**)	None on site: Gregarious; on non-breeding grounds (southern Africa), spends much of day in air, often at high altitude, but lower in mornings and evenings when hawking emergent insects. Frequently perches on dead trees, telephone poles and wires, and fence lines. Aggregates in late evening at communal roosts, sometimes containing 1 000+ birds. Settles at dusk, dispersing to foraging area at first light. In east of region, small numbers associate with large flocks of Amur Falcons and/or Lesser Kestrels. Flight graceful, with much gliding and soaring. European breeding population reduced by habitat loss and pesticide spraying.	Highly unlikely Due to a lack of suitable breeding habitat.
Falco biarmicus (Lanner Falcon) (**NT/VU**)	None on site: Most frequent in open grassland, open or cleared woodland, and agricultural areas. Breeding pairs generally favour habitats where cliffs are available as nest and roost sites, but will use alternative sites such as trees, electricity pylons and building ledges if cliffs are absent (Hockey *et al*. 2005). Mountains or open country, from semi desert to woodland and agricultural land, also cities (Maclean, 1993), even on forest-grassland ecotones. Generally a cliff nesting species and its wider distribution is closely associated with mountains with suitable cliffs. Able to breed on lower rock faces than Peregrine Falcon *Falco peregrinus* and also utilises the disused nests of other species, such as crows, other raptors and storks, on cliffs, in trees and on power pylons, and also quarry walls (Tarboton *et al*. 1987). Generally prefers open habitats e.g. alpine grassland and the Kalahari, but exploits a wide range of habitats – grassland, open savanna, agricultural lands, suburban and urban areas, rural settlements – in both flat and hilly or mountainous country. Also breeds in wooded and forested areas where cliffs occur (Harrison *et al*. 1997a).	Highly unlikely Due to a lack of suitable breeding habitat. Uncommon resident in open areas in Gauteng (Marais & Peacock, 2008)
Falco peregrinus (Peregrine Falcon) (**NT/LC**)	None on site/: Resident *F. p. minor* mostly restricted to mountainous riparian or coastal habitats, where high cliffs provides breeding and roosting sites. Breeding pairs prefer habitats that favour specialised, high speed, aerial hunting, e.g. high cliffs overhanging vegetation with raised and/or discontinuous canopy (e.g. forest, fynbos, woodland), or expanses of open water. Also uses quarries and dam walls, and frequents city centres, e.g. Cape Town, where tall buildings substitute for rock faces. Migrant *F. p. calidus* in more open country, often coastal, even roosting on ground on almost unvegetated salt flats.	Highly unlikely Due to a lack of suitable breeding habitat. Could move through the area or rare occasions. Uncommon resident and summer migrant in Gauteng (Marais & Peacock, 2008)
Phoenicopterus ruber (Greater Flamingo)	Yes/None on site: Breeds at recently flooded, large, eutrophic wetlands (favoured foraging habitat), shallow salt pans; at other times, at coastal mudflats,	Highly unlikely Due to a lack of suitable foraging and

SPECIES NAME*	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE ON STUDY SITE
(**NT/NT**)	inland dams, sewage treatments works, small ephemeral pans and river mouths (Hockey *et al*. 2005). Usually breeds colonially on mudflats in large pans (Harrison *et al*. 1997a). Shallow pans, especially saline pans when they have water; also occasionally on other bodies of shallow water such as dams and vleis (Tarboton *et al.* 1987). Large bodies of shallow water, both inland and coastal; prefers saline and brackish water (Maclean 1993). Occasionally forages along sandy coasts.	breeding habitat. Mainly restricted to the south-eastern Gauteng (Marais & Peacock, 2008)
Phoenicopterus minor (Lesser Flamingo) (**NT/NT**)	Yes/None on site: Primarily open, shallow eutrophic, wetlands and coastal lagoons and may occur on water bodies which are more saline and more alkaline than those used by *Phoenicopterus ruber* (Greater Flamingo). Breeds on saline lakes, salt pans and mudflats far out in pans and lakes (Harrison *et al*. 1997a). Non-breeding birds aggregate at coastal mudflats, salt works and sewage treatment works where salinities are high. Small, ephemeral freshwater wetlands very important for birds dispersing from breeding grounds (Hockey *et al*., 2005). Shallow pans, especially saline pans when they contain water (Tarboton *et al.*, 1987). Large brackish or saline inland and coastal waters (Maclean, 1993).	Highly unlikely Due to a lack of suitable foraging and breeding habitat. Mainly restricted to the south-western and south-eastern Gauteng (Marais & Peacock, 2008)
Pelecanus rufescens (Pink-backed Pelican) (**VU/VU**)	None on site: Wide range of wetlands, including lakes, dams and slow-flowing rivers, saline pools, lagoons, estuaries and sheltered bays; rarely on open sea but sometimes forages close to shore at low tide in areas such as southern Mozambique (Hockey *et al*., 2005). Nests in colonies in trees bordering larger wetlands, but only known from a few sites.	Highly unlikely Due to a lack of suitable habitat. Very rare visitor to Gauteng
Mycteria ibis (Yellow-billed Stork) (**NT/EN**)	None on site: Utilises diverse wetlands and permanent and seasonal habitats, including alkaline and freshwater lakes, river, dams, pans, flood plains, large marshes, swamps, estuaries, margins of lakes or rivers, flooded grassland and small pools or streams where there are areas of shallow water free of emergent vegetation (Tarboton *et al.,* 1987); less often marine mudflats and estuaries (Hockey *et al*., 2005). Nests colonially on large trees adjacent to productive wetlands, but only locally and erratically during ideal conditions.	Highly unlikely Due to a lack of suitable habitat Common at large wetlands within Gauteng; erratic elsewhere (Marais & Peacock, 2008)
Ciconia nigra (Black Stork) (**NT/VU**)	None on site: Dams, pans, flood plains, shallows of rivers, pools in dry riverbeds, estuaries and sometimes on marshland and flooded grassland; uncommon at seasonal pans lacking fish. Associated with mountainous regions (Hockey *et al*., 2005) where they nest (Maclean, 1993) on cliffs (Harrison *et al*. 1997a). Feeds in shallow water, but occasionally on dry land, in streams and rivers, marshes, floodplains, coastal estuaries and large and small dams; it is typically seen at pools in large rivers.	Highly unlikely Due to a lack of suitable breeding and foraging habitat

SPECIES NAME*	PRESENCE OF SUITABLE HABITAT AND HABITAT REQUIREMENTS	LIKELIHOOD OF OCCURRENCE ON STUDY SITE
Ciconia abdimii (Abdim's Stork) (**NT/NT**)	None on site: Grassland, savanna woodland, pan edges, pastures, cultivated land and suburban areas. On migration and after good rains, in semi-desert habitats, including Kalahari. Generally absent from wetlands, but uses rice paddies and marshes near Beira, Mozambique (Hockey *et al*., 2005).	Highly unlikely Due to a lack of suitable mangrove habitat.
Buphagus erythrorhynchus (Red-billed Oxpecker) (**NT/LC**)	Yes: Open savanna, up to 3 000 m a.s.l. (Hockey *et al*., 2005). Uses mammal feeding hosts in a variety of woodlands, all in rainfall zones of more than 400 mm/annum. Needs holes in trees for nesting and uses Ilala Palms, tree Aloes, reed beds and rarely larger game to roost on at night (Harrison *et al*. 1997a). Their presence is highly dependent on the availability of tick on large game species and cattle.	Unlikely Only on rare occasions

*Red data status according to Barnes (2000)/Red Data status according to Taylor *et al* (2015)
Red Data Species Categories for the birds (according to BirdLife SA 2014 Checklist of Birds – List of Threatened Species – The 2014 Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland Unpubl)
EX= Extinct (regionally), **CR** = Critically Endangered **EN** = Endangered, **VU** = Vulnerable, **NT** = Near-threatened, **LC** = Least Concern, **DD** = Data Deficient, **NR** = Not Recognised by BirdLife International, **NA** = Not Assessed.

6. FINDINGS AND POTENTIAL IMPLICATIONS

6.1 Red Data avifaunal species confirmed from the study site for which suitable foraging, breeding and roosting habitat was confirmed:

None

6.2 Red Data avifaunal species confirmed within the study area for which suitable foraging, breeding and roosting habitat was confirmed:

None

6.3 Red Data avifaunal species for which suitable foraging, breeding and/or roosting habitat was confirmed from the study site and study area:

Red-billed Oxpecker (*Buphagus erythrorhynchus*):

Red Data Status according to Barnes (2000): Near-Threatened.
Red Data Status according to BirdLife SA (Taylor et al 2015): Regionally: **Leased Concern**, Globally: Leased Concern

Habitat: Red-billed Oxpecker occurs in a variety of open woodland in rainfall region of more than 400mm p.a. where ungulate host are present (Chittenden, 2007 and Harrison *et al* 1997). It needs holes in trees for nesting (Stutterheim, 1982a in Harrison *et al.* 1997) and uses ilala palms, reed beds and large game to roost at night (Maclean 1993 in Harrison *et al.* 1997). Its main food supply is ticks on about 15 species of wild mammalian hosts but healthy populations also exist outside reserves where only livestock (mainly cattle and donkeys) is present (Harrison *et al.* 1997). It is a natural tick-control agent (Grobler, 1980 in Harrison *et al.* 1997)
Threat: Hunting of game, on which this species is dependent, and the use of arsenic-based 'purple label' cattle dips, which poisoned both ticks and oxpeckers, dramatically reduced populations of this species and led to localised extinction events (Barnes, 2000). The implementation of oxpecker-friendly 'green-label' dips has led to population

recoveries. Although the general decline in the region has apparently ceased, this species warrants monitoring because it has not yet recovered its former range and it is susceptible to any change in dipping practices (Barnes, 2000).
On site conclusion: This species was recently removed (2015) from the Red Data list of southern African birds, previously ranked as Near-Threatened it is now ranked as Least Concerned (Taylor *et al* 2015). It is unlikely that Red-billed Oxpecker will occur on the study site due to the absence of large game species. However, the presence of cattle on the study site could host ticks on which this species feed on. This species indicate a very low reporting rate according for to the SABAP1 and SABAP2 data and was not recorded for the pentad in which the study site is situated.

The study area does not offer suitable habitat for any of the other Red Data avifaunal species recorded for the 2527DB q.d.g.c. Some are only likely to move through the area on very rare occasions.

Position Statement on the effect of solar power facilities on birds:

There are currently two types of solar power generators available:

Solar photovoltaic (PV) electricity generation involves turning solar radiation directly into electricity in a solar panel and, Concentrated Solar Power (CSP) farms (plants) with a series of mirrors/heliostats through panels that reflect sunlight. The reflected heat is concentrated onto a tall (on average 200m in height) central receiver tower and the smaller towers (standby focal points). The heat is used to raise steam to drive turbines and generators.

The main concerns with PV and CSP farms are the displacement or exclusion of nationally and/or globally threatened, rare, endemic or range-restricted bird species from important habitats. Displacement or exclusion from habitat can also cause common birds to become less common. Habitat loss for resident avifaunal species can be caused by the establishment of the solar farms and its relative infrastructure, such as power lines, roads and pipelines. Disturbance of resident bird species is usually caused by construction activities and is therefore short term but can also continue over the long term into the operational and maintenance phases.

A major impact on avifaunal species of both types of facilities is light pollution as they are both reliant on the reflective surfaces and any reflective surface has a potential effect on avifaunal species.

CSP farms potentially have greater impacts on avifaunal species than PV farms because of the associated central receiver tower, standby focal points and heliostats. Anticipated avifaunal issues concerned with the CSP farms are:

- Collision with heliostats (mirrors) and the central receiver tower - reflective surfaces act as attractants for approaching birds. These surfaces may be confused for large water bodies (and can have similar effects as windows) and causes disorientation of flying birds, resulting in injury and/or death.
- Mirrors are used to concentrate sunlight to create large amounts of heat and the heat could cause mortalities of close overflying birds.
- Birds could be burnt when in the vicinity of the central receiver or when entering the standby focal point (specifically relevant to swallows, swifts and martins which spend most of their time in flight).
- Pollution caused by leaching of chemical substrates into waste water evaporation ponds at CSP facilities. This could be lethal to birds using these ponds. Artificial

evaporation ponds serve as an additional attractant to waterbirds, which could increase cumulative collision, burning or poisoning impacts.
- Roosting, foraging and nesting on or around the CSP plant infrastructures (i.e. attracting more birds to the solar facilities).

Loss of habitat and disturbance of resident bird species caused by construction, operation and maintenance activities (of both CSP and PV farms).

These above-mentioned impacts become significant only when a great number of birds occur within the vicinity of the CSP and are thus exposed to these mortality factors.

The following issues are related directly to the associated infrastructure for both CSP and PV farms:

- Collisions and electrocution caused when perching on or flying into power line infrastructure.
- Habitat destruction and disturbance/exclusion of avifauna through construction (short-term) and maintenance (long-term) of new power line infrastructure.
- Habitat destruction and disturbance of birds caused by construction and maintenance of new roads, pipelines and visitor centres.

Of great concern is that avifaunal attractants may amplify the above impacts. These attractants are:

- Open water evaporation ponds on or in the vicinity of the CSP
- Heliostats (mirrors) and/or parabolic troughs
- Foraging spots under or around the panelling.

Birds attracted to the above sources may enter one or more focal points when descending and, as a result, could be burnt to death.

There is little information available on the impacts of solar farms on avifaunal species within southern Africa.

Apart from the Marikana Thornveld being an endangered vegetation type the construction of the solar farm will take place in an area that is of low relevance for nature conservation and outside a protected or important bird area.

There are no large trees close to the study site where large raptors such as Martial Eagle and vultures (White-backed Vulture) breed.

The proposed solar farm will be constructed outside any known sensitive or Red Data avifaunal migration route.

The solar farm will be constructed outside any known water avifaunal flight paths.

The habitat systems on site will not favour any of the mentioned Red Data avifaunal species due to a lack of suitable breeding, roosting and/or foraging habitat on and surrounding the study site. The avifaunal species observed on or that are likely to occur on the study site are the more common woodland avifaunal species and species that are able to adapt to areas transformed by man.

7. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

The Galago Environmental team has appropriate training and registration, as well as extensive practical experience and access to wide-ranging data bases to consider the derived species lists with high limits of accuracy. In this instance the biodiversity of all Alignments has to a greater or lesser extent been jeopardized, which renders the need for field surveys unnecessary. In instances where uncertainty exists regarding the presence of a species it is listed as a potential occupant, which renders the suggested mitigation measures and conclusions more robust.

Even though every care is taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are to some extent made on reasonable and informed assumptions built on *bone fide* information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems additional information may come to light at a later stage. Galago Environmental can thus not accept responsibility for conclusions and mitigation measures made in good faith based on own databases or on the information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

The on-site bird survey was done at the end of the main breeding season of most species and during the time when most Palaearctic and intra-African migrants had already migrating to the north. This, however, will not have an effect on recording Red Data species, since most Red Data species are resident to South Africa and the few Red Data species that are Palaearctic migrants are mainly threatened in their northern hemisphere distribution ranges.

The site survey was done during several hours in one day and not on a regular basis during several seasons over a period of time, thus the avifaunal biodiversity could change slightly as more species are confirmed from the various habitat systems within the study area. The time of the day and weather condition also has an effect on the number of species recorded in the study area during the site visit. The weather condition during the site survey was overcast, windy and cold. The general assessment of species rests mainly on the 1987 atlas for birds of the then-Transvaal (Tarboton *et al*. 1987), the 1997 SABAP1 atlas data (Harrison et al. 1997) and the current data for the SABAP2 period for comparison, so any limitations in either of those studies will by implication also affect this survey and conclusions.

The general assessment of species rests mainly on the 1997 SABAP1 atlas data (Harrison et al. 1997) for comparison with the current SABAP2 atlas, so any limitations in either of those studies will by implication also affect this survey and conclusions.

The primary data for this assessment came from the distribution and status information collected for southern African birds during the SABAP1 atlas project, comparison with the incoming data for the on-going SABAP2 atlas project, and is therefore only as accurate and reliable as the limitations and assumptions described for those exercises (Harrison *et al*. 1997; www.sabap2.org.za; Bonnevie 2011; Retief 2013), augmented with information from earlier atlas studies of the old Transvaal (Tarboton *et al*. 1987). I also had access to suitable databases, information and identification resources, and did not consider that the present assignment warranted a more detailed (and expensive) survey.

The field experience of the avifauna specialist includes community surveys across a wide range of southern African habitats and particular work with birds on power lines.

Furthermore the number of atlas cards received and the diversity of habitat systems surveyed for avifaunal species within a q.d.g.c. or pentad or lack thereof could also have an effect on the avifaunal diversity that could potentially occur on the study site. 239 atlas cards were received for the 2527DB q.d.g.c. over the SABAP1 project period and to date, 465 cards for the entire 2527DB q.d.g.c. over the current SABAP2 project period and 20 cards for the 2535_2755 pentad (in which the study site is situated) since 1 July 2007.

8. RECOMMENDED MITIGATION MEASURES

The following mitigation measures are proposed by the specialist for **CSP solar farms** – although the proposed development is a PV plant, these mitigation measures should be kept in mind should the client want to change from a PV plant to a CSP plant:

- Concentrated Solar Power (CSP) plants should not be constructed in formally or informally protected areas or Important Bird Areas (IBA's) but in areas of low relevance for nature conservation.
- Solar arrays (a linked assembly of heliostrats) should be built outside of the known waterbirds flight paths, between pans, wetlands and dams.
- It should be ensured that artificial evaporation ponds are covered with wire mesh or netting so that birds are not able to land on these, where they may drown, or to drink water.
- The artificial evaporation ponds should be kept free of pollutants.
- At CSP facilities the concrete receiver tower must be clearly visible to avifaunal species (see www.reelwings.com/ and other similar websites) and its position and height needs to be taken into account.
- It should be noted that parabolic trough CSP plants are being developed where sunlight is focused on a receiver which is very close to the mirror – as a result it is less likely that birds will fly between the receiver and mirror.
- Impact Assessment Practitioners are urged to examine the technology to be used at CSP installations with detailed care and not merely to extrapolate from on type of technology to another.

The following mitigation measures are proposed by the specialist for **PV solar farms**

- It is recommended that the Solar photovoltaic (PV) solar farm type be used since this will have the least impact on avifaunal species.
- Where possible the construction of the solar farm should take place in the area that has already been disturbed or degraded by past and present human activities.
- Construction in dense woodland area, especially along drainage lines should be avoided, as many avifaunal species are associated with trees that grow along these conduits.
- Construction should not take place near large trees which serves as nesting or roosting sites for raptors and vultures – large trees are a limited resource in dry areas.

- Solar arrays should not be constructed in areas close to roosting and breeding sites of significant populations of threatened, endemic, rare or range-restricted avifaunal species, as their flight paths might be across the solar farm.
- Ideally, the solar facility should be designed from concept stage to feed into existing power lines or should be used locally and therefore be independent of the grid.
- New lines should be constructed in such a way that they have a minimal impact on the birds by using bird-friendly designs and appropriate devices for marking the wires.
- New power lines should follow existing roads wherever possible.
- The amount of vegetation that is cleared should be kept to the minimum so as to limit habitat loss.
- Grazing or careful mowing should be used to retard the regrowth of vegetation and not chemical herbicides.
- The vegetation under the solar panels should be kept short at all times to prevent fires and to prevent avifaunal from breeding or nesting on the ground.
- The technology that is used can be chosen to minimise impact on birds, as reflective surfaces which are parabolic (curved) will reduce the extent of sky reflection, relative to flat heliostats. It should be ensured that trough receivers utilise evacuated glass tubes or similar technology to reduce heat loss. This will mean lower surface temperatures which will not burn birds.
- The plant should either be upgraded or decommissioned after the normal 20 year expected lifespan.
- The cables of high voltage powerlines connecting the solar farm with the Schietfontein grid, especially the thin earth-wires or lines above large powerlines that could form part of the site should be fitted with bird diverters such as tags to prevent birds from colliding with the powerlines. This should not only be done at the direct vicinity of the study site but along the entire route that the powerlines will follow to their destination.

Monitoring:

- The construction phase of the solar power plant is likely to be highly impactful, although many of these impacts will be temporary. Having environmental monitors present on site to guide management and mitigation efforts and to monitor the effects of construction activities is optimal, but not necessarily mandatory for smaller sites and/or lower risk sites.
- The effects that the solar farm has on avifaunal species should be constantly monitored and recorded in a database. The area within and surrounding a solar farm should be inspected on a daily basis. Any avifaunal carcasses should be kept in fridges for identification purposes by a specialist and for other research purposes to study the effect of the solar farm on the bird population in this region. Each individual solar farm should be analysed on a case-by-case basis.
- Post-construction monitoring is not required for lower-risk projects (assessment regime 1), although it is encouraged. Any incidents of bird injuries or mortalities observed during operations should be recorded and reported.
- For higher-risk projects (assessment regimes 2 and 3), post-construction monitoring is necessary to a) determine the actual impacts of the SEF, b)

determine if additional mitigation is required at the SEF and c) learn about impacts and improve future assessments.

- Post-construction monitoring does not negate the need to first avoid, minimise and mitigate negative impacts during the project development stage.
- Post-construction monitoring should be started as the facility becomes operational, bearing in mind that the effects of a solar plant may change over time
- Post-construction monitoring can be divided into three categories: a) habitat classification, b) quantifying bird numbers and movements (replicating baseline data collection), and c) estimating bird mortalities.
- There are three components to estimating bird fatality rates: a) estimation of searcher efficiency and carcass persistence rates, b) carcass searches, and c) data analysis incorporating systematically collected data from a and b above.
- A minimum of 20 - 30% of the solar hardware (plus an area with a diameter of 300 m around the CSP power tower, where relevant) should be methodically searched for fatalities, with a search interval informed by carcass persistence trials and objective monitoring. Any evidence of mortalities or injuries within the remaining area should be carefully recorded and included in reports as incidental finds.
- The search area should be defined and consistently applied throughout monitoring.
- Observed mortality rates must to be adjusted to account for searcher efficiency (which can change seasonally depending on vegetative condition of the site), scavenger removal and the proportion of the facility covered by the monitoring effort. Some of these factors may change seasonally due to the breeding season of scavengers and whether visibility of the survey area changes through the year.
- The duration and scope of post-construction monitoring should be informed by the outcomes of the previous year's monitoring, and should be reviewed annually. The findings and recommendations of the post-construction monitoring report should be included in the updated Environmental Management Programme.
- Post-construction monitoring of bird abundance and movements and fatality surveys should span 2-3 years to take inter-annual variation into account. However, if significant problems are found or suspected, the post-construction monitoring should continue as needed in conjunction with adaptive management, taking into account the risks related to the particular site and species involved.

General mitigation measures for the construction phase:

- Disturbance should be reduced by limiting construction activities to daytime.
- Minimize the use of earthmoving equipment that results in noise generation.
- Construction staff must be restricted to an allocated area and should not gain access to sensitive habitat types.
- Provide adequate ablution facilities to avoid using natural (sensitive) areas as toilets.
- All disturbed areas during construction and operation, including discard dumps, should be levelled to prevent run-off.
- Harvesting of firewood or any plant material is strictly prohibited. Staff shall only assist with the (necessary) removal of important plant species if requested to do so, under supervision.

- All staff should be advised by means of environmental awareness training on the significance importance of the area and its conservation importance.
- Intentional killing of any faunal species (including invertebrates) should be avoided by means of awareness programmes presented to the labour force.
- Any outside lighting (e.g. for security) should be designed to minimize impacts on fauna. All outside lighting should be directed away from sensitive areas. Fluorescent and mercury vapour lighting should be avoided and sodium vapour (yellow) lights should be used wherever possible. This will minimize attraction of invertebrates that fly at night being attracted to and killed at lights, and the effects of these losses on other fauna (for food) and flora (for pollination/dispersal). Lights and insects also attract insectivores and their predators.
- Physical barriers must be constructed around fuel depots and generators to prevent spilled fuel from spreading or coming into contact with surface or ground water.
- Chemicals and equipment for the treatment of fuel spillages must be available on site at all times.
- Prevent introduction of alien plant species, using indigenous species already present in the area where necessary.
- It is recommended that a monitoring programme be implemented to enforce continual eradication of alien and invasive species.
- Appropriate road design and traffic control measures are recommended to reduce air pollution and animal mortality.
- Where overhead lines (power lines or telephone lines) are to be constructed within/adjacent to open space systems, the Eskom-EWT strategic partnership should advise on appropriate mitigation measures. The design (including mitigation measures) and location of any proposed power lines (whether new alignments or refurbishment/upgrading of existing lines) should be endorsed by the bird conservation experts of the Eskom-EWT strategic partnership. Anti-collision devices such as bird flappers should be installed where power lines cross corridors, rivers or ridges.
- An appropriate management authority must be contractually bound to implement the Environmental Management Plan (EMP) and Record of Decision (ROD) during the operational and restoration phases of the development. This authority should be identified and informed of their responsibilities in terms of the EMP and ROD.
- Where possible, **work should be restricted to one area at a time**, as this will give the smaller birds, mammals and reptiles a chance to weather the disturbance in an undisturbed zone close to their natural territories.
- Where possible the construction of the proposed solar facility should take place during the winter months during the time when most avifaunal species are not breeding.
- **No vehicles should be allowed to move in or across the wet areas or drainage lines and possibly get stuck.** This leaves visible scars and destroys habitat, and it is important to conserve areas where there are tall reeds or grass, or areas where there is short grass and mud.
- The contractor must ensure that no fauna is disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- It is suggested that where work is to be done close to the drainage lines, these areas **be fenced off during construction,** to prevent heavy machines and trucks from trampling the plants, compacting the soil and dumping in the system.
- During the construction phase, noise must be kept to a minimum to reduce the impact of the development on the fauna residing on the site.

- Alien and invasive plants must be removed.

9. CONCLUSIONS

Although the Marikana Thornveld vegetation type is considered endangered it is highly unlikely that the construction of the solar farm will have a negative effect on any of the Red Data avifaunal species recorded for the 2527DB q.d.g.c. The *Acacia* dominated woodland as well as any mixed broadleaf woodland is species-rich in terms of avifaunal biodiversity and any natural woodland is ecologically important, especially when taking in consideration that the Marikana thornveld vegetation is considered endangered as mentioned above. Any disturbance or transformation of the natural woodland vegetation will result in habitat loss for the avifaunal species that occur or that are likely to occur in the study area and will thus reduce its ecological and conservation importance.

The woodland on the study site is largely undisturbed with the exception of the access road and the quarry area in the north-western corner of the study site. It is important to retain as much as possible of the Marikana Thornveld, especially areas with medium and dense growth and in areas with deep soils. Although none of the Red Data avifaunal species are recorded for the q.d.g.c. in which the study site is situated, the drainage line and its vegetation should be regarded as highly sensitive in terms of avifaunal biodiversity. The rest of the *Acacia* dominated woodland or Marikana Thornveld should be regarded as medium sensitive to ensure future avifaunal biodiversity on the study site (Figure 11).

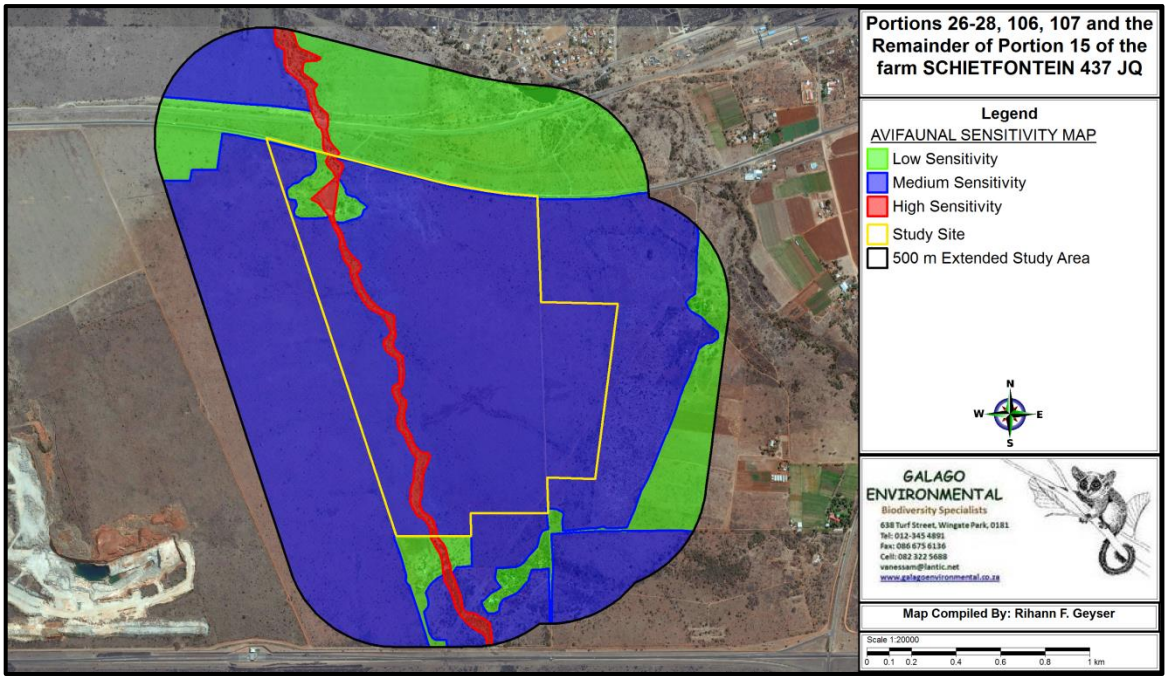

Figure 11: Avifaunal Sensitivity Map

10. LITERATURE SOURCES

Barnes, K.N. (ed.). 1998. *The Important Bird Areas of southern Africa*. Johannesburg: BirdLife South Africa.

Barnes, K.N. (ed.). 2000. *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland*. BirdLife South Africa, Johannesburg.

Bonnevie, Bo T. 2011. Some considerations when comparing SABAP 1 with SABAP 2 data. Ostrich 82: 161-162.

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V. & Brown, C.J. (eds.). 1997. *The Atlas of Southern African Birds.* Vol. 1 & 2. BirdLife South Africa, Johannesburg.

Hockey, P.A.R., Dean, W.R.J. & Ryan, P.G. 2005. *Roberts Birds of Southern Africa VII th Edition*, The Trustees of the John Voelcker Bird Book Fund, Cape Town.

Jenkins, A.R., Ralston-Paton, S., & Smith-Robinson, H.A. 2016 *Draft Bird and Solar Energy Best Practice Guidelines*. BirdLife South Africa

Maclean, G.L., 1990. *Ornithology for Africa*. University of Natal Press, Pietermaritzburg.

Mucina, L. & Rutherford, M.C. (eds) 2006. *The vegetation of South Africa, Lesotho and Swaziland.* Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Retief, E. 2013. 2528AB Pienaarsrivier – analysis of SABAP1 and SABAP2 data for the quarter degree square. Ornithological Observations, Vol 4: 107-118

Sinclair, I., Hockey, P., Tarboton W & Ryan P. 2011. *Sasol Birds of Southern Africa*. 4th edition, Struik, Cape Town.

Tarboton, W.R., Kemp, M.I., & Kemp, A.C. 1987. *Birds of the Transvaal*. Transvaal Museum, Pretoria.

Taylor, MR, Peacock F, Wanless RW (eds). 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Birdlife South Africa. Johannesburg. South Africa

Websites

www.iucnredlist.org
www.birdlife.org.za/publications/checklists
http://sabap2.adu.org.za/pentad_info.php?pentad=2535_2755&section=species