Oyster Bay Wind Project

Bird Impact Scoping Study

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Executive summary

Renewable Energy Systems (RES) Southern Africa (Pty) Ltd has appointed Savannah Environmental (Pty) Ltd to undertake an Environmental Impact Assessment (EIA) and to compile an Environmental Management Plan (EMP) for a proposed Wind Energy Facility on a site near Oyster Bay. Chris van Rooyen Consulting was appointed to assess the potential impacts the facility will have on birds.

The principal areas of concern with regard to effects on birds are the following:

- Collision mortality on the wind turbines
- Collision with the proposed power line
- Displacement due to disturbance
- Habitat change and loss

Micro habitats identified for this study area are listed below. This should not be seen as exhaustive as additional micro-habitat might be identified during future site visits:

- Irrigated pastures
- Fynbos
- Old lands and pastures
- Dams
- Wetlands

A total of 48 priority species potentially occurring in the study area were identified, based on the following criteria:

- Nationally threatened species
- Taxa listed under provisions of relevant legislation that provide protection for particular categories of taxa whether threatened or not.
- Taxa naturally occurring at low densities because of their ecological function high in the trophic order. This relates primarily to taxa like raptors that are top-order predators.
- Taxa that are of special cultural significance e.g. the Blue Crane, which is South Africa's national bird.
- Any other taxa that regulatory authorities require to be considered for a particular site, such as species not included in the categories above but for which the site is especially significant e.g. range restricted species.

A **preliminary** assessment, based on a desk top analysis, of potential impacts was conducted. A more detailed impact assessment will be provided in the EIA phase, taking into account the results of field work involving actual bird counts and recording of flight behaviour.

The following aspects will be covered in the Bird Impact Assessment Report for the EIA phase of the project:

- A description of all environmental issues that were identified during the environmental impact assessment process;
- A detailed assessment of the significance of direct, indirect and cumulative impacts;
- A description and comparative assessment of all alternatives identified during the environmental impact assessment process;
- Recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Plan (EMP);
- An indication of the extent to which the identified impacts could be addressed by the adoption of mitigation measures;
- A description of any assumptions, uncertainties and gaps in knowledge;
- The details of a pre-construction monitoring plan with the following aims:
  - To estimate a population size for all the key species within the development area as a baseline to measure potential **displacement** due to the construction and operation of the wind farm.
  - To estimate the risk of key species **colliding** with the wind turbines by recording flight behaviour.

1. INTRODUCTION

Renewable Energy Systems (RES) Southern Africa (Pty) Ltd has appointed Savannah Environmental (Pty) Ltd to undertake an Environmental Impact Assessment (EIA) and to compile an Environmental Management Plan (EMP) for a proposed Wind Energy Facility on a site near Oyster Bay. Chris van Rooyen Consulting was appointed to assess the potential impacts the facility will have on birds.

1.1 Project components

The project consists of the establishment of a wind energy facility and associated infrastructure within a broader site of 23 km² located approximately 6 km north of Oyster Bay in the Eastern Cape Province. The proposed facility will have a generating capacity of up to 160MW and the following infrastructure:

- Up to 80 wind turbines;
- Cabling between the turbines, to be placed underground where practical;
- On-site substation/s to facilitate the connection between the wind energy facility and the grid;
- A new overhead power line to be connected to Eskom's existing Melkhout Substation;
- Internal access roads to each turbine; and
- Workshop area for maintenance and storage.

The wind energy facility is proposed on the following farm portions: Portion 3 of Farm Klein Rivier 713; Portion 1, 2, 3, 4 and the Remainder of Farm Rebok Rant 715; Portion 1 and 3 of Farm Ou Werf 738; Portion 5 of Farm Klippedrift 732; Portion 10 and Portion 12 of Farm Kruis Fontein 681.

See Figure 1 below for a map of the study area.

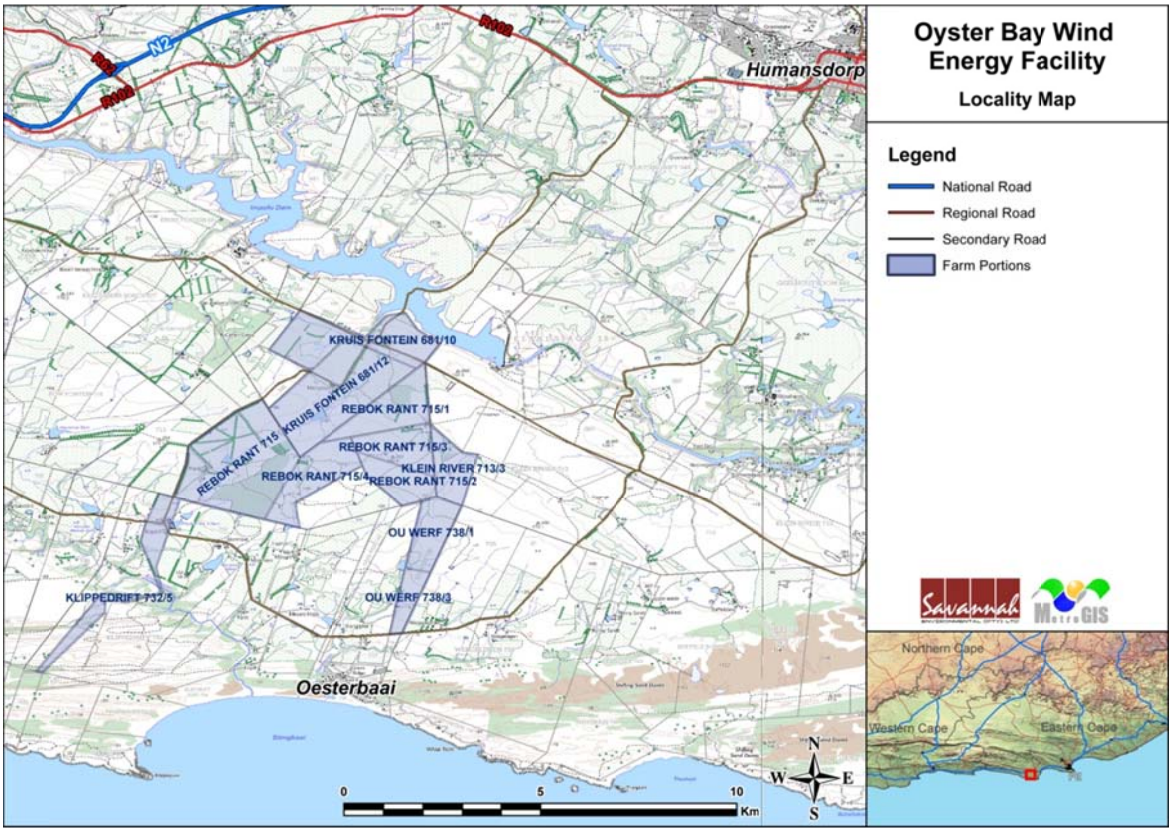

Figure 1: Map of the study area (Source: Savannah Environmental Consulting)

1.2 Terms of reference

This report constitutes a **desk top** scoping study and includes the following components:

- A 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 impacts of the identified issues evaluated in terms of the following criteria:
    - The nature, which includes a description of what causes the effect, what will be affected and how it will be affected;
    - The extent, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international
- A statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts;

- Identification of potentially significant impacts to be assessed within the EIA phase and details of the methodology to be adopted in assessing these impacts. This includes a description of the proposed method of assessing the potential environmental impacts associated with the project.

1.3 Sources of information

The following information sources were consulted in order to conduct this study:

- Bird distribution data of the Southern African Bird Atlas Project (SABAP – Harrison *et al,* 1997) obtained from the Avian Demography Unit of the University of Cape Town, as a means to ascertain which species occur within the study area. A data set was obtained for the QDGC (quarter degree grid cell) within which the development will take place, namely 3424BA. A QDGC corresponds to the area shown on a 1:50 000 map (15' x 15') and is approximately 27 km long (north-south) and 23 km wide (east-west).
- The SABAP data was supplemented with SABAP2 data for the relevant QDGC. This data is much more recent, as SABAP2 was only launched in May 2007, and should therefore be more accurate. For SABAP, QDGCs were the geographical sampling units. For SABAP2 the sampling unit has been reduced to pentad grid cells (or pentads); these cover 5 minutes of latitude by 5 minutes of longitude (5. × 5.). Each pentad is approximately 8 × 7.6 km. This finer scale has been selected for SABAP2 to obtain more detailed information on the occurrence of species and to give a clearer and better understanding of bird distributions. There are nine pentads in a QDGC.
- Additional information on large terrestrial avifauna and habitat use was obtained from the Coordinated Avifaunal Roadcounts (CAR) project of the Animal Demographic Unit (ADU) of the University of Cape Town.
- The conservation status of all bird species occurring in the aforementioned quarter degree squares was determined with the use of Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Barnes 2000).
- A classification of the vegetation types from an avifaunal perspective in the quarter degree squares was obtained from SABAP1.
- Detailed satellite imagery from Google Earth (imagery date January 2004) was used in order to view the study area on a landscape level and to help identify bird habitat on the ground.
- Personal observations by the author, who is familiar with the variety of birdlife and bird habitats due to his involvement in other wind farm developments in the Jeffreys Bay and Humansdorp area.
- An extensive review of relevant international literature on birds and wind farm impacts was conducted, which is fully referenced in Section 6 of this report.

1.4 Assumptions

This study made the basic assumption that the sources of information used are reliable. However, it must be noted that the following factors may potentially detract from the accuracy of the predicted results:

- The SABAP1 data covers the period 1986 -1997. Bird distribution patterns fluctuate continuously according to availability of food and nesting habitat.
- Sources of error in the SABAP databases, particularly inadequate coverage of some QDGCs. This means that the reporting rates of species may not be an accurate reflection of the true densities in quarter degree squares that were sparsely covered during the data collecting period, as was the case with several of the squares (for a full discussion of potential inaccuracies in SABAP1 data, see Harrison et al, 1997). It must be noted that in this instance the 3424BA QDGC was reasonably well covered with data being recorded on a total of 51 SABAP1 checklists, and 43 SABAP2 checklists.
- As this is a desk top study, detailed, verified information on micro-habitat level was not available of bird occurrence, densities and movements, therefore all conclusions are based on secondary sources. Primary observations will only be conducted during site visits in the EIA phase and later.
- Wind facilities are a relatively new development in South Africa. An extensive body of knowledge of avian interactions with wind generation facilities in a southern African context has yet to emerge; therefore strong reliance had to be placed on studies from overseas. Some speculation with regard to how South African birds are likely to interact with the proposed wind facility was therefore unavoidable.
- With certain classes of birds, particularly cranes and bustards, very little research has been conducted on potential impacts with wind facilities world-wide. The precautionary principle was therefore applied in assessing the potential impacts on species belonging to these classes. The World Charter for Nature, which was adopted by the UN General Assembly in 1982, was the first international endorsement of the precautionary principle. The principle was implemented in an international treaty as early as the 1987 Montreal Protocol and among other international treaties and declarations is reflected in the 1992 Rio Declaration on Environment and Development. Principle 15 of the Rio Declaration 1992 states that: “in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation.”

- There have been few comprehensive studies, and even fewer published, peer-reviewed scientific papers on the impacts of wind farms on birds. Many studies suffer from a lack of before and after, or wind farm area and reference area comparisons, or a total lack of assessment of relevant factors such as collision risk, differences in bird behaviour between night and day, or are of inadequate duration to provide conclusive results (Langston & Pullen 2003). It is therefore inevitable that an element of speculation will enter the conclusions in this report, due to inconclusive and sometimes contradictory scientific evidence on the nature and extent of the impacts caused by wind farms, and the lack of any research on this topic in South Africa.

2. DESCRIPTION OF THE AFFECTED ENVIRONMENT

2.1 Vegetation types and bird habitats

Vegetation structure is more critical in determining bird habitat than actual plant composition (Harrison *et.al.* 1997). Therefore, the description of vegetation presented in this study concentrates on factors relevant to bird species, and does not give an exhaustive list of plant species which occur in the study area.

The description of the vegetation type occurring on site makes use of information presented in the Atlas of southern African birds (Harrison *et.al.* 1997). The criteria used to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, **likely to be relevant to birds**, and (2) the results of published community studies on **bird/vegetation associations**. It is important to note that no new vegetation unit boundaries were created, with use being made only of previously published data.

The proposed development site is situated within the Fynbos biome (Harrison *et.al*. 1997). The Fynbos biome is characterized by a high diversity in plant species composition and endemism. This diversity is not paralleled in its avifaunal composition, and Fynbos is regarded as relatively poor in avifaunal diversity compared to other southern African biomes. The endemic Fynbos avifauna consists of the Cape Rockjumper *Chaetops frenatus*, Victorin's Warbler *Cryptillas victorini*, Cape Sugarbird *Promerops cafer*, Orange-breasted Sunbird *Anthobaphes violacea*, Protea Seedeater *Crithagra leucopterus* and Cape Siskin *Crithagra totta*. The Black Harrier *Circus maurus*, a southern African endemic, also uses the Fynbos biome extensively for breeding. In the study area, these endemics are either absent or very sparsely distributed. There are however populations of priority species which are not restricted to the Fynbos biome.

Whilst some of the distribution and abundance of the bird species in the study area can be explained by the description of vegetation types above, it is even more important to examine the micro habitats available to birds. These are generally evident at a much smaller spatial scale than the vegetation types, and are determined by a host of factors such as vegetation type, topography, land use and man-made infrastructure.

Micro habitats identified for this study area are described below. **This should not be seen as exhaustive as additional micro-habitat might be identified during future site visits:**

- **Irrigated pastures.** The study area contains extensive cultivated pastures, most of which are irrigated. The area's most important economic activity is dairy farming, and the pastures have replaced most of the indigenous Fynbos, especially along the coastal flats. The pastures are important for several priority species such as Blue Crane *Anthropoides paradiseus*, Black-winged Lapwing *Vanellus melanopterus* and Denham's Bustard *Neotis denhami* (see Table 1). In the summer months, large flocks of White Storks *Ciconia ciconia* frequent the pastures. Irrigated pastures are present on the farm Klippedrift 732/5, as well as on properties south of the study area.

- **Fynbos.** The remaining areas of Fynbos are of importance for priority species such as Secretarybird *Sagittarius serpentarius*, Denham's Bustard, Black Harrier, Rock Kestrel *Falco rupicolus*, Jackal Buzzard *Buteo rufofuscus* and Steppe Buzzard *Buteo vulpinus* (see Table 1). Other species that are likely to be encountered here are Helmeted Guineafowl *Numida meleagris* and Red-necked Spur-fowl *Phalaropus lobatus* and, in degraded areas, Crowned Lapwing *Vanellus coronatus* and Spotted Thick-knee *Burhinus capensis*. There are extensive remaining areas of Fynbos in the study area, especially on the farms Klippedrift 732/5 and Ou Werf 738/1 and 2.

- **Old lands and dry land pastures.** There are several areas in the study area where the original Fynbos vegetation was cleared when agriculture was practiced at some stage in the past (mostly wheat farming). These areas are now reverting back to a form of grassy Fynbos, which constitutes ideal habitat for Blue Crane, Denham's Bustard and Secretarybird (see Table 1). Some of the old lands have been planted with indigenous grasses which are intermingling with indigenous Fynbos. These areas are also very suitable for the species mentioned above, as well as foraging Black Harrier and White-bellied Korhaan *Eupodotis senegalensis*. Raptors such as Lanner Falcon *Falco* *biarmicus* will also hunt for birds in the cleared areas. Old lands are present on several of the properties in the study area.

- **Dams.** The area contains several dams and water bodies, mostly man made but some also natural and seasonal. These dams and pans, depending on the shape, can be important for some bird species. Dams with shallow sloping sides are suitable for a wider range of species. In the context of this study, shallow dams with sloping sides are important roost sites for Blue Cranes and White Storks. These dams will also be frequented by a variety of waders, ducks and flamingos, most of which are priority species (see Table 1). Directly north of the study area a large dam, the Impofu Dam, is situated in the Krom River. Dams are present on several properties, with large dams on Rebok Rant 715 and Kruis Fontein 681/12. Several dams are also present on adjoining properties south of the study area.

- **Wetlands.** There are many wetlands in the study area, which may be of importance to a variety of priority species, including Blue Crane and African Marsh Harrier *Circus ranivorus* (see Table 1). Prominent wetlands are present on Kruis Fontein 681/10 and 12, and Klein River 713/3.

2.2 Avifauna in the study area

The following criteria were applied to identify priority bird taxa that potentially might be affected by the proposed wind facility:

- Nationally threatened species, i.e. species listed in The Eskom Red Data book of birds of South Africa, Lesotho and Swaziland (Barnes 2000)
- Taxa listed under provisions of relevant legislation that provide protection for particular categories of taxa whether threatened or not. This includes international treaties. From an international perspective, the Convention on Biological Diversity (CBD) (1992) to which South Africa is a signatory, is applicable. The overall objective of the Convention is the "…conservation of biological diversity, [and] the sustainable use of its components and the fair and equitable sharing of the benefits …". Another international convention which is applicable in this case is the Convention on the Conservation of Migratory Species of Wild Animals (http://www.unep-aewa.org). This Convention, commonly referred to as the Bonn Convention, (after the German city where it was concluded in 1979), came into force in 1983. This Convention's goal is to provide conservation for migratory terrestrial, marine and avian species throughout their entire range. This is very important, because failure to conserve these species at any particular stage of their life

cycle could adversely affect any conservation efforts elsewhere. The fundamental principle of the Bonn Convention, therefore, is that the Parties to the Bonn Convention acknowledge the importance of migratory species being conserved and of Range States agreeing to take action to this end whenever possible and appropriate, paying special attention to those migratory species whose conservation status is unfavourable, and individually, or in co-operation taking appropriate and necessary steps to conserve such species and their habitat. Parties acknowledge the need to take action to avoid any migratory species becoming endangered. Agreements are the primary tools for the implementation of the main goal of the Bonn Convention. Moreover, they are more specific than the Convention itself, more deliberately involve the Range States of the species to be conserved, and are easier to put into practice=implement than the Bonn Convention itself. One such agreement is the African-Eurasian Waterbird Agreement (AEWA), which is an international agreement aimed at the conservation of migratory waterbirds.

- Taxa naturally occurring at low densities because of their ecological function high in the trophic order. This relates primarily to taxa like raptors that are top-order predators.
- Taxa that are of special cultural significance e.g. the Blue Crane, which is South Africa's national bird.
- Any other taxa that regulatory authorities require to be considered for a particular site, such as species not included in the categories above but for which the site is especially significant e.g. range restricted species.

Appendix A contains the list of priority species that have been recorded in 3424BA by SABAP and SABAP2. The criteria listed above were used in establishing the list of priority species in the study area.

3. IDENTIFICATION OF KEY IMPACTS PERTAINING TO AVIFAUNA

To be effective, wind farms must be sited in open, exposed areas where there are high average wind speeds. This means that they are often proposed in upland, coastal and offshore areas, thus potentially affecting important habitats for breeding, wintering and migrating birds. The effects of a wind farm on birds are highly variable and depend on a wide range of factors including the specification of the development, the topography of the surrounding land, the habitats affected and the number and species of birds present. With so many variables involved, the impacts of each wind farm must be assessed individually. The principal areas of concern with regard to effects on birds are listed below. Each of these potential effects can interact, either increasing the overall impact on birds or, in some cases, reducing a particular impact (for example where habitat loss or displacement causes a reduction in birds using an area which might then reduce the risk of collision).

- Collision mortality on the wind turbines
- Collision with the proposed power line
- Displacement due to disturbance
- Habitat change and loss

4. IMPACT ASSESSMENTS

4.1 Collisions

4.1.1 Collision mortality on the wind turbines

The majority of studies of collisions caused by wind turbines have recorded relatively low levels of mortality. This is perhaps largely a reflection of the fact that many of the studied wind farms are located away from large concentrations of birds. It is also important to note that many records are based only on finding corpses, with no correction for corpses that are overlooked or removed by scavengers (Drewitt & Langston 2006).

Internationally, relatively high collision mortality rates have been recorded at several large, poorly sited wind farms in areas where large concentrations of birds are present (including Important Bird Areas (IBAs)), especially migrating birds, large raptors or other large soaring species, e.g. Altamont Pass in California, USA, Tarifa and Navarra in Spain. In these cases, actual deaths resulting from collision are high, notably of Golden Eagle *Aquila chrysaetos* and Eurasian Griffon *Gyps fulvus*, respectively. With the exception of White Stork *Ciconia ciconia* in summer, large flocks of soaring species are not a characteristic of the present study area.

Collision risk depends on a range of factors related to bird species, numbers and behaviour, weather conditions and topography and the nature of the wind farm itself, including the use of lighting. Clearly, the risk is likely to be greater on or near areas regularly used by large numbers of feeding or roosting birds, or on migratory flyways or local flight paths, especially where these are intercepted by the turbines. Risk also changes with weather conditions, with evidence from some international studies showing that more birds collide with structures when visibility is poor due to fog or rain, although this effect may be to some extent offset by lower levels of flight activity in such conditions. Birds that are already on migration, however, cannot avoid poor weather conditions, and will be more vulnerable if forced by low cloud to descend to a lower altitude or land. Fortunately, the phenomenon of mass migrations is not a feature of the study area. Strong headwinds also affect collision rates and migrating birds in particular tend to fly lower when flying into the wind (Drewitt & Langston 2006).

Accepting that many wind farms result in only low levels of mortality, even these levels of additional mortality may be significant for long-lived species with low productivity and slow maturation rates (e.g. Blue Crane, Greater Flamingo, Martial Eagle and Denham's Bustard), especially when rarer species of conservation concern are affected. In such cases there could be significant effects at the population level (locally, regionally or, in the case of rare and restricted species, nationally), particularly in situations where cumulative mortality takes place as a result of multiple installations (Carette *et al* 2009).

Large birds with poor manoeuvrability (such as cranes and bustards) are generally at greater risk of collision with structures and species that habitually fly at dawn and dusk or at night are perhaps less likely to detect and avoid turbines (e.g. cranes arriving at a roost site after sunset, or flamingos flying at night). Collision risk may also vary for a particular species, depending on age, behaviour and stage of annual cycle (Drewitt & Langston 2006).

While the flight characteristics of cranes, flamingos and bustards make them obvious candidates for collisions with power lines, it is significant that these classes of birds (unlike raptors) do not feature prominently in literature as collision victims of wind turbines. It may be that they avoid wind farms entirely, resulting in lower risks of collision (see the discussion of Displacement 4.2.1 below).

The precise location of a wind farm site can be critical. Particular topographic features may be used for lift by soaring species (Barrios & Rodriguez 2004; De Lucas *et al* 2008) or can result in large numbers of birds being funnelled through an area of turbines (Drewitt & Langston 2006). For example, absence of thermals on cold, overcast days may force larger, soaring species (e.g. Martial Eagle and Secretarybird) to use slopes for lift, which may increase their exposure to turbines. Birds also lower their flight height in some locations, for example when following the coastline or crossing a ridge, which might place them at greater risk of collision with rotors. In the present case, the entire study area is located on a flat area, and from studying the contour lines, no obvious funnels could be detected. Local, low altitude movement by species such as Blue Crane and Denham's Bustard happens frequently (pers. obs), and may be influenced by the topography.

The size and alignment of turbines and rotor speed are likely to influence collision risk, however, physical structure is probably only significant in combination with other factors, especially wind speed, with gentle winds resulting in the highest risk (Barrios & Rodriguez 2004; Stewart *et al* 2007). Lattice towers are generally regarded as more dangerous than tubular towers because many raptors use them for perching and occasionally nesting; however Barrios & Rodriguez (2004) found tower structure to have no effect on mortality, and that mortality may be directly related to abundance for certain species (e.g. Common Kestrel *Falco tinnunculus*). De Lucas *et al* (2008) found that turbine height and higher elevations may heighten the risk (taller = more victims), but that abundance was not directly related to collision risk, at least for Eurasian Griffon *Gyps fulvus*.

Aviation warning lights on turbines may increase the risk of collision by attracting and disorientating birds. The effects of lights in these circumstances are poorly known, though collisions of large numbers of migrants with illuminated structures, especially during overcast nights with drizzle or fog, are well documented (Erickson *et al* 2001). The current advice is to use the minimum number of intermittent flashing white lights of lowest effective intensity (Drewitt & Langston 2006). It is not known if the use of lights on the outer turbines alone, which would perhaps result in more diffuse lighting, would be less likely to disorientate birds than a single bright point source. It must be noted that the risk of nocturnal collisions with lighted turbines have been studied within the context of large numbers of nocturnal migrants in the northern hemisphere, which is not a feature of the current study area.

A review of the available literature indicates that, where collisions have been recorded, the rates per turbine are very variable with averages ranging from 0.01 to 23 bird collisions annually (the highest figure is the value, following correction for scavenger removal, for a coastal site in Belgium and relates to gulls, terns and ducks amongst other species) (Drewitt & Langston 2006). Although providing a helpful and standardized indication of collision rates, average rates per turbine must be viewed with some caution as they are often cited without variance and can mask significantly higher rates for individual turbines or groups of turbines (Everaert *et al* 2001 as sited by Drewitt & Langston 2006).

Some of the highest levels of mortality have been for raptors at Altamont Pass in California (Howell & DiDonato 1991, Orloff & Flannery 1992 as sited by Drewitt & Langston 2006) and at Tarifa and Navarre in Spain (Barrios & Rodriguez unpublished data as sited by Drewitt & Langston 2006). These cases are of particular concern because they affect relatively rare and long-lived species such as Griffon Vulture *Gyps fulvus* and Golden Eagle *Aquila chrysaetos* which have low reproductive rates and are vulnerable to additive mortality. At Altamont, Golden Eagles congregate to feed on super-abundant prey which supports very high densities of breeding birds. In the Spanish cases, extensive wind farms were built in topographical bottlenecks where large numbers of migrating and local birds fly through a relatively confined area due to the nature of the surrounding landscape, for example through mountain passes, or use rising winds to gain lift over ridges (Barrios & Rodriguez 2004). Although the average numbers of fatalities annually per turbine were generally low at Altamont Pass and Tarifa, ranging from 0.02 to 0.15 collisions/turbine, overall collision rates were high because of the large numbers of turbines involved (over 7000 at Altamont). At Navarre, corrected annual estimates ranging from 3.6 to 64.3 mortalities/turbine were obtained for birds and bats (unpublished data). Thus, a minimum of 75 Golden Eagles are killed annually at Altamont and over 400 Griffon Vultures are estimated (following the application of correction factors) to have collided with turbines at Navarre. Work on Golden Eagles at Altamont Pass indicated that the population was declining in this area, thought to be at least in part due to collision mortality (Hunt *et al* 1999, Hunt 2001 as sited by Drewitt & Langston 2006).

It must be noted that the study site is not a regular migration funnelling point for large birds. No estimate can however be made of potential collision rates, due to the lack of data. This aspect will require the implementation of a monitoring protocol in order to make meaningful predictions based on actual flight behaviour (see 5 below).

4.1.2. Collisions with the proposed power line

A proposed 132kV power line that will link the wind energy facility to the grid could pose a collision risk, depending on the final alignment of the line. No electrocution risk is envisaged, as only vultures are at risk of electrocution on 132kV structures, and they do not occur in the area (Van Rooyen 2000).

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern

Africa are electrocution of birds (and other animals) and birds colliding with power lines (Ledger & Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs & Ledger 1986a; Hobbs & Ledger 1986b; Ledger *et.al.* 1992; Verdoorn 1996; Kruger & Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000). Electrocutions are not envisaged to be a problem on the proposed 132kV line. Collisions, on the other hand, could be a potential problem.

Collisions kill far more birds annually in southern Africa than electrocutions (Van Rooyen 2007). Most heavily impacted upon are bustards, storks, cranes and various species of water birds. These species are mostly heavy-bodied birds with limited maneuverability, 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 - of the 2369 avian mortalities on distribution lines recorded by the Endangered Wildlife Trust (EWT) between August 1996 and October 2007, 1512 (63.8%) were Red listed species (Van Rooyen 2007).

In the Overberg region of the Western Cape, which has a very similar Red listed species composition and habitat use as the current study area, power line collisions have long been recorded as a major source of avian mortality (Van Rooyen 2007). Most numerous amongst power line collision victims are Blue Crane and Denham's Bustard (Shaw 2007). It has been estimated that as many as 10% of the Blue Crane population in the Overberg are killed annually on power lines, and figure for Denham's Bustard might be as high as 30% of the Overberg population (Shaw 2007). These figures are extremely concerning, as it represents a possible unsustainable source of unnatural mortality.

Unfortunately, the dynamics of the collision problem is poorly understood. In the most recent study on this problem in the Overberg, Shaw (2007) identified cultivated land and region as the significant factors influencing power line collision risk. Lines that cross cultivated land pose a higher risk, as expected, as this is the preferred habitat of Blue Cranes in the Overberg. In the current study area, it can be postulated that the old lands and pastures will be higher risk from a power line collision perspective, as this constitutes primary habitat for Blue Crane and Denham's Bustard. Collision rates are higher for birds in flocks, as they may panic, or lack visibility and room for maneuver because of the close proximity of other birds (APLIC, 1994). Other factors, such as proximity to dams, wind direction and proximity to roads and dwellings did not emerge as significant factors, but she readily admits that her broad-scale analysis may have been too crude to demonstrate their effects. It is for example a well known fact that cranes are particularly vulnerable to power lines skirting water bodies used as roosts, as they often arrive there or leave again in low light conditions (pers. obs.).

4.2 Displacement

4.2.1 Displacement due to disturbance

The displacement of birds from areas within and surrounding wind farms due to visual intrusion and disturbance can amount effectively to habitat loss. Displacement may occur during both the construction and operational phases of wind farm, and may be caused by the presence of the turbines themselves through visual, noise and vibration impacts, or as a result of vehicle and personnel movements related to site maintenance. The scale and degree of disturbance will vary according to site- and species-specific factors and must be assessed on a site-by-site basis (Drewitt & Langston 2006).

Unfortunately, few studies of displacement due to disturbance are conclusive, often because of the lack of before-and-after and control-impact (BACI) assessments. Onshore, disturbance distances (in other words the distance from wind farms up to which birds are absent or less abundant than expected) up to 800 m (including zero) have been recorded for wintering waterfowl (Pedersen & Poulsen 1991 as sited by Drewitt & Langston 2006), though 600 m is widely accepted as the maximum reliably recorded distance (Drewitt & Langston 2006). The variability of displacement distances is illustrated by one study which found lower post-construction densities of feeding European White-fronted Geese *Anser albifrons* within 600 m of the turbines at a wind farm in Rheiderland, Germany (Kruckenberg & Jaene 1999 as sited by Drewitt & Langston 2006), while another showed displacement of Pink-footed Geese *Anser brachyrhynchus* up to only 100–200 m from turbines at a wind farm in Denmark (Larsen & Madsen 2000 as sited by Drewitt & Langston 2006).

Studies of breeding birds are also largely inconclusive or suggest lower disturbance distances, though this apparent lack of effect may be due to the high site fidelity and long life-span of the breeding species studied. This might mean that the true impacts of disturbance on breeding birds will only be evident in the longer term, when new recruits replace existing breeding birds. Few studies have considered the possibility of displacement for short-lived passerines (such as larks), although Leddy *et al* (1999) found increased densities of breeding grassland passerines with increased distance from wind turbines, and higher densities in the reference area than within 80 m of the turbines, indicating that displacement did occur at least in this case. The consequences of displacement for breeding productivity and survival are crucial to whether or not there is likely to be a significant impact on population size. In the absence of any reliable information on the effects of displacement on birds, it is precautionary to assume that significant displacement will lead to a population reduction (Drewitt & Langston 2006).

Studies show that the scale of disturbance caused by wind farms varies greatly. This variation is likely to depend on a wide range of factors including seasonal and diurnal patterns of use by birds, location with respect to important habitats, availability of alternative habitats and perhaps also turbine and wind farm specifications. Behavioural responses vary not only between different species, but between individuals of the same species, depending on such factors as stage of life cycle (wintering, moulting, breeding), flock size and degree of habituation. The possibility that wintering birds in particular might habituate to the presence of turbines has been raised (Langston & Pullen 2003), though it is acknowledged that there is little evidence and few studies of long enough duration to show this, and at least one study has found that habituation may not happen (Altamont Pass Avian Monitoring Team 2008) . A recent systematic review of the effects of wind turbines on bird abundance has shown that increasing time since operation resulted in greater declines in bird abundance (Stewart *et al*. 2004 as sited by Drewitt & Langston 2006). This evidence that impacts are likely to persist or worsen with time suggests that habituation is unlikely, at least in some cases (Drewitt & Langston 2006, Altamont Pass Avian Monitoring Team 2008).

In the present study area, it can be reasonably inferred that sensitive species such as White-bellied Korhaan, Denham's Bustard and Blue Crane will be affected by the noise (and the movement) of the construction and operation of the turbines.

It is a known fact that White-bellied Korhaan requires areas of suitable habitat well away from anthropogenic activities (high human densities). The White-bellied Korhaan is extremely sensitive to human intrusion and will promptly vacate areas when humans are detected, and may often flush away from human intrusion at distances of up to one kilometre measured between the korhaan individuals and the observer (Niemand 2009). Likewise, Morrison (1998) found that the probability of finding Blue Crane nests decrease as the number of roads in an area increase. She further found that Blue Cranes actively avoided tar and gravel roads, houses and areas of agricultural activity when selecting a nest site. It can therefore be postulated that the noise and movement at the wind farm will most likely serve as a deterrent to the species. Indications are that Great Bustard *Otis tarda* (a species related to the Denham's Bustard) are displaced by wind farms within one kilometre of the facility (Langgemach 2008). From personal observations it is clear that Denham's Bustard are very sensitive to anthropogenic activity and are likely to react in the same manner. Actual displacement (if any) will have to be measured through appropriate monitoring protocols (see 5 below).

The effect of birds altering their migration flyways or local flight paths to avoid a wind farm is also a form of displacement. This effect is of concern because of the possibility of increased energy expenditure when birds have to fly further, as a result of avoiding a large array of turbines, and the potential disruption of linkages between distant feeding, roosting, moulting and breeding areas otherwise unaffected by the wind farm. The effect depends on species, type of bird movement, flight height, distance to turbines, the layout and operational status of turbines, time of day and wind force and direction, and can be highly variable, ranging from a slight 'check' in flight direction, height or speed, through to significant diversions which may reduce the numbers of birds using areas beyond the wind farm (Drewitt & Langston 2006).

A review of the literature suggests that none of the barrier effects identified so far have significant impacts on populations (Drewitt & Langston 2006). However, there are circumstances where the barrier effect might lead indirectly to population level impacts; for example where a wind farm effectively blocks a regularly used flight line between nesting and foraging areas, or where several wind farms interact cumulatively to create an extensive barrier which could lead to diversions of many tens of kilometres, thereby incurring increased energy costs.

It is not possible to make any firm projections in the current study area as to the significance of this potential impact due to a lack of data. It has to be assumed that it could be a factor for several species, including sensitive Red listed species such as White-bellied Korhaan, Denham's Bustard, and Blue Crane, which make frequent low altitude flights. However, the implementation of a pre- and post-construction monitoring programme will be essential to estimate actual displacement rates (see 5 below).

4.2.2 Habitat change and loss

The scale of direct habitat loss resulting from the construction of a wind farm and associated infrastructure depends on the size of the project but, generally speaking, is likely to be small per turbine base. Typically, actual habitat loss amounts to 2–5% of the total development area (Fox *et al*. 2006 as sited by Drewitt & Langston 2006), though effects could be more widespread where developments interfere with hydrological patterns or flows on wetland or peatland sites (unpublished data). Some changes could also be beneficial. For example, habitat changes following the development of the Altamont Pass wind farm in California led to increased mammal prey availability for some species of raptor (for example through greater availability of burrows for Pocket Gophers *Thomomys bottae* around turbine bases), though this may also have increased collision risk (Thelander *et al.* 2003 as sited by Drewitt & Langston 2006). In the study area, direct habitat loss is not regarded as a major impact on avifauna, relative to other impact such as disturbance.

4.3 Assessment criteria

A preliminary assessment of impacts has been included in this scoping study. This is subject to a more detailed assessment to be conducted in the EIA phase.

The assessment of impact significance is based on the following convention:

- **Nature of impact** – this reviews the type of effect that a proposed activity will have on the environment and includes "what will be affected and how?"
- **Extent** – this indicates whether the impact will be local and limited to the immediate area of development (the site); limited to within 5km of the development; or whether the impact may be realized regionally, nationally or even internationally.
- **Duration** – this reviews the lifetime of the impact, as being short term (0 – 5 years), medium (5 – 15 years), long term (>15 years but where the impacts will cease after the operation of the site), or permanent.
- **Intensity** – here it is established whether the impact is destructive or innocuous and it is described as either low (where no environmental functions and processes are affected), medium (where the environment continues to function but in a modified manner) or high (where environmental functions and processes are altered such that they temporarily or permanently cease).
- **Probability** – this considers the likelihood of the impact occurring and is described as improbable (low likelihood), probable (distinct possibility), highly probable (most likely) or definite (impact will occur regardless of prevention measures).

The status of the impacts and degree of confidence with respect to the assessment of the significance is stated as follows:

- **Status of the impact**: A description as to whether the impact will be positive (a benefit), negative (a cost), or neutral.
- **Degree of confidence in predictions**: The degree of confidence in the predictions, based on the availability of information and specialist knowledge. This is assessed as high, medium or low.

Based on the above considerations, an overall evaluation of the significance of the potential impact is provided, which is described as follows:

- **Low***:* Where the impact will not have an influence on the decision or require to be significantly accommodated in the project design
- **Medium:** Where it could have an influence on the environment which will require modification of the project design or alternative mitigation;
- **High:** Where it could have a 'no-go' implication for the project unless mitigation or re-design is practically achievable.

Figure 2 below constitute a sensitivity map, indicating the spatial distribution of sensitive areas in the study area.

It is important to note that impact assessment in Table 2 below is a **preliminary** assessment, based on a desk top analysis. A more detailed impact assessment will be provided in the EIA phase, taking into account the results of field work involving actual bird counts and recording of flight behavior (see 5 below).

Table 2: Impact assessment table

Impact description	Status	Extent	Duration	Intensity	Probability	Significance (without mitigation)	Confidence level
Bird collisions, particularly priority species, with the wind turbines	Negative	Local (within 5km of the development)	Long term >15 years	Medium	Probable for raptors, but unknown for cranes and bustards, as the latter may avoid the area after construction.	Low	Medium/low due to lack of South African precedents.
Power line: Bird collisions with the power line	Negative	Local (within 5km of the development)	Long term >15 years	Medium	Probable (raptors, cranes and bustards)	Medium	High
Displacement due to disturbance	Negative	Local (within 5km of the development)	Long term >15 years	Medium	Probable for cranes and bustards. Improbable for raptors.	Medium	Medium/low due to lack of South African precedents.
Habitat change and loss due to the footprint of the infrastructure	Negative	Local (within 5km of the development)	Long term >15 years	Low	Probable	Low	Medium

Figure 2: Sensitivity map of the study area

5. PLAN OF STUDY FOR THE EIA PHASE

The following aspects will be covered in the Bird Impact Assessment Report for the EIA phase of the project:

- A description of all environmental issues that were identified during the environmental impact assessment process;
- A detailed assessment of the significance of direct, indirect and cumulative impacts;
- A description and comparative assessment of all alternatives identified during the environmental impact assessment process;
- Recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Plan (EMP);
- An indication of the extent to which the identified impacts could be addressed by the adoption of mitigation measures;
- A description of any assumptions, uncertainties and gaps in knowledge;
- The details of a pre-construction monitoring plan with the following aims:
    - To estimate a population size for all the key species within the development area as a baseline to measure potential **displacement** due to the construction and operation of the wind farm.
    - To estimate the risk of key species **colliding** with the wind turbines by recording flight behaviour.

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APPENDIX A: PRIORITY SPECIES

Priority species (excluding marine species) recorded in 3424BA by SABAP1 (Harrison *et al* 1997) and SABAP2 (http://sabap2.adu.org.za).

EN = Nationally endangered (Barnes 2000)
VU = Nationally vulnerable (Barnes 2000)
NT = Nationally near threatened (Barnes 2000)
AEWA = Listed in Annexure 2 of the African-Eurasian Waterbird Agreement
Ra = Raptor
SS = Special regional significance
CT = Collision with turbines
CP = Collision with power line
DI = Displacement

Common Name	Scientific Name	Conservation Status (Barnes 2000)	Potential Impact	Habitat requirements (Barnes 1998; Barnes 2000; Hockey *et al* 2005; Young *et al* 2003; Harrison *et al* 1997; personal observations)
African Fish-Eagle	*Haliaeetus vocifer*	Ra	CT CP	Large water bodies. May be encountered on large dams in the study area.
African Goshawk	*Accipiter tachiro*	Ra	-	Forest and forest margins, riparian woodland. Not much suitable habitat in the study area, with the possible exception of Rebok Rant 715.
African Harrier-Hawk	*Polyboroides typus*	Ra	CT CP	Wide range of woodland. May be encountered anywhere in the study area.
African Marsh-Harrier	*Circus ranivorus*	VU, Ra	CT CP	Inland and coastal wetlands, and adjacent moist grassland. Most likely to be encountered in large wetlands such as Kruis Fontein 681/12 and Klein Rivier 713/3.
African Sacred Ibis	*Threskiornis aethiopicus*	AEWA	CT CP	Margins of wetlands, dams, sewerage ponds and cultivated fields. Anywhere in the study area.

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Common Name	Scientific Name	Conservation Status (Barnes 2000)	Potential Impact	Habitat requirements (Barnes 1998; Barnes 2000; Hockey *et al* 2005; Young *et al* 2003; Harrison *et al* 1997; personal observations)
African Spoonbill	*Platalea alba*	AEWA	CT CP	Shallow aquatic margins. Dams and wetlands anywhere in the study area.
Aghulhas Long-billed Lark	*Certhilauda brevirostris*	NT	CT	Fallow and recently ploughed fields, sparse shrubland dominated by renosterveld. Marginally recorded in the study area. Most likely to be in Fynbos areas and old lands.
Barn Owl	*Tyto alba*	Ra	CT CP	Prefers open habitat, often associated with man-made structures. Anywhere in the study area.
Black Crake	*Amaurornis flavirostris*	AEWA	-	Freshwater fringed with emergent vegetation. Most likely to be encountered in large wetlands such as Kruis Fontein 681/12 and Klein Rivier 713/3.
Black Harrier	*Circus maurus*	V, Ra	CT CP	Fynbos, Karoo shrublands, dry grassland and croplands. Anywhere in the study area.
Black-shouldered Kite	*Elanus caeruleus*	Ra	CT CP	Open woodland, grassland and agricultural areas. Anywhere in the study area.
Black-winged Stilt	*Himantopus himantopus*	AEWA	CT CP	Shallow inland water bodies, estuaries and lagoons. Mostly at dams in the study area.
Black-winged Lapwing	*Vanellus melanopterus*	NT	CT CP	Highland plateaus and slopes, fallow fallow fields, meadows, pastures, coastal flats and mown grass. In the study area most likely to be found in irrigated pastures.

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Common Name	Scientific Name	Conservation Status (Barnes 2000)	Potential Impact	Habitat requirements (Barnes 1998; Barnes 2000; Hockey *et al* 2005; Young *et al* 2003; Harrison *et al* 1997; personal observations)
Blue Crane	*Anthropoides paradiseus*	VU, AEWA	DI CT (?) CP	Old lands, pastures, wetlands, dams and pans for roosting. Anywhere in the study area.
Booted Eagle	*Aquila pennatus*	Ra	CT CP	Mountainous areas with cliffs. Anywhere in the study area.
Cape Cormorant	*Phalacrocorax capensis*	NT, AEWA	-	Inshore marine habitats, also estuaries and lagoons. Unlikely to be in the study area, more a coastal species.
Cape Teal	*Anas capensis*	AEWA	CT CP	Prefers open saline or brackish wetlands. May be encountered on large dams in the study area.
Caspian Tern	*Sterna caspia*	NT, AEWA	CT CP	Along the coast mostly in sheltered bays and estuaries. Inland, at large water bodies, with preference for saline pans and large impoundments. May be encountered on large dams in the study area.
Common Greenshank	*Tringa nebularia*	AEWA	CT CP	Inland water bodies, beaches, estuaries and salt pans. May be encountered on the fringes of large dams in the study area.
Common Moorhen	*Gallinula chloropus*	AEWA	-	Most freshwater bodies with emergent vegetation. May be encountered on large dams and wetlands in the study area.
Common Ringed Plover	*Charadrius hiaticula*	AEWA	CT CP	Primarily coastal.
Common Sandpiper	*Actitis hypoleucos*	AEWA	CT CP	Most aquatic habitats. May be encountered on large dams and wetlands in the study area.
Common Name	**Scientific Name**	**Conservation Status (Barnes 2000)**	**Potential Impact**	**Habitat requirements (Barnes 1998; Barnes 2000; Hockey *et al* 2005; Young *et al* 2003; Harrison *et al* 1997; personal observations)**
Common Tern	*Sterna hirundo*	AEWA	-	Marine and coastal habitats. Not likely to be in the study area.
Common Whimbrel	*Numenius phaeopus*	AEWA	-	Mostly coastal, not likely to be in the study area.
Crowned Lapwing	*Vanellus coronatus*	AEWA	CT CP	Short grassland and bare open areas. Anywhere in the study

APPENDIX A: PRIORITY SPECIES

				area.
Curlew Sandpiper	*Calidris ferruginea*	AEWA	CT CP	Coastal lagoons, estuaries, sheltered coastlines and inland wetlands with muddy fringes. May be encountered on large dam fringes in the study area.
Denham's Bustard	*Neotis denhami*	VU	DI CT(?) CP	Fynbos, old lands and pastures. Anywhere in the study area.
Egyptian Goose	*Alopochen aegyptiacus*	AEWA	CT CP	Most inland waters. May be encountered on large dams and wetlands in the study area. Also forage in fields.
Greater Flamingo	*Phoenicopterus ruber*	NT, AEWA	CT CP	Coastal mudflats, inland dams, sewage treatment works, small ephemeral wetlands and river mouths. May be encountered on large dams in the study area.
Grey Plover	*Pluvialis squatarola*	AEWA	-	Largely coastal, especially intertidal and coastal zones. Not likely to be in the study area.
Grey-headed Gull	*Larus cirrocephalus*	AEWA	CT CP	Marine and coastal habitats, also inland at dams, rivers, and sewerage works. May be encountered on large dams in the study area.
Half-collared Kingfisher	*Alcedo semitorquata*	NT	-	Prefers fast flowing, clear streams. May be encountered on the Krom River, but unlikely to be in the study area.
Common Name	**Scientific Name**	**Conservation Status (Barnes 2000)**	**Potential Impact**	**Habitat requirements (Barnes 1998; Barnes 2000; Hockey *et al* 2005; Young *et al* 2003; Harrison *et al* 1997; personal observations)**
Jackal Buzzard	*Buteo rufofuscus*	Ra	CT CP	Hilly and mountainous areas. Anywhere in the study area.
Kelp Gull	*Larus dominicanus*	AEWA	-	Marine and coastal habitats. Unlikely to be in the study area.
Kittlitz's Plover	*Charadrius pecuarius*	AEWA	-	Muddy margins along open water bodies, also coastline.
Knysna Warbler	*Bradypterus sylvaticus*	VU	-	Dense tangles thickets on the edges of water courses. Unlikely to be in the study area.
Lanner Falcon	*Falco biarmicus*	NT, Ra	CT CP	Generally prefers open habitat, but exploits a wide range of habitats. Anywhere in the study area.
Little Stint	*Calidris minuta*	AEWA	CT CP	Coastal and inland wetlands. May be encountered on large

				dams and wetlands in the study area.
Marsh Sandpiper	*Tringa stagnatilis*	AEWA	CT CP	Mostly freshwater bodies, also along the coast. May be encountered on large dams and wetlands in the study area.
Martial Eagle	*Polemaetus bellicosus*	VU, Ra	CT CP	Diverse habitats, from open grassland and scrub to woodland. Typically found in flat country. Anywhere in the study area.
Osprey	*Pandion haliaetus*	Ra	CT CP	Mostly aquatic, also lagoons and estuaries. May be encountered on large dams and wetlands in the study area.

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Common Name	Scientific Name	Conservation Status (Barnes 2000)	Potential Impact	Habitat requirements (Barnes 1998; Barnes 2000; Hockey *et al* 2005; Young *et al* 2003; Harrison *et al* 1997; personal observations)
Pied Avocet	*Recurvirostra avosetta*	AEWA	CT CP	Saline and inland freshwater bodies. May be encountered on large dams and wetlands in the study area.
Red-knobbed Coot	*Fulica cristata*	AEWA	CT CP	Most freshwater bodies. May be encountered on large dams and wetlands in the study area.
Rock Kestrel	*Falco rupicolus*	Ra	CT CP	Wide variety of habitats, mostly near rocky outcrops. Anywhere in the study area.
Ruddy Turnstone	*Arenaria interpres*	AEWA	-	Mostly coastal, on rocky shores. Not likely to be in the study area.
Ruff	*Philomachus pugnax*	AEWA	CT CP	Mostly inland water bodies. May be encountered on large dams and wetlands in the study area.
Sanderling	*Calidris alba*	AEWA	-	Open sandy beaches, less often in estuaries, a few inland records. Unlikely to be in the study area.
Sandwich Tern	*Sterna sandvicensis*	AEWA	-	Marine and coastal habitats. Unlikely to be in the study area.
Secretarybird	*Sagittarius serpentarius*	NT, Ra	DI CT CP	Grassland, old lands, open woodland. Anywhere in the study area.
South African Shelduck	*Tadorna cana*	AEWA	CT CP	Most inland waters, especially in arid regions. May be encountered on large dams and wetlands in the study area.

APPENDIX A: PRIORITY SPECIES

Common Name	Scientific Name	Conservation Status (Barnes 2000)	Potential Impact	Habitat requirements (Barnes 1998; Barnes 2000; Hockey *et al* 2005; Young *et al* 2003; Harrison *et al* 1997; personal observations)
Spotted Eagle-Owl	*Bubo africanus*	Ra	CT CP	Wide range of habitats. Anywhere in the study area.
Spur-winged Goose	*Plectropterus gambensis*	AEWA	CT CP	Large inland waters, dams, floodplains and adjacent grassland. Anywhere in the study area.
Steppe Buzzard	*Buteo vulpinus*	Ra	CT CP	Open woodland, grassland and agricultural areas. Anywhere in the study area.
Three-banded Plover	*Charadrius tricollaris*	AEWA	CT CP	Open shorelines at a wide range of water bodies. May be encountered on large dams and wetlands in the study area.
White-bellied Korhaan	*Eupodotis senegalensis*	VU	DI CT CP	Fairly tall, dense grassland, especially in sour and mixed grassland, in open or lightly wooded, undulating to hilly country. Occasionally in pastures and burnt ground. In the study area the most likely habitat will be old agricultural fields.
White-fronted Plover	*Charadrius marginatus*	AEWA	CT CP	Sandy coastal shores, estuaries and inland river systems with sandy shores. May be encountered on large dams and wetlands in the study area.

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Common Name	Scientific Name	Conservation Status (Barnes 2000)	Potential Impact	Habitat requirements (Barnes 1998; Barnes 2000; Hockey *et al* 2005; Young *et al* 2003; Harrison *et al* 1997; personal observations)
White-winged Tern	*Chlidonias leucopterus*	AEWA	CT CP	Mostly inland water bodies. May be encountered on large dams and wetlands in the study area.
Wood Sandpiper	*Tringa glareola*	AEWA	CT CP	Wide range of inland freshwater habitats. May be encountered on large dams and wetlands in the study area.
Yellow-billed Duck	*Anas undulata*	AEWA	CT CP	Most inland waters. May be encountered on large dams and wetlands in the study area.
African Black Oystercatcher	*Haematopus moquini*	NT, AEWA	-	Coastal species. No interaction with wind energy facility envisaged.