ABERDEEN WIND ENERGY FACILITY

AVIFAUNAL IMPACT ASSESSMENT

SCOPING STUDY

OCTOBER 2011

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EXECUTIVE SUMMARY

Eskom Holdings Limited is proposing to establish a commercial wind energy facility (WEF) and associated infrastructure on a site located approximately 24 km west of Aberdeen in the Eastern Cape Province. It is proposed for a cluster of between 100 and 150 wind turbines (described as a wind energy facility or a wind farm) to be constructed over an area of approximately 8198 ha in extent. 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. A site visit was conducted from the 19th – 21st September 2011.

The site was found to be moderately sensitive in terms of avifauna, with areas of high, medium and unknown sensitivity being present on site. Various micro habitats were observed on site and within the broader study area. On the site itself, the most important and prevalent micro habitats are Farm Dams, Cultivated Lands, and Karroo Shrublands, with the latter being the most extensive. The list of 'focal species' for this study is as follows: Martial Eagle, Lesser Kestrel, Rock Kestrel, Black Harrier, Ludwig's Bustard, Blue Crane, Secretary Bird and White Stork. Blue Cranes appeared abundant and were observed on numerous occasions on the site during the site visit.

A thorough literature review found that, typically, a wind energy project of this nature can be expected to impact on avifauna as follows: disturbance of birds (including displacement) , and habitat destruction during construction and maintenance; collision of birds with turbines during operation; collision and electrocution of birds on associated electrical infrastructure. 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 result of the EIA phase will be a more detailed assessment of all impacts, and recommended mitigation where necessary.

The recommendations regarding the various sensitivity categories are extremely important, and this map should be used to guide final project design. The extent to which collision and displacement impacts will actually occur will need to be determined through rigorous pre and post construction monitoring as outlined in Jenkins *et al* (2011), and discussed in Appendix 2 of this report.

DECLARATION OF CONSULTANTS' INDEPENDENCE & QUALIFICATIONS

Andrew Pearson (Avifaunal Specialist – Endangered Wildlife Trust) is an independent consultant to Savannah Environmental Pty (Ltd). He has no business, financial, personal or other interest in the activity, application or appeal in respect of which he was 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 this specialist performing such work.

Andrew is employed by the Endangered Wildlife Trust's Wildlife and Energy Programme as a specialist investigator for conducting avifaunal specific specialist reports. Andrew has a Four Year BSc in Conservation Ecology, certificates in Environmental Law, as well as five years experience in the environmental management field. The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information.

1. INTRODUCTION

Eskom Holdings Limited is proposing to establish a commercial wind energy facility and associated infrastructure on a site located approximately 24 km west of Aberdeen in the Eastern Cape Province. It is proposed for a cluster of between 100 and 150 wind turbines (described as a wind energy facility or a wind farm) to be constructed over an area of approximately 8198 ha in extent. 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. A site visit was conducted from the 19th – 21st September 2011.

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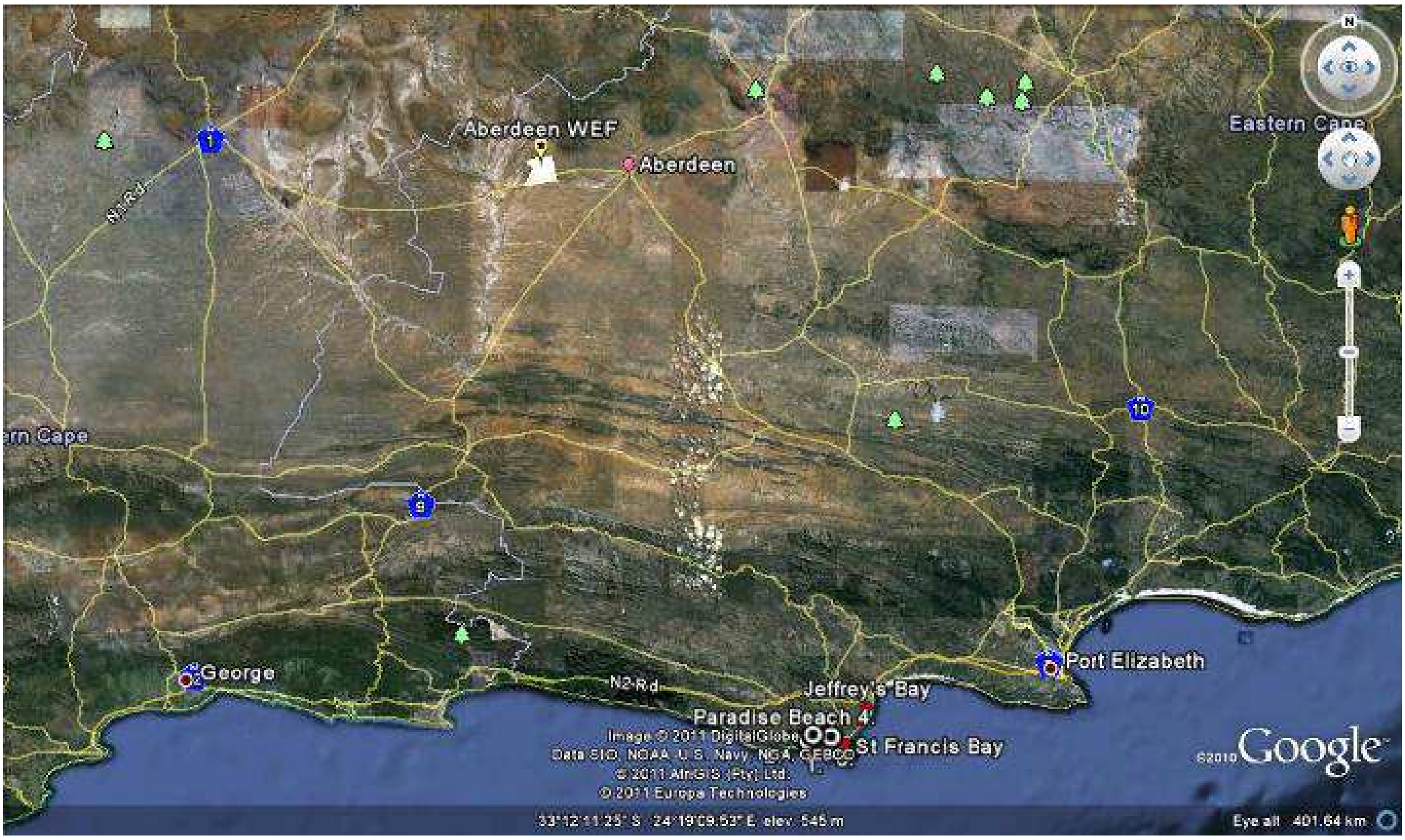

Figure 1- The proposed Aberdeen WEF site location in relation to Major Cities, Town and Roads.

2. TERMS OF REFERENCE

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

- Description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed project.
- A description and evaluation of environmental issues and potential impacts (including direct, indirect and cumulative impacts) that have been identified.
- Direct, indirect and cumulative aspects of the identified aspects must be evaluated within the Scoping Report in terms of the following criteria:
    - The nature – which shall include a description of what causes the effect, what will be affected and how it will be effected
    - The extent – wherein it will be indicated whether the impact will be local (limited to the immediate area or site) regional, national or international.
- A statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts
- A comparative evaluation of any feasible alternatives (and if relevant the nomination of a preferred alternative for consideration in the EIA phase)
- Identification of potentially significant impacts for investigation 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.
- 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 using various GIS layers and Google Earth.

- A site visit was conducted to investigate these sensitive areas more fully as well as to get an idea of what micro-habitats occur in the area.
- Species observed during the three day site visit were recorded.

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 site.
- The Southern African Bird Atlas Project 2 data for the pentads in the study area was examined.
- The Important Bird Areas report (Barnes 1998) was consulted for data relevant to the study area.
- Conservation status of species occurring in the study areas was determined using Barnes (2000)
- Local and International literature on avian interactions with wind energy facilities.
- Data sets from the Co-ordinated Avifaunal Road count project (CAR – Young et al 2003) for Eastern Cape Karoo Precinct were consulted.
- Coordinated Waterbird Counts (CWAC) (Taylor, Navarro, Wren-Sargent, Harrison & Kieswetter, 1999).
- A classification of the vegetation types in the study area was obtained from Mucina and Rutherford (2006).
- Information on the micro-habitat level was obtained through visiting the area and obtaining a firsthand perspective.
- Electronic 1:50 000 maps were obtained from the Surveyor General.
- Satellite Imagery of the area was studied using Google Earth ©2010.

3.3. Limitations & assumptions

- Any inaccuracies in the above sources of information could limit this study. In particular, the Bird Atlas data is now 14 years old (Harrison *et al* 1997).
- This study relies entirely upon secondary data sources such as the Atlas of Southern African Birds (Harrison et al 1997). The scope of this scoping phase did not allow for any significant primary data collection by the EWT on the proposed site.

- The site visit was conducted in spring, over which time various species may not have been present in the study area.
- The entire site was not accessible during the site visit.

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 facility 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. In reality 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 energy 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. In spite of the focus of this section on turbine collisions, 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 energy 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. 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).

Table 1- Summary of Wind energy and collision rates from overseas.

Country	**Organisation**	**Collision Rate (Birds/turbine/year)**	**Comment**
USA	National Wind Co-ordinating Committee	2.3(Range of 0.63 to 10)	Curry & Kerlinger (2000) found that 13% of turbines at Altamont Pass, California were responsible for all Golden Eagle and Red-tailed Hawk collisions
Australia	Australian Wind Energy Association	0.23 to 2.7	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	New Zealand Wind Energy Association	No reports	Wind power in New Zealand is relatively new
Spain	Janss(2000)	0.03	A study by Acha (1997) found that 28 of the 190 turbines killed 57% of vultures at Tarifa
Germany	German Wind Energy Association	0.5	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, three wind turbines have been constructed at a demonstration facility at Klipheuwel in the Western Cape, in 2002 and 2003, as well as one turbine in Coega in the Eastern Cape. (Although four turbines have been constructed privately at a site near Darling, access to these for the purpose of monitoring bird impacts has been restricted). However, a recent visit to this Darling site, by the Author, revealed no visible mortalities (most likely due to a high scavenging rate). A monitoring program, conducted by Jacque Kuyler (2004), was put in place once the Klipheuwel 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 any forms of 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 related information

Although only one study has so far shown a direct relationship between numbers 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).

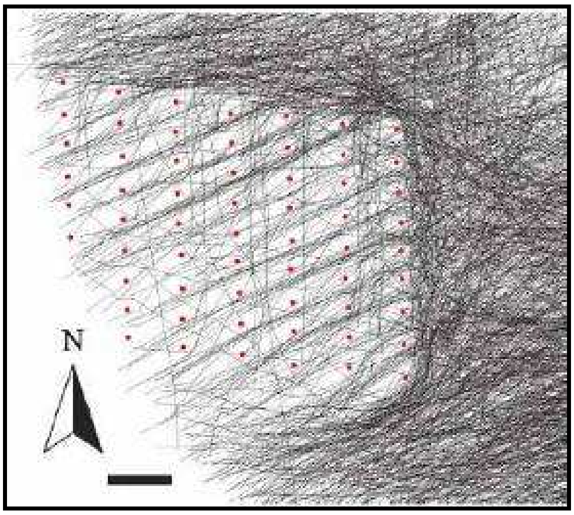

Figure 2- Radar tracked movement of ducks and geese relative to an offshore wind facility in Denmark. Scale bar = 1000m. (Desholm & Kahlert, 2005) scale bar = 1000m

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. 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 potentially large number turbines at the proposed Aberdeen 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.

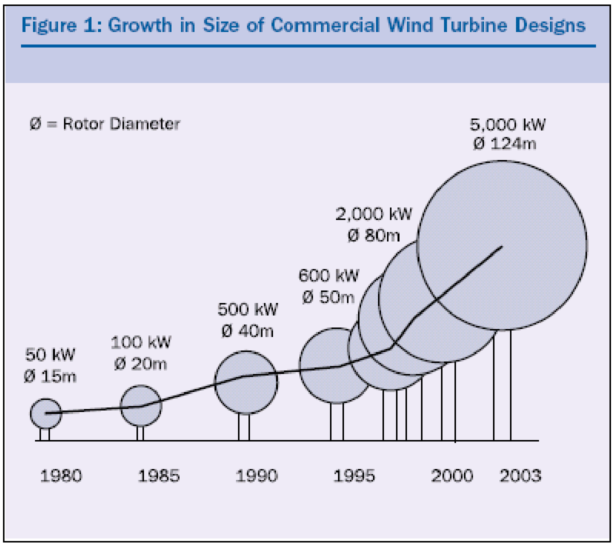

Figure 3- The development of turbine size since the 1980's – European Wind Energy Association (EWEA)

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 tubular towers will be used for the Aberdeen Wind Energy Facility, although this will be confirmed in the EIA phase. Tubular towers 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. New access roads constructed will also have a disturbance and habitat destruction impact.

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.

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).

During the construction phase and maintenance of power lines and substations, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, the clearing of servitudes and the leveling of substation yards. 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 to the servitude, through the modification of habitat.

During the construction and maintenance of electrical infrastructure, a certain amount of disturbance results. For shy, sensitive species this can impact on their usual daily activities, particularly whilst breeding.

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 more than 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:

Turbine design

Several different turbine designs exist, apart from the conventional 3 blade design, and are potentially of less impact to avifauna. These turbines turn in the wind on the same plane as the tower as opposed to the three bladed design which turns at right angles to the tower. Another important aspect is that some of these designs are a solid mass and thus not having the gaps between the blades should be more visible to birds and hence result in fewer collisions. However, the general consensus in the Industry is that these designs are far less efficient at electricity production, and are very unlikely to be favored by developers.

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 and the black thin stripe pattern staggered across the three blades. 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.

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. Birds will perch on turbines that are not in operation, and therefore effective maintenance, to decrease down-time, is an effective indirect mitigation, to prevent perching.

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 impact 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. The EWT is not aware of any field testing of these blades to date.

4.2. Description of the proposed wind energy facility

The proposed activity is the establishment of a wind energy facility and associated infrastructure. Based on a detailed site identification process undertaken by Eskom, and confirmed for environmental suitability by Savannah Environmental through a Regional Assessment process, a broader area which falls within the Camdeboo Local Municipality has been identified by Eskom for consideration within an Environmental Impact Assessment (EIA).

It is proposed for a cluster of between 100 and 150 wind turbines (described as a wind energy facility or a wind farm) to be constructed over an area of approximately 8198 ha in extent. The facility would have a generating capacity of approximately 200 MW (depending on the choice of turbine). The proposed facility would also include:

- Concrete foundations to support the turbine towers
- Cabling between the turbines to be lain underground

- An on-site substation to facilitate the connection between the facility and the electricity grid
- An overhead power line (400kV) feeding into Eskom's electricity grid at the Droërivier Substation, approximately 140 km from the site1
- Main access road to site
- Internal access roads between wind turbines
- External roads to access the site may be required
- Borrow pits within the site for the construction of access roads
- Office/Workshop area for operations, maintenance and storage
- Temporary water storage for construction and small storage for Operation
- Storage of fuel during construction
- Small Information centre and Operational & Maintenance building

At this time there is no alternative site for consideration. The alternative option that will be considered in this study is therefore the "No-go" option (i.e. the development does not get built). Alternate corridors or line-option alternatives for the power lines connecting the facility to an existing substation has been provided by Eskom. Possible alternatives will be investigated in a separate EIA process.

[1] Note that the power line is the subject of a separate EIA process.

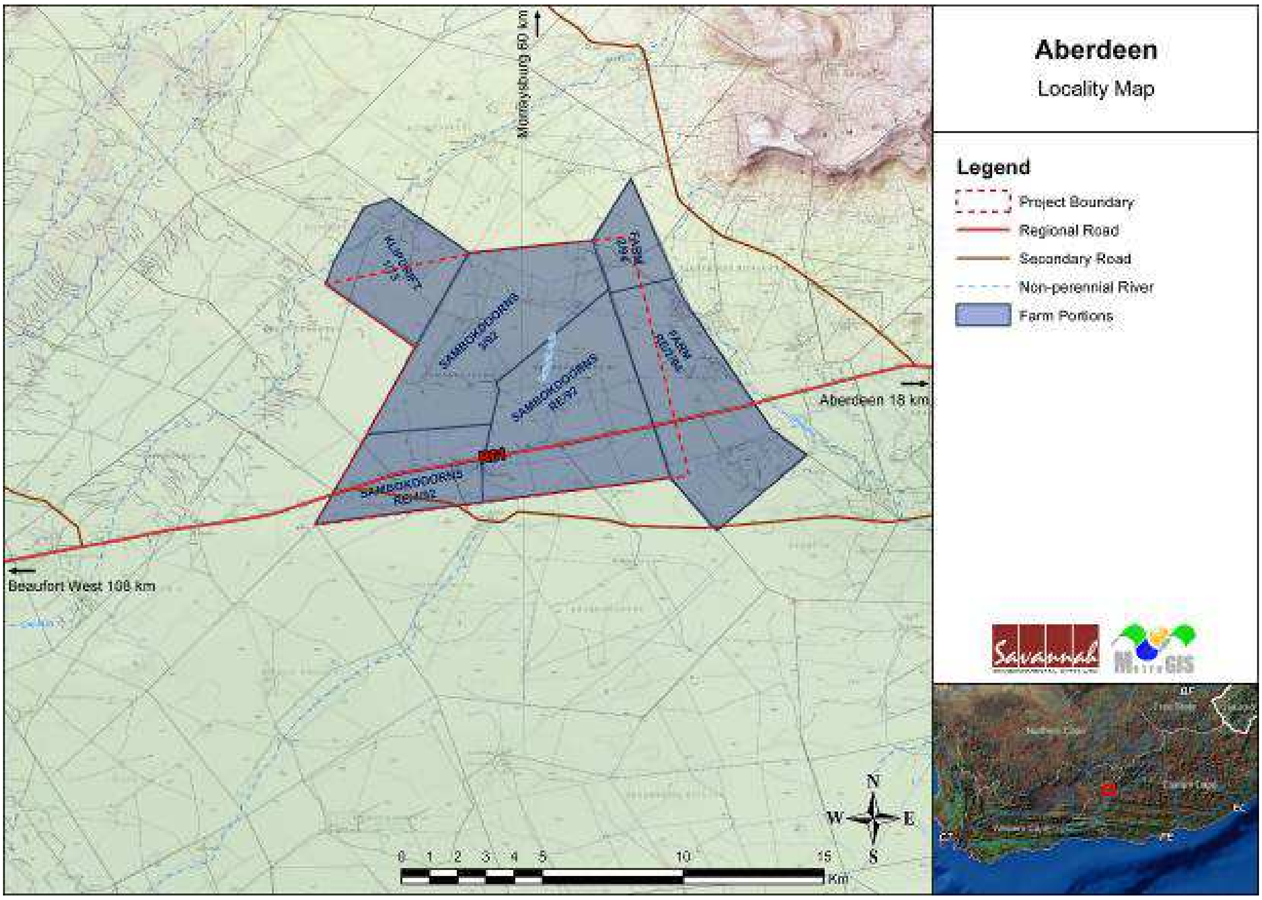

Figure 4- Layout of the study area showing the proposed site for the Aberdeen Wind Energy Facility (map supplied by Savannah Environmental).

5. DESCRIPTION OF AFFECTED ENVIRONMENT

5.1 Vegetation of the study area

While this report is an avifaunal specialist report, vegetation and micro habitats are very important in determining avifaunal abundances and likelihood of occurrences. As such, a map has been produced below (Figure 2) showing the vegetation classification of the broader area (Mucina & Rutherford, 2006). 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.

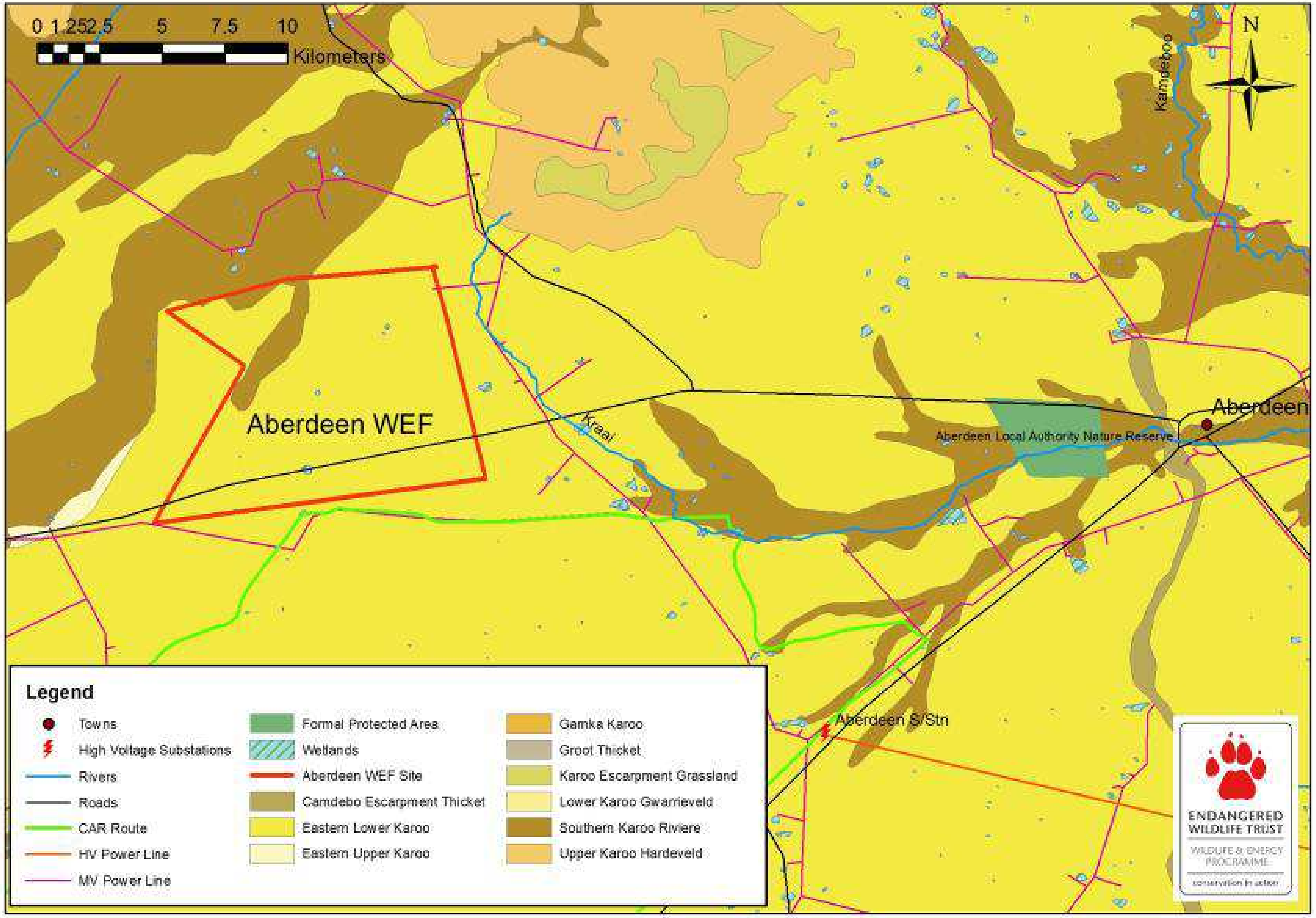

Figure 5- Vegetation classification for the study area (Mucina & Rutherford 2005)

The dominant vegetation types in the broader study area are "Eastern Lower Karoo", "Southern Karoo Riviere" and to a lesser extent "Upper Karoo Hardeveld". Also present are elements of "Camdeboo Escarpment Thicket", "Eastern Upper Karoo", "Gamka Karoo", "Groot Thicket", "Lower Karoo Gwarrieveld", and "Karoo Escarpment Grassland". The vast majority of the wind farm site itself is "Eastern Lower Karoo", with a small element of "Southern Karoo Riviere", both of which form part of the greater Karoo Biome. From an examination of these vegetation types, it can be expected that species favouring Karoo type vegetation can be expected. These are species that favour short, "shrubland" type vegetation such as Korhaans, Larks, Pipits, Prinia and Bustards.

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. These micro habitats will be critically important in siting the proposed turbines within the affected farms. The following micro habitats were identified in the study area during the site visit.

Rivers or streams and drainage lines: A small river, the Kraai Rivier is situated in close proximity to the site, and was identified at a desk –top level. It was observed to be flowing steadily during the site visit (see figure 6). A number of small streams as well as drainage lines also bisect the affected farms. In the study area although many of these water courses seldom contain water, these systems are important, as they have a different vegetation composition to the remainder of the plains, often including woody species such as *Acacia Karoo.* Wooded riparian habitat along rivers may provide habitat for various species such as the Hamerkop, African Darter, various cormorants, kingfishers, bee-eaters, robin-chats and numerous smaller species. Rivers also represent feeding areas for fish eating raptors such as the African Fish Eagle. Black Storks favour River courses, as do Geese and Ibises. Furthermore any river, stream or drainage line represents an important flight path for many bird species.

Figure 6- A crossing of the Kraai Rivier, east of the Study site.

Figure 7- An example of a dry drainage line.

Arable or cultivated land: Arable or cultivated land represents a significant feeding area for many bird species in any landscape for the following reasons: through opening up the soil surface, land preparation makes many insects, seeds, bulbs and other food sources readily accessible to birds and other predators; the crop or pasture plants cultivated are often eaten themselves by birds, or attract insects which are in turn eaten by birds; during the dry season arable lands often represent the only green or attractive food sources in an otherwise dry landscape. Arable lands exist sparsely in this study area and have mostly been planted to pasture for live-stock grazing. Relevant bird species that may be attracted to these areas may include Blue Crane, Ludwig's Bustard and White Stork. In particular the White Stork has a high affinity with arable lands, with 86% of sightings in South Africa recorded on arable lands (Allan 1985, Allan 1989, Allan 1997 in Hockey, Dean & Ryan 2005).

Figure 8 - Arable land planted to pasture in the study area.

Figure 9 – A pasture in the vicinity of the study area. Note the presence of Blue Cranes and Egyptian Geese.

Dams: Various artificially constructed dams were observed in the study area, ranging in size, Dams, in general, have become important attractants to various bird species in the South African landscape. Various waterfowl, such as Spur-winged geese, South African Shelduck, Egyptian geese, and numerous duck species, may frequent these areas. The construction of these dams has probably resulted in a range expansion for many water bird species that were formerly restricted to areas of higher rainfall, such as darters and cormorants. More importantly, Blue Cranes use dams to roost in communally, and at least one such dam on site is suspected to be used as a roost, as the author observed a pair of cranes at this dam (see figure 10), in the late afternoon during the site visit. Therefore dams are a key element of this study.

Figure 10- A large dam in the study area, at which Cranes are suspected to Roost overnight.

Thickets and Woodland: Narrow strips of thicket exist in the study area and are associated with rivers, streams and drainage lines, as well as on the slopes of some hills. While the river valleys and drainage lines (with water present), may attract numerous species due to the presence of water (which is discussed above), the thicket areas themselves are important to physically smaller bird species such as Robin-chats, Scrub-Robins, Warblers, Prinia, Doves and Bulbuls.

Figure 11- Thicket areas observed in a drainage line.

Hills and Ridges: There are hilly/mountainous areas in the broader study area, but not on the proposed site itself, which is relatively flat. The prominent mountain/hill features seen in figures 10 and 11 above, as well as below, are approximately 5km north east of the north eastern extremity of the study site. . The position of these mountains, which form part of the Kamdebooberge Range, can be identified in Figure 5 by their associated vegetation types, namely "Upper Karoo Hardeveld" and "Karoo Escarpment Grassland". Cliffs, Ridges and Hills represent important habitat for a number of species. Most relevant to this study are the aerial species such as raptors and swifts/swallows – which favor flying along ridges where there are favorable air currents. Raptors in particular will be prevalent along pronounced ridges and are likely to hunt along the ridge edge, which results in them being distracted by potential prey, thereby making them more vulnerable to collision with vertical structures such as wind turbines.


Figure 13- Hills and Ridges on site.


Figure 14- A ridge and Cliff area observed on site.

"Karoo" Shrublands: These are vast open areas of relatively low "shrub-like" vegetation. This is the predominant Micro-habitat on site. More "grassy" shrub-land micro-habitats (e.g. figure 16) are also present, with elements of grass, but do not represent true "Grasslands".
"Shrublands" may be frequented by Karoo Korhaan, Southern Black Korhaan, Blue Crane, and Ludwig's Bustard. Raptors such as Southern Pale Chanting Goshawk, Jackal Buzzard, Martial

Eagle, Rock Kestrel and Black Harrier, may hunt in these areas. Smaller passerines such as Larks, Pipits, Chats, Robin-Chats and Prinia also occur. Terrestrial game birds such as Guineafowl and Spurfowl, will also frequent this micro-habitat.

Figure 14- A view over the proposed wind farm site looking west from the vicinity of the site's eastern boundary. The extensive, flat, "Karoo Shrublands" can be seen.

Figure 15- Open "Shrublands", showing some grassy elements, are frequented by Blue Cranes.

Figure 16- Karoo shrublands on the proposed wind farm site.

5.3 Bird presence in the study area

Table 2 lists the Red Data bird species recorded in the four quarter degree squares covering the study area by the Southern African Bird Atlas Project (Harrison et al, 1997), i.e. 3223BC, 3223BD, 3223DA and 3223DB. The total number of all species recorded and the number of cards (counts) submitted per square is also shown. In total 9 Red Data species were recorded, comprising 5 Vulnerable and 4 Near-threatened species. In addition the White Stork is included in Table 2 as it is protected internationally under the "Bonn Convention on migratory species".

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. The likelihood of each species actually being present, on the proposed site itself, during the project life cycle, is shown in the final column. Species shown in bold were observed on site during the recent site visit.

Table 2- Red Listed species recorded in the quarter degree squares covering the study area (Harrison *et al* 1997)

Species	Cons. status	Report rate (%)				Preferred micro-habitat	Likelihood of Occurrence
		3223BC	**3223BD**	**3223DA**	**3223DB**		
Total species		*180*	*164*	*124*	*86*		
Number of cards		*35*	*18*	*21*	*10*		
Martial Eagle	VU	6	17	5	-	Savanna, woodlands, semi-arid shrubland	Possible
Lesser Kestrel	VU	14	28	5	-	Savanna, grassland, shrubland, arable land	Likely
Blue Crane	VU	31	28	-	30	Grassland, wetland, arable land, dams	Highly Likely
Kori Bustard	VU	60	22	5	10	Savanna, woodland, shrubland, grassland	Likely
Ludwig's Bustard	VU	40	22	29	50	Shrubland, arid savanna, Fynbos	Likely
Black Stork	NT	-	11	-	-	Rivers and Kloofs	Possible
Secretary Bird	NT	43	28	10	-	Grassland, arable lands	Highly Likely
Black Harrier	NT	-	11	-	-	Fynbos, Renosterveld, grassland, karoo shrub lands, croplands	Likely
Lanner Falcon	NT	11	17	-	-	Open grassland, woodland	Possible
White Stork	Bonn	9	39	5	30	Grassland, arable lands, wetland, dams	Likely

CR = Critically Endangered; EN = Endangered; V = Vulnerable; NT = Near-threatened; Bonn = Protected Internationally under the Bonn Convention on Migratory Species.

Of these, the Blue Crane, Kori Bustard, Ludwig's Bustard, Secretarybird and White Stork are species with relatively high recorded abundance in the area. These species have all proven vulnerable to collision with other obstacles such as power lines. International experience has shown that medium to large raptors are particularly vulnerable to collision with wind turbine blades, and therefore both Martial Eagle Black Harrier become important species for this study (even though both have a relatively low report rates in the table above).

Southern African Bird Atlas Project 2 (SABAP2)

SABAP 2 data for the pentads in the study area was also examined, and it was found that the area is poorly counted by this project at present (i.e. low numbers of cards have been submitted per pentad). Of the four pentads (3225_2340, 3225_2345, 3230_2340 and 3230_2345), over which the site falls, only pentads 3225_2345 and 3230_2340 had been counted, and thus are included in table 3 below. Data for three additional pentads (which had been counted more than once) in the broader vicinity of the study site, are also included in the table below. The table shows report rates, based on the number of cards submitted, for the red data species identified in table 2, as well as additional species deemed relevant to the study by the author. The location of the relevant pentads, in relation to the proposed WEF site, is shown in figure 17 below.

Table 3- Report rates from Southern African Bird Atlas Project 2, for relevant species.

	Pentad Report Rate (%)				
	3225_2345	**3230_2340**	**3225_2350**	**3220_2345**	**3225_2400**
No Cards	*1*	*5*	*2*	*3*	*9*
Total Species	*63*	*60*	*44*	*67*	*120*
Martial Eagle	-	60	-	-	-
Lesser Kestrel	-	-	-	-	44.4
Blue Crane	-	20	-	33.3	22.2
Kori Bustard	-	60	50	-	-
Ludwig's Bustard	-	20	-	-	44.4
Black Stork	-	-	-	-	-
Secretary Bird	-	-	-	-	-
Black Harrier	-	-	-	-	-
Lanner Falcon	-	-	-	-	-
White Stork	-	-	-	-	-
Rock Kestrel	100	-	50	-	22.2
Karoo Korhaan	100	80	-	-	33.3
Verreaux's Eagle	100	-	-	-	-
Southern Pale Chanting Goshawk	100	80	100	-	55.6
Peregrine Falcon	-	-	-	-	33.3
Amur Falcon	-	-	-	-	22.2

Interestingly, 5 of the relevant species identified in the SABAP 1 data (i.e. Table 2), have not been recorded in the SABAP 2 data for the pentads examined. They are: Black Stork; Secretary Bird; Black Harrier; Lanner Falcon and White Stork. This however, does not necessarily mean that these species do not occur here, or that they have moved from the area, post SABAP1, but may merely be due to the low counting effort of the pentads. In fact, both Black Harrier and Secretarybird were observed during the site visit, thus confirming their presence.

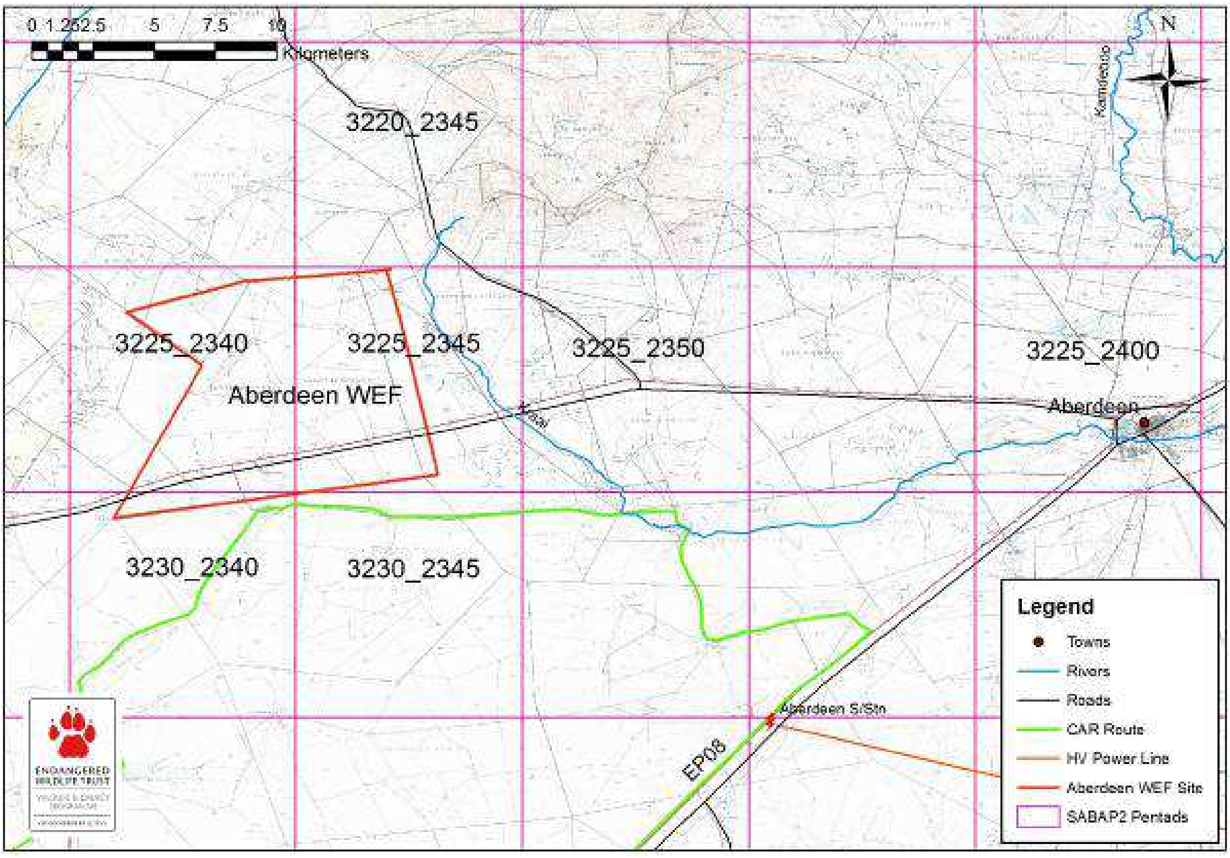

Figure 17- Location of CAR Route EP08, as well as the relevant SABAP 2 pentads, in relation to the proposed WEF site.

Coordinated Avifaunal Road-count (CAR) data

A CAR route, EP08, was identified as relevant to the study, and runs to the south of the study site (see figure 17). The route falls within the Port Elizabeth Precinct (EP), and within the larger Eastern Cape Karoo Precinct. In summer, White Stork is abundant in the Eastern Cape Karoo Precinct. Blue Crane is present in summer and winter, while Ludwig's Bustard show's higher densities in winter. This route has also recorded Kori Bustard, Secretarybird, Southern Black Korhaan and Karoo Korhaan.

Coordinated Water bird count data (CWAC)

No CWAC sites exist within the boundaries of the WEF, or within close proximity to the study area.

Important Bird Areas project (IBA)

There are no IBAs within close vicinity to the project area, and therefore this data was deemed not relevant to the study.

Observational Data

Appendix 1 is the sightings list of birds observed on site during the site visit. Note that this is merely for indicative purposes, and the species are listed in no particular order. Furthermore, it must be noted that the visit was conducted in spring, and this list represents incidental observations (which could be positively identified). Data from this table needs to be used with caution, as observations over such a short period, in one season, and in fairly similar weather conditions cannot be taken as a true indication of the presence of bird species in the area. In particular, the focal species (discussed below) for this study are threatened, rare species, so the likelihood of seeing one during 3 day period is limited. This study has therefore attached far more weight to the secondary data sources such as the bird atlas project (Harrison et al, 1997) which collected data over a far longer period, and more diverse conditions. It must be noted that many "non Red Data" bird species also occur in the study area and could be impacted on by the proposed project. Although this impact assessment focuses on Red Data species, the impact on non Red Data species is also assessed, albeit in less detail. Furthermore, much of the mitigation recommended for Red Data species will also protect non Red Data species in the study area.

Figure 18- One of a pair of Karoo Korhaans observed during the site visit.

Focal species for this study

Determining the focal species for this study, i.e. the most important species to be considered, is a three step process. The above data represents the first step, i.e. which species occur in the area at significant abundances. Secondly, the recent document "A briefing document on best practice for pre-construction assessment of the impacts of onshore wind farms on birds" (Jordan & Smallie, 2010) was consulted to determine which groups of species could possibly be, and are more likely to be, impacted on by wind farms. This document summarizes which taxonomic groups of species have been found to be vulnerable to collision with wind turbines in the USA, UK, EU, Australia and Canada. The taxonomic groups that have been found to be vulnerable in two or more of these regions are as follows: Pelicaniformes (pelicans, gannets, cormorants); Ciconiiformes (storks, herons, ibises, spoonbills); Anseriformes (swans, ducks, geese); Falconiformes (birds of prey); Charadriiformes (gulls, terns, waders); Strigiformes (owls); Caprimulgiformes (nightjars); Gruiformes (cranes, bustards, rails); Galliformes (pheasants, grouse, francolins); and Passeriformes (songbirds). The third step is to consider the species conservation status or other reasons for protecting the species. This involved primarily consulting the Red List bird species (Barnes 2000) as in Table 2.

The resultant list of 'focal species' for this study is as follows: Martial Eagle, Lesser Kestrel, Rock Kestrel, Black Harrier, Ludwig's Bustard, Blue Crane, Secretary Bird and

White Stork. In some cases, these species serve as surrogates for other similar species which also may be impacted upon, examples being Martial Eagle for Verreaux's Eagle, Ludwig's Bustard for Kori Bustard and White Stork for Black Stork.

As discussed elsewhere in this report, the impact of most concern for these species is that of collision with turbines. Of these species, the Raptors, Bustards and Blue Crane are perhaps of most concern, not only in terms of collision with turbines, but also the less direct impact resulting from the wind farm clusters forming barriers to the bird's movement within this area (i.e. habitat disturbance). Assorted more common species will also be relevant to this study, but it is believed that the above focal species will to a large extent serve as surrogates for these in terms of impact assessment and management.

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

6.1. Description and preliminary assessment of interactions between avifauna and the proposed development

These have largely been summarised and discussed generically in 4.1 above. Each impact has been assessed briefly for this scoping phase in the section below. A much more detailed assessment, as per a set of standard criteria, will be done during the EIA phase. This is because such an assessment will rely on information regarding site layout and turbine positions, as well as the routing of the overhead power line to connect the facility to the Eskom grid. Such information was not available during this scoping phase study, and as such the ratings below serve only as estimates of severity, to be confirmed and finalized during the EIA phase of the study,

6.1.1. Wind energy facility

Disturbance of birds

Nature of the Impact: Disturbance of birds during construction and maintenance		
	Without Mitigation	**With Mitigation**
Spatial Extent	Local – site & immediate surrounds only	Local
Significance	**Medium – particularly breeding species**	**Medium to low**
Status (positive or negative)	Negative	Negative

Habitat destruction

Nature of the Impact: Habitat destruction during construction and maintenance		
	Without Mitigation	**With Mitigation**
Spatial Extent	Local – site & associated infrastructure	Local
Significance	**Medium to low**	**Medium to low**
Status (positive or negative)	Negative	Negative

Collision with turbines

Nature of the Impact: Collision of birds with turbines		
	Without Mitigation	**With Mitigation**
Spatial Extent	Impact will occur locally, but have national implications for certain species	Impact will occur locally, but have national implications for certain species
Significance	**Medium to high**	**Medium to high**
Status (positive or negative)	Negative	Negative

Collision with power lines linking turbines

Nature of the Impact: Collision with overhead power lines		
	Without Mitigation	**With Mitigation**
Spatial Extent	Impact will occur locally, but may have national implications for certain species	Impact will occur locally, but have national implications for certain species
Significance	**Medium to high (route dependent)**	**Low to Medium (route dependent)**
Status (positive or negative)	Negative	Negative

6.1.2 Associated infrastructure

Very little detail with regards to associated infrastructure has been supplied at this stage, and therefore, the associated impacts will only be fully assessed in the EIA phase. The ratings in the tables below are merely for indicative purposes only to show the possible impacts and their likely levels of severity.

Collision with over-head power lines.

Nature of the Impact: Collisions on the power lines		
	Without Mitigation	**With Mitigation**
Spatial Extent	Impact will occur locally, but may have national implications for certain species	Impact will occur locally, but have national implications for certain species
Significance	**High**	**Medium**
Status (positive or negative)	Negative	Negative

Electrocution on power line

Nature of the Impact: Electrocutions on the power lines		
	Without Mitigation	**With Mitigation**
Spatial Extent	Impact will occur locally, but may have national implications for certain species	Impact will occur locally, but have national implications for certain species
Significance	**Medium**	**Low-Medium**
Status (positive or negative)	Negative	Negative

Habitat destruction during construction and maintenance for the line and the access roads.

Nature of the Impact: Habitat destruction by the power lines and access road		
	Without Mitigation	**With Mitigation**
Spatial Extent	Local – site & immediate surrounds	Local
Significance	**Medium**	**Medium -Low**
Status (positive or negative)	Negative	Negative

Disturbance during construction and maintenance of the power line and access road

Nature of the Impact: Disturbance on the power lines and access road		
	Without Mitigation	**With Mitigation**
Spatial Extent	Local – site & immediate surrounds	Local
Significance	**Medium**	**Medium- Low**
Status (positive or negative)	Negative	Negative

Many of the above discussed impacts could be partially mitigated for by placing the proposed infrastructure adjacent to existing similar infrastructure, where applicable. This will be investigated further during the EIA phase.

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

In general the site is moderately sensitive in terms of avifauna, based on the occurrence of a number of listed species in the study area, as well as the various micro-habitats available to avifauna. The high, medium and unknown sensitivity zones are mapped and described below.

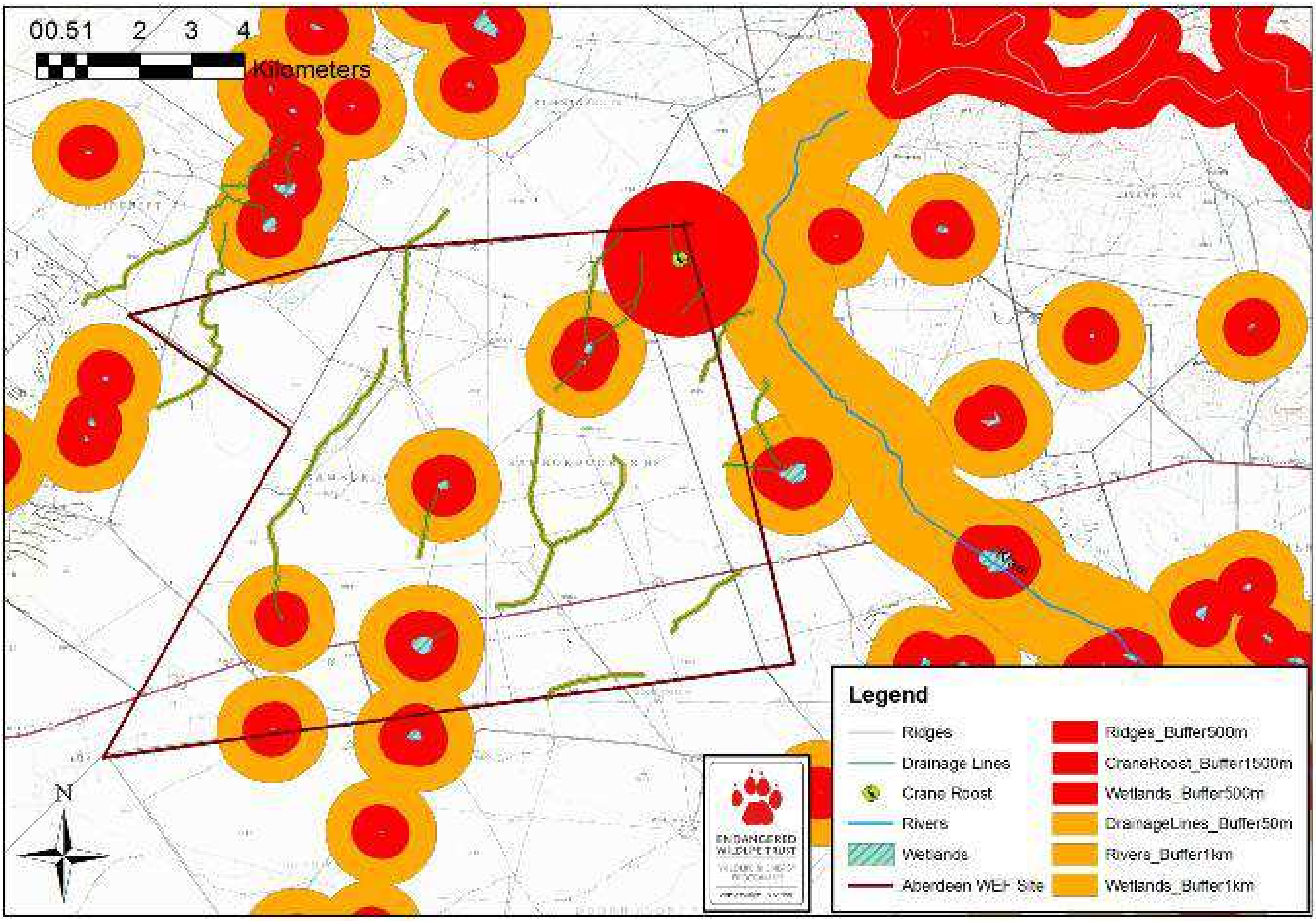

Figure 19 – Sensitivity analysis of the proposed site.

The sensitivity categories were assigned using the following factors:

High sensitivity:

The high sensitivity zones are indicated by Red on the map. They include a 1.5km buffer around an identified Blue Crane Roost site, a 500m buffer around prominent ridges (of which there are none on the site itself, but are included in this analysis in order to guide any additional infrastructure that may exceed the site boundaries), as well as a 500m buffer around wetlands and/or farm dams. No construction of infrastructure in these zones should be permitted, and it is recommended that these be designated as “no-go” areas. The confidence with which these “High sensitive” areas were identified was medium.

Medium Sensitivity:

The medium sensitivity zones are indicated by Orange on the map, and include a 1km buffer around rivers, as well as a buffer zone from 500m -1km around wetland and/or farm dams. Small drainage lines, identified at a desk top level, are buffered by 50m and also regarded as being of medium sensitivity. It is recommended that turbines and other infrastructure should not be built within these areas. However, upon consultation with EWT, and subject to monitoring results, construction of infrastructure may be possible, with caution, in these areas.

Unknown Sensitivity:

These are all the remaining areas, and are not colour coded on the map. No obvious avifaunal features or patterns could be identified during the study, and it is likely that the majority of these areas could be designated as Low sensitivity. However some areas could be designated as Medium to High sensitivity, in the future upon availability of new data and/or after additional site analysis. At this stage (without suitable monitoring data) there is no good reason that infrastructure should not be built in these areas. Therefore, these unknown sensitivity areas are preferred for construction, particularly of early phases.

NOTE: *Although some of the dams (discussed and mapped above) were identified and confirmed during the site visit, the remaining were mapped using available GIS data at a desk top level. Therefore, should any of these dams no longer exist on site; its associated sensitivity zone would then fall away. Like-wise, should any new dams be present (that were not known to the author at the time of writing, these would then have to be buffered accordingly.*

7. COMPARISON OF ALTERNATIVES

With Regards to the wind farm only the following types of alternative options will be considered:

- <u>The design or layout of the activity</u>
    - o The design and layout is critical to avifauna, especially the micro-sighting of Turbines, and the sensitivity map in this report must inform this planning.

- The technology to be used in the activity
  - This is not expected to affect the impacts on avifauna. However, should the number of turbines be reduced in future planning (possible due to the use of turbines with higher Megawatt capacities), this may reduce the likelihood of bird collisions.
- The option of not implementing the activity (i.e. "No-go").
  - The current status quo would be maintained by not implementing the proposed wind farm. The current farming activities will continue and the land use will not change. Presence and abundance of bird species, as described in this Avifaunal Scoping Report, would remain the same. Purely in terms of impacts on avifauna, this option would have the least impacts.

A new overhead power line will be required to connect the wind farm to the Eskom grid three alternatives options have been identified by Eskom which will be assessed in a separate EIA process:

- An approximately 127km long 400kV line linking to Droërivier substation near Beaufort West.
  - This line is expected to have a medium to large, negative impact on avifauna.
  - Alternative routes would need to be proposed, and visited during the EIA phase by an avifaunal specialist, which would require additional budget from the client.
  - Due to its size and length, it is highly likely that bird collisions will occur.
  - A large amount of mitigation will most likely be required in the form of bird flight diverters.
  - An intensive "avifaunal walkthrough" would be required in the EMP phase to ensure correct placement of such mitigation.
- An approximately 20km long 132kV line connecting to the Aberdeen substation.
  - This is by far the preferred alternative in terms of avifauna.
  - This line is expected to have a low to medium, negative impact on avifauna.
  - This option would not necessitate an additional site visit by the avifaunal specialist, as the area through which it passes was visited during the initial WEF site visit.
  - Collision mitigation measures may be required on certain spans.

8. CONCLUSION AND PLAN OF STUDY FOR EIA PHASE

In Conclusion, the proposed site was found to be moderately sensitive in terms of avifauna, with areas of high, medium and unknown sensitivity being present on site. Various micro habitats were observed on site and within the broader study area. On the site itself, the most important and prevalent micro habitats are Farm Dams, Cultivated Lands, and Karroo Shrublands, with the latter being the most extensive. The list of 'focal species' for this study is as follows: Martial Eagle, Lesser Kestrel, Rock Kestrel, Black Harrier, Ludwig's Bustard, Blue Crane, Secretary Bird and White Stork. Blue Cranes appeared abundant and were observed on numerous occasions on the site during the site visit.

The proposed facility has the potential to significantly impact on avifauna in the area, although our confidence in this assessment is low, due to the lack of operation experience of commercial scale wind farms in South Africa. Following the Scoping phase however, no fatal flaws with regards to avifauna have been identified (due mostly in part to the low confidence with which impacts of Wind Turbines, on South African bird species, can be predicted) and it is recommended that the project proceeds to the EIA phase. The scoping phase has identified potential avifaunal issues associated with the proposed Aberdeen Wind Energy Facility and its associated infrastructure. Site sensitivity has also been established and it is recommended that this information is used to determine final infrastructure placement. The EIA Phase will include the following components:

- All identified issues will be investigated in more detail during the EIA phase, and rated according to the prescribed criteria.
- Alternatives will be considered in more detail, and appropriate recommendations made.
- Landscape factors relevant to this study will be investigated further.
- Suitable mitigation measures will be recommended for all issues identified as significant.
- The extent to which collision and displacement impacts actually occur will need to be determined through rigorous pre and post construction monitoring as outlined in Jenkins *et al* (2011), and discussed in Appendix 2 of this report.
- It is recommended that Pre-construction monitoring on the site begins a soon as possible, so that data collected can be used to inform the final Avifaunal EIA report.
- A site specific avifaunal EMP as well as a monitoring programme pre and post construction is seen as a critical next step to increase our confidence, refine the

sensitivity map and to strengthen the mitigation measures in order to have the least impact possible on avifauna in the area.

- Details of the proposed monitoring methodology are contained in Appendix 1.
- It is recommended that an avifaunal specialist be appointed by Eskom to refine this methodology for the proposed site, and to train and supervise observers, analyze data and report on the monitoring programme.

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Appendix 1

Seq	Common name	Taxonomic name	Count	Count index	Breeding code	Notes	i	Status	
30	Warbler, Rufous-eared	Malcorus pectoralis	0	0	0	add			delete
29	Turtle-Dove, Cape	Streptopelia capicola	0	0	0	add			delete
28	Starling, Pale-winged	Onychognathus nabouroup	0	0	0	add			delete
27	Secretarybird, Secretarybird	Sagittarius serpentarius	0	0	0	add			delete
26	Pigeon, Speckled	Columba guinea	0	0	0	add			delete
25	Kestrel, Greater	Falco rupicoloides	0	0	0	add			delete
24	Lark, Red-capped	Calandrella cinerea	0	0	0	add			delete
23	Lark, Cape Clapper	Mirafra apiata	0	0	0	add			delete
22	Lapwing, Blacksmith	Vanellus armatus	0	0	0	add			delete
21	Korhaan, Southern Black	Afrotis afra	0	0	0	add			delete
20	Korhaan, Karoo	Eupodotis vigorsii	0	0	0	add			delete
19	Kite, Black-shouldered	Elanus caeruleus	0	0	0	add			delete
18	Kestrel, Rock	Falco rupicolus	0	0	0	add			delete
17	Ibis, Hadeda	Bostrychia hagedash	0	0	0	add			delete
16	Heron, Black-headed	Ardea melanocephala	0	0	0	add			delete
15	Harrier, Black	Circus maurus	0	0	0	add			delete
14	Hamerkop, Hamerkop	Scopus umbretta	0	0	0	add			delete
13	Guineafowl, Helmeted	Numida meleagris	0	0	0	add			delete
12	Goshawk, Southern Pale Chanting	Melierax canorus	0	0	0	add			delete
11	Goose, Egyptian	Alopochen aegyptiacus	0	0	0	add			delete
10	Fiscal, Common	Lanius collaris	0	0	0	add			delete
9	Dove, Red-eyed	Streptopelia semitorquata	0	0	0	add			delete
8	Chat, Karoo	Cercomela schlegelii	0	0	0	add			delete
7	Avocet, Pied	Recurvirostra avosetta	0	0	0	add			delete
6	Crow, Pied	Corvus albus	0	0	0	add			delete
5	Crane, Blue	Anthropoides paradiseus	0	10-99	0	add			delete
4	Coot, Red-knobbed	Fulica cristata	0	0	0	add			delete
3	Chat, Anteating	Myrmecocichla formicivora	0	0	0	add			delete
2	Buzzard, Jackal	Buteo rufofuscus	0	0	0	add			delete
1	Bulbul, African Red-eyed	Pycnonotus nigricans	0	0	0	add			delete

Appendix 2

Preliminary avifaunal pre and post construction monitoring plan.

The above study states that it is essential that a comprehensive monitoring programme be implemented at this site. This section of the report provides details of how to go about this monitoring. This detail has been provided from the "Birds and Wind Energy Specialist Group" (BAWESG) guidelines on the monitoring of wind farms in SA, by Jenkins *et al* (2011).

The EWT believe that the ideal model through which to implement the monitoring programme is as follows:

- A suitably qualified avifaunal specialist should supervise the monitoring programme, train the necessary observers, collate, analyse, report and publish data.
- This specialist should be contracted by the developer
- The first step for the appointed specialist will be to identify the key information required in the protocol below. This will be best done through a short site visit, which will also serve to train the identified observers and generally iron out any teething problems with the methodologies.
- The bulk of the actual work involved should be done by trained observers, under the guidance and supervision of a qualified and experienced ornithologist. This role could be filled by a number of people or entities, but will need to be the same entity for the duration of the programme.
- The specialist could advise the developer on available options to source observers

Specific challenges in a southern African context

The monitoring protocols that are available from Europe and the USA are mostly aimed at estimating population densities of small passerines in a relatively small study area. In southern Africa, the majority of priority species are large species that are relatively thinly distributed. Specific challenges in a local context are the following:

- Some priority species are sparely distributed with large territories, e.g. many of the large raptors and cranes. These species could easily be missed during surveys.
- Some priority species are nomadic with fluctuating densities related to habitat conditions, particularly rainfall, e.g. bustards. To cover all possible conditions in the study area would require an effort which will be impractical, both in terms of resources and length of monitoring time.
- Some of the sites are extremely remote and access restricted. This means that sample size will be determined by what is practically possible, introducing bias towards areas within the study area which are accessible, and potentially missing important habitat. This is fortunately not the case at the Middleton site.
- Limited availability of suitably experienced individuals that can do monitoring.

The suggested monitoring protocol is an attempt to address the challenges listed above whilst still maintaining a measure of practical realism as to what is possible with limited resources.

A) PRE-CONSTRUCTION MONITORING

Aims of monitoring:

1. To estimate an abundance index for all the priority species within the wind farm area as a baseline to measure potential **displacement** due to the construction and operation of the wind farm.
2. To estimate the risk of priority species **colliding** with the wind turbines by recording flight behaviour. Recommended method is **vantage point observations**.

1. Displacement due to the construction and operation of the wind farm:

*1.1 Methodology for calculating an abundance index using line **transects**:*

- Establish boundaries for the wind farm area (including buffer zones), taking into account the priority species likely to be present, for the area to be surveyed (hereafter referred to as the wind farm area). The experience of the ornithologist will be priority in establishing the buffer zones, **the decision to include an area will depend on the priority species that are likely to be present in the wind farm area.** It is important that this is done realistically and objectively, taking into account the potential impacts of the wind farm and the availability of resources to conduct the monitoring.
- Identify, delineate and calculate the percentage of each distinct habitat type from a priority species perspective in the wind farm area using a combination of satellite imagery (Google Earth) and GIS tools e.g. agricultural land, ridges, fynbos, woodland.
- Within the study area, selection of transects will largely depend on practical factors e.g. access, but ideally transects should cover as much as possible of the study area, and be as representative as possible of all the habitat types. However, it must be accepted that site variance will be unavoidable given varying capacity, time and access. Standardization of monitoring protocols should however always be attempted across studies, especially in the same regions e.g. the Overberg, West Coast, Karoo etc. in order for results to be extrapolated for comparison purposes, with some degree of confidence.
- Line transects should be counted in summer (from November to March) and in winter (May to August). Transects should be counted at least four times per season. A proposed practical method is for the observer to drive very slowly with a vehicle and stop every 250m and scan the surrounding habitat with binoculars in a 360° radius. All priority species must be recorded. The following data must be recorded:
    - Date of count
    - Number of count (each count must be numbered individually)
    - Duration of count i.e. the time it has taken to travel the transect (s)
    - Species
    - Weather conditions
    - Habitat type where the bird is recorded - overflying birds should be noted as such and not linked to a habitat type. In this respect the judgment of the observer will be crucial e.g. a bird that is foraging on the wing in a specific habitat type (e.g. a Black Harrier quartering in fynbos) should be distinguished from a bird that is obviously passing through.
- Ideally a similar exercise should be conducted for a control site of similar habitat composition and size, to make post-construction comparisons meaningful. **There may be merit in use of shared control or reference sites for several wind farms in a well-defined**

geographical area. Control sites should have the following characteristics:

    - Host a similar mix of bird species present on the wind farm development site.
    - Be similar in size to the wind farm area.
    - Be located on ground with a similar mix of habitats and similar topography and aspect.
    - Be as closely matched as possible to the wind farm site, the main difference being the absence of wind turbines from the control.
    - Be situated as close as possible to the wind farm area without its bird populations being so close as to be affected by wind farm operations.

- It is important to record information on priority species occurrence from secondary sources, for example CAR counts or local bird watchers as well. Although this information cannot be analyzed as part of the formal protocol, it is nonetheless important, especially if the source is reliable. Typical examples would be if the existence of nesting sites on the property which is known to the landowner. This should be incorporated into the final report.

1.2 Output:

- The main output of the transect monitoring is an abundance index for priority species expressed as species/km for both the wind farm area and the control area. This information will feed into the avifaunal specialist report for the EIA study.

2. Collision risk

*2.1 Methodology for estimating collision risk using **vantage point (VP) observations**:*

- Vantage point (VP) observations are a means of quantifying flight activity of priority species that take place within the wind farm area, with the principal aim of determining the likely collision risk.
- The purposes of vantage point watches are to collect data on priority species that will enable estimates to be made of:
    - The time spent flying over the defined survey area;
    - The relative use of different parts of the defined survey area;
    - The proportion of flying time spent within the upper and lower height limits as determined by the rotor diameter and rotor hub height.
    - The flight activity of other species - secondary species using the defined survey area.
- When selecting VPs, the aim should be to cover all of the survey area such that no point is greater than 2km from a VP, but this is not always feasible.
- It is very important that VPs are chosen in order to achieve maximum visibility with the minimum number of points.
- Typically, a site measuring 1000ha will require at least 2 VP's.
- As acuity of observations will decrease with distance, VPs should be located as close to the survey boundary as possible.
- VPs should not be located near to the nest site of target species and observers should try to position themselves inconspicuously so as to minimise their effects on bird movements.
- Coordinates of VPs must be recorded using a GPS. Observers should take care to re-use the exact VP location in successive watches.
- VP observations should be conducted in summer (November to March) and in winter (May to August). A total of 18 hours (two days) of vantage point (VP) observations pre- and post-construction per season per VP should be conducted. VP watches should be conducted in

three hour shifts, to account for different levels of bird activity:
    - Shift 1: starting one hour before dawn sunrise?
    - Shift 2: starting noon
    - Shift 3: starting two hours before sunset until visibility becomes too low
- The following data must be recorded at the start of the watch:
    - Watch number
    - Date
    - Start time
    - Wind strength (light, moderate, strong)
    - Wind direction
    - Flight activity for priority species must be recorded in the following manner (number each flying bout consecutively), the use of markers on laminated maps are strongly recommended:
        - Species
        - Flight duration (starting at time of detection until bird disappears from view)
        - Flight height (below the rotor arc; within the rotor arc; above the upper rotor arc - recorded at 15 second intervals until bird disappears from sight)
        - Flight direction recorded at 15 second intervals until bird disappears from sight.
        - Flight mode recorded at 15 second intervals until bird disappears from site (soaring, gliding, flapping)
- Estimation of predicted collision mortality can be undertaken with a model such as that developed by SNH (Scottish Natural Heritage 2000b). Band et al (2007) provide further details, worked examples and discussion. The model leads to an initial estimate of collision risk based on the theoretical assumption that birds take no avoiding action. It is then necessary to build in a more realistic expectation that a high proportion of birds are likely to take avoiding action successfully (see SNH 2000a). Limited information on avoidance rates is available for some species, based on experience at actual wind farms (see SNH 2004). With time, avoidance rates for SA species will need to be established.

B) POST-CONSTRUCTION MONITORING

Aims:

- To compare the abundance index for all the priority species within the development area after construction against the pre-construction baseline to measure actual **displacement** due to the construction and operation of the wind farm. Recommended survey method is **line transect counts (see above).**
- To estimate the risk of priority species **colliding** with the wind turbines by recording actual collisions and comparing post-construction flight patterns with pre-construction baseline data. Recommended methods are **carcass searches and VP watches (see above)**.

1. Displacement due to the construction and operation of the wind farm:

*1.1 Methodology for calculating abundance index using **line transects**:*

- Methodology has been fully covered above.
- Ideally, surveys should be conducted in two seasons of years 1, 2, 3, 5, 10 and 15; after the

wind farm becomes operational. Bird responses to wind farms may operate over very long periods of time, and that monitoring needs to take this into account, as results from short term observational studies are unlikely to be representative.

2. Collision risk

*2.1 Methodology for estimating actual collision rates using **carcass searches**:*

- Carcass searches are the most direct way of estimating the number of collisions and hence the likely impact on species of conservation importance. Measures of the number of collisions can also help to quantify avoidance rates (as used in collision risk modeling calculations), and, when collisions can be ascribed to a particular time, contribute to an understanding of environmental conditions and behaviours that increase collision risk.
- The value of surveying the area for collision victims only holds if some measure of the accuracy of the survey method is developed. To do this, a sample of suitable bird carcasses (of similar size and color to the priority species – e.g. Egyptian Goose *Alopochen aegyptiacus*, domestic waterfowl and pigeons) should be obtained and distributed randomly around the site without the knowledge of the surveyor, some time before the site is surveyed. This process should be repeated opportunistically (as and when suitable bird carcasses become available) for the first two months of the monitoring period, with the total number of carcasses not less than 20. The proportion of the carcasses located in surveys will indicate the relative efficiency of the survey method.
- Simultaneous to this process, the condition and presence of all the carcasses positioned on the site should be monitored throughout the initial two-month period, to determine the rates at which carcasses are scavenged from the area, or decay to the point that they are no longer obvious to the surveyor. This should provide an indication of scavenge rate that should inform subsequent survey work for collision victims, particularly in terms of the frequency of surveys required to maximise survey efficiency and/or the extent to which estimates of collision frequency should be adjusted to account for scavenge rate. Scavenger numbers and activity in the area may vary seasonally so, ideally, scavenge and decomposition rates should be measured twice during the monitoring year, once in winter and once in summer.
- The area within a radius of at least 50 m of each of the turbines (from the outer edge of rotor zone) at the facility should be checked regularly for bird casualties. The frequency of these surveys should be informed by assessments of scavenge and decomposition rates conducted in the initial stages of the monitoring period (see above), but they should be done at least weekly for the first two months of the study. The area around each turbine, or a larger area encompassing the entire facility, should be divided into quadrants, and each should be carefully and methodically searched for any sign of a bird collision incident (carcasses, dismembered body parts, scattered feathers, injured birds). All suspected collision incidents should be comprehensively documented, detailing the precise location (preferably a GPS reading), date and time at which the evidence was found, and the site of the find should be photographed with all the evidence *in situ*. All physical evidence should then be collected, bagged and carefully labeled, and refrigerated or frozen to await further examination. If any injured birds are recovered, each should be contained in a suitably-sized cardboard box. The local conservation authority should be notified and requested to transport casualties to the nearest reputable veterinary clinic or wild animal/bird rehabilitation centre. In such cases, the immediate area of the recovery should be searched for evidence of impact with the turbine blades, and any such evidence should be fully documented (as above).

*2.2 Methodology for comparing post-construction flight patterns with pre-construction baseline data using **VP watches***

- Methodology has been fully covered above.

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