ESKOM GENERATION
WIND ENERGY FACILITY – WESTERN CAPE

AVIFAUNAL IMPACT ASSESSMENT
SCOPING STUDY

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EXECUTIVE SUMMARY

This study contains an extensive review of relevant literature on wind energy impacts on avifauna, and identifies potential impacts of the proposed Eskom Wind Energy Facility on avifauna in the study area. These expected impacts are: habitat destruction by the facility itself and the associated 132kV power line, disturbance by both activities, collision with turbines of the facility and with the associated 132kV power line, electrocution and impact of birds on quality of supply on the associated 132kV power line. The intention to bury the 11kV power line linking turbines under ground is supported as this would reduce the collision risk to birds.

The only sensitive features evident in the study area are three small pans that may hold water after rainfall, thereby attracting birds. Several other areas observed on the satellite image could potentially be similar pans. This will need to be investigated further during the EIA phase, and the significance of these pans as bird habitat will need to be assessed. Where possible, the turbines should be sited away from these pans (and any other sources of water) if possible, although these areas are not absolute 'no go' areas.

In addition, although the current site boundaries are considered to be far enough from the coast, and the Olifantsrivier, every bit further that the turbines can be from these two features will lessen the likelihood of impacts even further. It is therefore recommended that within the site, distance of turbines from the coast and the river be maximised if possible.

It is proposed that the 132kV line to Koekenaap Substation follow the route proposed in this study, largely adjacent to existing infrastructure. It is hoped that this will partially mitigate for impacts on avifauna – in particular collision of birds.

The above identified issues will be investigated in more detail during the EIA phase. In particular the significance of bird collisions with the turbines will be assessed in order to determine whether the risk warrants mitigation. The significance of this impact will depend on a number of factors such as abundance of certain bird species (and habitats and prey), topography, prevalence of evening fog and many others. The result of the EIA phase will be a more detailed assessment of all impacts, recommended mitigation where necessary, and a monitoring programme.

DECLARATION OF CONSULTANTS' INDEPENDENCE

J. Smallie and C. van Rooyen (Avifaunal Specialists – Endangered Wildlife Trust) are independent consultants to Savannah Environmental Pty (Ltd). They have no business, financial, personal or other interest in the activity, application or appeal in respect of which they were appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of these specialists performing such work.

1. INTRODUCTION

Eskom plan to construct a wind energy facility in the Western Cape on the west coast close to Vredendal. Savannah Environmental PTY (Ltd) were appointed to conduct the Environmental Impact Assessment study, and subsequently appointed the Endangered Wildlife Trust (EWT) to conduct the specialist avifaunal assessment.

The study was conducted by Jon Smallie – Biologist for the Endangered Wildlife Trust. Mr Smallie has eight years of experience in the field of avifaunal interactions with various electrical infrastructure, including one other generation EIA, ten transmission and approximately 30 distribution EIAs.

A site visit to the general area was conducted during March 2007. The initial site visit for the project was conducted during March 2007 and consisted of a visit to each of the three proposed sites in a two day field trip. Subsequent to this site visit, Eskom was required to supplement their original site identification process. The result was one consolidated area that was defined for examination during scoping. Since this area is close to the previous three sites examined, no additional site visit for scoping was needed for avifaunal purposes.

2. TERMS OF REFERENCE

The following are the terms of reference for the scoping phase, as supplied by Savannah Environmental PTY (Ltd):

- Collection of information on the micro habitat level associated with the sites
- Description of the general impacts that the proposed alternative sites will have on specific species and the general areas where these impacts will most likely occur will be identified.
- Mapping of bird sensitive areas of the study area
- Description of the affected environment and the bird communities most likely to be impacted. Different micro habitats will be described and the species associated with them will be identified.
- Listing of typical impacts that could be expected from the development as well as the expected impacts on the bird communities. Impacts will be quantified if possible and a full description of predicted impacts will be provided.
- Make recommendations for a preferred site for consideration in the EIA phase

3 STUDY METHODOLOGY

3.1. Approach

This study followed the following steps:

- An extensive review of available international literature, pertaining to bird interactions with wind energy facilities was undertaken in order to fully understand the issues involved and the current level of knowledge in this field. Care was taken to adapt the international knowledge to local conditions and species wherever necessary.
- A preliminary field visit to the general study area was undertaken with the project team during March 2007.
- The various data sets listed below were obtained and examined.
- The potential impacts of the proposed facility were described and evaluated
- Sensitive areas within the proposed site were identified.

3.2. Data sources used

The following data sources and reports were used in varying levels of detail for this study:

- The South African Bird Atlas Project data (Harrison *et al* 1997) for the quarter degree squares covering the three sites.
- The Important Bird Areas report (Barnes 1998) was consulted for data on the Olifants River Estuary area.
- Conservation status of species occurring in the study areas was determined using Barnes (2000)
- The bird specialist report for the original Klipheuwel demonstration facility (van Rooyen 2001)
- The report to Eskom Peaking Generation on the monitoring of bird mortalities at the demonstration facility at Klipheuwel (Kuyler 2004 – obtained from Eskom Peaking Generation)
- International literature on avian interactions with wind energy facilities.

3.3. Limitations & assumptions

- Any inaccuracies in the above sources of information could limit this study. In particular, the Bird Atlas data is now ten years old (Harrison *et al* 1997), but no reliable more recent data on bird species presence and abundance in the study area exists
- This study relies entirely upon secondary data sources such as the Atlas of Southern African Birds (Harrison et al 1997). The scope of this project (scoping study) did not allow for any significant primary data collection by the EWT on the proposed site. Ideally, monitoring for at least one summer and winter season should be conducted on the site to establish the species occurring there throughout the year.

4. BACKGROUND TO THE STUDY

4.1 Background to interactions between wind energy facilities and birds

The following section provides a background to avifauna - wind energy facility interactions. It is critical to understand the various issues and factors at play, before an accurate assessment of the impacts of the proposed wind energy farm on the birds of the area can be conducted. By necessity, the following description is based almost entirely on international literature, primarily from the United States. The reality is that the South African experience of wind energy generation has been extremely limited to date. Most of the principles that have been learnt internationally can, to a certain extent, be applied locally. However, care needs to be taken to adapt existing international knowledge to local bird species and conditions. Much of the work cited below has also been published in proceedings of meetings and conferences, not in formal peer reviewed journals. The information therefore needs to be used with some degree of caution, particularly when drawing comparisons, as the methodologies used were not always as scientific as desired. This section focuses largely on the impact of bird collisions with wind turbines. Wind facilities also impact on birds through disturbance and habitat destruction, and by means of their associated infrastructure. This has received less attention in the literature, probably because they are less direct (and less emotive) impacts. This study will assess all possible interactions between avifauna and the proposed facility.

A relatively recent summary of the available literature entitled "Wind Turbines and Birds, a background review for environmental assessment" by Kingsley & Whittam (2005) and the Avian Literature Database of the National Renewable Energy Laboratory (www.nrel.gov) have been used extensively in the discussion below.

Concern for the avian impacts of wind facilities first arose in the 1980's when raptor mortalities were detected in California (Altamont Pass - US) and at Tarifa (Spain). The Altamont Pass and Tarifa sites were the site of some extremely high levels of bird mortalities. These mortalities focused attention on the impact of wind energy on birds, and subsequently a large amount of monitoring at various sites has been undertaken. According to Kingsley & Whittam (2005), **"With a few important exceptions, studies that have been completed to date suggest very low numbers of bird fatalities at wind energy facilities.** The observed mortality caused by wind energy facilities is also very low compared to other existing sources of human caused avian mortality on a per structure basis". Curry and Kerlinger (www.currykerlinger.com) state that it appears now that the situation at Altamont Pass is an anomaly. Documents comparing wind energy mortalities to other forms of human induced mortality are numerous (for example Crockford, 1992; Colson & associates, 1995; Gill *et al*, 1996, and Erickson *et al*, 2001) and all point towards the *relatively* low numbers of birds killed by wind turbines. It must be stressed that the purpose of this study is to assess the impacts of the proposed Eskom Wind Energy Facility on birds, not to assess its impacts relative to other sources of avian mortality. Naturally, as more monitoring was conducted at different sites, a need arose for a standard means of expressing the levels of bird mortalities – in this case, number of mortalities per turbine per year. The following is a brief summary of some data that has emerged internationally. It is important to note that searcher efficiency (and independence) and scavenger removal rates need to be accounted for. Searcher efficiency refers to the percentage of bird mortalities that are detected by searchers, searcher independence refers to whether the person monitoring has certain objectives of their own which may influence the results of monitoring. Additionally, although the rates may appear relatively low – it is important to note that **it is the cumulative effect of a wind farm that is really important.** In other words, the absolute number of birds killed by a wind farm in a year is far more meaningful than an average per turbine. In addition, for some species, even a minute increase in mortality rates could be significant (long lived, slow reproducing species such as many of the South African Red Data species).

USA

The National Wind Co-ordinating Committee (NWCC, 2004) estimates that 2.3 birds are killed per turbine per year in the US outside of California – correcting for searcher efficiency and scavenger rates. However, this index ranges from as low as 0.63 in Oregon to as high as 10 in Tennessee (NWCC, 2004) illustrating the **wide variance in mortality rate between sites**. Curry & Kerlinger (2000) found that 13% of turbines at Altamont Pass, California were responsible for all Golden Eagle and Red-tailed Hawk collisions.

Australia

In Australia the recorded collision rates range from 0.23 to 2.7 birds per turbine per year (Australian Wind Energy Association – Wind Turbines, www.auswind.org). However, the monitoring site for this data consisted of only three wind turbines and one wind mast, so the results must be viewed with caution.

New Zealand

It seems that wind power in New Zealand is relatively new, and the only reference to bird mortalities is that there are no reports of rare, threatened or endangered species mortalities (New Zealand Wind Energy Association – Climate change and the environment Fact sheet, www.windenergy.org.nz).

Spain

At the Tarifa site, Janss (2000) estimated 0.03 birds killed per turbine per year. At the same site, collisions have also been found to be non-randomly distributed between turbines. A study by Acha (1997) found that 28 of the 190 turbines killed 57% of vultures at Tarifa.

Germany

The German Wind Energy Association (www.wind-energie.de) reports that German Friends of the Earth estimate an average of 0.5 bird deaths per turbine or a total of 8000 per year. However, the German Society for Nature Conservation (NABU) collated information from 127 case studies and concluded that only 269 birds were found to be killed by turbines across Germany since 1989.

South Africa

To date, only three wind turbines have been constructed at a demonstration facility at Klipheuwel in the Western Cape. These turbines were installed in 2002 and 2003. A monitoring program, conducted by Jacque Kuyler (2004), was put in place once the turbines were operational. This report was obtained from Eskom Peaking Generation. The monitoring involved site visits twice a month to monitor birds flying in the vicinity of the site, and detect bird mortalities. Important findings of this monitoring conducted from June 2003 to January 2004 are as follows:

- Between 9 and 57% of birds observed within 500m of the turbines were at blade height – there was great variation between months.
- Between 0 and 32% of birds sighted were close to the turbines defined as "between turbines or within outer router arc" and again showed great variation between months.
- Five bird carcasses were found on the site during this 8 month period. Two of these, a Helmeted Guineafowl and a Spotted Dikkop were determined to be killed by predators. **A Horus Swift and a Thick-billed Lark were determined to have been killed by collision with turbine blades.** A Cattle Egret was found with no visible injuries and was allocated to natural causes.
- If these two mortalities in eight months are expressed as # mortalities/turbine/year (using the three turbines at Klipheuwel), **the result is 1.00 mortalities per turbine per year**.
- Experimental assessment of the searcher efficiency revealed that 7 out of 9 (77%) carcasses placed in the study area were detected by the searcher.
- These nine carcasses were scavenged at between 12 and 117 days after their placement.

4.1.1. Factors influencing bird collisions with turbines

A number of factors influence the number of birds killed at wind farms. These can be classified into three broad groupings: bird related information; site related information and facility related information.

Bird information

Although only one study has so far shown a direct relationship between number of birds present in an area and number of collisions (Everaert, 2003, Belgium) it stands to reason that **the more birds flying through the area of the turbines, the more chance of collisions occurring**. The particular bird species present in the area is also very important as **some species are more vulnerable to collision with turbines than others**. This is examined further below. Bird behaviour and activity differs between species – with certain hunting behaviours rendering certain species more vulnerable. For example a falcon stooping after prey is too focused to notice other infrastructure. There may also be seasonal and temporal differences in behaviour, for example breeding males displaying may be particularly at risk. These factors can all influence the birds' vulnerability.

A controlled experiment with homing pigeons was undertaken by Cade (1994) to examine their flight behaviour in the proximity of turbines. Pigeons released near turbines clearly recognised the turbines and adjusted their flight as required. Of about 2270 pigeon flights near turbines, three collisions occurred. In a radar study of the movement of ducks and geese in the vicinity of an off-shore wind facility in Denmark, less than 1% of bird flights were close enough to the turbines to be at risk. This is graphically shown in FIGURE 2, where black lines represent bird flights, and red dots represent the position of turbines. It is clear that the birds avoided the turbines effectively (Desholm & Kahlert, 2005).

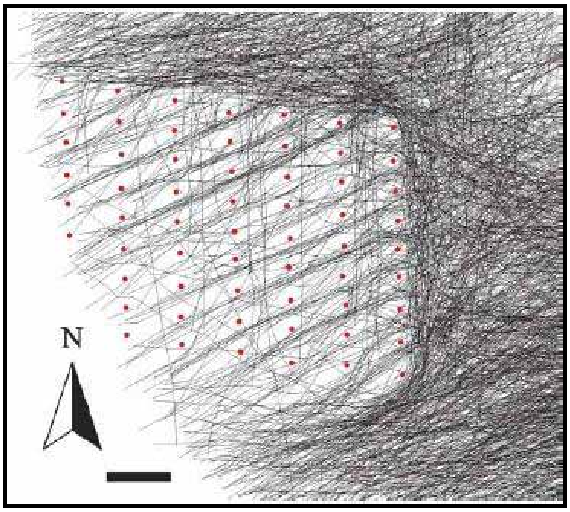

FIGURE 2. Radar tracked movement of ducks and geese relative to an offshore wind facility in Denmark. Scale bar = 1000m. (Desholm & Kahlert, 2005) scale bar = 1000m

Site information

Landscape features can potentially channel or funnel birds towards a certain area, and in the case of raptors, influence their flight and foraging behaviour. Elevation, ridges and slopes are all important factors in determining the extent to which an area is used by birds in flight. High **levels of prey** will attract raptors, increasing the time spent hunting, and as a result reducing the time spent being observant. Poor **weather affects visibility**. At the proposed site for the Eskom Wind Energy Facility, the fog that moves in off the sea at night and early morning will be an important factor (more detail on this will be obtained during the EIA phase). At Mountaineer Wind Energy Centre in Tucker County (US), 30 songbirds collided unexpectedly with a turbine during thick fog conditions in May 2003 (Cumberland Times). Very few collisions had been recorded prior to this weather incident. Birds **fly lower during strong headwinds** (Hanowski & Hawrot, 2000; Richardson, 2000; pers.obs.). This means that, when the turbines are functioning at their maximum speed, birds are likely to be flying at their lowest – a perilous combination.

Facility information

According to Kingsley & Whittam (2005), "**More turbines will result in more collisions**". Although only two mortalities have been recorded at Klipheuwel, the difference between the 3 turbines at Klipheuwel and a potential 100 turbines at the proposed Eskom Wind Energy Facility is significant. **Larger facilities also have greater potential for disturbance and habitat destruction.**

To date it has been shown that large turbines kill the same number of birds as smaller ones (Howell 1995, Erickson *et al*, 1999). **With newer technology and larger turbines, fewer turbines are needed for the same quantity of power generation, possibly resulting in less mortalities per KW of power produced** (Erickson *et al*, 1999). FIGURE 3 below shows the development of turbine size over the years.

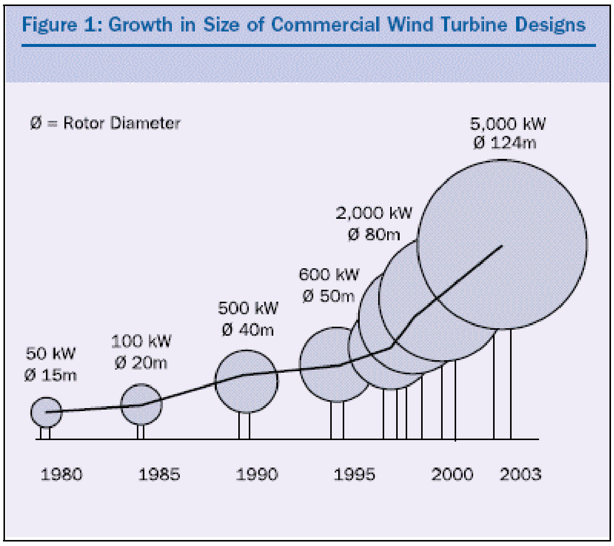

FIGURE 3. The development of turbine size since the 1980's – European Wind Energy Association (EWEA)

Certain **turbine tower structures may provide suitable perching space** to certain bird species, thereby increasing the chances of collisions as birds leave or enter the perch. It is anticipated that the tubular towers proposed for the Eskom Wind Energy Facility will not provide very desirable perching space as they are relatively smooth and rounded.

Lighting of turbines and other infrastructure has the potential to attract birds, thereby increasing the risk of collisions with turbines. In Sweden a large number of collisions were recorded with one turbine in one night. The turbine was not operational, but was lit (Karlsson, 1983: in Winkelman, 1995). At the Mountaineer site mentioned above, all collisions occurred on the three turbines closest to the substation (which was lit with a solid white light). No collisions occurred on any of the other 12 turbines which were lit with red strobe lights. The theory behind the relationship between lights and the number of collisions is that nocturnal migrants navigate using stars, and mistake lights for stars (Kemper, 1964). Another partial explanation may be that lights attract insects which in turn attract birds. **Changing constant lighting to intermittent lighting has been shown to reduce attraction** (Richardson 2000) and mortality (APLIC, 1994; Jaroslow, 1979; Weir, 1976) and **changing white flood light to red flood light resulted in an 80% reduction in mortality** (Weir, 1976). Erickson *et al* (2001) suggest that lighting is the single most critical attractant leading to collisions with tall structures.

One of the reasons suggested for bird collisions with turbine blades is 'motion smear' or retinal blur, terms used to describe the phenomenon whereby rapidly moving objects become less visible the closer the eye is to them. The retinal image can only be processed up to a certain speed, after which the image cannot be perceived. It stands to reason then that the slower the blades move, the less motion smear – and this should translate into less collisions. Interestingly, it is believed that at night there is no difference between a moving blade and a stationary one in terms of number of collisions (Kingsley & Whittam, 2005).

Infrastructure associated with the facility often also impacts on birds. Overhead power lines pose a collision and possibly an electrocution threat to certain bird species. Furthermore, the construction and maintenance of the power lines will result in some disturbance and habitat destruction. Some bird species may choose to perch, roost or nest on the towers, thereby possibly impacting on the quality of electrical supply through causing faults. New roads constructed will also have a disturbance and habitat destruction impact.

Spacing between turbines at a wind facility can have an effect on the number of collisions. Some authors have suggested that paths need to be left between turbines so that birds can move along these paths. For optimal wind generation, relatively large spaces are generally required between turbines in order to avoid wake and turbulence effects in the case of the proposed Wind Energy Facility, turbines will be spaced approximately 300m apart. .

Extending the literature review to look at the international experience in terms of the different broad groupings of species, and their vulnerability, reveals that **very few collisions have been recorded relating to water birds, water fowl, owls and shorebirds. The majority of bird mortalities at Altamont Pass were raptors, however, in the US outside of California raptors only accounted for 2.7% of mortalities** (Erickson *et al*, 2001; Kerlinger 2001). **Songbirds comprise 78% of fatalities in US** (Erickson *et al*, 2001). A group of species **particularly at risk is grassland species with aerial courtship displays** – such as the Horned Lark in the US (Kerlinger & Dowdell, 2003). Interestingly, at the Klipheuwel demonstration facility, a pair of Blue Cranes was recorded to breed within close proximity (400m) of the facility in 2003 (Ian Smit, pers. comm.; Kuyler, 2004).

4.1.2. Potential explanations for collisions of birds with turbines:

The three main hypotheses proposed for birds not seeing turbine blades are as follows (Hodos, 2002):

- An inability to divide attention between prey and obstacles. This seems an unlikely explanation as birds have been found to maintain good acuity in the peripheral vision, have different foveal region in the eye for frontal and ground vision and they have various other optical methods for keeping objects at different distances simultaneously in focus.
- The phenomenon of motion smear or retinal blur, explained earlier in this report.
- The angle of approach. If a bird approaches from side on to the turbine, the blades present a very small profile and are even more difficult to detect.

Mitigation measures should therefore focus on solving the problem of motion smear both from front and side angles.

4.1.3. Mitigation measures

Whilst bird mortalities have been comprehensively documented at numerous sites world-wide, very little has been written about the potential methods of reducing the level of mortalities. The following is a brief discussion of several forms of mitigation that have been either tested or merely suggested:

Painting turbines

Dr Hugh McIsaac and colleagues studied visual acuity in raptors (American Kestrels) using laboratory based behavioural testing methods (McIsaac, 2001). Key findings from their studies include the following:

- Acuity of kestrels appears superior when objects are viewed at a distance, suggesting that the birds may view nearby objects with one visual field and objects further away with another
- Moderate motion of the stimulus significantly influences kestrel acuity. Kestrels may be unable to resolve all portions of turbine blades under some conditions such as blade rotation, low contrast of blade with background and dim illumination.
- Results **suggest that careful selection of blade pattern will increase conspicuity**. Blade patterns that were proven to be conspicuous to humans also proved to be conspicuous to kestrels. Patterns across the blade produce better conspicuity in humans and kestrels than patterns down the length of blades. These authors **recommend a pattern of square wave black and white components that run across the blade width**.

William Hodos (2002) also studied acuity in American Kestrels in laboratory conditions using electrode implants in the retinas of the birds to record the pattern electroretinogram (Hodos, 2002):

- A solution to motion smear, is to maximise the time between successive stimulation of the same retinal region. Applying the same pattern to each blade does not achieve this. Each blade should have a different pattern so that a pattern on one blade is not repeated in the same position on another blade. This would have the effect of almost tripling the time between stimulations of the same retinal region.
- Various laboratory-based testing of seven blade patterns led to the conclusion that the **most visible blade pattern across the widest variety of backgrounds were the single black blade pattern (FIGURE 4) and the black thin stripe pattern staggered across the three blades (FIGURE 5). Since the single black blade pattern has the advantage of being easier and cheaper to implement, it is recommended for use by Hodos (2002).**

Unfortunately these tests (and the above by McIsaac) confirm only that the blades will be more visible if painted. They do not test what the psychological response of birds to the blades will be. Birds may be scared and repelled from the blades, or may be curious and be attracted closer. Only field testing can confirm these responses. To date these issues have not been tested in the field to the knowledge of this author.

FIGURE 4. Single solid black blade pattern (Hodos, 2002)

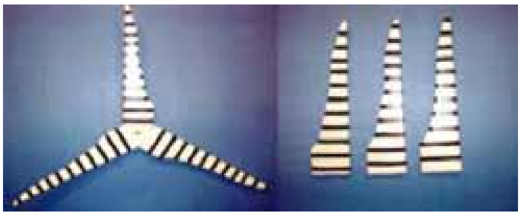

FIGURE 5. Thin black stripes on all three blades (Hodos, 2002)

Anti perching devices

Perching on turbines has been implicated in increasing collision rates, although this may have been predominantly on lattice type towers and not tubular towers.

Construction of pylons:
It has been suggested (but not tested) that building pylons around the line of turbines would reduce the number of collisions as birds would be forced around the turbines. In other words a line of pylons could serve as a shield to the turbines. This is not considered a realistic option and is not discussed further.

Summary of the main points from the above literature review:

- **With a few exceptions (such as at Altamont Pass and Tarifa), studies have found low numbers of bird mortalities at wind facilities.**
- **There is a huge variance in mortality between sites, and even between individual turbines within sites.**
- **The majority of collisions seem to involve raptors and/or songbirds.**
- **At the Klipheuwel site, monitoring for 8 months revealed two mortalities, a Horus Swift and a Thick-billed Lark (now named Large-billed Lark). The lark mortality is in accordance with literature which states that grassland species with aerial courtship displays (such as larks, many of which perform aerial displays) are particularly vulnerable to collisions.**
- **Factors affecting the number of mortalities at a facility include: bird species present, prey abundance, landscape features, weather, number of turbines, turbine size, turbine spacing and facility lighting.**
- **Associated infrastructure such as power lines etc also impacts on birds.**
- **It appears that intermittent lighting may be less attractive than continuous lighting, and that possibly red light is less attractive than white light.**
- **The primary explanation for collisions appears to be the phenomenon of motion smear or retinal blur. Mitigation measures should therefore focus on reducing motion smear effects.**
- **In laboratory testing, two studies have found that painting turbine blades increases their visibility to American Kestrels. The most visible patterns appear to be black stripes across the blade, in different positions on each blade so as to reduce retinal blur or motion smear or more simply a single solid black blade with two solid white blades. Unfortunately these tests confirm only that the blades will be more visible if painted. They do not test what the psychological response of birds to the blades will be. Birds may be scared and repelled from the blades, or may be curious and be attracted closer. Only field testing can confirm these responses. We are not aware of any field testing of these blades to date.**

4.2. Description of the proposed wind energy farm

Most of South Africa's wind resource is situated along the west coast. The current proposed wind farm will have the following characteristics:

- A wind farm consisting of up to 100 turbines. This will require a total area of approximately 25 square kilometres.
- Turbines will be situated in a roughly straight parallel lines and will have a twenty year lifespan.
- Turbines will be sited ~300m apart from each other, with rows being as much as 700m apart. This is to minimise wake effects and wind turbulence.
- Each turbine will consist of a tubular tower approximately 80m tall, with three blades approximately 45m long giving a total diameter of 90m. The foundation will be 15m x 15m concrete platform.
- At this stage it is planned to light those turbines which are situated on the outer extremity of the wind farm with two red strobe lights per turbine.
- An access road to the site will be built or if possible existing roads will be upgraded, as well as a road within the site linking all the turbines.
- A substation will be built, possibly in a central position.
- The substation will be linked to the turbines by underground electrical cables.
- A small visitors centre/office may be built at the entrance to the facility.
- The wind farm will be linked into the grid by means of a 132kV overhead power line to the closest substation (most likely Koekenaap Substation) – a distance of approximately 25km. The preference is for this line to follow the access road/other power lines as far as possible.

FIGURE 6 shows the location of the proposed site for the facility.

5. DESCRIPTION OF AFFECTED ENVIRONMENT

5.1 Vegetation of the study area

The following description of the vegetation focuses on the vegetation structure and not species composition. It is widely accepted within ornithological circles that vegetation structure and not species composition is most important in determining which bird species will occur there. The classification of vegetation types below is from Harrison (1997), who presents a classification based primarily on the work of Acocks (1953) and Low & Rebelo (1996).

FIGURE 6. Layout of the study area showing the proposed site for the wind energy facility (map supplied by Savannah).

TABLE 1. Vegetation composition of the two quarter degree squares which cover the study area (Harrison *et al*, 1997)

Biome	**Vegetation type**	**3118AC**	**3118CA**
Succulent karoo	Succulent karoo	100%	100%
Fynbos	Fynbos	-	-

It is clear from TABLE 1 that the study area is classified (on the basis of area) as “succulent karoo”.

5.1.1. Succulent karoo

The Succulent Karoo biome occurs in the far west of the country, generally at altitudes of less than 800m. The succulent karoo is primarily determined by low winter rainfall (20 to 290mm per annum). It consists of flat to undulating plains with some hilly and broken veld. This vegetation type is characterised by dwarf succulent plants and an almost total absence of trees. Grasses are rare, except in some sandy areas. The number of plant species is high in this biome. Of importance in the area ecologically are the “heuweltjies”, i.e. raised mounds of calcium rich soil – thought to have been created by termites. These mounds often support distinct plant communities which could in turn affect bird distribution. The Karoo in general supports high numbers of endemic bird species, mostly ground living species of open habitats. These include species such as Ludwig’s Bustard, Secretarybird, Thick-billed (Large billed) Lark, Karoo Lark, Black Korhaan.

5.2 Bird micro habitats

The above vegetation description partially describes the species likely to occur in the study area. However, more detail is required in order to understand exactly where within the study area certain species will occur. These “micro” habitats are formed by a combination of factors such as vegetation, land use, and others. The following micro habitats are encountered in the study area:

Natural succulent Karoo shrubland: This is the dominant micro habitat available to birds in the study area. Succulent Karoo vegetation type has been described above. Species likely to occur in these areas are discussed above.

Old agricultural lands: These areas have not been planted for at least 12 years according to Nick Helme (pers. comm.) and are in a state of natural rehabilitation. They are effectively more similar to natural vegetation than typical regularly cultivated arable lands and hence represent a very similar habitat to the above.

Pans: At least one small pan is evident on the proposed site, and according to Nick Helme (pers. comm.) there are at least a further two smaller pans. These pans may hold water periodically after rainfall and would attract various bird species at that time. Several other areas look like they may be pans and will be examined more closely during the EIA phase.

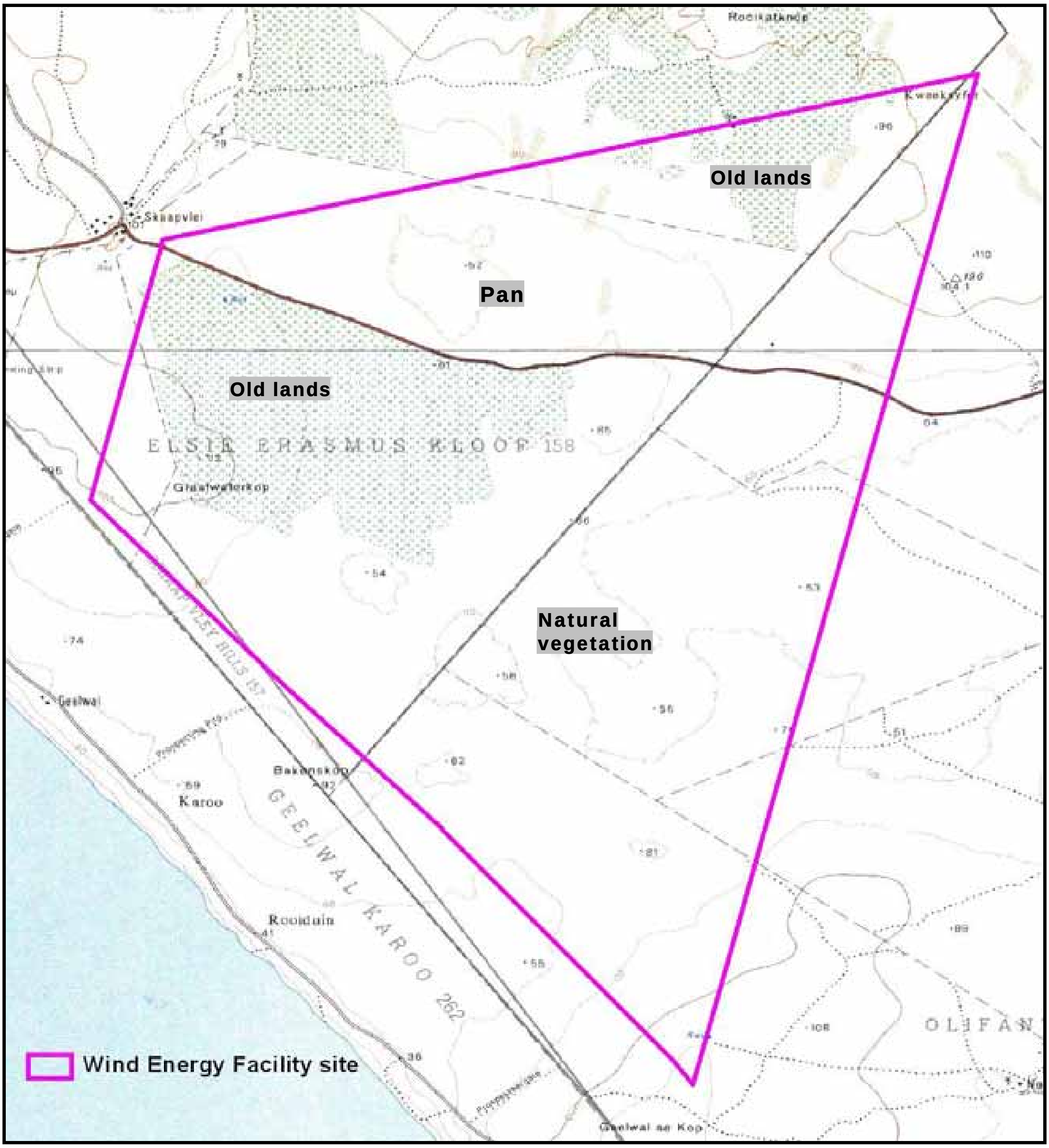

FIGURE 7. Proposed Wind Energy Facility site – showing micro habitats

5.3 Bird "hot spots"

Within the proposed site, no significant bird "attractants" have been identified at this stage. Within the broader landscape, at a macro scale, there are two areas that will attract birds. The first and most significant of these is the Olifants River Estuary which is an extremely sensitive area in terms of birds, and has in fact been recognised as an Important Bird Area by Barnes

(1998). It is one of only four perennial estuaries on the west coast, making it an extremely attractive haven for many coastal bird species. Approximately 125 bird species have been recorded there, most of which are water birds, regularly over 15 000 water birds occur on the estuary. Several Red Data species regularly occur there such as: Greater & Lesser Flamingo; Caspian Tern; African Marsh Harrier; African Black Oystercatcher; White Pelican; Damara Tern. The estuary forms a vital staging ground for various species moving between various sites further south such as Langebaan, and the Orange River Mouth further north. The river mouth is approximately 16km from the closest boundary of the proposed site. At its closest point, the Olifants river is approximately 8km from the closest boundary. This is considered to be a sufficient distance for there to be little interaction between birds attracted to the river and the Wind Energy Facility.

The second area where birds tend to congregate is the actual coastline, specifically at "Die Toring", "Robeiland", and "The Cliff Point". The bird species that congregate at these sites are cormorants and other marine species, and are unlikely to fly inland. However, in poor weather conditions these birds may become disoriented or blown off course and end up further inland than normal.

5.4 Bird presence in the study area

TABLE 2 lists the Red Data bird species recorded in the two quarter degree squares covering the study area by the Southern African Bird Atlas Project (Harrison *et al*, 1997). The total number of all species recorded and the number of cards (counts) submitted per square is also shown. The relatively low total number of species and Red Data species recorded in 3118AC is most likely related predominantly to the low number of counts conducted in the square (i.e. 9)

A total of eighteen Red Data species were recorded across the study area, six of which are classified as "vulnerable" and twelve as "near-threatened". Report rates are essentially percentages of the number of times a species was recorded in the square, divided by the number of times that square was counted. It is important to note that these species were recorded in the entire quarter degree square in each case, and may not actually have been recorded on the proposed site for this study.

TABLE 2. Red Data species recorded in the two quarter degree squares covering the study area (Harrison *et al* 1997)

Species	**Conservation status**	**3118AC Report rates**	**3118CA Report rates**
Total # species		70	205
Total # cards		9	61
Ludwig's Bustard	V	33	5
Jackass Penguin	V	-	2
Cape Gannet	V	-	18
Bank Cormorant	V	-	3
African Marsh Harrier	V	-	23
Lesser Kestrel	V	-	3
Cape Cormorant	NT	27	56
Black Harrier	NT	11	20
Karoo Lark	NT	44	33
White-chinned Petrel	NT	-	3
White Pelican	NT	-	44
Crowned Cormorant	NT	-	25
Greater Flamingo	NT	-	54
Lesser Flamingo	NT	-	51
Secretarybird	NT	-	2
African Black Oystercatcher	NT	-	28
Chestnut-banded Plover	NT	-	20
Caspian Tern	NT	-	39

V = "Vulnerable"

NT = "Near threatened"

Species that are likely to occur regularly on the proposed site itself have been shaded in TABLE 2. Many of the remaining species are coastal species and are unlikely to frequent the study area. Ludwig's Bustard has a relatively high report rate in 3118AC, and is likely to occur in the study area (this was confirmed by an observation of a pair of this species on the site by Nick Helme – pers. comm.). This species is extremely vulnerable to collision with overhead power lines, and may potentially also be vulnerable to collision with turbines. Although recorded at much lower abundance, the Secretarybird is a similar large terrestrial bird, also vulnerable to collision with power lines, although this species tends to fly less often than the Ludwig's Bustard. African Marsh Harrier, Black Harrier (observed by Nick Helme on site – pers. comm.) and Lesser Kestrel are also likely to frequent the study area – and being raptors are likely to be vulnerable to collisions with the turbines as discussed above in section 3.3. The Karoo Lark is a slightly different species in that it is physically much smaller than the above species – and may be vulnerable to collision due to its aerial displays in breeding seasons. These displays consist of flying up from a perch and hovering or cruising at certain heights above the ground (Keith *et al* 1992 in Hockey *et al* 2005). These displays could place the bird directly in the zone of the rotating turbine blade.

Importantly, the species in TABLE 2 represent many of the broad groupings of bird species i.e. large terrestrial birds (Ludwig's Bustard and Secretarybird), raptors (harriers and Lesser Kestrel), small grassland/shrubland species (Karoo Lark). Assessing the impacts on the species in TABLE 2 then potentially covers impacts on other species from these groupings that were not recorded but may occur on the site. An example of this is the Kori Bustard that is not recorded in TABLE 2, but could potentially occur on the site due to the suitable habitat present. Impacts on this species will be very similar to those on the Ludwig's Bustard.

This study concentrates on assessing the impacts on the Red Data species as these are the species of most conservation concern, and are often the species most sensitive to any artificial impacts. However, impacts on non Red Data species that are believed to be relevant to this study are also described. In particular, non Red Data species groups such as raptors, owls, lapwings, and thick-knees. Swallows, swifts and martins will be relevant to this study due to the amount of time they spend in the air, which increases chances of collisions.

6. IDENTIFICATION OF IMPACTS OF PROPOSED FACILITY & SENSITIVE AREAS WITHIN THE PROPOSED SITE

6.1. Generic description of interactions between avifauna and wind energy facilities

These have largely been discussed in 4.1 above but will be summarised and explained here:

6.1.1. Wind energy facility

Disturbance

Construction, and to a lesser extent maintenance, will create disturbance to birds in the proposed site and surrounding area. This will be more significant for any species breeding in the vicinity.

Habitat destruction

A certain amount of natural vegetation will be destroyed during the construction of the facility. Although the actual final footprint of the facility is relatively small, heavy machinery needed during construction is anticipated to need large turning circles and hence destroy a larger area of vegetation than the final footprint. A permanent road linking turbines will also be built which will result in the removal of some vegetation.

Collision with turbines

This impact has been adequately discussed above in 4.1.

Collision with power lines linking turbines (11kV)

Collision of birds with overhead power lines is a significant threat to many species and will be described in more detail below in reference to the 132kV line. Eskom have stated that the 11 kV power line linking the turbines will be underground. This is strongly supported from an avifaunal perspective.

Electrocution on power lines linking turbines

This impact is also described in more detail below in reference to the 132kV line. If this line is built overhead it may pose an electrocution risk.

6.1.2. Associated infrastructure

The only associated infrastructure that is not on the proposed Wind Energy Facility site is likely to be the 132kV power line linking the facility to Koekenaap or Juno Substations. Due to the presence of an existing secondary road to the site it is unlikely that a new road will be needed, and if this road is upgraded the impacts will be negligible.

Collision with 132kV power line to Koekenaap/Juno Substation

Collisions are one of the biggest single threats posed by overhead power lines to birds in southern Africa (van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001). Unfortunately, many of the collision sensitive species are considered threatened in southern Africa. The Red Data species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. These species have not evolved to cope with high adult mortality, with the result that consistent high adult mortality over an extensive period could have a serious effect on a population's ability to sustain itself in the long or even medium term.

Species in this study area that are vulnerable to collision include Ludwig's Bustard and Secretarybird.

Electrocution on 132kV power line

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004).

The electrocution risk of the proposed 132kV line can only be assessed once the tower structure to be used is known. Species that could be impacted upon include herons and some large eagles (non Red Data species).

Habitat destruction during construction and maintenance for 132kV line

During the construction phase and maintenance of power lines some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, and the clearing of servitudes. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimise the risk of fire under the line which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through modification of habitat. Species that will be impacted upon are likely to be the smaller species with small territories that could be displaced through destruction of a small amount of natural habitat.

Disturbance during construction and maintenance for 132kV line

Similarly, the above mentioned construction and maintenance activities impact on birds through disturbance, particularly during breeding activities.

Impact of birds on quality of supply on 132kV line

Birds are able to cause electrical faults on power lines through the mechanisms described below. The more faults that occur on a line, the lower the quality of electrical supply to the end customers.

In the case of a bird streamer induced fault, the fault is caused by the bird releasing a “streamer” of faeces which can constitute an air gap intrusion between the conductor and the earthed structure thereby creating a short circuit. Bird pollution is a form of pre-deposit pollution. A flashover occurs when an insulator string gets coated with pollutant, which compromises the insulation properties of the string. When the pollutant is wetted, the coating becomes conductive, insulation breakdown occurs and a flashover results. Bird nests may also cause faults through nest material protruding and constituting an air gap intrusion. Crows in particular often incorporate wire and other conductive material into their nests. When nests cause flashovers, the nesting material may catch fire. This in turn can lead to equipment damage or a general veld fire. Apart from the cost of replacing damaged equipment, the resultant veld fire can lead to claims for damages from landowners.

Both bird streamers and bird pollution occurs as a result of birds perching on pylons or towers, often directly above live conductors. In the current study area where suitable trees are largely absent, birds are highly likely to perch on towers. However, risk of bird related faulting cannot be assessed until the tower structure to be used is known. Bird species relevant to this study area that are likely to cause streamer induced faulting include herons and large eagles.

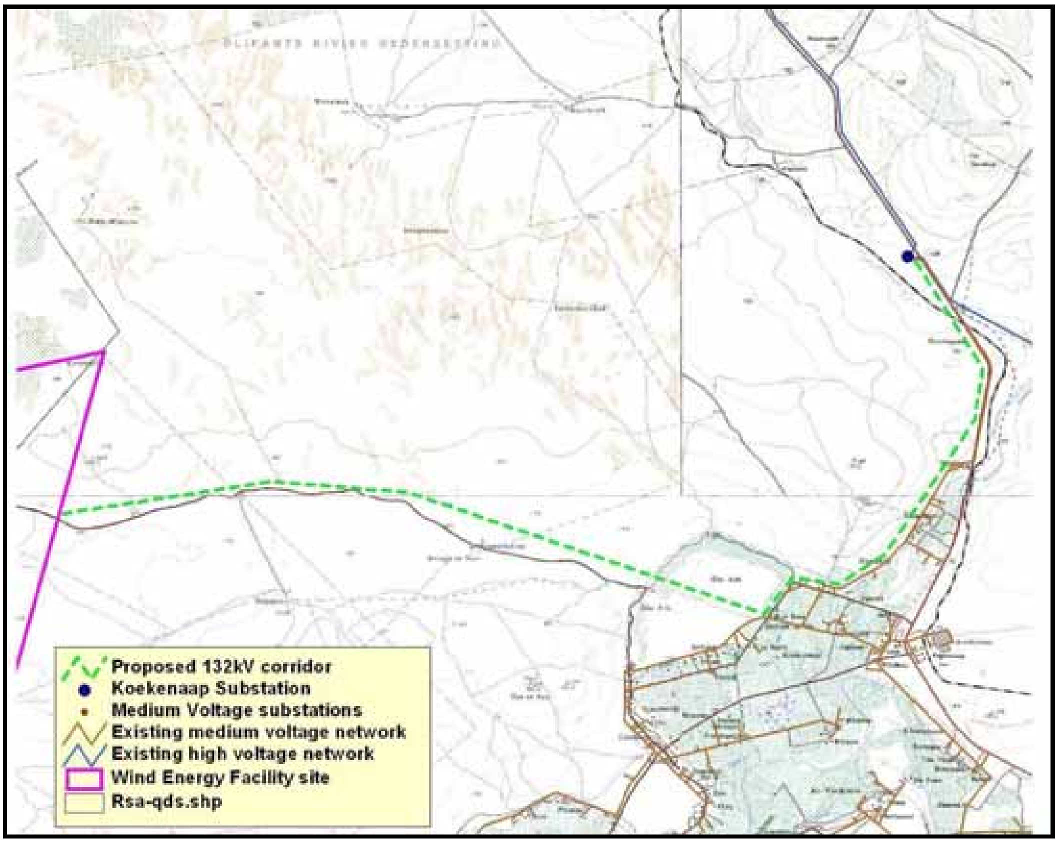

FIGURE 8. Position of Wind Energy Facility relative to Koekenaap Substation, with proposed route for 132kV power line

6.2. Description of the impacts of this proposed facility

TABLE 3 below contains a preliminary description of impacts and an assessment of the significance of each impact at the proposed site.

TABLE 3. Preliminary description and assessment of anticipated impacts of the Wind Energy Facility and associated infrastructure on avifauna.

Nature of Impact	**Species involved**	**Extent**	**Significance**
Wind Energy Facility			
Disturbance of birds by construction & operation activities	*Red Data:* All species will be affected by disturbance during construction (and operational phase to a lesser extent), particularly if breeding near the site *Non Red Data:* All species	This impact will occur on the site itself and the surrounding area.	Medium
Destruction of habitat by construction & operation activities	*Red Data:* All species will be affected by this during construction (and operational phase to a lesser extent). *Non Red Data:* same as above	The site itself	Medium
Collision of birds with turbines during operational phase	Red Data: Species such as the raptors and smaller ground dwelling species such as larks are likely to be affected, although extent is unknown *Non Red Data:* raptors, larks, swallows, swifts, martins	Turbine sites	Medium
Collision of birds with 11kV power line	Not possible if line is built underground as planned.	-	-
Electrocution of birds on 11kV power line	Not possible if line is built underground as planned.	-	-
Associated infrastructure			
Collision of birds with 132kV power line	*Red Data*: Ludwig's Bustard, Secretarybird *Non Red Data*: Black Korhaan	Site of power line	Medium
Electrocution of birds on 132kV power line	Red Data: none Non Red Data: Eagles such as Verreaux's Eagle	Site of power line	Dependant on tower structure
Disturbance of birds during construction and maintenance activities for the 132kV power line	Red Data: all species Non Red Data: most species	Surrounds of power line	Low
Habitat destruction during construction and maintenance activities for the 132kV power line	All species	Site of power line	Low
Impact of birds on quality of supply of 132kV power line	Non Red Data: herons, ibises, eagles	Site of power line	Low

6.3. Identification of sensitive and "no go" areas within the proposed site.

At this stage, the only sensitive features evident are three small pans (the largest of which is shown in FIGURE 7) that may hold water after rainfall, thereby attracting birds. Several other areas observed on the satellite image could potentially be similar pans. This will need to be investigated further during the EIA phase, and the significance of these pans will be assessed. Where possible the turbines should be sited away from these pans (and any other sources of water) if possible, although these areas are not absolute no go areas.

In addition, although the current site boundaries are considered to be far enough from the coast, and the Olifants River as described above, every bit further that the turbines can be from these two features will lessen the likelihood of impacts even further. It is therefore recommended that within the site, distance of turbines from the coast and the river be maximised if possible.

It is proposed that the 132kV line to Koekenaap Substation follow a route adjacent/parallel to the existing infrastructure (as proposed in FIGURE 8). It is hoped that this will partially mitigate for impacts on avifauna – in particular collision of birds.

7. CONCLUSION AND PLAN OF STUDY FOR EIA PHASE

The scoping phase has identified potential avifaunal issues associated with the proposed Wind Energy Facility and its associated infrastructure. These issues will be investigated in more detail during the EIA phase. In particular the significance of bird collisions with the turbines will be assessed in order to **determine whether the risk warrants mitigation such as painting turbines** as discussed above. The significance of this impact will depend on a number of factors such as abundance of certain bird species (and habitats and prey), topography, prevalence of evening fog and many others. The result of the EIA phase will be a more detailed assessment of all impacts, recommended mitigation where necessary, and a monitoring programme.

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