Prepared for

Blue Wind Energy Facility

Bird Monitoring

Pre-construction phase - 2013/ 2014

Report – July 2013 to March 2014

March 2014

LOOKING DEEP INTO NATURE

www.bioinsight.co.za

EXECUTIVE SUMMARY

The Blue Wind Energy Facility is proposed to be developed by Diamond Wind (Pty) Ltd. The proposed wind energy facility includes up to 54 wind turbines, foundations to support turbines, an on-site substation, underground (where practical) cabling between turbines to this substation, an overhead power line, internal access roads and a workshop area. The site is within the Nama Khoi Local Municipality and within a De Beers mining area in the Northern Cape Province, approximately 6km north-east of Kleinsee.

To date a 4 seasons **pre-construction bird monitoring programme** has been completed at the site, between July 2013 and March 2014. Various field techniques were employed to define the local bird community present at the development site, and to assess possible risks to bird communities derived from the construction and operation of the wind energy facility, including: linear transects (in the wind energy facility site and a the control area to characterise the passerine bird community); 5 vantage points to characterise the populations and determine its utilisation and collision hazard index of raptors and large birds; 1 vehicle-based transect to detect species less prone to flight, such as bustards and cranes; Nesting and roosting locations searches, inspection and monitoring; Water bodies monitoring; Incidental observations made by the observers while traversing the study area.

Twelve bird species recorded during the field surveys are considered sensitive to the impacts of wind energy facilities: Black-chested Snake Eagle (*Circaetus pectoralis*), Jackal Buzzard (*Buteo rufofuscus*), Pale Chanting Goshawk (*Melierax canorus*), African Black Oystercatcher (*Haematopus moquini*), Greater Kestrel (*Falco rupicoloides*), Lanner Falcon (*Falco biarmicus*), Peregrine Falcon (*Falco peregrinus*), Kori Bustard (*Ardeotis kori*), Ludwig's Bustard (*Neotis ludwigii*), African Sacred Ibis (*Threskiornis aethiopicus*), Greater Flamingo (*Phoenicopterus roseus*) and Lesser Flamingo. From these species 7 are listed as having a conservation status of concern: African Black Oystercatcher, Lanner Falcon, Peregrine Falcon, Greater Flamingo and Lesser Flamingo, all classified as *Near Threatened*; and Kori Bustard and Ludwig's Bustard, considered *Vulnerable* (Barnes 2000).

The overall activity in the wind energy facility site, for the general community was very low, comparing with other sites of South Africa or even within the Northern Province. The arid conditions of the vegetation, the absence of trees, suitable perching spots and roosting or nesting available locations may be a major influence on the low activity levels detected. **The low activity dictates that the collision risk is low**; however the risk cannot be excluded. Some large bird species, such as the Kori Bustard and Ludwig's Bustard, are considered sensitive to collisions with power lines, which were confirmed during the monitoring programme. These potentially sensitive species do not occur frequently on the Blue site, but where detected in the vicinities of the aerial power line, present east of the study area.

Considering the general low activity **the study area was classified as having low sensitivity for birds, with no no-go-areas being considered**.

The results of the pre-construction monitoring programme conducted to date indicated that the major concerns would be directed to **risk of collision of Bustards with power lines**, and the **risk of collision with wind turbines, associated with the nests of kestrels** identified within the wind energy facility.

Concerning these possible impacts already identified some mitigation measures were recommended. An adequate monitoring programme for monitoring the impacts during the operational phase of the wind energy facility is advised in order to better understand the effects of the operational phase of the project on the bird community and prevent and/or mitigate any negative effects. **Other mitigation measures are proposed for construction and operation phases** of the project, considering the potential effects identified.

TECHNICAL TEAM

The technical team responsible for the monitoring surveys and report compilation is presented in following table.

Technician	Qualifications	Role on project
David Anger	Level 1 Nature Guide	Field observer
Eugene Fuhri	FGASA (Field Guide Association of South Africa) Level 3 Specialist Skills in Dangerous Animals and Birding	Field observer
Robyn Kadis	Nature Conservation student	Field observer
Peter Nupen	Coordinator of the South African Bird Atlas Project 2 for the Western Cape Licensed wild bird ringer since 2003 Experienced birder in South Africa	Field observer
Francisco Cervantes	Master in Environmental Management Environmental and Marine Biology Majors Degree in Biology	Report compilation Field observer
Joana Marques	Masters in Ecology and Environmental management Degree in Environmental Biology	Report compilation
Ricardo Ramalho	PhD in Environmental studies BSc Honours Degree in Biological Sciences Registered Professional Natural Scientist Zoological Sciences (400028/14)	Technical coordination
Jo-Anne Thomas	Masters of Science degree in Natural Science BSc Honours Degree in Natural Science Registered Professional Natural Scientist (Pr.Sci.Nat)	Report review

Report delivered in March, 2014.

CITATION

Recommended citation when using this report as a reference: BioInsight (2014). *Blue wind energy facility – Bird monitoring. Pre-construction phase*. Preliminary report July 2013 – March 2014.

COPYRIGHT

DISCLAIMER

This report provides information regarding the pre-construction bird community monitoring of Blue Wind Energy Facility. It does not include the data from the complete proposed monitoring programme, complete data processing and analyses. When submitting this report to 3rd parties it must be clearly mentioned that it is a report that includes solely the content described below.

PREFACE: BIRDS AND WIND TURBINES

Wind power has grown exponentially in the last decade and it is one of the main alternative energy sources to fossil fuels (Gsänger & Pitteloud 2013). Its development in South Africa has just started and by the end of 2012 only 10 MW were installed in the country (Gsänger & Pitteloud 2013). South Africa, the largest CO_2 emission country of the African continent, is also considered to represent one of the fastest growing wind energy industry markets (Mukasa *et al.* 2013).

This energy source is however not free from environmental impacts. The installation of wind energy facilities around the world has revealed some issues regarding wildlife conservation, specially related to bird and bat communities. Since 1992, when were published the first episodes of avian fatalities related to wind turbines (Orloff & Flannery 1992), social concern has arisen, and many articles and reports have been published to date. Several recent reviews on this topic are available and this introductory chapter provides a summary of these (Drewitt & Langston 2006; Arnett *et al.* 2007; NRC 2007; Strickland *et al.* 2011) in an attempt to outline the possible impacts of wind energy facilities on bird communities.

Mortality from collision with wind turbines

Direct mortality is caused by collision with the rotating blades of the wind turbines. Although most of the attention has been directed to raptors and other large-sized birds, most of the fatalities recorded at wind farms were passerines and other small species. The reason for considering raptors and large birds to be more sensitive to this impact is because of their relatively low numbers (i.e. proportion of fatalities and abundance), important role in ecosystems, and their low densities and reproduction rates. Therefore, the loss of a few individuals can have significant implications at the local and regional level, and combined and synergic effects of several projects can be detrimental at a broader scale. This is especially true for endangered, rare or scarce species.

Bearing this in mind, it is important to note that the majority of the wind energy facilities operating internationally report low levels of bird fatalities from collision with wind turbine blades. In fact, for passerines it is considered a relatively minor source of mortality compared to other human structures such as windows or communication towers. However, the cumulative effects and the development of new installations in places where there was no previous human presence are important factors to take into consideration.

Although most of the projects do not result in high fatality rates, some of them have reported important episodes (e.g. Altamont Pass, California (Orloff & Flannery 1992; Smallwood & Thelander 2004); Tarifa, Spain (Barrios 1995; Barrios & Rodríguez 2004); Navarra, Spain (Lekuona & Ursúa 2007) and some uncertainty about the real numbers of wind turbine bird fatalities remains (e.g. due to lack of standardisation of the studies).

It is considered that collision probability is related to particular characteristics of the species present in the area (e.g. large species with low flight manoeuvrability and/or with particular flight behaviours are more prone to collisions), to the presence of certain environmental features (e.g. ridges, forests or wetlands that could attract different species), and to the characteristics of the infrastructure (e.g. lighting, shape and material of the wind turbines and rotor size) and wind turbine layout.

Habitat related impacts

Direct habitat loss due to the installation of turbines is not considered a general critical issue, as the amount of habitat directly transformed by the development of wind energy facilities is not usually high.

Nevertheless, the construction of roads and other infrastructure associated with wind developments in sensitive habitats could lead to displacement of species with narrow ecological niches.

Some species may suffer from displacement due to disturbance produced by human activity in the area. This is highly dependent on different species and on the characteristics and availability of the habitats at each location. Habituation to these changes cannot be assumed as some studies undertaken internationally concluded that bird abundance declines with time after the impact occurs, at least if the impact persists (Hotker, Thomsen & Jeromin 2006; de Lucas, Janss & Ferrer 2008).

Wind energy facilities located directly within migration or local commuting routes can produce barrier effects, causing avoidance of the area and therefore the utilization of alternative routes. If this alternative route consumes more energy, linkages between areas of biological importance for birds, such as feeding, roosting or nesting can be affected, and result in significant reductions in use of the area and/or species fitness (Winkelman 1992; Christensen *et al.* 2004).

Cumulative effects

Cumulative impacts of a development project may be defined as “impacts resulting from incremental actions from the project, by addition with other past, present or future impacts resulting from other actions/project reasonable predictable” (Walker & Johnston 1999)and more recently as “additional changes caused by a proposed development in conjunction with other similar developments or as the combined effect of a set of developments, taken together” (SNH 2012). This assumes the knowledge of other projects or actions whose effects could be added to the ones resulting from the project being assessed. Once it is not reasonably viable to consider in the analysis all the existing or proposed projects for a certain region, the analysis should focus on (Masden *et al.* 2010; SNH 2012):

- The projects known for the area and its surroundings and for which there’s information readily available;
- The projects mentioned above and that could be relevant in terms of the expected impacts, in relation to the project under assessment;
- The target species more relevant and/or susceptible to the expected impacts.

Even where fatality rates may appear low, it should be given adequate attention to it. The cumulative effects of several facilities on the same species could be considerable, particularly if these are located in the same region and impact on the same population of the species. Also most of the long lived and slow reproducing Red Listed species may not be able to sustain any additional mortality factors over and above existing factors.

The cumulative effects of large wind farm installations may be considerable if bird movements are consequently displaced. This may lead to the disruption of ecological links between feeding, breeding and roosting areas.

The need to evaluate these effects, outlined above, is more relevant in South Africa since South African experience of wind energy generation has been extremely limited to date and wind energy developments are currently under expansion. Until recently, only eight wind turbines had been constructed and operated in South Africa, namely, 3 at a demonstration facility at Klipheuwel in the Western Cape, 4 at a site near Darling, and 1 at Coega near Port Elizabeth. Moreover, to date only a 1 year preliminary study assessing birds and bird fatalities has been completed in South Africa and the results published, reporting bat and bird fatalities produced by wind energy facilities (Doty & Martin 2013). This study was undertaken at a pilot turbine installed in the Coega Industrial Development Zone, Port Elizabeth, Eastern Cape. Only one bird fatality was reported, i.e. a Little Swift (*Apus affinis*). In this study no information regarding habitat related issues were determined. The potential impacts of wind turbines on South African bird communities are still largely unknown. Therefore, data collection and further investigation are needed and pre- and post-construction monitoring should be implemented to fill these gaps and promote the sustainability of wind energy developments in South Africa.

The Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa (Jenkins *et al.* 2012) were developed in collaboration with BirdLife South Africa and the Endangered Wildlife Trust (EWT). These guidelines provide technical guidance for consultants to carry out impact assessments and monitoring programmes for proposed wind energy facilities, in order to ensure that pre-construction monitoring surveys produce the required level of detail for authorities reviewing environmental authorisation applications. These guidelines outline minimum standards of best practice and highlight specific considerations relating to the pre-construction monitoring of proposed wind energy facility sites in relation to birds.

In conclusion, the selection of the correct location of these facilities at various levels, from the location of the project to the micro sitting of the turbines, and the application of the correct mitigation measures are considered critical issues in reducing the impacts and reconciling development of the wind energy industry and biodiversity conservation.

Index Page

1. Introduction

This is the report of the local bird community pre-construction monitoring programme, including the results from 4 seasons monitoring period from, July 2013 to March 2014 (both inclusive), for the Blue Wind Energy Facility site being developed by Diamond Wind (Pty) Ltd**.** The analysis and results included in this report will be completed upon completion of the 12-month pre-construction monitoring programme, in June 2014 and the total information will be presented in an updated report. The purpose of this monitoring programme was to provide a general characterisation of the bird community, provide baseline data to assess predicted future changes as a result of the installation and/or operation of the project and provide inputs and general recommendations regarding the infrastructure layout, aiming to minimise the impacts of the project on birds.

1.1. Scope of work and Objectives

The main overall objective of the pre-construction bird monitoring programme was to characterise the bird community present in the area and provide baseline information to assess bird habitat use in a pre-impact scenario and the potential impact from the Blue Wind Energy Facility on the bird community present in the area (such as bird collision mortality, displacement due to disturbance, barrier effects and habitat loss (Drewitt & Langston 2006)). The specific objectives outlined for the pre-construction bird monitoring programme are:

a) Establish the pre-impact baseline reference and characterisation of the bird communities occurring within the development area;

b) Identify the bird species or groups more susceptible to suffering potential impacts (displacement and/or collision) during the construction and operation phase of the wind energy facility;

c) Identify the project elements more likely to produce impacts on the avifauna and/or habitats during and after construction;

d) Evaluate potential changes in the way sensitive and target-species, and the general bird community, use the wind energy facility site during the construction and operation phases;

e) Assess and map the collision risk for sensitive and target-species. Outline sensitive areas and/or No-Go areas if necessary;

f) Propose measures to avoid or, if unavoidable, mitigate, compensate and monitor, identified potential impacts.

In order to achieve the objectives of the pre-construction bird monitoring programme an experimental protocol was established, covering the Wind Energy Facility site (WEF), its immediate surroundings and a Control area (CO). This pre-construction bird monitoring programme was based on extensive experience in bird and wind farm monitoring and was designed in order to comply with the key requirements of the "Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa" (Jenkins *et al.* 2012) and the indications of the draft Environmental Impact Assessment (EIA) report of the proposed Blue Wind Energy Facility site (Savannah Environmental 2012). This programme entails the implementation of standardized study methods before, during and after construction, in the area of the Wind Energy Facility, its immediate surroundings and a Control area (BACI, Before-After Control-Impact analysis) as proposed by national and international references (such as (SNH 2009; Atienza *et al.* 2011; Strickland *et al.* 2011; Jenkins *et al.* 2012; USFWS 2012).

Although the general bird community was surveyed, the experimental protocol was specially directed to the 22 sensitive species expected to occur at the site. These species were defined based on the methodology presented in section 2.1.1 (Table 1).

The pre-construction bird monitoring programme of the community of birds includes the following components:

- Vantage point survey – to allow for the detection of large bird species present in the study area, the estimation of their abundance, seasonality, the characterisation of their flights and will give a general idea of their use of the habitats. This data is important in achieving Objectives a) to e).
- Walked linear transects survey – designed to survey passerines and other small to medium sized birds. Using this technique, densities and composition of these groups of birds are estimated for the different habitats, seasons and sampling sites. This data is important in achieving Objectives a) to d) and Objective e).
- Vehicle based transects – implemented in order to detect other large bird species less prone to flight (such as bustards), and allows covering greater areas in the wind energy facility surroundings. This technique was used to complement nest and roost surveys and for defining the distribution of target species. This data is important in achieving Objectives a) to d).
- Water bodies monitoring – used for characterizing the use of these features by water birds, and contribute to Objectives a) to d).
- Inventory, search, inspection and monitoring of important nesting and/or roosting locations in the area surrounding the wind energy facility – during pre-construction and operation phases. This data is important in achieving Objectives a) to d).

The implementation of the continuation of a similar monitoring programme during the operation phase of the development should include the implementation of bird carcass searches around the turbines and determination of the searcher detection efficiency and carcass removal (by scavengers or decomposition) which will provide data to quantify bird fatalities associated with the wind energy facility and determine the species affected

By referring to the baseline scenario established and implementing a BACI analysis it will be possible to validate the potential impacts identified, to determine if other impacts are occurring and adequately adjust any mitigation measures proposed at this stage (or propose new and more appropriate ones if necessary).

All the above methodologies will enable the accomplishment of Objective f).

Table 1 - Sensitive Bird species considered central to the avian impact assessment process for the Blue Wind Energy Facility, listed in the Avian Impact Assessment (Simmons & Martins 2012) – [AvIA] and in the list of priority species regarding the impacts of wind energy facilities. (Retief *et al*., 2012). These species were identified through the methodology referred in section 2.1.1. A summary of the information given in these documents is presented in the table: conservation status considered to South Africa (Barnes 2000) and in parenthesis, global conservation status (IUCN 2013), level of endemism and estimated conservation or ecological significance of the local population.

Species	Scientific name	AvIA	Priority sp.	Conservation status	Endemicity	Importance of local population	Risk		
							Collision	Electrocution	Disturbance/ Habitat loss
African Black Oystercatcher	*Haematopus moquini*	X	-	Near Threatened (Near Threatened)	-	Locally common	-	-	High
African Sacred Ibis	*Threskiornis aethiopicus*	-	X	-	-	Common	High	-	HIgh
Bank Cormorant	*Phalacrocorax neglectus*	X	-	Vulnerable (Endangered)	Endemic	Scarce to locally common	High	-	High
Black Harrier	*Circus maurus*	X	X	Near Threatened (Vulnerable)	Endemic	Uncommon	Moderate	-	Moderate
Black-chested Snake Eagle	*Circaetus pectoralis*	-	X	-	-	Uncommon to locally common	Moderate	High	Moderate
Cape Cormorant	*Phalacrocorax capensis*	X	X	Near Threatened (Near Threatened)	-	Common to locally abundant	High	-	Moderate
Cape Gannet	*Morus capensis*	X	-	Vulnerable (Vulnerable)	Breeding Endemic	Locally abundant	Moderate	-	High
Crowned Cormorant	*Phalacrocorax coronatus*	X	-	Near Threatened (Near Threatened)	Endemic	Uncommon to rare	High	-	High
Damara Tern	*Sterna balaenarum*	X	X	Endangered (Near Threatened)	-	Locally common	Moderate	-	High
Great White Pelican	*Pelecanus onocrotalus*	X	X	Near Threatened	-	Locally fairly common	High	-	Moderate
Greater Flamingo	*Phoenicopterus roseus*	X	X	Near Threatened	-	Locally abundant	High	-	High
Greater Kestrel	*Falco rupicoloides*	-	X	-	-	Fairly common	High	Moderate	-
Jackal Buzzard	*Buteo rufofuscus*	X	X	-	Endemic	Fairly common	Moderate	-	Moderate
Kori Bustard	*Ardeotis kori*	X	X	Vulnerable	-	Sparse to locally common	High	-	Moderate
Lanner Falcon	*Falco biarmicus*	X	X	Near Threatened	-	Fairly common	High	Moderate	-
Lesser Flamingo	*Phoeniconaias minor*	X	X	Near Threatened (Near Threatened)	-	Locally abundant	High	-	High

Species	Scientific name	AvIA	Priority sp.	Conservation status	Endemicity	Importance of local population	Risk		
							Collision	Electrocution	Disturbance/ Habitat loss
Ludwig's Bustard	*Neotis ludwigii*	X	X	Vulnerable (Endangered)	Near Endemic	Sparse to locally common	High	-	Moderate
Martial Eagle	*Polemaetus bellicosus*	X	X	Vulnerable (Near Threatened)	-	Uncommon	Moderate	High	Moderate
Pale Chanting Goshawk	*Melierax canorus*	-	X	-	Near Endemic	Rare to locally common	Moderate	Moderate	Moderate
Peregrine Falcon	*Falco peregrinus*	-	X	Near Threatened	-	Uncommon	High	Moderate	-
Secretarybird	*Sagittarius serpentarius*	X	X	Near Threatened (Vulnerable)	-	Locally fairly common	High	-	Moderate
Southern Black Korhaan	*Afrotis afra*	-	X	-	Endemic	Uncommon to common	High	-	Moderate

1.2. Terms of reference

The following assessment was conducted according to the specialist terms of reference:

- Conduct a review of national and international specialized literature and experiences regarding birds and wind farms;
- Conduct a field investigation to determine the avifauna community present in the study area, describe the affected environment, identify species of special concern and assess potential negative impacts from the wind energy facility;
- Map sensitive areas in and around the proposed Wind Energy Facility site;
- Provide recommendations for relevant mitigation measures which will allow the reduction of negative impacts and the maximization of the benefits associated with any identified positive impacts.

1.3. Legal framework

It is considered best practise for bird monitoring to be undertaken on wind energy facility sites, in order to fulfil the requirements outlined by the "Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa" (Jenkins *et al.* 2012).

There are no permit requirements dealing specifically with birds in South Africa. However, legislation which applies to birds includes the following:

National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004):

Sections 2, 56 and 97 are of specific reference. Section 97 considers the Threatened or Protected Species Regulations: The Act calls for the management and conservation of all biological diversity within South Africa.

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected.

NEM:BA also deals with endangered, threatened and otherwise controlled species, under the ToPS Regulations (Threatened or Protected Species Regulations). The Act provides for listing of species as threatened or protected, under one of the following categories:

- Critically Endangered: any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- Endangered: any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.
- Vulnerable: any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- Protected species: any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

A ToPS permit is required for any activities involving the removal or destruction of any ToPS-listed species.

Northern Cape Nature Conservation Act, 2009 (Act No 9 of 2009)

At a Provincial level, birds are protected by Northern Cape Department of Environment and Nature Conservation (DENC) under the National Environmental Management: Biodiversity Act (see above). In addition, provincially protected species are listed in the Northern Cape Nature Conservation Act, 2009 (Act No 9 of 2009).

It is considered best practise for bird monitoring to be undertaken on wind energy facility sites, following the requirements outlined by the Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa" (Jenkins *et al.* 2012). Nevertheless, the recommendations proposed by the guidelines must be adapted to the projects specificities and as it is stated in that document "the scale of each project, the level of detail and technical input, and the relative emphasis on each survey and monitoring component, will vary from site to site in terms of the risk potential identified by the initial scoping or environmental impact assessment".

IUCN Red List of Threatened Species

The International Union for the Conservation of Nature (IUCN) Red List of Threatened Species ranks plants and animals according to threat levels and risk of extinction, thus providing an indication of biodiversity loss. This has become a key tool used by scientists and conservationists to determine which species are most urgently in need of conservation attention. In South Africa, a number of birds are listed on the IUCN Red List.

1.4. Proposed wind energy facility and study area

The proposed Blue Wind Energy Facility includes up to 54 wind turbines distributed across an area of approximately 3300 ha. The turbine dimensions were not yet known by the elaboration of the present study, so rotor dimensions considered were from 28 to 183m above ground in order to enclose all hypotheses. The project is divided into three stages, for a phased construction process; nonetheless this study evaluates the three phases as one.

The project also includes foundations to support turbines, an on-site substation, underground (where practical) cabling between turbines to this substation, an overhead power line, internal access roads and a workshop area (Appendix I - Figure 13). The site is located in the Northern Cape Province, approximately 6 km north-east of Kleinsee. The site is within the Nama Khoi Local Municipality and within a De Beers mining area. The site implementation is proposed on the following farms: Dikgat 195, Kleinsee 193, Dreyers pan 192 and Predikant Vlei 190 (Appendix I - Figure 13). The road 355 and Buffles River pass south of the study area.

The site falls within the Succulent Karoo biome (Mucina & Rutherford, 2006). The site is within Namaqua Strandveld, however due to the proximity with the coastal area to the west of the site Namaqua Duneveld vegetation is dominant. The Buffels River south of the site and the Saltpans located west within the Namaqua Dunevels are part of the Azonal Vegetation Biome and the Namaqualand Riviere and Namaqualand Salt pans vegetation type respectively (Mucina & Rutherford, 2006; Appendix I - Figure 14).

The natural habitats have been severely degraded in the area close to the mining site being in process of recovery. The remaining area of the site remains natural with vast areas of shrubs. The proposed Blue project falls within the more natural area, only marginally occupying the degraded vegetation area (Photograph 1). The sampling locations were therefore located in areas of scrubland as this is the dominant type of vegetation present. The Control area was chosen north of the proposed site with the same type of vegetation and topography.

It is important to outline the key role rivers may have as birds' major reference for spatial movements, leading to some disturbance and/or displacement effects. In this area this may be relevant due to the presence of the Buffels River south of the study area; however the site does not intersect the river and is located at a minimum distance of 1.5 km.

The closest National Park to the proposed wind energy facility site is the Richtersveld National Park and is located at approximately 30 km to the north and the Namaqua National Park, 50km south, so no major concern is foreseen in this respect.

The closest Important Bird Areas (IBA) is located at 140km east of the proposed site, the Haramoep & Black Mountain Mine Nature Reserve (ZA026). Other IBA, the Bitterputs Conservation Area (ZA027) is located at 165km east of the study area. Though these areas may be important for the broader community they are considered to be too far away from the site to provide support to the study area local community.

The Haramoep & Black Mountain Mine Nature Reserve is a natural area consisting of extensive sandy and gravel-plains with deser grassland and shrubs. Also the Haramope Mountains provide support for several cliffs nesting species, Black Harrier (*Circus maurus*) amongst them. Other species present are Ludwig's Bustard (*Neotis ludwigii*), Karoo Bustard (*Eupodotis vigorsii*), Red Lark (*Certhilauda burra*) and Sclater's Lark (*Spizocorys sclateri*) (BirdLife International 2014a).

Regarding the Bitterputs Conservation Area, it consists mainly of flat gravel plains with a red dune system, desert grassland and granitic-gravel plains. It also presents similar range of species as Haramoep & Black Mountain Mine Nature Reserve such as Black Harrier (*Circus maurus*) and Ludwig's Bustard (*Neotis ludwigii*) (BirdLife International 2014b).

Also approximately 70km east is the Goegab Nature Reserve and 115 km north is the Ramsar site Orange River Mouth Wetland. Special concern was directed to this location during the EIA Draft report, as it provides a feeding and resting location for night commuting species, such as Flamingos and Pelicans.

At least another four wind energy development are planned to be implemented in the area. They will be implemented at a maximum distance of 100 km (Kangnas/Springbok WEF), 60km (Koignaas WEF), 20km (Kannikwa Vlakte WEF) and a minimum distance of 13km (Kleinsee WEF) (CSIR 2012).

(A)

(B)


(C) 

Photograph 1 – Photographs indicating the general landscape of the Blue wind energy facility site: A – Natural vegetation of Namaqualand Strandveld – shrubs; B – Degraded Strandveld vegetation in recovery process and Namaqua Duneveld vegetation to the west of the proposed site; C – Rocky escarpments south of the study area, in the surroundings of the Buffels River, near Kleinsee.

1.5. Summary of the Avian Impact Assessment

During the Environmental Impact Assessment process an Avifaunal Impact Assessment Report (Simmons & Martins 2012) was compiled. This document reviewed the location of the wind energy facility using published bird-atlas information and 2-day and 5-day site visits.

This proposed site may support at least 168 bird species, from which 15 species have a conservation status of concerns (Table 1), and 44 are endemic species. The main facts, regarding birds, potentially conditioning the development were identified and are summarised below:

- Presence of bustards that move into the area with good rainfall (e.g. breeding Ludwig's Bustards);
- Presence of flocking water birds such as red-listed cormorants and flamingos (e.g. White Pelicans);
- Presence of fifteen raptor species (e.g. Secretarybirds, (breeding) Jackal Buzzards, Greater Kestrel and Black Harrier);
- Presence of endemic passerines (26% of the total number of species) which could be affected by disturbance impacts.

The above-mentioned species were all collision-prone species identified on site during the visits conducted. Considering the species characteristics and the occurrence of breeding behaviours, the potential identified impacts were:

- Habitat alteration by the facility itself and associated power lines or substation/s;
- Disturbance by construction and maintenance activities;
- Possible displacement or disturbance of sensitive species;
- Direct collision with blades of the wind turbines or the associated power line network;
- Electrocution of larger avifauna species on the power lines.

During this assessment three nesting locations were identified: one of Greater Kestrel, another nest of Jackal Buzzard and a nest of Ludwig's Bustard. No important water features were identified on site, however some concerns were raised regarding migratory birds species (such as flamingos and pelicans) that could use the area as a flight corridor to commute between breeding and feeding areas such as the Orange River mouth, located to the north. No particular no-go areas were identified in this assessment, however it was highlighted that Areas 2 and 3 of the proposed wind energy facility were high risk zones for threatened birds given the presence and breeding of collision-prone bustards there.

To mitigate the possible issues raised above it was recommend that:

- Power lines should be marked with bird flappers to reduce possible collisions with large migrating birds;
- Turbine blades should be marked with UV paint to increase the probability that birds flying through the area see and avoid them;
- Turbine strings are orientated north-south where possible to reduce the possibility that birds migrating along the coast collide with the turbines or are attracted to them.

A 12-month pre-construction phase monitoring of all birds, was also recommended in order to provide more detailed assessments of all impacts, provide passage rates of critical species and inform on recommended mitigation where necessary.

2. Monitoring Programme Description

The proposed methodology assumes as a baseline the requirements outlined by the most recent version of the *Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa "* (Jenkins *et al.* 2012). Although this document is not considered a document that is required to be complied with by law, it should, however, be considered as recommendations for what should be the good practice for implementing Bird monitoring programmes at Wind Farms in South Africa. Complementarily, the methodology is based on the current international good practices (Table 2).

2.1. Desktop preparatory work

Prior to the initiation of field surveys, a desktop survey was conducted to compile the best information possible, in order to provide a better evaluation of all conditions present within the study area. Therefore, data sources (as detailed in Table 2) were consulted in order to assess the species likely to occur within the Blue wind energy facility. The following steps were taken:

- Based on a desktop study and considering all literature references available (Table 2), a list of all bird species considered to potentially occur within, or in close proximity to the site was compiled.
- Abundance of all species listed from the aforementioned process was assessed at a national level in terms of endemism, population trend, habitat preferences and conservation status.
- The sensitivity of these species towards the potential impacts from wind energy developments was evaluated using the Avian Wind Sensitivity Map (Retief *et al.* 2012). Other species not listed in the referred document were also considered sensitive because of their abundance, flight characteristics, ecological role, population trend and conservation status (refer to Section 2.2.4 for selection criteria).
- A short list of target species, to which the assessment and monitoring programme should pay special attention to, was compiled from the draft Avifaunal Impact Assessment (Simmons & Martins 2012), and supplemented with sensitive species identified in the previous steps.
- A desktop study, based on all the available information such as topographic South Africa maps, Google Earth imagery, and Geographical Information System software was conducted for a preliminary evaluation of the area. A reconnaissance field visit was conducted in September 2012 to achieve an initial understanding of its characteristics. This allowed the development of an appropriate design of the pre-construction bird monitoring programme.

It is important to characterise the study area in terms of the vegetation and habitat present on site. The method used for vegetation classification is that developed by Mucina & Rutherford (2006). Even more important than the biomes are the vegetation units, which are shaped by various local factors. Bird density, abundance and movement are all determined largely by available vegetation. It is therefore essential to characterise the study area in these terms. Google Earth imagery and most importantly, field work, was used to identify the available micro-habitats on site.

The monitoring effort and methodological approach was defined and implemented.

The following data sources and reports were consulted and taken into consideration for the compilation of this report, in varying levels of detail. Many other references were consulted for particular issues (these are detailed in chapter 5).

Table 2 – Data sources consulted for the evaluation of the avifauna present in the study area. The international references and guidelines used to support the methodological approach and result analysis are presented.

Type	Title	Bibliographic Reference	Detail of information
Data sources	South African Bird Atlas Project 2 (SABAP2)	http://sabap2.adu.org.za/	Local
	South African Bird Atlas Project 1 (SABAP1)	(Harrison *et al.* 1997)	Local
	Avian Wind Farm Sensitivity Map for South Africa	(Retief *et al.* 2012)	Pentad (5 x 5 minutes)
	Coordinated Avifauna Roadcounts (CAR)	http://car.adu.org.za/	Local
	Coordinated Waterbird Counts	http://cwac.adu.org.za/	Local
	Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland	(Barnes 2000)	National level
	Renewable Energy Application Mapping – Report version I	(CSIR 2012)	National level
	Global List of Threatened Species	(IUCN 2013)	Global level
Guidelines and other international references	BirdLife South Africa/Endangered Wildlife Trust best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa	(Jenkins *et al.* 2012)	National level Methodological approach
	Wind energy development and Natura 2000	(European Commision 2010)	International level Methodological approach and analysis
	Good Practice Wind Project	www.project-gpwind.eu/	International level Methodological approach and analysis
	Comprehensive Guide to Studying Wind Energy/Wildlife Interaction	(Strickland *et al.* 2011)	International level Methodological approach and analysis
	U.S. Fish and Wildlife Service Land-Based Wind Energy Guidelines	(USFWS 2012)	International level Methodological approach and analysis
	Directrices para la evaluación del impacto de los parques eólicos en aves y murciélagos	(Atienza *et al.* 2011)	International level Methodological approach and analysis
	Windfarm impacts on birds guidance	www.snh.gov.uk/	International level Methodological approach and analysis

2.1.1. Definition of the different types of surrogate species

A double approach was used to define abundances, distributions and flying patterns within the study area. First, the records of all bird species were considered, and in a second approach, directed towards evaluating the effects of development on the avifauna community. For this second approach only species considered to be particularly sensitive to the impacts of wind energy facilities were considered.

These were identified by implementing a structured decision process (refer to Figure 1) in which several factors related to the species' physiology and biology are considered, such as its; taxonomic order (Jordan & Smallie 2010), threatened status (Barnes 2000; IUCN 2013) ecological role (e.g. raptors are considered to be key elements of the ecosystems and particularly vulnerable to collision with wind turbines (Strickland *et al.* 2011), abundance (Hockey, Dean & Ryan 2005) and population trend (IUCN 2013). Sensitive species list also included priority species (Retief *et al.* 2012) and target species (Simmons & Martins 2012)[1]. The sensitive species identified for the proposed Blue wind energy facility site are presented in Table 1 (refer to section 1.1).

The use of the analysis of sensitive species, as a complement to the in-depth analysis of the results gathered for the target species, will add valuable information on particular assessments, whether it would be cumulative effects, turbine micro sitting or post-construction Before-After Control-Impact. It also separates common, abundant events or species, from those more scarce or rare, allowing for its detection.

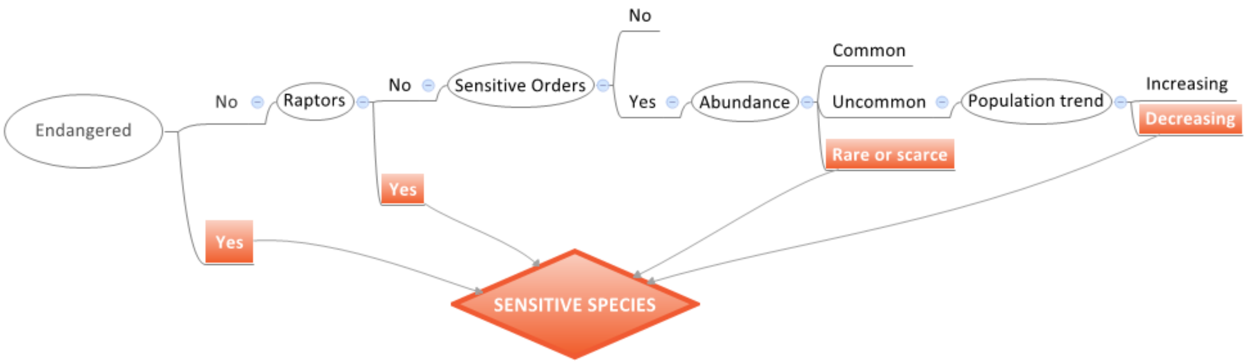


Figure 1 - Decision process scheme used to define sensitive species. A species is sensitive when following its characteristics through the scheme it ends in a green square. On the other hand if it ends in a red square it would not be considered sensitive for the Blue Wind Energy Facility area.

[1] **Priority species -** Species listed in the Avian Wind Farm Sensitivity Map for South Africa (Retief *et al.* 2012). This list of species is considered a priority as it sets the basis for a common evaluation scheme in South Africa and therefore is believed that any species contained in these documents should be identified as a priority for conservation. The criteria used by Retief et al., 2012 were: species conservation concern - IUCN (2013) and *The Eskom Red Data Book of Birds of South Africa*, Lesotho and Swaziland (Barnes 2000) -, species endemism and species that might be sensitive to wind farms based on a bibliographic review and comparing to the groups affected in other parts of the world.

Target species - This is a shortlist of species defined by the Avian Specialist that conducted the previous stages of the EIA. This is stated in the *Best Practice Guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa* (Jenkins *et al.* 2012). Based in their experience as well as project specifics, the specialist draws up a list of species to which special concern should be placed. In-detailed data for all species, particularly those under special concern, should be recorded in the field.

2.2. Field Surveys

While main emphasis of the pre-construction monitoring programme was focussed on the sensitive species identified at the Table 1, a systematic approach was implemented in order to determine the general composition of the avifauna community within the study area, as well as to evaluate the potential negative effects that the operational phase of the Blue Wind Energy Facility has on this group. The surveys conducted involved the following methodologies (Figure 2):

- Vantage points monitoring, to define the utilisation of the area by raptors and other large birds;
- Linear walking transects, to determine factors related to passerine and small bird communities on the wind energy facility site and the control area;
- Vehicle based transects, to complement the vantage point, nest and roost survey and aid in the definition of the distribution of some species not prone to flying, such as bustards and, to a lesser extent, cranes.
- Priority species nest survey, to locate and monitor active nesting sites of sensitive species within the study area and immediate surroundings;
- Water body monitoring, to evaluate the species present and their relevant movements at and between the main water bodies.

All contacts made with target species during the driving and/or walking transects of the observers in the study area were recorded as incidental observations and were used as complementary data to characterize the bird community and its utilization of the site, as recommended by the Best Practice Guidelines (Jenkins *et al.* 2012) and Avian Impact Assessment (Simmons & Martins 2012).

Control areas were used with the aim of comparing the results with a reference, non-affected area, in order to distinguish between impacts produced by the project and background effects produced by natural processes (SNH 2009; Atienza *et al.* 2011; Strickland *et al.* 2011; Jenkins *et al.* 2012; USFWS 2012).

2.2.1. Sampling Period

The surveys of the bird community monitoring programme, included in this preliminary report were conducted between July 2013 and March 2014. Therefore, to date, the monitoring programme included a total of 9 visits to the site that allowed at least 4 different surveys for walked transects to be performed, as well as up to 9 surveys for the vantage points. These surveys were conducted from July 2013 to March 2014, both inclusive, and included four seasons (Table 3).

Table 3 – Schedule of bird monitoring fieldwork at the Blue Wind Energy Facility site. Occasional observations refer to all the surveys conducted by observers in the study area and immediate surroundings, by car or walking, used as a complementary methodology. VP – Vantage points; WT – Walked transects; VT – Vehicle transects; NE – Nest searches, inspection and monitoring; WB – Water body inspection and monitoring; Oca – Occasional observations.

Year	Month	Season	Survey	Methods
2013	July (22th to 28th)	Winter	Study design / Winter I	WT; VP; VT; NE; Oca
	August (4th to 8th)		Winter II	VP; VT; Oca
	September (3th to 6th)	Spring	Spring I	VP; VT; NE

Year	Month	Season	Survey	Methods
	October (14th to 20th)		Spring II	WT; VP; VT; NE; WB; Oca
	November (12th to 18th)		Spring III	WT; VP; VT; NE; WB; Oca
	December (16th to 20th)	Summer	Summer I	VP; VT; NE; WB; Oca
2014	January (20st to 24th)		Summer II	VP; VT; WB; Oca
	February (12th to 21th)		Summer III	WT; VP; VT; NE; WB; Oca
	March (1st to 5th March)	Autumn	Autumn I)	VP; VT; NE; WB; Oca
	April		Autumn II	To be conducted
	May		Autumn III	To be conducted
	June	Winter	Winter III	To be conducted

2.2.2. Weather conditions

The average weather conditions recorded by the field observers were generally mild with temperatures averaging 20ºC (minimum 7ºC and maximum 35ºC). No important daily variations were recorded. Regarding wind speed (at ground level), the highest values were recorded during the spring surveys, reaching average wind speeds of about 5.9 m/s. Wind speeds were fastest during midday (11am to 3pm), averaging at 5.8 m/s or in the afternoon (3pm to 7pm), averaging 6.5 m/s. Precipitation events were very occasional, occurring only during one winter survey and one spring survey. Surveys were not conducted during rain.

2.2.3. Passerine and small bird communities – walked transects

A systematic approach was implemented in order to determine several parameters that define basic characteristics of local passerine and other small to medium sized terrestrial bird communities.

These parameters will provide a baseline scenario that will allow the detection of spatial and temporal variations in subsequent phases of the project. Comparing the results obtained at the wind energy facility to a similar Control area[2], will give a no-impact framework so as to distinguish between the impacts derived from the installation of the project and natural random effects, by means of a BACI analysis, with data collected in subsequent phases.

2.2.3.1. Evaluated parameters

To characterize the passerine and small bird communities occurring in the study area a Kilometric Abundance Index (KAI) was estimated for each species and transect, both in the wind energy facility as well as in the control area. This index is expressed as the amount of birds detected, per linear kilometre surveyed, without distance limit (Bibby *et al.* 2000).

2.2.3.2. Data collection techniques and methods

The passerine and small bird communities were characterized by conducting 10 linear transects of 1000 m each, in total length - 5 located within the wind energy facility (WEF) and 5 at the control area (CO). The control area is separated by a minimum distance of about 5 km from the closest wind turbine (refer to Figure 2). Linear transects were established after the completion of a desktop study and a preliminary inspection of the area by an expert bird specialist. These transects are meant to be representative of the biotopes present within the study area, which consist mainly of shrub vegetation. The location of these sampling units within the wind energy facility was established within the radius considered to be influenced by the turbines (within a distance of 500 m from the turbines) (Hotker, Thomsen & Jeromin 2006; Drewitt & Langston 2006). To avoid pseudo replication, linear transects were located at a minimum distance of 400 m apart from one another (Hurlbert 1984; Sutherland 2006) (Figure 2).

Each linear transect was conducted by two expert bird observers, who recorded all bird contacts (both seen and heard) by walking slowly along the line of progression. Observations were made on both the left and right side of the line of progression, and with no distance limit between the observer and the bird being used (Buckland *et al.* 1993; Bibby *et al.* 2000). Transects were conducted once in each survey. Surveys started after sunrise and were performed during the early morning (the first 3 hours after sunrise) in order to avoid the warmer periods of the day (when birds may be less active and hence, less conspicuous (Bibby *et al.* 2000)).

The following parameters were registered in the field and all records were noted on a standard field sheet, especially designed for this methodological approach:

- bird species, gender and age (whenever possible);
- perpendicular distance to the line of progression and the biotope were registered. Distance measures were assigned to 5 different classes, i.e.: 0-25 m, 25-50 m, 50-75 m, 75-100 m and more than 100 m (Buckland *et al.* 1993; Bibby *et al.* 2000);

---

[2] A control area is one which is similar in nature to the proposed wind energy facility and which will not be impacted by the development of the wind energy facility. This allows for comparison of results during post-construction and operational monitoring determining the effect of the wind energy facility on the bird communities.

- environmental conditions (air temperature, wind speed and direction, occurrence of precipitation, cloud cover and visibility).

Whenever pertinent, additional information was collected in order to contribute to the detailed characterization of the areas usage by the species.

2.2.3.3. Data analysis and criteria

The analysis of all collected data parameters allows for the detection of spatial and temporal variations being placed on the bird community occurring at the study area, as well as for important and/or special sensitive areas.

A Linear Model was carried out to test for possible differences in the mean bird abundances estimated between seasons (Winter vs. Spring vs. Autumn) and sampling sites (Wind Energy Facility vs. Control). All analyses were performed by using R software (R Development Core Team 2012).

2.2.4. Raptors and large terrestrial birds - vantage points

Vantage points were used to detect raptors and large terrestrial birds. Therefore, a systematic approach to detect and characterize the species of this group, many of them endangered or sensitive species, was implemented. This methodology included a standard way of collecting data (e.g. flying patterns and characteristics), which allows for the comparison between different areas and sampling periods (SNH 2009; Atienza *et al.* 2011; Strickland *et al.* 2011; Jenkins *et al.* 2012).

This methodology allows the collection of accurate records based on the movements of raptors and large birds through the study area. The main objectives for this methodology is to record the behaviour, estimate activity indexes and, if possible, determine the number of breeding pairs that frequently utilize the study area.

In order to effectively evaluate the potential effects of the project over the aforementioned *taxa* (e.g. displacement effects and fatality risk), the immediate surroundings of the wind energy facility, not under the turbines' direct influence, are considered as Control areas and used to compare possible changes in the calculated parameters. A distance of 750 m from the proposed wind turbine locations were considered as areas of influence that the wind turbines would have on the raptors and large terrestrial birds' community occurring within the area (Drewitt & Langston 2006). Thus the use of distant reference areas that could potentially be different (particularly in the case of surveying raptors and large terrestrial birds) was avoided. A Before-After Control Impact will then be applied over the areas further than 750 m from wind turbines in subsequent phases of the development, by analysing the distribution of contacts in relation to the distance to the turbines.

In this section, all the non-standardized observations for these groups of birds (made during the time spent by the field team on site) were also noted and considered for the definition of species distribution.

2.2.4.1. Evaluated parameters

The methodological approach allowed for the determination of the presence of raptors and other species or groups of species of large birds potentially sensitive to impacts derived from wind energy production infrastructures.

The following parameters were evaluated:

- <u>Activity Index</u> - determined by considering the number of contacts recorded in each 500m x 500m grid cell during the surveys conducted. In this case every bird is considered a contact, thus a flock of five birds would be considered five contacts.

- Frequency Index – is defined by the number of flights recorded in each 500 m x 500 m grid cell for each species, despite the total number of birds involved in the flight. It is an important parameter for distinguishing flocking effects from constant moves along time of single or few birds.
- Activity Index at rotor height - determined by considering the number of contacts at rotor height recorded in each 500m x 500m grid cell during the surveys conducted.
- Collision Hazard Index - The probability of collision of raptors and large terrestrial sensitive birds of the study area was determined using a *Collision Hazard Index* – CHI (Desholm *et al.* 2006; Band, Madders & Whitfield 2007; Strickland *et al.* 2011).

2.2.4.2. Data collection techniques and methods

Five vantage points were defined, based on the preliminary desktop survey (by means of an integrated Geographical Information System (GIS)) and preliminary visits to the study area. These sampling points were located at strategic locations within the wind energy facility and set up to allow the visual coverage of the wind energy facility (placing special emphasis on turbine locations) and its immediate surroundings (Figure 2).

Two experienced observers, using good quality binoculars and a spotting scope, sampled each vantage point covering an area of 360º. Each location was surveyed at least three surveys per season, for a minimum of 9 hours of observation per season divided through the early morning, midday and late afternoon times of day (Jenkins *et al.,* 2012). To date each Vantage Point was surveyed for a total of 3 hours in Winter, 9 hours in Spring, 9 hours in Summer and 3 hours in Autumn. During the remaining field surveys for Winter and Autumn seasons (Table 3) each Vantage Point will be surveyed for 6 additional hours to fulfil the minimum requirements of the pre-construction bird monitoring guidelines (Jenkins *et al.,* 2012).

All the raptors and large bird species observed during this period were recorded and their flight paths registered. For each observation the number of individuals and, whenever possible, the gender and age was recorded. Behavioural patterns observed were also recorded. This included:

- Type of flight - passage flight, soaring, display, territorial;
- Flight height[3] - <30 m - below rotor height, 30 m to 180 m - rotor height , >180m - above the rotor height;
- Time lost – duration of the observation, and;
- Environmental conditions (air temperature, wind speed and direction, occurrence of precipitation, cloud cover and visibility).

Individual movements were mapped in detail over a regular grid (500 m x 500m) designed for the full study area. All the records were noted on a standard field sheet especially designed for this methodological approach.

---

[3] Estimating the height of birds while flying can be challenging, especially during pre-construction phase when there's no physical height reference (e.g. such as power lines or wind turbines). This is overcome by the field observers by specific training in height estimation and extensive field work experience, aided by rangefinders in the field to constantly calibrate the observers distance bearings. The field measurements are, however, estimates to best reflect the reality so the data can be used to drawn fairly robust conclusions.

Whenever pertinent, additional information was collected in order to contribute to the detailed characterization of the usage of the area by each species.

During all the observers' movements within and around the study area (through slow driving or walking), all the contacts with raptors and large terrestrial birds (particularly those regarding pathway flights, hunting and display behaviours or those suggestive of important feeding, nesting or roosting sites) were recorded with the same detail as described above and were noted as "extra" or incidental observations (Jenkins *et al.* 2012). This methodology complemented the results from the vantage points and subsequently contributed to increasing the information regarding the distribution of the species over the relatively large study area.

2.2.4.3. Data analysis and criteria

All the data collected during the fieldwork (vantage points and complementary records recorded during observer's movements throughout the study area) were inserted into a geographical information system in order to map the areas used by sensitive species and to perform a spatial analysis of the results. This allowed the estimation of several indexes and parameters (refer to section 2.2.4.1), calculated by analysing the distribution of the flight records throughout each 500m x 500 m grid cell.

In order to determine the Collision Hazard Index (CHI), a differential value was attributed to each different type and height of flight of the observed birds. The collision risk was considered higher when the flight height coincided with the swept area of the turbine blades. At the same time, behaviours in flight such as hunting, territorial and/or exhibition and soaring flights were considered as posing higher risks, and hence attributed a higher score (Barrios & Rodríguez 2004).

CHI values for each flight observed were calculated using the following mathematical formula:

$$\mathrm{CHI} = \sum_{i=1}^{n} \frac{N \times h \times b}{8}$$

Where **N** was the number of birds observed, **h** was the score given by the flight height and **b** was that given by the behaviour of the birds.

The final score given to each 500 m x 500 m grid cell corresponds to the sum of the CHI values attributed to the bird routes registered within it. It was considered that the higher the value, the higher the risk of collision with a turbine.

A double approach was used to characterize activity within the study area. Firstly, regarding the definition of the variables described earlier, all records of raptors and large terrestrial birds were considered. In a second approach, only species considered sensitive (2.1.1) were analysed for calculating these variables.

To undertake a proper analysis, the species were divided into different groups based on particular characteristics relevant to their biology, ecology and behaviour. This classification is not just ecological, but rather practical and aiming to focus on the specific impacts likely to occur by the installation of the wind energy facility, depending on the characteristics of the birds affected (Table 4). Thus, the species were divided into:

- Falcons - usually smaller raptors that make use of fast flight. Many of them display specific hunting behaviours such as hovering while looking for small prey. Some species tend to roost and hunt in large numbers;
- Accipitrids (other Raptors) - fairly large raptors, usually presenting a large wingspan and making use of thermal uplifts or hillside currents when soaring or gliding;Crows - corvid species are classified within this group. They are usually common, widespread, opportunistic species. Although they often tend to fly at

rotor height, they have not been found to be particularly affected by wind energy facilities. Sometimes they appear in large numbers and their populations are often unbalanced by the extra available resources found in human-influenced habitats.

- Waterbirds - mainly ducks, cormorants, geese and other water body-associated species (usually swimmers or divers) appear in this group;
- Ciconids - Ibis, Egrets and Herons mainly occur in this group. While also being closely associated to water, these species are not swimmers or divers and are, in fact, often found away from actual water bodies (but in relatively muddy areas.

2.2.5. Vehicle-Based Transects

As a complementary method, one vehicle-based transects was conducted in the Wind Energy Facility and its immediate surroundings in all surveys between July 2013 and March 2014 (Figure 2). The vehicle transects has approximately 30 km.

The purpose of the survey was to provide a measure of abundance and richness for those species observed (large terrestrial birds and raptors). At the same time, this information complements that obtained from the vantage point surveys and aids in the detection of species less prone to flying, such as bustards or, to a lesser extent, cranes. It also helps in detecting roosting and nesting sites as it covers extensive areas in a short period of time.

Each transect was conducted by two expert observers; one driving slowly and the other recording all of the contacts being seen or heard. During each linear transect, the total number of birds observed was counted and recorded. The following parameters were recorded: species and number of individual's present, perpendicular distance from the road, bird activity at the moment of observation and any additional notes that were considered relevant. If the contacts were seen flying, it was noted. The distance from the observer to the point where the bird was first detected was then recorded.

The following parameters were recorded and all records were taken note of on a standard field sheet especially designed for this methodological approach:

- bird species, gender and age (whenever possible);
- number of individuals;
- perpendicular distance from the road;
- bird activity observed and type of observation (acoustic/visual).

Whenever relevant, additional information was collected in order to contribute to the detailed characterisation of areas usage by the species.

2.2.6. Nest survey and monitoring

Several nesting locations of priority species (Jackal Buzzard, Greater Kestrel, Ludwig's Bustard) were recorded in the Avifaunal Impact Assessment Report (Simmons & Martins 2012) as referred previously in section 1.5. Assuming that these species may breed in the area, nest monitoring was focused on identifying and monitoring these locations and searching for unknown nesting sites, always taking into account the indications presented in the referred document.

Surveys were conducted in the area in order to detect nesting and/or roosting locations of sensitive species. These surveys took place in every season. The habitats located within the impact zone are likely to support key species, such as cliffs, power lines, stands of large trees, marshes and drainage lines were surveyed by the combination of different inspection techniques (Malan 2009) according to the specifics of each site.

The location and status of the nests were determined by active searches and direct observations, by making use of a handheld GPS (Garmin® ETREX 10 and ETREX 20), a pair of binoculars and a spotting scope. After the nest was located, the observer spent a minimum of 30 min observing the nest. The following parameters were registered: type of nest (e.g. cliff, tree, pylon, building, rock cavity), vertical position at the supporting structure of the nest, orientation (north, south, etc.), status (e.g. good condition, bad condition, collapsed) and, whenever possible, construction phase (e.g. inactive, building, fixing, green branches). When an active nest was found, the following parameters were registered: reproduction phase (e.g. construction, incubation and chicks), presence of parents in the nest, number of eggs, number of descendants/flying offspring. Whenever relevant, additional information was registered according to observations found in the field.

2.2.7. Water body monitoring

Although in the preliminary assessment phase, the Avian Impact Assessment report did not identified any water features of particular interest, this methodology was implemented for a complete assessment of the site.

The main water bodies present within the study area were first identified on a Geographical Information System by using 1:50 000 topographic maps and aerial photos. They were identified, mapped and later surveyed in order to determine their level of utilization by water birds.

The water bodies found to be most relevant were visited by two expert observers at least twice during the first year of monitoring in the pre-construction phase (Figure 2). The observers were aided by a pair of binoculars and a spotting scope. Whenever a relevant water body was found to be present, the methodological approach followed the established for the Coordinated Waterbird Counts (Taylor *et al.* 1999). The observations were made simultaneously by two observers, from a fixed point, for a minimum of 30 min. The species present were then recorded at the beginning of the observation. For the remaining period, the observer recorded the main movements around the water body. The following parameters were registered: species and number of birds present, gender and age (adult, juvenile/chicks) (whenever possible), direction of arrival/departure from the water body and any additional notes that may have been important.

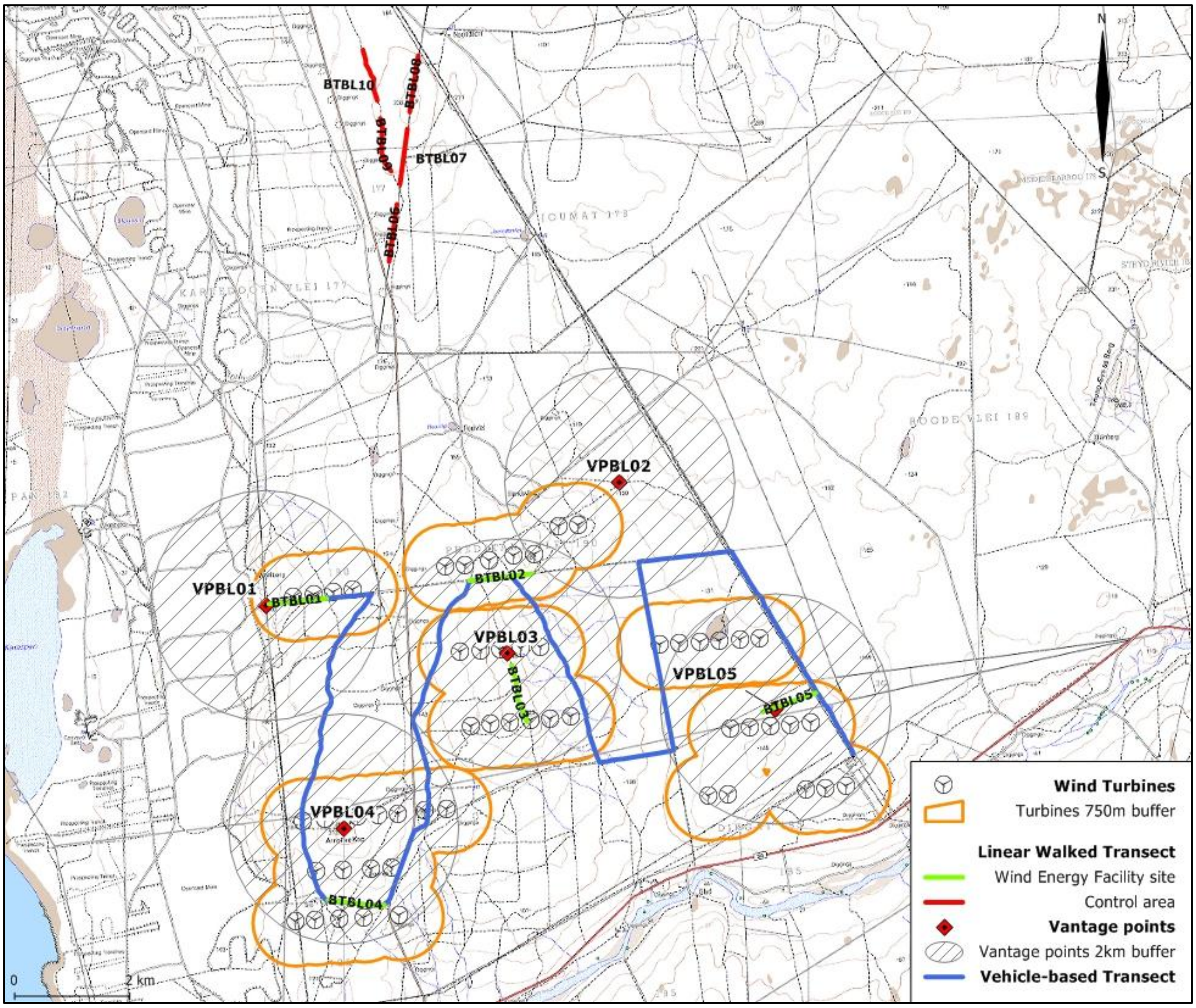


Figure 2 - Location of all the sampling locations at the study area (walked and vehicle-based transects, vantage points and observed area).

3. Results & Discussion

The results presented in this report present the recorded information during the first 9-month period of the 12-month pre-construction bird monitoring programme for the Blue wind energy facility. Taking this into account, the baseline reference of the bird communities during the pre-construction phase of the Wind Energy Facility is established in this chapter. The discussion is based on the analysis of data collected so far and specialized bibliographic information available.

3.1. General results

From the bibliographic sources, databases and field work, a list of 180 bird species with potential occurrence within the study area was developed (refer to Appendix II). From these 180 species, 169 were considered as possibly present in the area by the Avian Impact Assessment (Simmons & Martins 2012).

Throughout the surveys conducted to date and as a result of all the methodologies implemented, a total of 80 bird species were recorded within the study area, including the wind energy facility and its surrounding control areas. The total number of species detected in the monitored period accounts for about 40% of the total number considered to have potential of occurrence according to the Avian Impact Assessment. The field visits also allowed the detection of 12 other species that were not previously referred to in the EIA Assessment, including six endemic and two near-endemic species of southern Africa (refer to Appendix II).

The methodology implemented allowed for concentrating and maximizing the sampling efforts to sensitive species with higher collision risk and/or globally or nationally endangered; endemic or those that have a very restricted distribution. Regarding the 22 sensitive species possibly occurring in the site, 12 of them were recorded in the study area during the surveys conducted to date, i.e.: Black-chested Snake Eagle (*Circaetus pectoralis*), Jackal Buzzard (*Buteo rufofuscus*), Pale Chanting Goshawk (*Melierax canorus*), African Black Oystercatcher (*Haematopus moquini*), Greater Kestrel (*Falco rupicoloides*), Lanner Falcon (*Falco biarmicus*), Peregrine Falcon (*Falco peregrinus*), Kori Bustard (*Ardeotis kori*), Ludwig's Bustard (*Neotis ludwigii*), African Sacred Ibis (*Threskiornis aethiopicus*), Greater Flamingo (*Phoenicopterus roseus*) and Lesser Flamingo (*Phoeniconaias minor*) (Appendix II).

From the 80 species detected, 8 are listed as having conservation importance in South Africa (Barnes 2000), i.e.: African Black Oystercatcher, Caspian Tern, Lanner Falcon, Peregrine Falcon, Greater Flamingo and Lesser Flamingo, all classified as *Near Threatened*; and Kori Bustard and Ludwig's Bustard, considered *Vulnerable*.

Regarding the global threat status of the species confirmed within the study area, the Global Red List considers the Maccoa Duck, African Black Oystercatcher and Lesser Flamingo to be *Near Threatened* and the Ludwig's Bustard as *Vulnerable* (IUCN 2013).

From the 29 species endemic to Southern Africa (that are considered to likely occur within the site according to the desktop review), 19 were confirmed during the field surveys (Appendix II). Also 15 out of the 21 species that are considered as *Near Endemic* (that were identified during the desktop review), were confirmed on site.

3.2. Passerine and small bird communities

The community of passerine and small birds observed during the surveys conducted to date was mostly composed of resident species (with the exception of Barn Swallow which is a Non Breeding Migrant), and a large proportion of endemic and near-endemic species to Southern Africa (70%). The great majority of these species are common to locally common within their distribution range, so they were expected to occur within the study site. All of the passerine species identified to date are considered to be of Least Concern conservation status.

The species community found to be using the site was mostly composed of Flycatchers, Chats, Robins and Wheatears and Larks, however a wider array of species groups was observed, including Warblers, Finches, Buntings, Cisticolas, Kingfishers, Penduline-Tits, Shrikes and Bushshrikes, Sparrows, Sunbirds, Swallows, Swifts and Tits (Appendix II). Most of these species are associated with scrub vegetation and arid vegetation, however some other species usually occur in areas of richer vegetation, with more resources available, such as fields or short grassland (Hockey, Dean & Ryan 2005), which were also found in the area, though mostly during winter and spring.

None of these species presented a conservation status of concern, or was considered sensitive to impacts caused by the wind energy facility project.

Considering the parameters estimated for passerine and small bird community it was observed that the average number of birds/km, a measure of abundance, decreased over time, with a higher abundance being observed in winter, and them progressively decreasing until the summer survey (conducted in February). The decrease in activity over time is significant, with the abundance observed in winter being significantly higher than spring (p = 6.85e-05) or summer (p= 5.64e-06)

The community abundance displayed a similar behaviour in the two sampling areas considered, the wind energy facility and in the control area located north. However the control area always presented a significant higher abundance in comparison with the wind energy facility site (p = 0.000297). This evidence may indicate that the in relation to the broader surrounding, the wind energy facility site presents lower interest for passerine and small species, perhaps due to a proximity of degraded areas and human infrastructures (*e.g.* the mining facility located west of the wind energy facility).

The comparison of the activity between transects, considering the vegetation in the surrounding area in presented in Figure 4. The vegetation is very homogenous among the control site and the wind energy facility, indicating that the differences between the two areas are not due to an apparent vegetation change. The vegetation present within the wind energy facility is part of the hipper-arid Namaqualand Coastal Duneveld, and the western part of the site area has already suffered intervention by mining activities, though it is on the process of vegetation recovery. Some of the bird species that can occur in the area are endemic to the region and dependent from the natural vegetation present to the east of the wind facility. Nonetheless the proportion of vegetation that will be modified by the implementation of the wind energy facility is very reduced, compared to the area of natural vegetation available north and east of the study area.

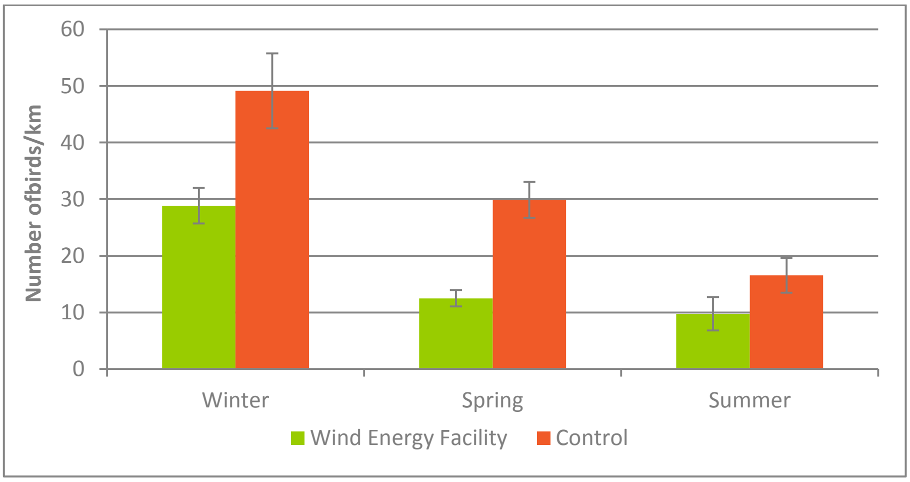


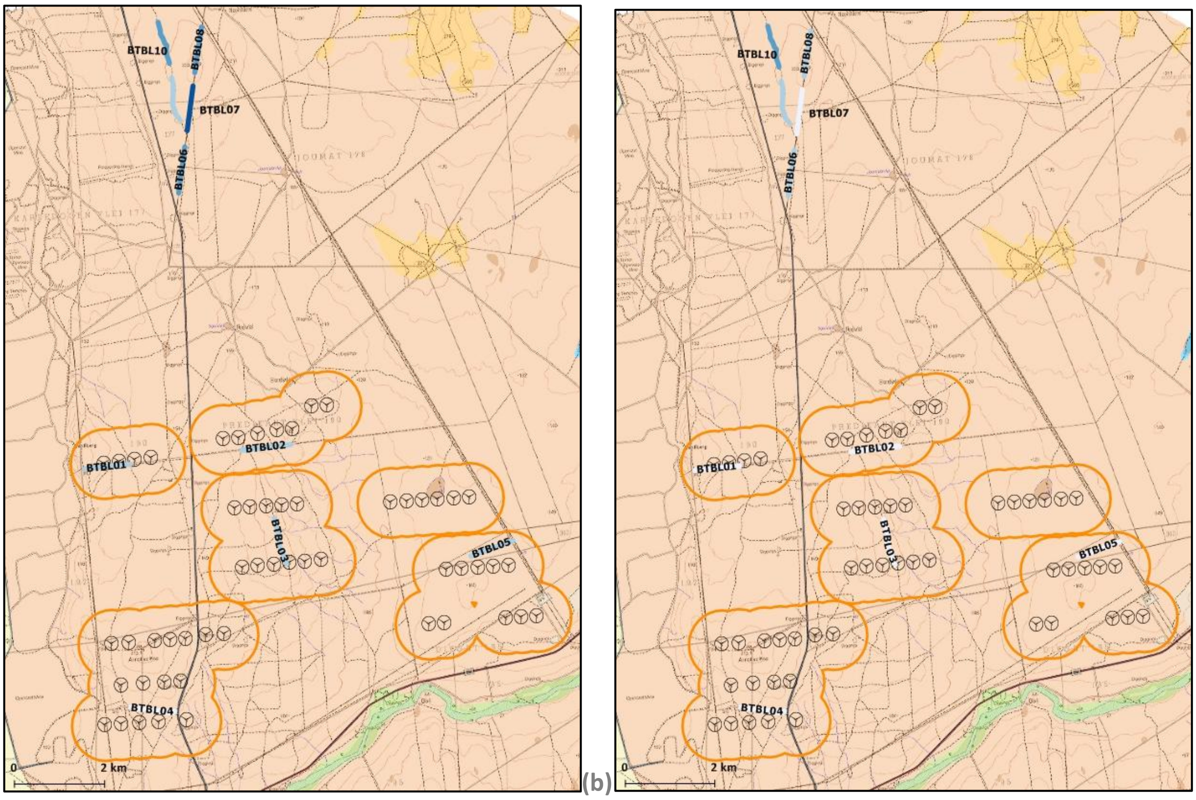
Figure 3 - Average Kilometric Index of Abundance (number of birds/km) measured in the different sampling sites surveyed for each season surveyed. Vertical bars represent the Standard Error of the mean.

As already stated from the analysis of the previous figure, bird activity decreases substantially over time, reaching minimum levels in summer, especially in the wind energy facility site. Transects where the activity detected was slightly higher in the wind energy facility site were in the central and northern group of turbines (Figure 4). However it must be noted that even if the activity was slightly higher in those transects, it was always below the levels of activity detected in transects located north, in the control area.

Comparing the activity observed to date at the Blue site (average of 24 birds/km) with other projects in the country, during the same time period, bird abundance was slightly lower than in other sites in Northern Cape (28 birds/km) and in the Free State (27 birds/km), but half the abundance registered in sites located in the Western Cape per example (64 birds/km).

The slight difference in species composition from winter to summer, associated to a very low activity indicates that the area is particularly unsuitable for some species in the hottest and driest season of the year (*i.e*. summer), and presents conditions to some widespread species in the winter season, when the weather is cooler and presents some precipitation.

Considering the levels of activity detected, and the knowledge of the area gained through the monitoring programme, it is not expected that the levels of activity will be significantly different in the remaining surveys.



(a) (b)

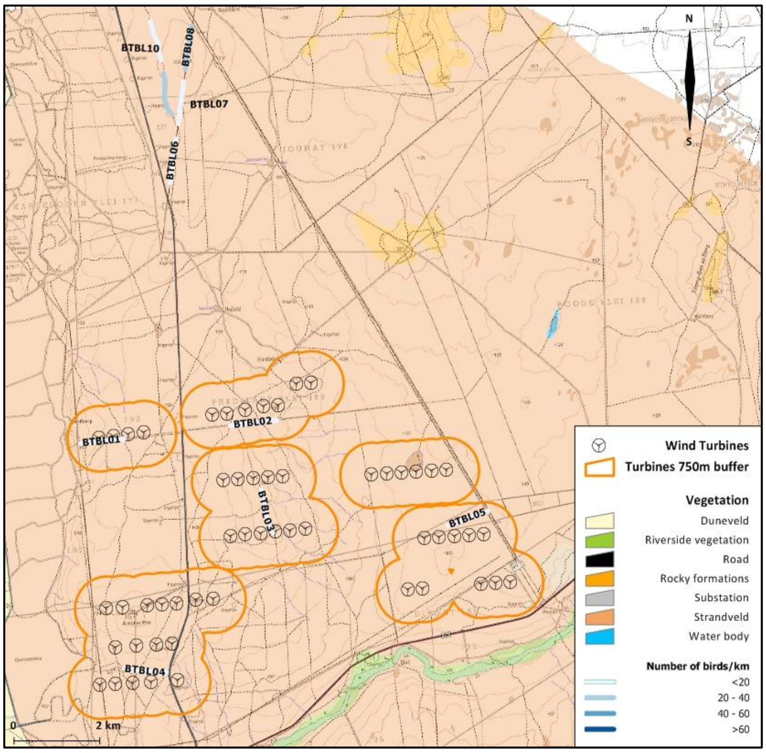
(c)


Figure 4 – Relative abundance of birds, expressed as number of birds/km recorded in each transect for each season: a) Winter; b) Spring and c) Summer.

3.3. Raptors and large birds

3.3.1. Community composition

In terms of the results obtained from vantage points, vehicle transects and incidental observations, a total of 11 raptor and other large bird species were observed in the study area and its surroundings (including two species of corvids). If also considering the monitoring of water bodies, the count would go up to 40 species.

According to the South African Red List Conservation Status (Barnes 2000), 2 of the confirmed species are considered *Vulnerable* – Kori Bustard and Ludwig's Bustard; and other 6 species are considered *Near Threatened* - African Black Oystercatcher, Caspian Tern, Lanner Falcon, Peregrine Falcon, Greater Flamingo and Lesser Flamingo (Appendix II). Regarding their worldwide status, the Maccoa Duck, African Black Oystercatcher and Lesser Flamingo are classified as *Near Threatened*, while the Ludwig's Bustard is considered *Vulnerable* (IUCN 2013). From these species with conservation status of concern, all but the African Black Oystercatcher, Caspian Tern and Maccoa Duck were observed within the wind energy facility site. These three species were only recorded in water bodies located 6 km south of the study site and are not considered likely to occur within the wind energy facility site.

Three of the raptors and large bird species identified within the study area are endemic to Southern Africa, namely the Jackal Buzzard (*Buteo rufofuscus*), the South African Shelduck (*Tadorna cana*) and the Hartlaub's Gull (*Chroicocephalus hartlaubii*). Another three species are considered to be near-endemic to southern Africa, the Pale Chanting Goshawk (*Melierax canorus*), the Cape Shoveler (*Anas smithii*) and the Ludwig's Bustard (*Neotis ludwigii*).

From the data collected during the vantage point surveys, the average number of contacts per hour and the *Collision Hazard Index* for the sensitive species (risk of collision with wind turbines) were calculated (presented in Figure 7 and Figure 8).

Regarding the contacts recorded from the 5 vantage points set up at the wind energy facility , a sum of 182 flights were recorded, comprising a total of 394 bird records (Table 4). These corresponded to 7 species, 4 of which are considered to be sensitive to the installation of wind energy facilities, 3 of them raptors and one falcon (Table 4). Two of these sensitive species were also considered as target species in the Avian Impact Assessment report (Simmons & Martins 2012).

Regarding the Activity Index for the different species, the vast majority of the records of large birds corresponded to Crows and Falcons, being the Cape Crow (1.17 records/hour) and Rock Kestrel (0.72 records/hour) amongst the most abundant species in the study area (Table 4). None of the above referred species are considered sensitive to the impacts of wind energy facilities, or have a conservation status of concern. Regarding the area where these species where mostly active, Cape Crow was also the most abundant species within the area of influence of the proposed turbine locations, with 23% of the contacts recorded at less than 500 m form a turbine location. Among the species sensitive to wind facilities, the Ludwig's Bustard was the species with a higher percentage of contacts near turbine locations (18%). However it is of note that the overall observed activity of this species was very low, with 0.4 contacts per hour (Table 4).

Besides the proximity to wind turbines it is also important to consider the amount of time sensitive species were observed at rotor height, as this may provide indications regarding the probability of collision with turbines during the operational phase of the project. The analysis of this parameter is presented in Figure 5. Raptor species (Accipitrids) spent a higher proportion of time between 30 m and 80 m than the other groups, especially during summer and autumn seasons. In summer 60% of all raptor time of use was recorded at rotor height. Note, however that raptor total time of use was of 0.11 seconds (per observation hour), while falcons had a total time of use of 2.03 seconds (per observation hour) and crows were recorded for 6.31 seconds (per observation hour). The absence of contacts and time of use obtained for other raptor (Accipitrids) species during the surveys conducted inflated the proportion presented in Figure 5, as the few observation made were mostly recorded at rotor height. However note that, comparing with the other groups, other raptor (Accipitrids) species are only sporadically present in the area and make little use of it. For the remaining seasons, falcons spent more time at rotor height. Nonetheless, it is important to note that the amount of time spent at rotor height is relatively small, mostly below 40% of the total observed time, being likely that these figures do not represent a significant risk for the species that use the area.

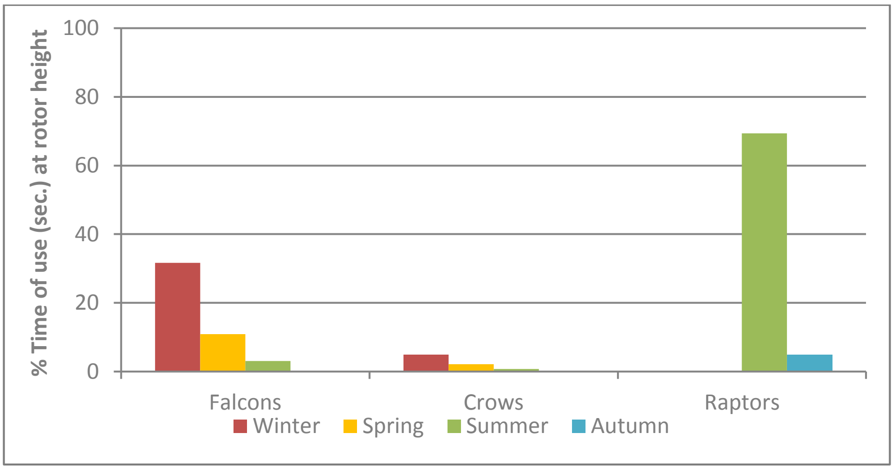


Figure 5 – Proportion of observed time spent at rotor height (between 30 and 180m) in the different seasons, for the groups of species considered. Data from the observations conducted between July 2013 and March 2014 in Blue Wind Energy Facility and immediate surroundings.

On the other hand, comparing the activity recorded in Blue Wind Energy Facility with other locations, it is observed that activity of the same species is in general lower than in other locations in the Northern Cape (per example Greater kestrel presented an activity of 2.6 contacts/hour on a site near Springbok).

In summary, the species which are more abundant in the Blue wind energy facility site and immediate surroundings are raptors and falcon species; however the activity recorded is very low, even when compared with relatively closely locations (i.e. the control area). Most of the observations of raptors and falcons were associated with the perching sites provided by the aerial power line poles and towers, located east of the proposed wind facility site. Raptors and Falcons are species known to have potential collision risk with wind turbines, especially falcons due to records of fatality of the genus Falco sp. at wind farms internationally (Barrios & Rodríguez 2004; Madders & Whitfield 2006; de Lucas, Janss & Ferrer 2008). Therefore these species are considered as sensitive species to this type of infrastructure (Retief *et al.* 2012), due to their high risk of collision with wind turbines.

Therefore, special attention should be given to sensitive species, as even with few contacts, risk of impacts remains. A spatial analysis will be conducted in the next section of the report to provide further information of raptors and other sensitive species' movements within the study area.

Table 4 – Activity Index (AI) and Frequency Index (FI) recorded during the surveys conducted between July 2013 and March 2014. Percentage of 500m x 500m grid cells (GC) used by each raptor and large terrestrial birds species in the study area. SA RLCS - Red List Conservation of Status of South Africa (Barnes 2000) and RLCS (IUCN 2013): VU – Vulnerable; EN - Endangered, LC – Least Concern; na – not assessed; Population Trend (IUCN 2013); Abundance – Abundance at a national scale (Hockey, Dean & Ryan 2005); **Target sp. (Simmons & Martins 2012); Sensitive – Species considered sensitive in this report (refer section 2.1.1 for details).**

Group	Common name	Scientific Name	AI (contacts/hour)	FI (routes/hour)	%GC		SA RLCS	RLCS	Population Trend	Abundance	Target sp.	Sensitive sp.
					Total	<500m turbine						
Raptors	Black-chested Snake Eagle	*Circaetus pectoralis*	0.11	0.05	1.68	0.00	-	LC	Unknown	Uncommon to locally common	-	X
	Jackal Buzzard	*Buteo rufofuscus*	0.08	0.06	6.72	1.52	-	LC	Stable	Fairly common	X	X
Bustards	Ludwig's Bustard	*Neotis ludwigii*	0.40	0.19	16.81	18.18	VU	EN	Decreasing	Sparse to locally common	X	X
Crows	Cape Crow	*Corvus capensis*	1.17	0.46	15.55	22.73	-	LC	Increasing	Common	-	-
	Pied Crow	*Corvus albus*	0.62	0.33	18.91	15.15	-	LC	Stable	Common to abundant	-	-
Falcons	Rock Kestrel	*Falco rupicolus*	0.72	0.23	7.56	10.61	-	na	-	Common to uncommon	-	-
	Greater Kestrel	*Falco rupicoloides*	0.62	0.43	10.50	12.12	-	LC	Stable	Fairly common	-	X

3.3.2. Spatial Analysis

In relation to the analysis of the Activity Index distribution, it is observed how most of the wind energy facility area presents low activity indexes (refer to Figure 7). However, two small areas of low/medium activity were recorded in the observed areas near the power line that runs north from Grootmis substation in the south eastern end of the facility site.

The study area is mostly featureless and the vegetation remains unchanged for most of the facility site, therefore the presence or absence of activity may be related to the existence of particular features that may be important for birds of prey: perching sites. The fact that medium activity was observed in the areas closest to the power line is due to the presence of perching sites provided by this structure since high trees suitable for raptors to perch are absent from the remaining area. Therefore, the area occupied by the power lines can be considered a relevant avian micro-habitat by itself.

The potential *Collision Hazard Index* (CHI) analysis for the sensitive species identified through vantage points (refer to Table 4) also highlights that the areas with higher potential risk where observed near the Gromis substation, within the surroundings of the aerial power line (Figure 8). The spatial analysis of the Collision Hazard Index determined for the sensitive species also shows that some wind turbines were marginally within areas of potential risk (these were mainly associated with areas with pre-existent infrastructures, such as power lines, poles, fences), but the majority of the area does not present a high risk for impact due to collision, for raptors and large birds of prey. This allied with the proposed wind facility being located in a very homogeneous habitat indicates that the facility poses a relatively low collision risk for the raptor species using the site.

To achieve a better insight of the factors involved in these CHI values, a particular analysis for each of the groups of species was undertaken. These results are shown in Figure 9.

As can be observed in Figure 9, all recorded groups presented a similar risk of collision with wind turbines with only slight variation between the collision risk that accounts for all factors (number of individuals and behaviour) and the collision risk calculated taking into account only the behaviour factors. This indicates that the behaviour risk observed where from single individuals or very small groups, being the risk associated with behaviours that have been documented as presenting risk of collision (e.g. hunting, soaring or territorial – (Barrios & Rodríguez 2004; de Lucas, Janss & Ferrer 2008).

Crows, Falcons and other Raptors presented similar indexes of collision risk, with the Bustards group presenting the lower risk of collision observed. Nonetheless it is important to highlight that despite the absence of behaviours of risk from this group, which includes Ludwig's Bustards, during the November surveys two bustards were found dead beneath the above mentioned power line, indicating that although no observations of risk behaviours were made, the possibility of collisions, especially with power lines to which bustards are known to be particularly sensitive, exists. The dead individuals were detected beneath the existing aerial power line that runs north from the Gromis substation (Figure 10).

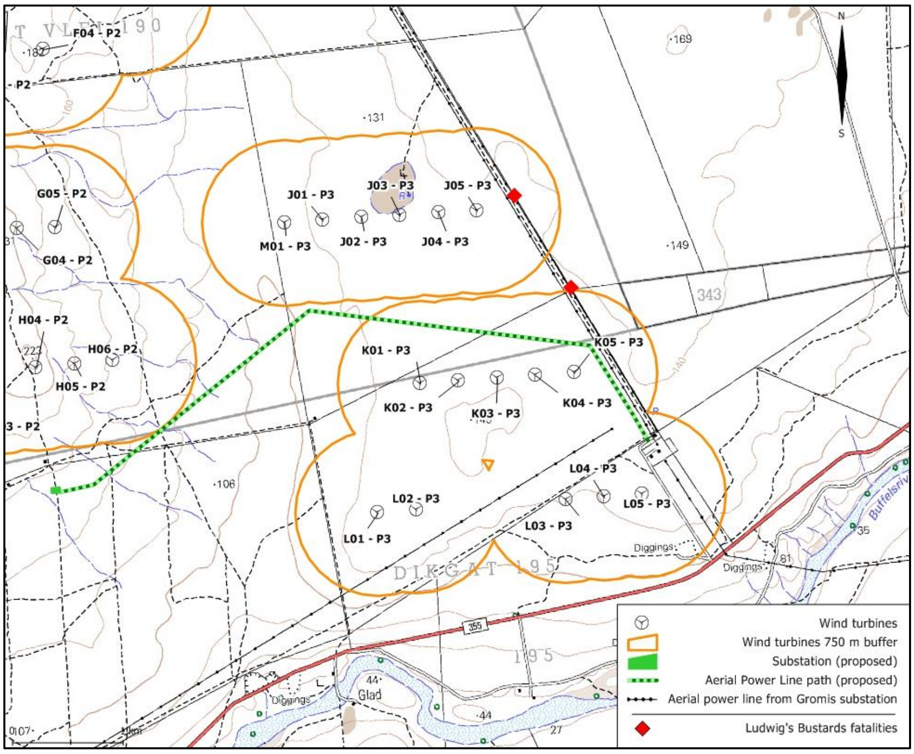


Figure 6 – Location of the Ludwig's Bustards corpses beneath the aerial power line that runs north from Gromis substation.

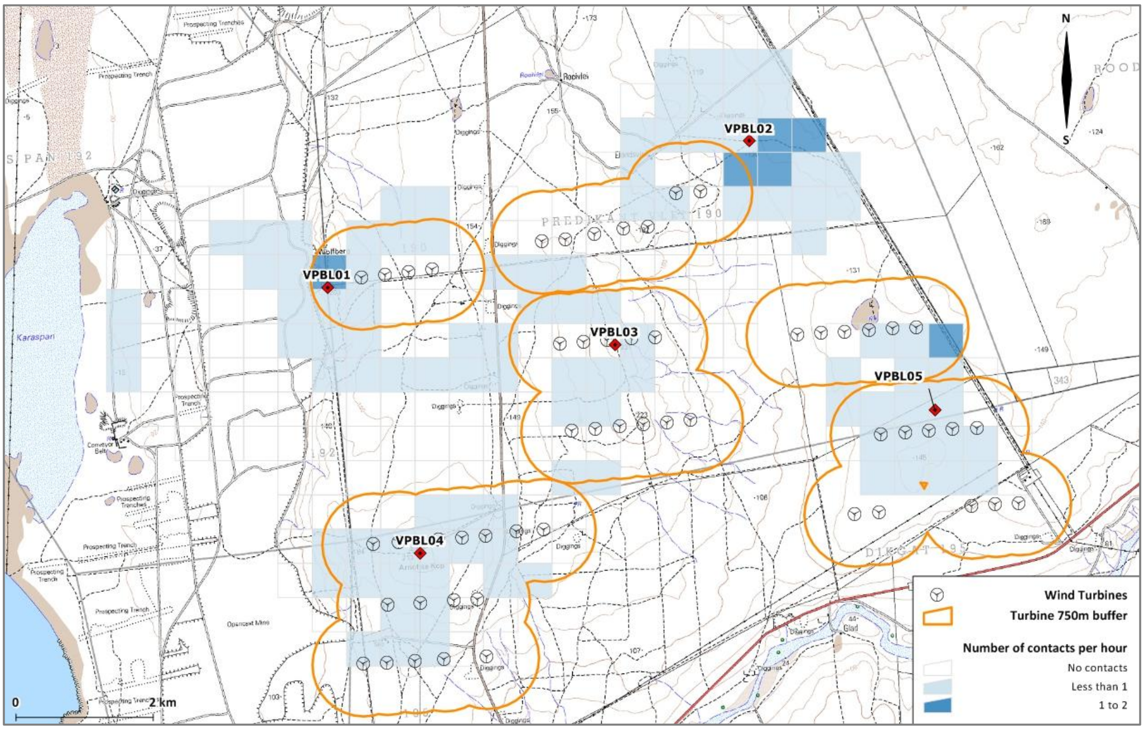


Figure 7 - Average number of contacts per hour. This data refers to the results of the vantage points (represented as red dots) conducted at the Blue Wind Energy Facility and immediate surroundings between July 2013 and March 2014.

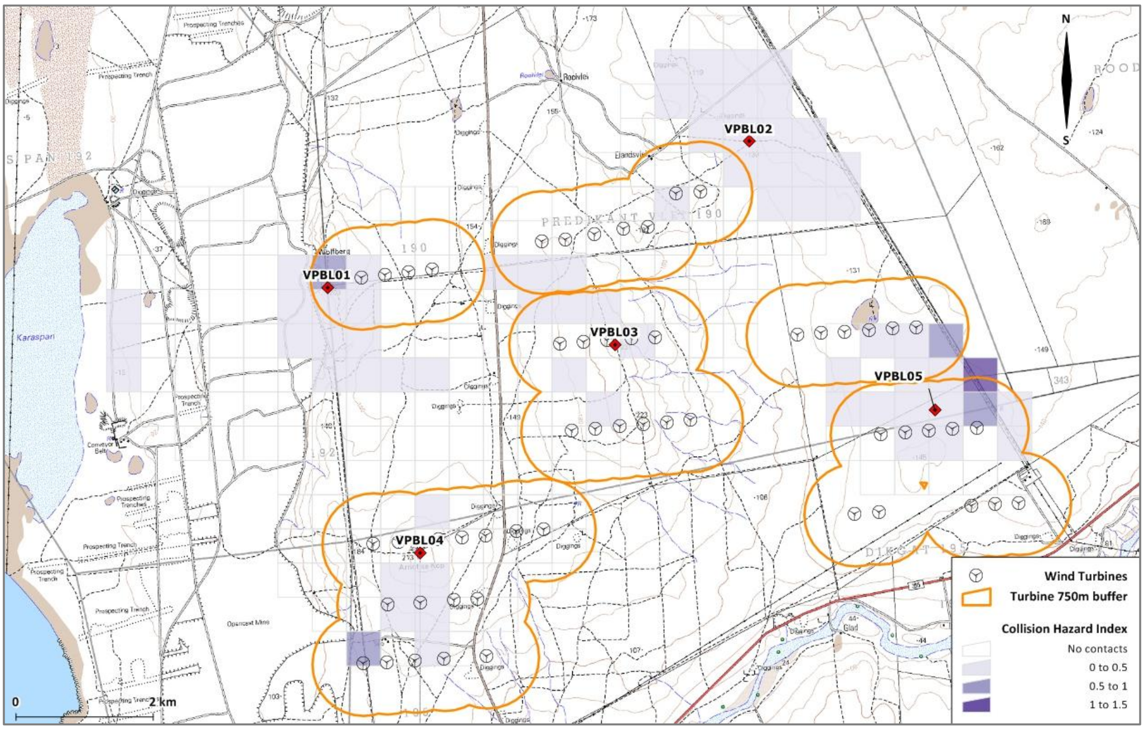


Figure 8 - ***Collision Hazard Index*** **for sensitive species per hour. This data refers to the results of the vantage points conducted (represented as red dots) at the Blue Wind Energy Facility and immediate surroundings between July 2013 and March 2014.**

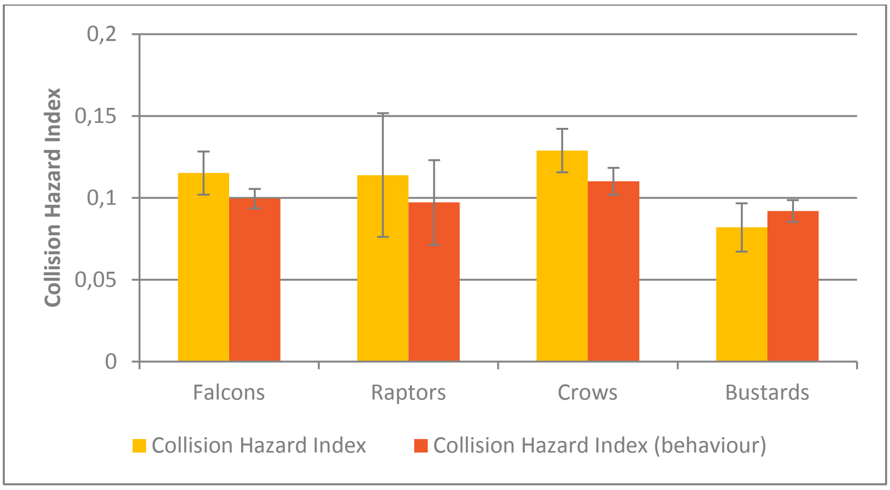


Figure 9 - Average ***Collision Hazard Index*** **values per flight recorded for the different groups of species considered – considering all factors and considering only behaviour analysis. Vertical bars represent the Standard Error.**

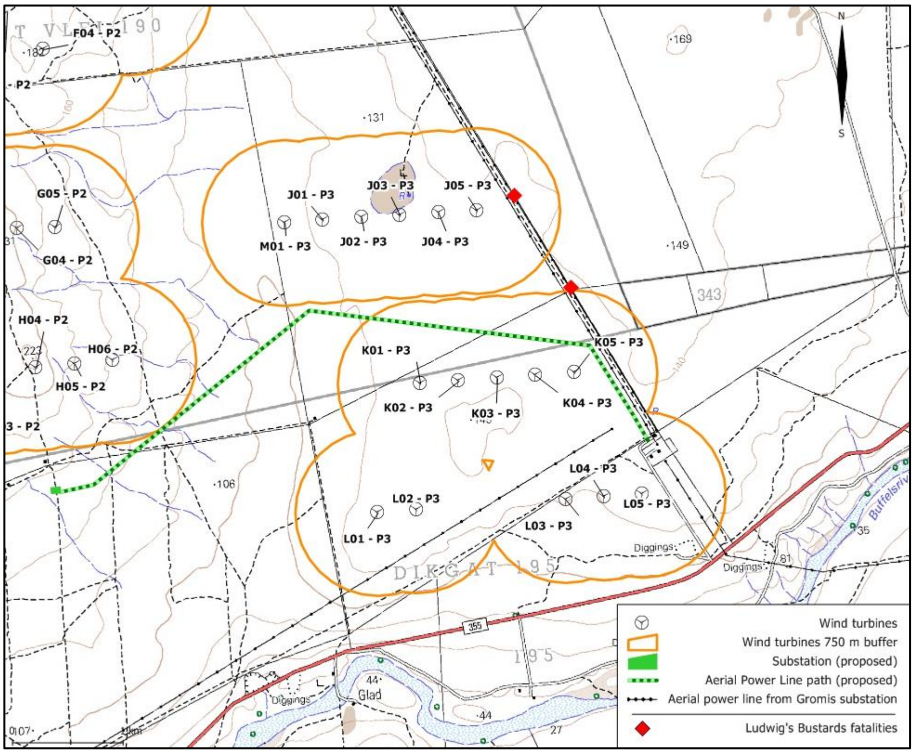


Figure 10 – Location of the Ludwig's Bustards corpses beneath the aerial power line that runs north from Gromis substation.

3.4. Nest monitoring

As referred to in section 1.5, the avian impact assessment undertaken within the EIA for the facility found the presence of three nesting sites within the wind energy facility area (Simmons & Martins 2012).

During the field surveys conducted, the previously identified nests were located and visited. The nesting sites of Ludwig's Bustard were not found and no evidences of Bustards breeding were detected to date on the site. Ten additional nesting locations were identified throughout the wind energy facility site (Table 5; Figure 11). Nine of these nests belonged to Greater Kestrels, one is a nest of Rock Kestrel (NEBL04), another was observed being used by several species (Greater Kestrel, Lanner Falcon and Peregrine Falcon) (NEBL09), another is potentially a nest of Jackal Buzzard (NEBL10 – previously identified during the EIA Assessment) and the remaining nest is considered a possible nest of Black-chested Snake Eagle (NEBL13), located at approximately 7 km from the nearest wind turbine (refer to Appendix III).

During the surveys conducted during spring, successful reproduction was identified at two locations: NEBL04 and NEBL05, the first a Rock Kestrel nest, and the latter a Greater Kestrel nest. Both nests are located at less than 500 m from a proposed wind turbine location (E02-P2, A07-P1 and A10-P3) (Figure 11). This may represent an additional risk of collision with the proposed wind turbines as fledglings and juveniles are known to be more collision prone with wind turbines, especially during the summer season while hunting (Barrios & Rodríguez 2004).

In the remaining nests the activity observed was only from adult individuals and no reproduction was confirmed (Table 5). Despite this fact, other nesting locations identified within a buffer of 750m from wind turbines are considered to present some risks in future reproduction seasons, and they should be monitored accordingly. Within the Wind Energy Facility site, NEBL01, NEBL02, NEBL07 and NEBL08 are included in this situation (Figure 11).

The study area is characterized by the absence of trees or other natural structures that could be used by raptors and other birds (e.g. crow species) to nest or roost. Therefore most of the identified nests are located in the most abundant tall structures available in the study area, i.e. poles or towers associated with aerial power line located east of the proposed site.

Table 5 – Description of the activity observed on the nests identified within Blue wind energy facility site and its immediate surroundings throughout the surveys conducted between July 2013 and March 2014. (Grey cells indicated that the nests where not known at that date).

Nest	Species	Season					
		Spring			Summer		Autumn
		Spring I	Spring II	Spring III	Summer I	Summer III	Autumn I
NEBL01	Greater Kestrel	One adult	No observations	No observations	No observations	No observations	No observations
NEBL02	Greater Kestrel	No observations	Two adults	One adult	No observations	One adult	No observations
NEBL03	Greater Kestrel	One adult	No observations	No observations	No observations	No observations	No observations
NEBL04	Rock Kestrel	Two adults	Two adults	Two adults. Four chicks observed	Two adults	No observations	No observations
NEBL05	Greater Kestrel	One adult	One adult	One adult. Three chicks	Two adults	No observations	No observations
NEBL06	Greater Kestrel			One adult	One adult	No observations	No observations
NEBL07	Greater Kestrel			One adult	No observations	No observations	No observations
NEBL08	Greater Kestrel			One adult	No observations	No observations	No observations
NEBL09	Greater Kestrel/Lanner Falcon/Peregrine Falcon			Three adults Peregrine Falcon	One adult Grater Kestrel	Two adults Lanner Falcon	No observations
NEBL10	Greater Kestrel				Two adults	No observations	No observations
NEBL11	Jackal Buzzard					No observations	No observations
NEBL12	Greater Kestrel					One adult	No observations
NEBL13	Eagle sp.					No observations	No observations

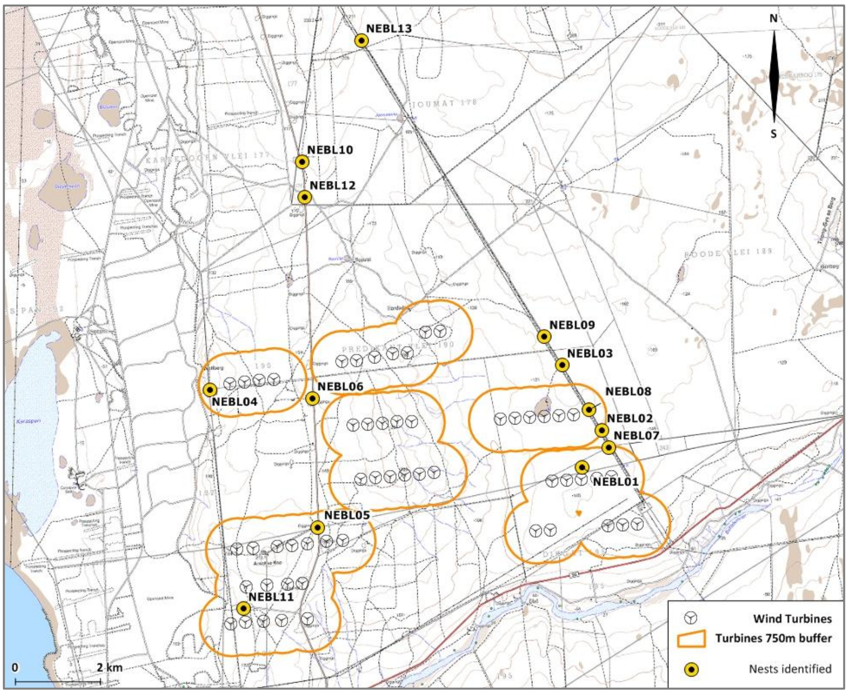


Figure 11 – Location of the nesting locations identified during the surveys conducted between July 2013 and March 2014 in Blue Wind Energy Facility and immediate surroundings.

3.5. Water body monitoring

Between July 2013 and March 2014, four water features with potential importance for birds were identified near Kleinsee (Figure 12). From these four locations, WBBL01 and WBBL02 presented a special importance due to the observation of Greater and Lesser Flamingos in October, November, January and February surveys. These are sensitive species with a conservation status of concern, as they are Near Threatened (Barnes 2000) and were both previously considered as target species (Simmons & Martins 2012) and priority species (Retief *et al.* 2012). However no movements within the wind farm area or other observations of these two species were made within the developable area up to date, as the location where these species were recorded is approximately 6 km south of the proposed site.

Two other sensitive species were detected at these water features including African Black Oystercatcher (*Haematopus moquini*) and African Sacred Ibis (*Threskiornis aethiopicus*). Over time a great number of water birds were detected at these two locations, especially at WBBL01, located close to Kleinsee at the mouth of the Buffels River, were a total of 719 birds were recorded to date.

Considering that both water bodies are located at more than 6000 m from the closest wind turbines, the placement of the Blue Wind Energy Facility does not seem to present immediate impacts to the species present, especially as the species were not yet observed using the area and no adequate habitats for them occur within the wind energy facility area.

Regarding WBBL03, though this is the water feature closest to the wind facility site, only six birds from two common species were observed using the site to date: Three-banded Plover, Egyptian Goose. Therefore it is not considered that this site represents an area of interest for birds.

A few temporary pans are located west of the wind energy facility area (the biggest one the Karaspan – WBBL04) and were visited during the March survey. However the area was dry and revealed no interest for birds, as no water was observed in the visited locations, nor were birds observed using the site. This area is known to be dry for most of the time, supporting water only when heavy rains occur.

Overall it can be stated that the water bodies in the area that contribute to the gathering of large flocks of birds are WBBL01 and WBBL02. In these locations their importance is highlighted by the presence of sensitive migratory species, such as the Flamingos. It is however likely that the migratory flights incurred by the two observed species will occur mainly along the shoreline, and not through the wind energy developable area. If birds using the wind energy facility site also use these water features, they may be prevented to do so by the construction and operation activities. However, through the surveys conducted to date, no major movements were observed from birds leaving or arriving at the water bodies from the wind energy facility site.

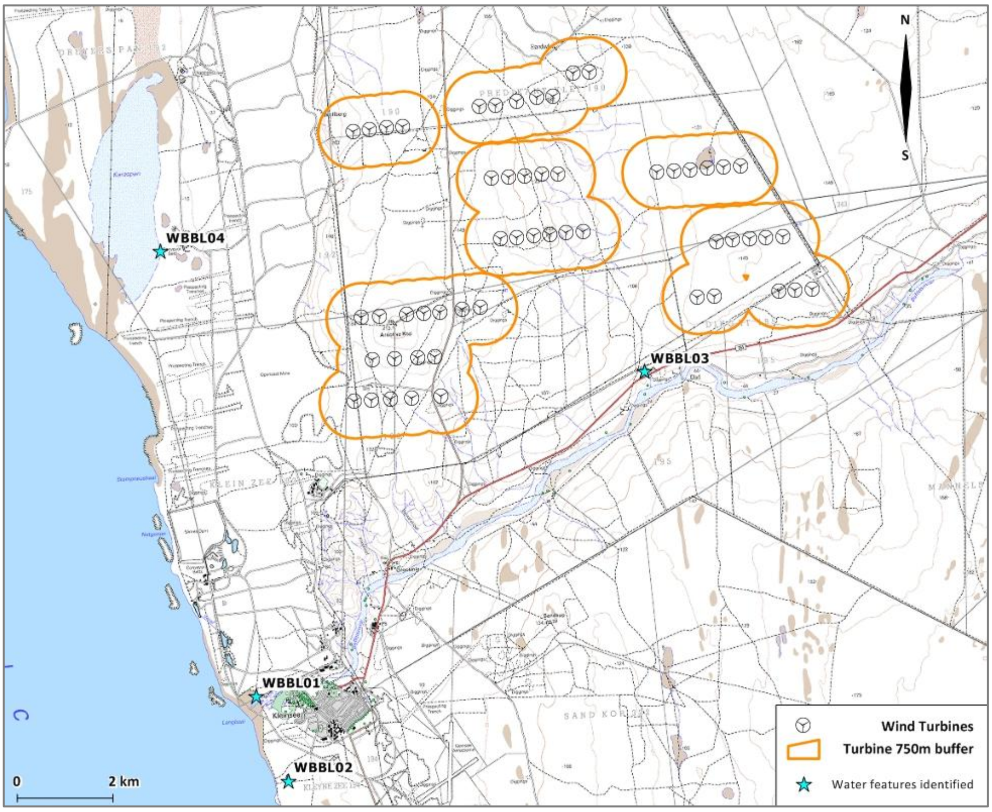


Figure 12 – Location of the water bodies monitored between July 2013 and March 2014 at the Blue wind energy facility.

3.6. Sensitive areas analysis

The area in terms of general sensitivity is considered as a low sensitivity area, tending to be of medium sensitivity, during breeding season, in some areas due to the presence of nesting locations used for reproduction:

- North-western group of turbines: a nest with confirmed reproduction of Greater Kestrel is located as less than 500m from wind turbine E02-P2. The surrounding area of the nest may also present some higher activity of Greater Kestrel associated with territorial and/or hunting activities during reproduction period;
- South-eastern group of turbines: several nests without confirmed reproduction were identified in the poles and towers of the power line located east of this group of turbines. Some of the nests are located at less

than 500 m from the following turbines: J05-P3, K02-P3, K03-P3, K04-P3. In this area was also observed a higher number of observations of raptors and falcons associated with the nests present, but also with the availability of perching sites provided by the power line associated infrastructure.

- South-western group of turbines: one nest of Rock Kestrel with confirmed reproduction is located at less than 500m from two wind turbines: A07-P1 and A10-P3. The surrounding area of the nest may also present some higher activity of Rock Kestrel associated with territorial and/or hunting activities during reproduction period;

However the above mentioned areas are important only during some periods of the year, and implementation of a proper management plan may reduce the risks associated with these features (refer to section 4.2). Besides the area around the nesting locations with successful breeding, it is also considered that the perching locations provided by the existing aerial power line located east of the facility site poses some collision risk for the raptors and falcon species.

Therefore, analysing the areas referred to above, that include the turbines that are located at less than 500 m from the nests with successful reproduction (NEBL04 and 05) and within a 200 m buffer from the power line, it can be concluded that only A07 - P1, A10 - P3 and E02 - P2 turbines fall within these categories since no turbines are located at less than 200 m from the already existing aerial power line. Though other wind turbines are located at less than 500m from other nests, these are considered to be the more sensitive turbine locations, as in the nests located around J05-P3, K02-P3, K03-P3, K04-P3 no reproduction was observed to date.

From the Avian Impact Assessment, the central and south-eastern groups of turbines were considered as having a high sensitivity, especially for Ludwig's Bustard, including turbines G01-P1, G02-P2, G03-P2, G04-P2, G05-P2, H01-P2, H02-P2, H03-P2, H04-P2, H05, P2, H06-P2, H01-P3, J01-P3, J02-P3, J03-P3, J04-P3, J05-P3, K01-P3, K02-P3, K03-P3, K04-P3, K05-P3, L01-P3, L02-P3, L03-P3, L04-P3 and L05-P3. No major movements or breeding evidences of the species were observed in this area presenting collision risk behaviours, or in the remaining study area. This area is considered of medium sensitivity during the bustards breeding season (August to December). Nonetheless, it was within the eastern group of wind turbines that two Ludwig's Bustards were found dead, due to collision with the existing aerial power line. This is an indication that similar negative impacts may arise from the proposed power line if adequate mitigation measures are not implemented.

Regarding these turbines that fall within potentially sensitive areas, and in order to mitigate impacts associated with the adjacent existent power line, and to the proposed power line, both located within the area 2 referred above, some recommendations are presented in section 4.2.

4. Conclusions and Recommendations

4.1. Monitoring programme main results and identified impacts

The overall activity of the proposed wind energy facility was low and no major sensitive areas were identified. Considering the results collected to date no changes to the proposed layout are considered necessary. Some particular potential impacts, related mostly with the occurrence of raptors and bustards were identified and in order to avoid and reduce the potential impacts some mitigation measures are proposed in this chapter.

Collision mortality with wind turbines and power lines

Large birds with low manoeuvrability in flight are usually more prone to collision with wind turbines. In this regard 11 of these species were detected from the vantage points, vehicle transects and as incidental observations. Seven of them are considered sensitive to impacts derived from the installation of wind energy facilities.

Within the facility site a power line is being planned following part of the existing power line, but also creating a new power line segment towards the central area of the facility site (refer to Figure 13). Regarding the impacts caused by this type of installation Bustard species are expected to be the mainly affected group. This has been inclusively referred to during the Avian Impact Assessment, raising concerns over Ludwig's Bustards presence. Bustards are also considered sensitive species due to their possibility of collision, but mainly with overhead power lines, regarded as one of the major threats for bustards in South Africa, namely for Ludwig's Bustard (Jenkins & Smallie 2009; Allan & Anderson 2010). There are no records internationally of bustard species collisions with wind turbines to date, but there is also no information available on this subject regarding the South African bustard species. Therefore, the potential collision risk cannot be completely ruled out, although based on the observations made on site it is considered low at this stage.

Ludwig's Bustard within the Blue wind energy facility, was observed mostly in the surroundings of the aerial power line that runs north from the Gromis substation. Individuals were observed conducting mainly low flights (below 5 m) or feeding on the ground. Therefore, no major potential collision risk situations with the proposed wind turbines in the proposed wind farm were yet identified for this species through the surveys conducted to date. However during the surveys conducted in November two bustards were found dead beneath the above mentioned existing power line, indicating that although no observations of risk behaviours were made, the possibility of collisions, especially with power lines to which bustards are known to be particularly sensitive, exists. The dead individuals were detected beneath the aerial power line that runs north from the Gromis substation.

Although the bustard fatalities detected are not directly related with the proposed project, this evidence may provide indications of some precautionary measures that can be taken to prevent the same type of impacts from the power line that is to be constructed as part of the Blue wind energy facility. Considering the spatial proximity between the existing power line and the proposed power line, the same impacts are expected if mitigation measures are not implemented, and thus these are suggested below (section 4.2).

For the different type of raptors considered, both raptors and Falcons, presented relatively small risk behaviours, and do not indicate a high potential for collision with the proposed wind turbine locations to date. Nonetheless there is some risk of collision associated with the existing power line located east of the facility, due to the higher utilization of the surrounding area, and the availability of perching and nesting locations. Considering the observations made to date, it is expected that the implementation of a similar power line associated to the wind facility site would provide the same features for raptors and falcons, increasing the collision risk in the area of the power line.

Exclusion effects by habitat alteration

In general terms it can be stated that the area is relatively poor regarding habitat diversity, with a portion already highly transformed by the mining activities and therefore no major habitat related impacts are foreseen. Although some of the bird species occurring are endemic to the region (especially passerines) and may be affected by disturbance and/or displacement effects, the proportion of habitat loss should be considered minimal, considering also the high extensions of the main habitat present on site. This impact should be considered even lower since the areas located north and east are less disturbed by human presence, being potentially more suitable for bird species present within the study site.

Cumulative impacts

Cumulative impacts of a development project may be defined as "additional changes caused by a proposed development in conjunction with other similar developments or as the combined effect of a set of developments, taken together" (SNH 2012). This assumes the knowledge of other projects or actions whose effects could be added to the ones resulting from the project being assessed. Once it is not reasonably viable to consider in the analysis all the existing or proposed projects for a certain region, the analysis should focus on (Masden *et al.* 2010; SNH 2012):

At least another four wind energy development are planned to be implemented in the area. They will be implemented at a maximum distance of 100 km (Kangnas/Springbok WEF), 60 km (Koignaas WEF)), 20km (Kannikwa Vlakte WEF) and at 13km (Kleinsee WEF) (CSIR 2012).

What this implies in terms of the analysed impacts and attending to the data gathered to date during this pre-construction monitoring programme would be that the sum of the fatalities of the four other wind developments could have detrimental effects at the local scale for the most common species, such as Cape Crow (although crow species, due to their behaviour are not considered to be significantly affected by the wind turbines). Finally for endemic passerines the cumulative effects of the mortality produced by the combination of the different wind farms could have some effects on local populations. It is not considered that this impact would be critical but careful monitoring of these effects is advised in other for them not to occur eventually at the regional or national level.

In terms of cumulative effects the project could have a greater impact on local communities, and therefore its impacts would be considered low to medium, as some species of conservation concern (possibly Ludwig's Bustard) may be affected by these cumulative effects.

4.2. Recommendations

The Blue Wind Energy Facility was considered to be of low sensitivity in terms of possible impacts on the bird community overall. The main concerns identified during the pre-construction monitoring year were:

- The presence of nesting locations, mainly kestrels, within the site, especially central and western sections of the development and associated with linear infrastructures such as power lines that provides suitable substrate;
- The detection of a community of raptors, presenting some potential risk areas especially surrounding the existing aerial power line located east of the facility site;

- Presence of endangered species such as Ludwig's Bustards, though in low numbers and apparently restricted locations.

No particular no-go areas were identified as a result of the data collected to date, and therefore no layout adjustments are foreseen. However some preventive mitigation measures, based on the concerns noted above are proposed.

Mitigation measures are proposed in order to minimize disturbance over the bird communities present at the site, and are related to each of the predicted impacts. The proposed mitigation measures are based on international standards, author's expertise and follow the general indications from the recent publication *"Birdlife South Africa and Endangered Wildlife Trust recommended conditions of approval for all wind energy facilities to monitor and reduce potential impacts on avifauna"* (BirdLife South Africa & EWT 2012).

Construction phase:

- Minimize areas of construction to the maximum extent possible;
- Disturbance during the breeding season of the species nesting in the area should be avoided to prevent and minimize impacts with sensitive species. Therefore, construction activities that involve heavy machinery and are prone to cause significant disturbance should be avoided during the breeding season (e.g. between August and October), if technically viable. The main concern in the area are the kestrel sp. nesting along the existing power lines and the previously confirmed nesting of Ludwig's bustard on site. Hence, these activities (e.g. opening roads, clearing of vegetation, movements or operation of heavy machinery, etc.) should be restricted during the periods these species are actively breeding on site in the areas where the nests are located;
- It could be considered, prior to the beginning of the construction phase, to relocate the existing raptor (mainly kestrel species) nesting locations within a 1000 m buffer around the areas of construction. The relocation of the nests should take place ONLY before the breeding season begins or after the end of the breeding activities of the species. This measure should always be evaluated by an experienced avifaunal specialist;
- Prior to the initiation of the construction activities, the area should be effectively searched to identify active breeding locations by an avifaunal specialist. The most appropriate solutions for the measures to be implemented (either involving the relocation or the definition of no-disturbance areas during construction activities) should be discussed by the avifaunal specialist team, as these should always be assessed and evaluated on a case-by-case scenario. Before the construction activities begin, all areas to be affected by infrastructures or working areas should be searched for nests of species that nest on the ground, such as Ludwig's Bustard, in order to avoid the impact:
    - A no-disturbance area of 500 m around the nesting locations should be defined whenever an active raptor or a bustard nest is identified. These should be considered no-go areas during construction;
    - In the case of bustard's nesting locations, an additional 500 m area with restricted disturbance, where activities with lower disturbance (e.g. people and vehicle movements) could take place, should be considered;
    - These proposed measures should be evaluated on a case-by-case basis by the environmental supervisor of the works provided the decisions are discussed together with an avifaunal specialist;

- The construction phase should be supervised as defined in the construction environmental management plan by a Zoologist in order to identify any conflictive situations, namely active breeding nests in the immediate surroundings of the known nest locations. If the raptors and other large terrestrial sensitive species are detected breeding, additional mitigation measures (if necessary) should be discussed with the avifaunal specialist and implemented;
- Appropriate training should be provided to all the construction personnel regarding avifaunal species and the need to minimise impacts in this regard. All persons working in the area should be aware of the sensitive areas and be alert of the potential impacts of the construction phase on the bird community;
- The removal of natural vegetation, especially riparian thicket vegetation or trees should be avoided or, if not technically viable, undertaken with extreme care due to is importance as roosting, nesting and as foraging habitat for birds.
- Aerial power connection between turbines should be equipped with bird flappers to reduce collision with large birds (e.g. Ludwig's Bustard).
- Sufficient drainage should be provided along access roads to prevent erosion and pollution of adjacent watercourses or wetlands.
- Structures should be designed to reduce the availability of perching sites in the area close to the turbines.
- The proposed power line should have all the poles fitted with anti-nesting and anti-perching structures.
- No chemical spills or any other material dumps should be conducted within the intervention area, with special focus in areas nearby riparian vegetation or drainage lines. All the maintenance of vehicles must be carried out in specially designated areas to prevent any type of pollution on the area.

Operation phase:

- Maintenance staff should be encouraged to keep noise and other disturbances to a minimum. If a confirmed nesting location of target species is confirmed within the wind energy facility, activities requiring heavy machinery must be avoided within 500 m from the active nests unless otherwise agreed with the environmental supervisor of the works and an avifaunal specialist.
- It is recommended that any cattle carcass should be removed from the surroundings of the turbines as soon as possible. This could attract carrion birds and some raptors that act as facultative scavengers.
- The utilization of guyed infrastructures should be avoided (e.g. meteorological and communication towers) or if unavoidable, visible markers should be used to improve the visibility of the wires (APLIC, 2012). Bird carcass searches on these structures should be included in the operation phase monitoring programme and conducted on a regular basis.
- In order to increase general bird protection, as well as water quality, the use of any pesticide in the wind energy facility area should be prohibited.
- Wind turbines platforms should suffer vegetation recovery interventions, and, if possible, use dense natural vegetation to reduce the suitability of the area as foraging grounds for raptors and falcons;
- Reduce, as far as possible, the existence of (or creation of new) structures suitable for raptors and falcons perching sites within the wind facility site, in order to avoid the utilization of areas close to wind turbines;

- The implementation of additional alternative nesting specific structures (e.g. modified electric poles, with nesting support) in areas farther away from the wind energy facility should be considered. This will contribute to compensating for the loss of suitable nesting locations by the implementation of previous measures and to promote the utilization by the species of areas at a safer distance from the wind turbines, particularly, where fledglings or juvenile bird's collision risk can be considerably reduced.
- Before the start of the operational phase of the project the area should be searched for any new nests that may impose the implementation of further mitigation measures due a new risk of impact.
- If turbines are to be lit at night, lighting should be kept to a minimum and should preferably not be white light. Flashing strobe-like lights should be used where possible[4];
- Lighting of the wind farm (for example security lights) should be kept to a minimum. Lights should be directed downwards.
- Ensure the implementation of a post-construction monitoring (operation phase) plan to survey bird communities on the Wind Energy Facility and the impacts resulting from the installed infrastructure (refer to Appendix V for an outline of what such a programme could include). This plan should have a minimum duration of at least two years. The continuity of the monitoring programme beyond this timeframe should be revised accordingly to the results obtained.
- The environmental management programme, specifically the operational monitoring programme, should be reviewed annually for the first three years of the operational phase of the facility.

Considering that the hypothesis of bird fatalities occurring at the Blue wind energy facility cannot be excluded and the need to properly evaluate the disturbance and displacement effects of the construction activities and ancillary infrastructures will have on the bird community, a monitoring programme should to be implemented during the operational phase of the project (a proposed approach is outlined in the Appendix IV). It is considered that a rigorous and well-planned monitoring programme is critical for proposing effective measures of the real impacts of the project.

This monitoring programme should have a minimum duration of 2 years during the operational phase, with its continuity being revised following consideration of the results obtained. The post-construction monitoring programme should follow the recommendations from Birdlife and any guidelines that may become available in this respect. This on-going monitoring should include both the continuation of the assessment of the bird communities on the site, complementing the information gathered during the pre-construction phase and allowing the detection of potential changes and effects caused by the project. The operational phase monitoring programme should include carcass searches and the determination of correction factors (observer's efficiency and carcass removal) in order to accurately determine the impact of the wind turbine on birds and determine any potential critical area and/or wind turbines. This will allow proposing mitigation measures, if necessary, adjusted to the site specificities. This mitigation measures must be evaluated in a case by case scenario as an effective mitigation measures plan is related to the

[4] Provided this complies with all the legal requirements (e.g. Civil Aviation Authority regulations)

accurate determination of the most problematic areas and/or wind turbines and the characterization of the environmental variables with higher influence on bird fatalities.

To properly calculate the real mortality associated to the wind energy facility it is recommended that correction factors are assessed it is essential to adopt a fatality estimator that adjusts the observed casualties by the estimated bias correction terms (Bernardino *et al.* 2013)..

The results of the construction and operational phase monitoring programme must be taken into account for the implementation of further mitigation measures, if considered necessary. If additional high collision risk areas are identified upon completion of the pre-construction monitoring programme, this should be evaluated by the avian specialists as soon as possible. Subsequent mitigation measures, adjusted to the risk situation identified, should be implemented.

At this stage no additional mitigation measures can be proposed. At the conclusion of the one year of pre-construction monitoring will be reassessed if further mitigation measures are considered necessary. Since these measures should be highly specific and objective, to answer a particular situation, and can have financial costs associated more information needs to be collected, which should be done during the construction and post-construction phased of the project. The implementation of additional mitigation measures should be implemented only if necessary and they should be carefully planned in other to maximize their efficacy in reducing bird mortality and assure the compatibility of the development with bird communities' conservation.

5. References

Allan, D. & Anderson, M.D. (2010) *Assessment of the Threats Faced by South Africa's Bustard Species*.

Arnett, E.B. (2006) A Preliminary Evaluation on the Use of Dogs to Recover Bat Fatalities at Wind Energy Facilities. *Wildlife Society Bulletin*, **34**, 1440–1445.

Arnett, E.B., Inkley, D.B., Johnson, D.H., Larkin, R.P., Manes, S., Manville, A.M., Mason, R., Morrison, M., Strickland, M.D. & Thresher, R. (2007) *Impacts of Wind Energy Facilities on Wildlife and Wildlife Habitat*. Bethesda, Maryland.

Atienza, J.C., Martín Fierro, I., Infante, O., Valls, J. & Domínguez, J. (2011) *Directrices Para La Evaluación Del Impacto de Los Parques Eólicos En Aves Y Murciélagos (vérsion 3.0)*. Madrid.

Band, W., Madders, M. & Whitfield, D.P. (2007) Developing field and analytical methods to assess avian collision risk at wind farms. *Birds and wind farms: risk assessment and mitigation* (eds M. de Lucas, G.F.E. Janss & M. Ferrer), pp. 259–275. Quercus, Madrid.

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

Barrios, L. (1995) No Energía eólica y aves en el Campo de Gibraltar. *La Garcilla*, **93**, 39–41.

Barrios, L. & Rodríguez, A. (2004) Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines. *Journal of Applied Ecology*, **41**, 72–81.

Bernardino, J., Bispo, R., Costa, H. & Mascarenhas, M. (2013) Estimating bird and bat fatality at wind farms: a practical overview of estimators, their assumptions and limitations. *New Zealand Journal of Zoology*, **40**, 63–74.

Bibby, C.J., Burgess, N.D., Hill, D.A. & Mustoe, H. (2000) *Bird Census Techniques*. Academic Press, London.

BirdLife International. (2014a) Haramoep and Black Mountain Mine Nature Reserve, http://www.birdlife.org

BirdLife International. (2014b) Bitterputs Conservation Area, http://www.birdlife.org

BirdLife South Africa & EWT. (2012) BirdLife South Africa and Endangered Wildlife Trust recommended conditions of approval for all wind energy facilities to monitor and reduce potential impacts on avifauna. , 4.

Buckland, S.T., Anderson, D.R., Burnham, K.P. & Laake, J.L. (1993) *Distance Sampling. Estimating Abundance of Biological Populations*. Chapman and Hall, London.

Christensen, T.K., Hounisen, J.P., Clausager, I. & Petersen, I.K. (2004) *Visual and Radar Observations of Birds in Relation to Collision Risk at the Horns Rev. Offshore Wind Farm. Annual Status Report 2003.* Rønde, Denmark.

CSIR. (2012) Renewable Energy EIA Applications Map, www.csir.co.za

Desholm, M., Fox, A.D., Beasley, P.D.L. & Kahlert, J. (2006) Remote techniques for counting and estimating the number of bird-wind turbine collisions at sea: a review. *Ibis*, **148**, 76–89.

Doty, A. & Martin, A. (2013) Assessment of bat and avian mortality at a pilot wind turbine at Coega, Port Elizabeth, Eastern Cape, South Africa. *New Zealand Journal of Zoology*, **40**, 75–80.

Drewitt, A.L. & Langston, R.H.W. (2006) Assessing the impacts of wind farms on birds. *Ibis*, **148**, 29–42.

European Commision. (2010) *Wind Energy Developments and Natura 2000*.

Gsänger, S. & Pitteloud, J.D. (2013) *Annual Report 2012*. Bonn.

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

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

Homan, H.J., Linz, G. & Peer, B.. (2001) Dogs increase recovery of passerine carcasses in dense vegetation. *Wildlife Society Bulletin*, **29**, 292–296.

Hotker, H., Thomsen, K. & Jeromin, H. (2006) *Impacts on Biodiversity of Exploitation of Renewable Energy Sources: The Example of Birds and Bats - Facts, Gaps in Knowledge, Demands for Further Research, and Ornithological Guidelines for the Development of Renewable Energy Exploitation*. Bergenhusen.

Hurlbert, S.H. (1984) Pseudoreplication and the Design of Ecological Field Experiments. *Ecological Monographs*, **54**, 187–211.

IUCN. (2013) The IUCN Red List of Threatened Species. Version 2013.2, http://www.iucnredlist.org

Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Harrison, J.A., Diamond, M. & Smit, H.A. (2012) *BirdLife South Africa / Endangered Wildlife Trust Best Practice Guidelines for Avian Monitoring and Impact Mitigation at Proposed Wind Energy Development Sites in Southern Africa*.

Jenkins, A. & Smallie, J. (2009) End of the line for Ludwig's Bustard? *Africa - Birds & Birding*, 35–39.

Jordan, M. & Smallie, J. (2010) *A Briefing Document on Best Practice for Pre-Construction Assessment of the Impacts of Onshore Wind Farms on Birds*.

Lekuona, J.M. & Ursúa, C. (2007) Avian mortality in wind power plants of Navarra (northern Spain). *Birds and Wind Farms* (eds M. de Lucas, G. Janss & M. Ferrer), pp. 177–192. Quercus, Madrid.

De Lucas, M., Janss, G.F.E. & Ferrer, M. (eds). (2008) *Birds and Wind Farms: Risk Assessment and Mitigation*. Quercus.

Madders, M. & Whitfield, D.P. (2006) Upland raptors and the assessment of wind farm impacts. *Ibis*, **148**, 43–56.

Malan, G. (2009) *Raptor Survey and Monitoring – a Field Guide for African Birds of Prey*. Briza Publications, Pretoria, South Africa.

Masden, E.A., Fox, A.D., Furness, R.W., Bullman, R. & Haydon, D.T. (2010) Cumulative impact assessments and bird/wind farm interactions: Developing a conceptual framework. *Environmental Impact Assessment Review*, **30**, 1–7.

May, R., Hamre, O., Vang, R. & Nygard, T. (2012) *Evaluation of the DTBird Video-System at the Smøla Wind-Power Plant Behaviour. Detection Capabilities for Capturing near-Turbine Avian Behaviour*. NINA Report 910, Trondheim.

Mukasa, A.D., Mutambatsere, E., Arvanitis, Y. & Triki, T. (2013) Development of Wind Energy in Africa.

NRC. (2007) *Environmental Impacts of Wind-Energy Projects*. Washington, D.C., USA.

Orloff, S. & Flannery, A. (1992) *Wind Turbine Effects on Avian Activity, Habitat Use and Mortality in Altamont Pass and Solano County Wind Resource Areas*. California, USA.

Paula, J., Leal, M.C., J., S.M., R., M., Costa, H. & Mascarenhas, M. (2011) Dogs as a tool to improve bird-strike mortality estimates at wind farms. *Journal for Nature Conservation*, **19**, 202–208.

R Development Core Team. (2012) *R: A Language and Environment for Statistical Computing*. R Foundation for Statistical Computing, Vienna, Austria.

Retief, E.F., Diamond, M., Anderson, M.D., Smit, H.A., Jenkins, A., Brooks, M. & Simmons, R. (2012) *Avian Wind Farm Sensitivity Map for South Africa. Criteria and Procedures Used*.

Savannah Environmental. (2012) *Draft Impact Assessment Report for the Proposed Project Blue Wind Energy Facility (Phases 1-3), North of Kleinsee, Northern Cape Province*.

Simmons, R. & Martins, M. (2012) *Kleinsee Blue Wind and Solar Wind Energy Facility. EIA Report - Birds*.

Smallwood, K.S. & Thelander, C.G. (2004) *Developing Methods to Reduce Bird Mortality in the Altamont Pass Wind Resource Area*. Sacramento, California, USA.

SNH. (2009) *Guidance on Methods for Monitoring Bird Populations at Onshore Wind Farms*.

SNH. (2012) *Assessing the Cumulative Impact of Onshore Wind Energy Developments*.

Strickland, M.D., Arnett, E.B., Erickson, W.P., Johnson, D.H., Johnson, G.D., Morrison, M.L., Shaffer, J.A. & Warren-Hicks, W. (2011) *Comphrehensive Guide to Studying Wind Energy/Wildlife Interactions*. Washington, D.C., USA.

Sutherland, W.J. (2006) *Ecological Census Techniques: A Handbook*. Cambridge University Press, New Jork.

Taylor, P.B., Navarro, R.A., Wren-Sargent, M., Harrison, J.A. & Kieswetter, S.L. (1999) *TOTAL CWAC Report: Coordinated Waterbird Counts in South Africa, 1992-97*. Cape Town.

USFWS. (2012) *U.S. Fish and Wildlife Service Land-Based Wind Energy Guidelines*. Arlington.

Voltura, K. & Davenport, J. (2012) Advances In Avian Radars For Protecting Birds At Challenging Wind Energy Sites.

Voltura, K., T.A., K., West, T., Smith, A., Lewis, J., Vidao, J. & Davenport, J. (2012) Roadmap for Mitigating Raptor Risk at Windfarms: Application of Advanced Avian Radar Technology.

Walker, L.J. & Johnston, J. (1999) *Guidelines for the Assessment of Indirect and Cumulative Impacts as Well as Impact Interactions*. Luxembourg.

Winkelman, J.E. (1992) *The Impact of the Sep Wind Park near Oosterbierum, the Netherlands on Birds 3: Flight Behaviour during Daylight*. Arnhem, the Netherlands.

6. Appendices

6.1. Appendix I - Figures

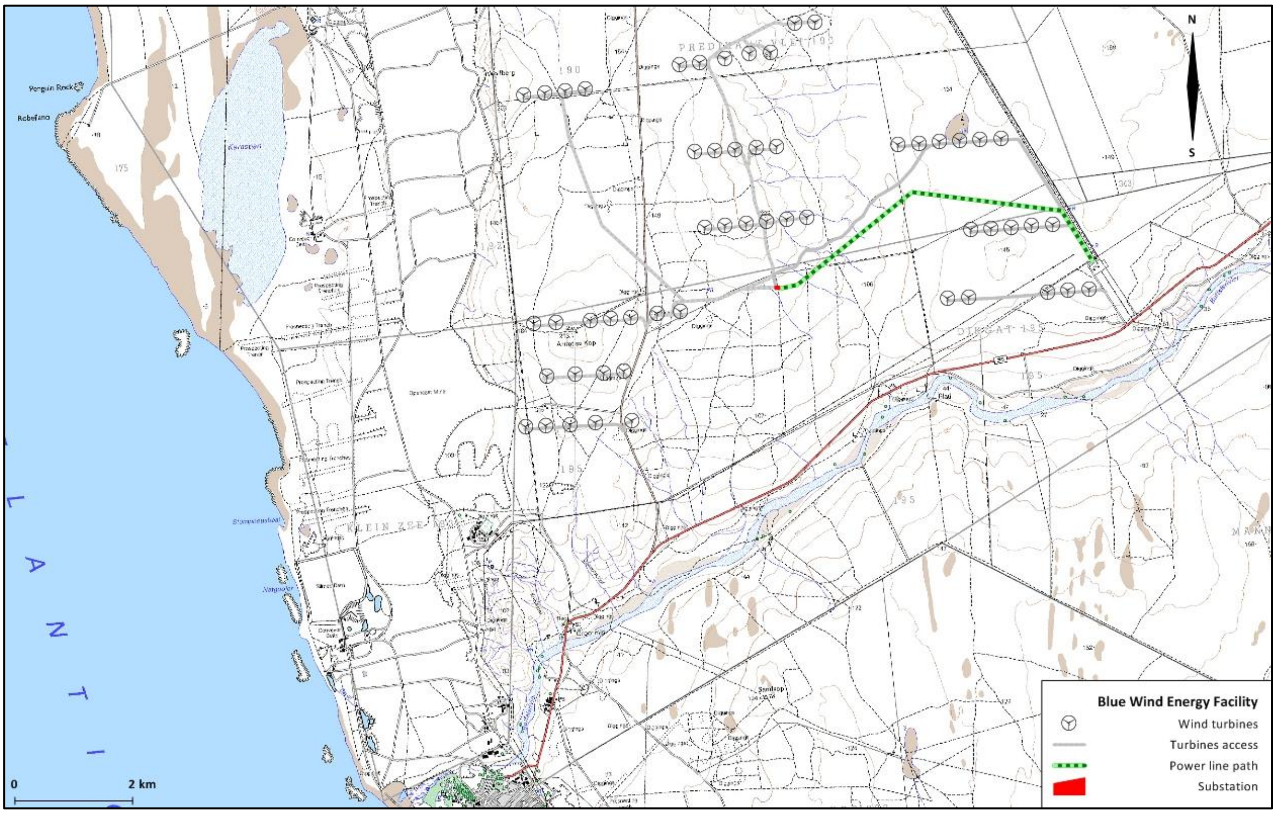


Figure 13 - Location of the proposed Blue wind energy facility turbine layout assessed in this report.

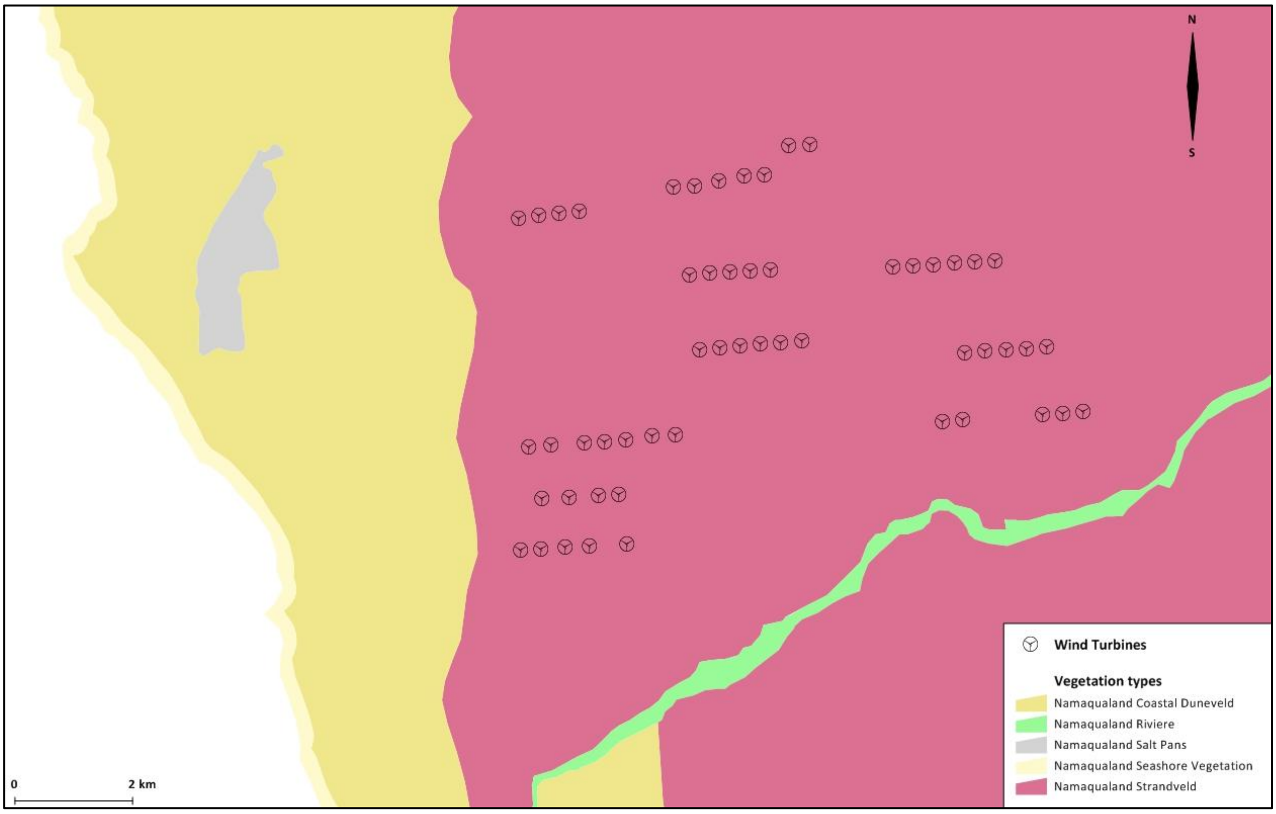


Figure 14 - Location of the study site in relation to the vegetation units as defined by Mucina & Rutherford (2006).

6.2. Appendix II - Species list occurring at the site

Species of birds identified in the study area by all the methodologies implemented for the monitoring programme. Phenology (IUCN 2013): R – Resident; NBM – Non breeding migrant. RLCS - IUCN Red List of Threatened Species Conservation Status (IUCN 2013) and SA RLCS - South Africa Red List Conservation Status (Barnes 2000): VU – Vulnerable, NT – Nearly Threatened, LC - Least concern; Population Trend (IUCN 2013). Endemic: E – Endemic, NE – Nearly Endemic. Priority sp. (Retief *et al.* 2012); Target sp. - species considered as priority in (Simmons & Martins 2012); Sensitive sp. – species considered sensitive in this document (see section 2.2.4.3); Desktop survey: (Harrison *et al.* 1997; Taylor *et al.* 1999; Barnes 2000; Hockey, Dean & Ryan 2005; Jenkins *et al.* 2012).

Order	Common Name	Scientific Name	Phenology	RLCS	SA RLCS	Population Trend	Abundance	Endemic SA	Target sp.	Priority sp.	Sensitive sp.	Study area		Desktop study
												WEF	CO	
ACCIPITRIFORMES	African Fish Eagle	*Haliaeetus vocifer*	R	LC	-	Stable	Locally common	-	-	X	-	-	-	X
ACCIPITRIFORMES	Black Harrier	*Circus maurus*	R	VU	NT	Stable	Uncommon	E	X	X	X	-	-	X
ACCIPITRIFORMES	Black-shouldered Kite	*Elanus caeruleus*	R	LC	-	Stable	Common	-	-	X	-	-	-	X
ACCIPITRIFORMES	Martial Eagle	*Polemaetus bellicosus*	R	NT	VU	Decreasing	Uncommon	-	X	X	X	-	-	X
ACCIPITRIFORMES	Steppe Buzzard	*Buteo vulpinus*	NBM	na	-	na	Common	-	-	X	-	-	-	X
ACCIPITRIFORMES	Verreaux's Eagle	*Aquila verreauxii*	R	LC	-	Stable	Locally fairly common	-	-	X	-	-	-	X
ACCIPITRIFORMES	Black-chested Snake Eagle	*Circaetus pectoralis*	R	LC	-	Unknown	Uncommon to locally common	-	-	X	X	X	X	X
ACCIPITRIFORMES	Jackal Buzzard	*Buteo rufofuscus*	R	LC	-	Stable	Fairly common	E	X	X	X	X	X	X
ACCIPITRIFORMES	Pale Chanting Goshawk	*Melierax canorus*	R	LC	-	Stable	Rare to locally common	NE	-	X	X	X	X	X
ANSERIFORMES	Cape Teal	*Anas capensis*	R	LC	-	Increasing	Uncommon to locally abundant	-	-	-	-	-	-	X
ANSERIFORMES	Fulvous Whistling Duck	*Dendrocygna bicolor*	R	LC	-	Decreasing	Common	-	-	-	-	-	-	X
ANSERIFORMES	Hottentot Teal	*Anas hottentota*	R	LC	-	Decreasing	Locally common	-	-	-	-	-	-	X
ANSERIFORMES	Southern Pochard	*Netta erythrophthalma*	R	LC	-	Decreasing	Common	-	-	-	-	-	-	X
ANSERIFORMES	Spur-winged Goose	*Plectropterus gambensis*	R	LC	-	Increasing	Locally common to very common	-	-	-	-	-	-	X

Order	Common Name	Scientific Name	Phenology	RLCS	SA RLCS	Population Trend	Abundance	Endemic SA	Target sp.	Priority sp.	Sensitive sp.	Study area		Desktop study
												WEF	CO	
ANSERIFORMES	Egyptian Goose	*Alopochen aegyptiaca*	R	LC	-	Decreasing	Common to abundant	-	-	-	-	X	X	X
ANSERIFORMES	South African Shelduck	*Tadorna cana*	R	LC	-	Increasing	Common	E	-	-	-	X	X	X
ANSERIFORMES	Cape Shoveler	*Anas smithii*	R	LC	-	Increasing	Rare to locally abundant	NE	-	-	-	-	X	X
ANSERIFORMES	Maccoa Duck	*Oxyura maccoa*	R	NT	-	Decreasing	Common	-	-	-	-	-	X	X
ANSERIFORMES	Red-billed Teal	*Anas erythrorhyncha*	R	LC	-	Decreasing	Very common	-	-	-	-	-	X	X
ANSERIFORMES	Yellow-billed Duck	*Anas undulata*	R	LC	-	Stable	Common	-	-	-	-	-	X	X
APODIFORMES	White-rumped Swift	*Apus caffer*	BM	LC	-	Increasing	Very common	-	-	-	-	-	-	X
APODIFORMES	Alpine swift	*Tachymarptis melba*	BM	LC	-	Stable	Generally common	-	-	-	-	X	-	X
CAPRIMULGIFORMES	Fiery-necked Nightjar	*Caprimulgus pectoralis*	R	LC	-	Stable	Common	-	-	-	-	-	X	-
CHARADRIIFORMES	Bar-tailed Godwit	*Limosa lapponica*	NBM	LC	-	Decreasing	Uncommon to locally common	-	-	-	-	-	-	X
CHARADRIIFORMES	Common Ringed Plover	*Charadrius hiaticula*	NBM	LC	-	Decreasing	Locally common	-	-	-	-	-	-	X
CHARADRIIFORMES	Common Sandpiper	*Actitis hypoleucos*	NBM	LC	-	Decreasing	Common	-	-	-	-	-	-	X
CHARADRIIFORMES	Common Tern	*Sterna hirundo*	NBM	LC	-	Decreasing	Very common	-	-	-	-	-	-	X
CHARADRIIFORMES	Common Whimbrel	*Numenius phaeopus*	NBM	LC	-	Decreasing	Common	-	-	-	-	-	-	X
CHARADRIIFORMES	Crowned Lapwing	*Vanellus coronatus*	R	LC	-	Increasing	Common	-	-	-	-	-	-	X
CHARADRIIFORMES	Curlew Sandpiper	*Calidris ferruginea*	NBM	LC	-	Increasing	Common	-	-	-	-	-	-	X
CHARADRIIFORMES	Damara Tern	*Sterna balaenarum*	BM	NT	E	Stable	Locally common	-	X	X	X	-	-	X
CHARADRIIFORMES	Eurasian Oystercatcher	*Haematopus ostralegus*	Rare or vagrant	LC	-	Decreasing	Rare	-	-	-	-	-	-	X
CHARADRIIFORMES	Grey Plover	*Pluvialis squatarola*	NBM	LC	-	Decreasing	Common	-	-	-	-	-	-	X
CHARADRIIFORMES	Grey-headed Gull	*Chroicocephalus cirrocephalus*	R	na	-	na	Fairly common	-	-	-	-	-	-	X
CHARADRIIFORMES	Kittlitz's Plover	*Charadrius pecuarius*	R	LC	-	Unknown	Locally common	-	-	-	-	-	-	X

Order	Common Name	Scientific Name	Phenology	RLCS	SA RLCS	Population Trend	Abundance	Endemic SA	Target sp.	Priority sp.	Sensitive sp.	Study area		Desktop study
												WEF	CO	
CHARADRIIFORMES	Pied Avocet	*Recurvirostra avosetta*	R	LC	-	Unknown	Locally common	-	-	-	-	-	-	X
CHARADRIIFORMES	Ruddy Turnstone	*Arenaria interpres*	NBM	LC	-	Decreasing	Common	-	-	-	-	-	-	X
CHARADRIIFORMES	Sanderling	*Calidris alba*	NBM	LC	-	Unknown	Common	-	-	-	-	-	-	X
CHARADRIIFORMES	Sandwich Tern	*Thalasseus sandvicensis*	-	na	-	na	-	-	-	-	-	-	-	X
CHARADRIIFORMES	Terek Sandpiper	*Xenus cinereus*	-	LC	-	Stable	-	-	-	-	-	-	-	X
CHARADRIIFORMES	Three-banded Plover	*Charadrius tricollaris*	R	LC	-	Unknown	Common	-	-	-	-	-	-	X
CHARADRIIFORMES	Wood Sandpiper	*Tringa glareola*	-	LC	-	Stable	-	-	-	-	-	-	-	X
CHARADRIIFORMES	Spotted Thick-knee	*Burhinus capensis*	R	LC	-	Stable	Fairly common to uncommon	-	-	-	-	X	-	X
CHARADRIIFORMES	African Black Oystercatcher	*Haematopus moquini*	R	NT	NT	Increasing	Locally common	-	X	-	X	-	X	X
CHARADRIIFORMES	Blacksmith Lapwing	*Vanellus armatus*	R	LC	-	Increasing	Common	-	-	-	-	-	X	X
CHARADRIIFORMES	Black-winged Stilt	*Himantopus himantopus*	R	LC	-	Increasing	Common	-	-	-	-	-	X	X
CHARADRIIFORMES	Caspian Tern	*Sterna caspia*	R	LC	NT	Increasing	Uncommon	-	-	X	-	-	X	X
CHARADRIIFORMES	Common Greenshank	*Tringa nebularia*	-	LC	-	Stable	-	-	-	-	-	-	X	X
CHARADRIIFORMES	Hartlaub's Gull	*Chroicocephalus hartlaubii*	R	LC	-	Increasing	Locally common to abundant	E	-	-	-	-	X	X
CHARADRIIFORMES	Kelp Gull	*Larus dominicanus*	R	LC	-	Increasing	Common	-	-	-	-	-	X	X
CHARADRIIFORMES	Little Stint	*Calidris minuta*	NBM	LC	-	Decreasing	Common	-	-	-	-	-	X	X
CHARADRIIFORMES	Ruff	*Philomachus pugnax*	NBM	LC	-	Decreasing	Common	-	-	-	-	-	X	X
CHARADRIIFORMES	Swift Tern	*Thalasseus bergii*	-	LC	-	Stable	-	-	-	-	-	-	X	X
CHARADRIIFORMES	Water Thick-knee	*Burhinus vermiculatus*	R	LC	-	Unknown	Locally common	-	-	-	-	-	X	-
CHARADRIIFORMES	White-fronted Plover	*Charadrius marginatus*	R	LC	-	Decreasing	Common	-	-	-	-	-	X	X
CICONIIFORMES	White Stork	*Ciconia ciconia*	NBM	LC	-	Increasing	Common to abundant	-	-	X	-	-	-	X

Order	Common Name	Scientific Name	Phenology	RLCS	SA RLCS	Population Trend	Abundance	Endemic SA	Target sp.	Priority sp.	Sensitive sp.	Study area		Desktop study
												WEF	CO	
COLIIFORMES	Red-faced Mousebird	*Urocolius indicus*	R	LC	-	Unknown	Locally common	-	-	-	-	-	-	X
COLIIFORMES	White-backed Mousebird	*Colius colius*	R	LC	-	Increasing	Locally common	E	-	-	-	-	-	X
COLUMBIFORMES	Cape Turtle Dove	*Streptopelia capicola*	R	LC	-	Increasing	Common to fairly common	-	-	-	-	-	-	X
COLUMBIFORMES	Laughing Dove	*Streptopelia senegalensis*	R	-	-	-	Common	-	-	-	-	-	-	X
COLUMBIFORMES	Namaqua Dove	*Oena capensis*	R	LC	-	Increasing	Fairly common to comon	-	-	-	-	-	-	X
COLUMBIFORMES	Red-eyed Dove	*Streptopelia semitorquata*	R	LC	-	Increasing	Fairly common to common	-	-	-	-	-	-	X
COLUMBIFORMES	Speckled Pigeon	*Columba guinea*	R	LC	-	Stable	Common	-	-	-	-	-	-	X
CORACIIFORMES	European Bee-eater	*Merops apiaster*	NBM	LC	-	Decreasing	Common	-	-	-	-	-	-	X
CORACIIFORMES	Malachite Kingfisher	*Alcedo cristata*	R	LC	-	Stable	Common to locally abundant	-	-	-	-	-	-	X
CORACIIFORMES	Pied Kingfisher	*Ceryle rudis*	R	LC	-	Unknown	Locally common	-	-	-	-	-	X	X
FALCONIFORMES	Secretarybird	*Sagittarius serpentarius*	R	VU	NT	Decreasing	Locally fairly common	-	X	X	X	-	-	X
FALCONIFORMES	Greater Kestrel	*Falco rupicoloides*	R	LC	-	Stable	Fairly common	-	-	X	X	X	X	X
FALCONIFORMES	Lanner Falcon	*Falco biarmicus*	R	LC	NT	Increasing	Fairly common	-	X	X	X	X	X	X
FALCONIFORMES	Peregrine Falcon	*Falco peregrinus*	R	LC	NT	Stable	Uncommon	-	-	X	X	X	X	-
FALCONIFORMES	Rock Kestrel	*Falco rupicolus*	R	na	-	-	Common to uncommon	-	-	-	-	X	X	X
GALLIFORMES	Common Quail	*Coturnix coturnix*	BM	LC	-	Decreasing	Very common	-	-	-	-	-	-	X
GRUIFORMES	Southern Black Korhaan	*Afrotis afra*	R	na	-	na	Uncommon to common	E	-	X	X	-	-	X
GRUIFORMES	Kori Bustard	*Ardeotis kori*	R	LC	VU	Decreasing	Sparse to locally common	-	X	X	X	X	X	X
GRUIFORMES	Ludwig's Bustard	*Neotis ludwigii*	R	EN	VU	Decreasing	Sparse to locally common	NE	X	X	X	X	X	X
GRUIFORMES	Common Moorhen	*Gallinula chloropus*	R	LC	-	Unknown	Locally common	-	-	-	-	-	X	X
GRUIFORMES	Red-Knobbed Coot	*Fulica cristata*	R	LC	-	Decreasing	Common	-	-	-	-	-	X	X
PASSERIFORMES	African Paradise Flycatcher	*Terpsiphone viridis*	BM	LC	-	Stable	Common	-	-	-	-	-	-	X

Order	Common Name	Scientific Name	Phenology	RLCS	SA RLCS	Population Trend	Abundance	Endemic SA	Target sp.	Priority sp.	Sensitive sp.	Study area		Desktop study
												WEF	CO	
PASSERIFORMES	African Pipit	*Anthus cinnamomeus*	R	na	-	na	Common	-	-	-	-	-	-	X
PASSERIFORMES	African Red-eyed Bulbul	*Pycnonotus nigricans*	R	LC	-	Increasing	Common	NE	-	-	-	-	-	X
PASSERIFORMES	African Reed Warbler	*Acrocephalus baeticatus*	BM	na	-	na	Fairly common	-	-	-	-	-	-	X
PASSERIFORMES	Brown-throated Martin	*Riparia paludicola*	R	LC	-	Decreasing	Locally common	-	-	-	-	-	-	X
PASSERIFORMES	Cape Bulbul	*Pycnonotus capensis*	R	LC	-	Stable	Common to very common	E	-	-	-	-	-	X
PASSERIFORMES	Cape Robin-Chat	*Cossypha caffra*	R	LC	-	Stable	Common	-	-	-	-	-	-	X
PASSERIFORMES	Cape Wagtail	*Motacilla capensis*	R	LC	-	Stable	Common	-	-	-	-	-	-	X
PASSERIFORMES	Cape Weaver	*Ploceus capensis*	R	LC	-	Stable	Common	E	-	-	-	-	-	X
PASSERIFORMES	Capped Wheatear	*Oenanthe pileata*	R	LC	-	Stable	Generally common	-	-	-	-	-	-	X
PASSERIFORMES	Common Fiscal	*Lanius collaris*	R	LC	-	Increasing	Generally common	-	-	-	-	-	-	X
PASSERIFORMES	Common Starling	*Sturnus vulgaris*	R	LC	-	Unknown	Common	-	-	-	-	-	-	X
PASSERIFORMES	Common Waxbill	*Estrilda astrild*	R	LC	-	Stable	Common	-	-	-	-	-	-	X
PASSERIFORMES	Fairy Flycatcher	*Stenostira scita*	R	LC	-	Stable	Locally common to abundant	E	-	-	-	-	-	X
PASSERIFORMES	Grey-backed Sparrow-lark	*Eremopterix verticalis*	R	LC	-	Stable	Locally abundant	NE	-	-	-	-	-	X
PASSERIFORMES	House Sparrow	*Passer domesticus*	R	LC	-	Decreasing	Locally common	-	-	-	-	-	-	X
PASSERIFORMES	Karoo Thrush	*Turdus smithi*	-	na	-	-	-	-	-	-	-	-	-	X
PASSERIFORMES	Lesser Swamp Warbler	*Acrocephalus gracilirostris*	R	LC	-	Stable	Common	-	-	-	-	-	-	X
PASSERIFORMES	Levaillant's Cisticola	*Cisticola tinniens*	R	LC	-	Stable	Locally common	-	-	-	-	-	-	X
PASSERIFORMES	Mountain Wheatear	*Oenanthe monticola*	R	LC	-	Stable	Locally common	NE	-	-	-	-	-	X
PASSERIFORMES	Namaqua Warbler	*Phragmacia substriata*	R	LC	-	Increasing	Common	E	-	-	-	-	-	X
PASSERIFORMES	Orange River White-eye	*Zosterops pallidus*	-	LC	-	Unknown	-	-	-	-	-	-	-	X
PASSERIFORMES	Pale-winged Starling	*Onychognathus nabouroup*	R	LC	-	Stable	Common	NE	-	-	-	-	-	X

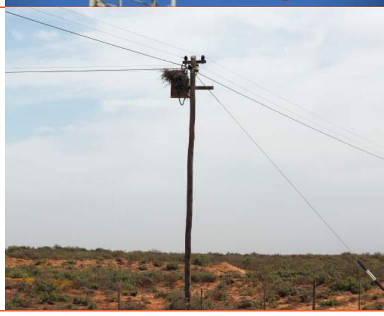
Order	Common Name	Scientific Name	Phenology	RLCS	SA RLCS	Population Trend	Abundance	Endemic SA	Target sp.	Priority sp.	Sensitive sp.	Study area		Desktop study
												WEF	CO	
PASSERIFORMES	Pearl-breasted Swallow	*Hirundo dimidiata*	R	LC	-	Stable	Sparse to locally common	-	-	-	-	-	-	X
PASSERIFORMES	Pied Starling	*Lamprotornis bicolor*	R	LC	-	Stable	Locally common to abundant	E	-	-	-	-	-	X
PASSERIFORMES	Pin-tailed Whydah	*Vidua macroura*	R	LC	-	Stable	Common	-	-	-	-	-	-	X
PASSERIFORMES	Red-billed Quelea	*Quelea quelea*	R	LC	-	Stable	Very abundant	-	-	-	-	-	-	X
PASSERIFORMES	Southern Grey-headed Sparrow	*Passer diffusus*	R	LC	-	Stable	Common to fairly common	-	-	-	-	-	-	X
PASSERIFORMES	Southern Masked Weaver	*Ploceus velatus*	R	LC	-	Stable	Common	NE	-	-	-	-	-	X
PASSERIFORMES	Southern Red Bishop	*Euplectes orix*	R	LC	-	Stable	Locally common to abundant	-	-	-	-	-	-	X
PASSERIFORMES	Spotted Flycatcher	*Muscicapa striata*	NBM	LC	-	Decreasing	Common	-	-	-	-	-	-	X
PASSERIFORMES	Stark's Lark	*Spizocorys starki*	R	na	-	na	Locally common to abundant	NE	-	-	-	-	-	X
PASSERIFORMES	Wattled Starling	*Creatophora cinerea*	R	LC	-	Stable	Locally common	-	-	-	-	-	-	X
PASSERIFORMES	White-throated Swallow	*Hirundo albigularis*	BM	LC	-	Increasing	Locally common	-	-	-	-	-	-	X
PASSERIFORMES	Yellow Bishop	*Euplectes capensis*	R	LC	-	Stable	Fairly common	-	-	-	-	-	-	X
PASSERIFORMES	Zitting Cisticola	*Cisticola juncidis*	R	LC	-	Increasing	Common to very common	-	-	-	-	-	-	X
PASSERIFORMES	African StoneChat	*Saxicola torquatus*	R	LC	-	Stable	Common to fairly common	-	-	-	-	-	X	X
PASSERIFORMES	Ant-eating Chat	*Myrmecocichla formicivora*	R	LC	-	Stable	Common	E	-	-	-	X	-	X
PASSERIFORMES	Barn Swallow	*Hirundo rustica*	NBM	LC	-	Decreasing	Common to abundant	-	-	-	-	X	X	X
PASSERIFORMES	Black-eared Sparrow-Lark	*Eremopterix australis*	R	LC	-	Decreasing	Locally common	E	-	-	-	-	X	X
PASSERIFORMES	Black-headed Canary	*Serinus alario*	R	LC	-	Stable	Locally common	E	-	-	-	X	-	-
PASSERIFORMES	Bokmakierie	*Telophorus zeylonus*	R	LC	-	Stable	Common	NE	-	-	-	X	X	X
PASSERIFORMES	Cape Bunting	*Emberiza capensis*	R	LC	-	Stable	Fairly common to common	E	-	-	-	-	X	X
PASSERIFORMES	Cape Clapper lark	*Mirafra apiata*	R	LC	-	Decreasing	Fairly common to common	E	-	-	-	X	-	-
PASSERIFORMES	Cape Crow	*Corvus capensis*	R	LC	-	Increasing	Common	-	-	-	-	X	X	X

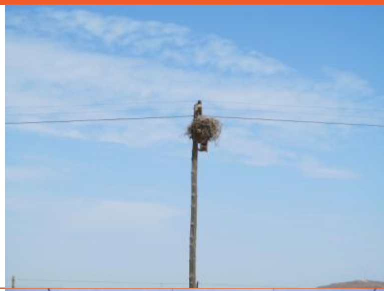
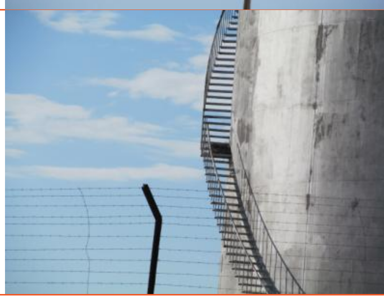
Order	Common Name	Scientific Name	Phenology	RLCS	SA RLCS	Population Trend	Abundance	Endemic SA	Target sp.	Priority sp.	Sensitive sp.	Study area		Desktop study
												WEF	CO	
PASSERIFORMES	Cape Long-billed Lark	*Certhilauda curvirostris*	R	LC	-	Decreasing	Locally common	E	-	-	-	X	X	X
PASSERIFORMES	Cape Penduline-Tit	*Anthoscopus minutus*	R	LC	-	Stable	Locally common	NE	-	-	-	X	X	X
PASSERIFORMES	Cape Sparrow	*Passer melanurus*	R	LC	-	Stable	Common to very common	NE	-	-	-	X	-	X
PASSERIFORMES	Chat Flycatcher	*Bradornis infuscatus*	R	LC	-	Stable	Fairly common	NE	-	-	-	-	X	-
PASSERIFORMES	Dusky Sunbird	*Cinnyris fuscus*	R	LC	-	Stable	Locally common	NE	-	-	-	X	X	X
PASSERIFORMES	Familiar Chat	*Cercomela familiaris*	R	LC	-	Stable	Common	-	-	-	-	X	X	X
PASSERIFORMES	Grey Tit	*Parus afer*	R	LC	-	Stable	Fairly common	E	-	-	-	X	-	X
PASSERIFORMES	Grey-backed Cisticola	*Cisticola subruficapilla*	R	LC	-	Decreasing	Locally common to very common	NE	-	-	-	X	X	X
PASSERIFORMES	Karoo Chat	*Cercomela schlegelii*	R	LC	-	Stable	Common	-	-	-	-	X	X	-
PASSERIFORMES	Karoo Lark	*Calendulauda albescens*	R	LC	-	Decreasing	Common to fairly common	E	-	-	-	X	X	X
PASSERIFORMES	Karoo Long-billed Lark	*Certhilauda subcoronata*	R	LC	-	Stable	Common	E	-	-	-	X	X	-
PASSERIFORMES	Karoo Prinia	*Prinia maculosa*	R	LC	-	Decreasing	Common to locally very common	E	-	-	-	X	X	X
PASSERIFORMES	Karoo Scrub Robin	*Erythropygia coryphoeus*	R	LC	-	Stable	Common	E	-	-	-	X	X	X
PASSERIFORMES	Large-billed Lark	*Galerida magnirostris*	R	LC	-	Increasing	Fairly common to common	E	-	-	-	X	X	-
PASSERIFORMES	Lark-like Bunting	*Emberiza impetuani*	R	LC	-	Stable	Common to very common	NE	-	-	-	X	-	X
PASSERIFORMES	Layard's Tit-Babbler	*Sylvia layardi*	R	LC	-	Stable	Common	E	-	-	-	X	X	-
PASSERIFORMES	Long-billed crombec	*Sylvietta rufescens*	R	LC	-	Stable	Common	-	-	-	-	X	X	X
PASSERIFORMES	Malachite Sunbird	*Nectarinia famosa*	R	LC	-	Stable	Common to locally abundant	-	-	-	-	-	X	X
PASSERIFORMES	Pied Crow	*Corvus albus*	R	LC	-	Stable	Common to abundant	-	-	-	-	X	X	X
PASSERIFORMES	Red-capped Lark	*Calandrella cinerea*	R	LC	-	Increasing	Common to locally abundant	-	-	-	-	X	X	X
PASSERIFORMES	Rock Martin	*Hirundo fuligula*	R	LC	-	Stable	Common	-	-	-	-	-	X	X

Order	Common Name	Scientific Name	Phenology	RLCS	SA RLCS	Population Trend	Abundance	Endemic SA	Target sp.	Priority sp.	Sensitive sp.	Study area		Desktop study
												WEF	CO	
PASSERIFORMES	Rufous-eared Warbler	*Malcorus pectoralis*	R	LC	-	Stable	Common	E	-	-	-	X	X	X
PASSERIFORMES	Sickle-winged Chat	*Cercomela sinuata*	R	LC	-	Stable	Uncommon to locally common	E	-	-	-	X	-	-
PASSERIFORMES	Southern Double-collared Sunbird	*Cinnyris chalybeus*	R	LC	-	Stable	Common	E	-	-	-	X	X	X
PASSERIFORMES	Spike-heeled Lark	*Chersomanes albofasciata*	R	LC	-	Decreasing	Fairly common to common	NE	-	-	-	X	X	-
PASSERIFORMES	Tractrac Chat	*Cercomela tractrac*	R	LC	-	Stable	Fairly common	NE	-	-	-	X	X	X
PASSERIFORMES	White-throated Canary	*Crithagra albogularis*	R	na	-	Stable	Locally common	NE	-	-	-	X	X	X
PASSERIFORMES	Yellow Canary	*Crithagra flaviventris*	R	LC	-	Stable	Common	NE	-	-	-	X	X	X
PASSERIFORMES	Yellow-bellied Eremomela	*Eremomela icteropygialis*	R	LC	-	Stable	Fairly common	-	-	-	-	-	-	X
PELECANIFORMES	African Spoonbill	*Platalea alba*	R	LC	-	Stable	Locally common	-	-	-	-	-	-	X
PELECANIFORMES	Black-crowned Night Heron	*Nycticorax nycticorax*	R	LC	-	Decreasing	Common	-	-	-	-	-	-	X
PELECANIFORMES	Black-headed Heron	*Ardea melanocephala*	R	LC	LC	Increasing	Common	-	-	-	-	-	-	X
PELECANIFORMES	Glossy Ibis	*Plegadis falcinellus*	R	LC	-	Decreasing	Locally common	-	-	-	-	-	-	X
PELECANIFORMES	Great White Pelican	*Pelecanus onocrotalus*	R	LC	NT	Unknown	Locally fairly common	-	X	X	X	-	-	X
PELECANIFORMES	Little Bittern	*Ixobrychus minutus*	R	LC	-	Decreasing	Generally uncommon	-	-	-	-	-	-	X
PELECANIFORMES	Little Egret	*Egretta garzetta*	R	LC	-	Increasing	Fairly common	-	-	-	-	-	-	X
PELECANIFORMES	Purple Heron	*Ardea purpurea*	R	LC	-	Decreasing	Uncommon to locally common	-	-	-	-	-	-	X
PELECANIFORMES	Reed Cormorant	*Phalacrocorax africanus*	R	LC	-	Decreasing	Common	-	-	-	-	-	-	X
PELECANIFORMES	Squacco Heron	*Ardeola ralloides*	R	LC	-	Decreasing	Locally common	-	-	-	-	-	-	X
PELECANIFORMES	Western Cattle Egret	*Bubulcus ibis*	R	LC	-	Increasing	Very common	-	-	-	-	-	-	X
PELECANIFORMES	Yellow-billed Egret	*Egretta intermedia*	R	na	-	na	Uncommon to locally common	-	-	-	-	-	-	X
PELECANIFORMES	African Sacred Ibis	*Threskiornis aethiopicus*	R	LC	-	Decreasing	Common	-	-	X	X	-	X	X
PELECANIFORMES	Hadeda Ibis	*Bostrychia hagedash*	R	LC	-	Increasing	Common	-	-	-	-	-	X	X

Order	Common Name	Scientific Name	Phenology	RLCS	SA RLCS	Population Trend	Abundance	Endemic SA	Target sp.	Priority sp.	Sensitive sp.	Study area		Desktop study
												WEF	CO	
PELECANIFORMES	Grey Heron	*Ardea cinerea*	R	LC	-	Unknown	Locally common	-	-	-	-	-	X	X
PHOENICOPTERIFORMES	Greater Flamingo	*Phoenicopterus roseus*	R	LC	NT	Increasing	Locally abundant	-	X	X	X	-	X	X
PHOENICOPTERIFORMES	Lesser Flamingo	*Phoeniconaias minor*	R	NT	NT	Decreasing	Locally abundant	-	X	X	X	-	X	X
PODICIPEDIFORMES	Black-necked Grebe	*Podiceps nigricollis*	R	LC	-	Unknown	Uncommon to locally common	-	-	-	-	-	X	X
PODICIPEDIFORMES	Little Grebe	*Tachybaptus ruficollis*	R	LC	-	Decreasing	Common to locally abundant	-	-	-	-	-	X	X
PTEROCLIDIFORMES	Namaqua Sandgrouse	*Pterocles namaqua*	R	LC	LC	Stable	Common	NE	-	-	-	X	X	X
STRIGIFORMES	Cape Eagle-Owl	*Bubo capensis*	R	LC	-	Stable	Generally common	-	-	X	-	-	-	X
STRIGIFORMES	Spotted Eagle-Owl	*Bubo africanus*	R	LC	-	Stable	Generally common	-	-	X	-	-	-	X
STRUTHIONIFORMES	Common Ostrich	*Struthio camelus*	R	LC	-	Decreasing	Unknown	-	-	-	-	-	-	X
SULIFORMES	Bank Cormorant	*Phalacrocorax neglectus*	R	EN	VU	Decreasing	Scarce to locally common	E	X	-	X	-	-	X
SULIFORMES	Cape Cormorant	*Phalacrocorax capensis*	R	NT	NT	Stable	Common to locally abundant	-	X	X	X	-	-	X
SULIFORMES	Cape Gannet	*Morus capensis*	R	VU	VU	Decreasing	Locally abundant	BE	X	-	X	-	-	X
SULIFORMES	Crowned Cormorant	*Phalacrocorax coronatus*	R	NT	NT	Stable	Uncommon to rare	E	X	-	X	-	-	X
SULIFORMES	African Darter	*Anhinga rufa*	R	LC	-	Decreasing	Fairly common	-	-	-	-	-	X	X
SULIFORMES	White-breasted Cormorant	*Phalacrocorax lucidus*	R	LC	-	Increasing	Common	-	-	-	-	-	X	X

6.3. Appendix III - Nests characterization

Reference	Description	Photo
NEBL01	Type: Pole Minimum distance to proposed turbine location: 310 m Species: Greater Kestrel Breeding: No Coordinates (Lat/Lon – WGS84) 17º9.876’ E 29º35.417’ S	
NEBL02	Type: Tower Minimum distance to proposed turbine location: 728 m Species: Greater Kestrel Breeding: No Coordinates (Lat/Lon – WGS84) 17º10.214’ E 29º34.957’ S	
NEBL03	Type: Tower Minimum distance to proposed turbine location: 1228 m Species: Greater Kestrel Breeding: No Coordinates (Lat/Lon – WGS84) 17º9.683’ E 29º34.137’ S	
NEBL04	Type: Tower Minimum distance to proposed turbine location: 497 m Species: Rock Kestrel Breeding: Yes Coordinates (Lat/Lon – WGS84) 17º4.504’ E 29º34.206’ S	
NEBL05	Type: Pole Minimum distance to proposed turbine location: 415 m Species: Greater Kestrel Breeding: Yes Coordinates (Lat/Lon – WGS84) 17º5.970’ E 29º36.024’ S	

Reference	Description	Photo
NEBL06	Type: Pole Minimum distance to proposed turbine location: 992 m Species: Greater Kestrel Breeding: No Coordinates (Lat/Lon – WGS84) 17º5.985' E 29º34.374' S	
NEBL07	Type: Tower Minimum distance to proposed turbine location: 727 m Species: Greater Kestrel Breeding: No Coordinates (Lat/Lon – WGS84) 17º10.289' E 29º35.204' S	
NEBL08	Type: Tower Minimum distance to proposed turbine location: 365 m Species: Greater Kestrel Breeding: No Coordinates (Lat/Lon – WGS84) 17º10.035' E 29º34.717' S	
NEBL09	Type: Tower Minimum distance to proposed turbine location: 1905 m Species: Greater Kestrel/Lanner Falcon/Peregrine Falcon Breeding: No Coordinates (Lat/Lon – WGS84) 17º9.439' E 29º33.747' S	
NEBL10	Type: Pole Minimum distance to proposed turbine location: 4833 m Species: Greater Kestrel Breeding: No Coordinates (Lat/Lon – WGS84) 17º6.040' E 29º31.383' S	
NEBL11	Type: Storage tank stairs Minimum distance to proposed turbine location: 357 m Species: Jackal Buzzard Breeding: No Coordinates (Lat/Lon – WGS84) 17º4.844' E 29º37.009' S	

Reference	Description	Photo
NEBL12	Type: Pole Minimum distance to proposed turbine location: 4002 m Species: Greater Kestrel Breeding: No Coordinates (Lat/Lon – WGS84) 17º6.044’ E 29º31.826’ S	
NEBL13	Type: Tower Minimum distance to proposed turbine location: 7060 m Species: Unknown (possibly Black-chested Snake Eagle) Breeding: No Coordinates (Lat/Lon – WGS84) 17º6.897’ E 29º29.882’ S	

6.4. Appendix IV – Proposed Post-Construction Bird Monitoring Programme

Objectives

The primary aims of this monitoring program are to assess the potential impacts resulting from the construction and operation of the Wind Energy Facility over the bird community of the study area. Therefore the main objectives of this monitoring program are:

a) Identify the bird species or groups more susceptible to suffer potential impacts (displacement and/or collision) during construction and operation phase of the wind energy facility;

b) Identify the project elements more likely to produce impacts in the avifauna or its habitat, during and after construction;

c) Evaluate potential changes in the way the sensitive and target-species, and the general bird community, use the wind energy facility site during construction and operation phases);

d) Assess and map the collision risk for sensitive and target-species;

e) Quantify bird fatalities associated with the wind energy facility operation phase, and determine the species affected.

f) Propose measures to monitor mitigate or, if unavoidable, compensate identified potential impacts.

In order to meet these objectives the following tasks will be conducted throughout the monitoring programme:

- Vantage point survey – will allow the detection of large bird species present in the study area, the estimation of their abundance, seasonality, the characterization of their flights and will give a general idea of their use of the habitats. Construction and operation phases. This information will be important in accomplishing Objectives a) to d).
- Walked linear transects survey – are designed to survey passerines and other small to medium sized birds. Using this technique densities and composition of these groups of birds are estimated for the different habitats, seasons and sampling sites. Construction and operation phases. This information will be important in accomplishing Objectives a) to c) and Objective d) to some extent.
- Vehicle based transects – will be implemented in order to detect other species less prone to flight, such as bustards and to assess other issues different from collision risk as could be habitat selection and infrastructure avoidance. Construction and operation phases. This information will be important in accomplishing Objectives a) to c).
- Inventory, search, inspection and monitoring of important nesting and/or roosting locations in the area surrounding the wind energy facility – during pre-construction and operation phases. This task will provide data that will enable to accomplish Objectives a) to c). Construction and operation phases.
- Water bodies monitoring – used for characterizing the use of these features by water birds, and contribute to Objectives a) to c). Construction and operation phases.
- Bird carcass searches around the turbines - to be conducted during the operation phase. This task will provide data that will enable to accomplish Objective e).

- Searcher efficiency and carcass removal (by scavengers or decomposition) trials - during operation phase. This task will provide data that will enable to accomplish Objective e).

All the above methodologies will enable the accomplishment of the objective f).

The experimental protocol should be directed to the sensitive and target-species identified. The methodologies to be implemented should follow the general guidelines presented in the Best Practice Guidelines for Bird Monitoring (Jenkins *et al.*, 2012), any update this document may be subjected prior to the start of post construction monitoring, and consider international experience and standards for bird monitoring at wind farms. Nevertheless a systematic approach is suggested in order to determine the general composition of the bird and evaluate the general potential negative effects of the construction and operation phase of the Blue wind energy facility on this group.

Monitoring protocols

The experimental protocol and sampling locations to be implemented in the construction and operational phases of the project should follow the same methodological approach implemented during the pre-construction phase allowing the baseline results to be comparable between all the monitoring programme of a wind energy facility. The monitoring programme should be implemented during the lifetime of the development, or until it is verified that there are significant negative effects on the bird community. The programme to implement should cover at least 1 year during the construction phase and at least 3 years during the operational phase. After this period the pertinence of the continuation of implementation of such monitoring programme should be evaluated by the bird specialist.

Linear Walking Transects

A systematic approach should be implemented in order to study several parameters that define basic characteristics of the local communities of passerine and other small to medium sized birds.

The analysis of these parameters should allow verification of the occurrence of spatial variations of the bird communities present at the study area with time by comparing the results from the Wind Energy Facility site with a similar control area(s), to be defined. Therefore this methodology aims to contribute to accomplish objectives a) to c), d) and f).

- *Methodology*

The methodology to be implemented should follow the general guidelines presented in the Best Practice Guidelines for Bird Monitoring (Jenkins *et al.*, 2012). For this purpose linear walking transects, of at least 1000 m each and being equally distributed between the Wind Energy Facility site and a Control area, should be conducted by two expert observers, walking slowly and all the bird contacts (seen or heard) should be recorded on the left and right sides of the transect.

- *Sampling locations and Sampling periods*

The location of the linear transects in the Wind Energy Facility site should be established within the influence radius of the turbines. Each linear transect should be walked at least once per season for at least 1 calendar year during construction phase and at least three years after the project becomes operational (operational phase).

- *Data analysis*

Through transect sampling surveys of the overall bird community the data collected should be analyzed in order to estimate at least the following population parameters:

- Relative Abundance/density of bird population/community;
- Average species richness of bird community;

Vantage Points

The raptors and large terrestrial birds monitoring should be implemented in order to evaluate the activity patterns of these birds in the Wind Energy Facility site, and surrounding areas. By collecting this information this methodology aims to contribute to accomplish objectives a) to d) and f).

- *Methodology*

The methodology to be implemented should follow the experimental design implemented during the pre-construction monitoring phase and general guidelines presented in the Best Practice Guidelines for Bird Monitoring (Jenkins *et al.*, 2012), or the most recent guideline document. Observations from each vantage point should be conducted for at least 9 to 12 hours per season.

- *Sampling locations and Sampling periods*

Suitable vantage points should be defined at strategic locations in the Wind Energy Facility area to allow the visualization of the wind energy facility area (with special emphasis on the turbine locations) and the immediate surroundings.

Each vantage point should be surveyed for at least 6 hours per season for a minimum of three years after the project becomes operational (operational phase).

- *Data analysis*

From the data collected from the vantage points the evaluation of the following parameters should be conducted:

- Species detected - raptors and large terrestrial birds (such as bustards, cranes, korhaans, geese, ducks);
- Mapping of the intensity of usage of the study area by bird species (*Activity Index*);
- Mapping of the intensity of usage of the study area by flight type for the target species;
- Mapping of the *Collision Hazard Index* of the study area.

Vehicle-based transects

Will allow the estimation of Kilometric Abundance Indexes for raptors and large terrestrial birds, especially target and sensitive species and also complement nest and roost survey

- *Methodology*

Transect should conducted by two expert observers, one driving slowly and the other recording all the contacts seen or heard. During each linear transect the total number of birds observed should be recorded. The following parameters must be recorded: species and number of individuals present, perpendicular distance from the road, bird activity at the moment of observation and any additional notes considered pertinent:

- bird species, gender and age (whenever possible);
- number of individuals;
- perpendicular distance off the road;

- bird activity observed and type of observation (acoustic/visual).
- *Sampling locations and Sampling periods*

The location of vehicle-based transects should cover the wind energy facility site and the immediate surroundings. Each linear transect should be undertaken at least once per season for at least 1 calendar year during construction phase and at least three years after the project becomes operational (operational phase).

- *Data analysis*

The vehicle-based transect sampling will allow the estimation of the following parameters:

- Relative Abundance of bird population/community - determined by a Kilometric Abundance Index – *KAI* (i.e. average number of observed individuals per kilometre);
- Average species richness of bird community – represented by average number of bird species per kilometre
- Habitat related variables may be recorded, including distance to turbines and other relevant infrastructures, in order to assess their effects in the distribution of target species.

Nest monitoring

This methodology is relevant for the evaluation of the impacted area as a suitable area the reproduction of priority, sensitive and target-species. The main objectives of this methodology are a) to c) and f).

- *Methodology*

The methodology to be implemented should follow the general guidelines presented in the Best Practice Guidelines for Bird Monitoring (Jenkins *et al.*, 2012).The area of the Wind Energy Facility site and its immediate surroundings should be investigated for nesting and/or roosting locations of priority species. All the nesting and/or roosting locations identified during the pre-construction monitoring surveys should be monitored.

- *Sampling period*

Nest searches and monitoring of the nest already detected, should be conducted during the construction phase and at least three years after the project becomes operational (operational phase).

- *Data analysis*

The data collected from nest survey and monitoring in the Wind Energy Facility will allow the evaluation of the following parameters:

- *Number and species of breeding couples;*
- *Productivity of breeding couples.*

Water body monitoring

Since water bodies are gathering places for water birds or other large terrestrial birds, it is important to evaluate whether or not they can be impacted by the Wind Energy Facility and associated infrastructure. This methodology aims to contribute to accomplish objectives a) to c), and f).

- *Methodology*

The main water bodies present in the area influenced by the proposed wind energy facility, and its immediate surroundings, should be identified, mapped and surveyed in order to determine the utilization of these areas by water birds. The methodological approach should follow, whenever pertinent, the prescribed by the Coordinated Waterbird Counts (Taylor *et al.,* 1999).

- *Sampling locations and Sampling periods*

Water body monitoring should be conducted during the construction phase and at least three years after the project becomes operational (operational phase). The monitoring of the main water bodies identified during the pre-construction phase should be continued.

- *Data analysis*

With the information collected from the water body monitoring, the following parameters will be assessed:

- Estimation of the number and densities of water bird species that use this type of areas in the Wind Energy Facility site and surrounding areas;
- Patterns of bird activity and movements in sensitive areas.

Fatality Assessment

- *Methodology*

The methodology to be implemented should follow the general guidelines presented in the Best Practice Guidelines for Bird Monitoring (Jenkins *et al.*, 2012) and the international best practices.

At onshore facilities the fatality estimation is based on carcass searches around wind turbines. However, the number of carcasses found during the searches does not correspond to the real number of birds killed by the wind farm, since not all carcasses are detected by searchers or, given the time elapsed between searches, some carcasses are removed (e.g. by scavengers or decay) from the site. Thus, to estimate the real mortality is necessary to determine the associated bias correction factor and adjust the observed mortality through the use of appropriate fatality estimators. If guyed infrastructures are implemented at the site, these should be subjected to the general methodology to access avian mortality.

Whenever bird and bat monitoring plans are simultaneously being implemented at a wind energy facility the bat collisions and bird collisions assessment could be combined, following the same general methodological approach. This methodology aims to contribute to accomplish objectives e), and f).

- *Carcass searches*

Regarding bird mortality evaluation, searches of dead birds around all the Wind Energy Facility wind turbines during the operational phase is proposed. The search plot will depend on the wind turbine characteristics (hub height and rotor diameter) and should be larger than the area covered by the rotor diameter with an addition of at least 5 meters. This area should be regularly inspected for bird casualties. The observer should adjust its dislocation speed to the terrain characteristics, inspecting as much area as possible. According to the terrain characteristics the observer may conduct the survey through parallel transects, or by dividing the area in four different quadrants, and carefully searching for any signs of bird collision incidents (carcasses, dismembered body parts, scattered feathers, injured birds). All evidence should be documented and recorded on a GPS, being the evidence collected in adequate preserving conditions, for further analysis in a laboratory.

- *Searcher efficiency and carcass removal trials*

Field trials should be conducted to determine the observed mortality correction parameters such as the carcass detection by observers and carcass removal (e.g. by scavengers).

In carcass removal trials, carcasses should be placed at a minimum distance of 500m from each other, with 1 km being the preferable distance. Once placed, carcasses should be checked to determine the time of removal of each one.

For the searcher efficiency trials, carcasses should be randomly placed around the turbines and then searched by the observers in order to assess their efficiency rate.

In both trials, the type of carcasses used should mimic the dimensions and body size of the existing wild species in the study area, such as domestic goose, pigeons, domestic waterfowls, etc.

- *Sampling locations and Sampling periods*

Mortality inspection, carcass detection and carcass removal should be implemented in the operational phase of the project for at least three years, except if stated otherwise.

- *Carcass searches*

Preferably the mortality inspection surveys should be conducted weekly (if not possible, then the surveys must be conducted at least every 15 days, or monthly in the worst case scenario) covering the whole annual period (Strickland *et al.,* 2011).

- *Searcher efficiency and carcass removal trials*

The carcass removal trials should be performed during four seasons: winter, spring, autumn and summer. In each campaign, the bird carcasses placed in the site should be checked daily. The number of carcasses used should be limited, in order not to attract too many scavengers.

In searcher efficiency trials, carcasses should be placed within the search plot of each turbine, If the habitats have no significant variation throughout the year, the trial could only be performed during one season of the year.

In order to obtain an accurate measure of the observed mortality, search efficiency rates and scavenging rates should be assessed during the first operational year of the Wind Energy Facility.

- *Data analysis*

The results from the trials conducted should provide the evaluation of the following parameters:

- Correction factor for the carcass detection by field observers;
- Correction factor for the carcass removal by scavengers and environmental factors;
- Real mortality estimates in the Wind Energy Facility, during its operational phase.

To properly calculate the real mortality associated to the Wind Energy Facility it is essential to adopt a fatality estimator that adjusts the observed casualties by the estimated bias correction terms. In the last years research has been conducted on this matter and several estimators have been proposed. However, so far there is still lacking a universal estimator that ensures good quality estimates under all circumstances (Bernardino *et al.,* 2013).

Therefore, when estimating the bird fatality associated to the Wind Energy Facility the best estimator available at the time should be used, which performance must be demonstrated in peer-reviewed studies.

bioinsight

Reports preparation and contents

A technical report containing the parameters referred to in the previous chapters should be delivered at the end of each year of monitoring. In this document an evaluation of the adequacy of the monitoring protocols should be conducted as well as an evaluation of the existence of any detectable potential impacts occurring over the bird community of the impacted area, caused by the Wind Energy Facility and associated infrastructures. In these reports, a data comparison with the results of previous years should be performed, in order to obtain more reliable conclusions. For this reason, the final reports of the monitoring program should present a review of the results obtained over the previous years that the monitoring activities were implemented.

6.5. Appendix V – Monitoring Programme Compliance with EIA and Guidelines

Recommendations from Guidelines	EIA Report Requirements	Methodological approach at Blue WEF	Further information/Justification
General requirements			
	Bird collisions in relation to the proposed sites of the turbines should be investigated in more detail during the monitoring phase to determine whether the risk warrants mitigation such as patterning of turbine blades.	The final layout was used for the treatment and presentation of the data gathered during the pre-construction monitoring period.	
At least 4 visits should be carried out through the year in order to obtain representative data for the different seasons.	Include sample surveys (1 km transects, Vantage Point surveys and wetland counts) at regular intervals every second month for large terrestrial species, raptors and other collision-prone species within the study area to determine the relative importance of local populations of priority taxa.	The multi-methodological approach implemented at Blue wind energy facility monitoring comprises methodologies to assess and provide robust and complete quantitative information on the distribution and abundance of birds. Vehicle based transects were implemented in order to detect other large bird species less prone to flight, and allows covering greater areas in the wind energy facility surroundings; Vantage points provided full detailed of use of the area by large terrestrial birds and raptor; walking transects provide abundances and densities for small birds and passerines and nests monitoring provide information on sensitive bird areas; water bodies monitoring provide information on water bird activity and nests monitoring provides information regarding breeding success within the study area. During the pre-construction monitoring programme a total of 12 visits will be undertaken thought the year, divided in four different seasons.,.	Spanning the visits through the year give a better insight of the meteorological and phenological variations.
	Include estimates of the extent and direction of movements of these species through the impact zone of the wind energy facility, in relation to coastlines, ridge tops and foraging areas	Different methodologies were set up to measure bird activity and to assess movements and activity patterns in the vicinity of the wind energy facility (vantage points, walked transects and vehicle transects).	
	Include identification of the least sensitive/lowest risk areas to locate wind turbines within the broader study area.	An analysis on the sensitivity of the different areas at the development site is undertaken based on the data recorded during the pre-construction monitoring programme.	

Recommendations from Guidelines	EIA Report Requirements	Methodological approach at Blue WEF	Further information/Justification
Bird density/activity should be focused on a shortlist of priority species, defined in terms of (i) threat status or rarity, (ii) uniqueness or endemism, (iii) susceptibility to disturbance or collision impacts, and (iv) relative abundance on site.		A shortlist of sensitive species was defined for the monitoring programme, considering all the target species listed during the Scoping phase, the priority species considered at the BAWESG sensitivity map. This species list was also complemented by our specialists in order to accommodate other "sensitive" species that may have not been previously considered on the previous sources and based in their (i) threat status, (ii) abundance, (iii) population trend, (iv) sensitivity to WEF. In this way our methodological approach allows the undertaking of several parallel analyses, at different levels of detail, considering species at various levels of priority and sensitivity to the wind development.	Bioinsight's methodological approach allows the undertaking of several parallel analyses, at different levels of detail, considering species at various levels of priority. Therefore the complexity of the priority species lists may be variable for the different analysis carried out.
Intensified monitoring in case of high densities or diversities of threatened and/or endemic species, or the proximity of know and important avian flyways or wetlands. Nigh time watches coincident with clear, moonlit conditions would be valuable at some sites.	Investigate flight paths of flamingos using dams and flooded pans within the WEF area, considering that these are nocturnal migrants	When the experimental design was defined and accordingly to the criteria defined in the Table 1 of the guidelines (Jenkins et al, 2012) the site falls within an area of low to medium sensitivity and the sampling effort was adjusted accordingly to the information available on the avifaunal community present on site. No standardized night searches, but during bat surveys all contacts with priority species are recorded as incidental observation and any special observations such as roosting sites are also noted.	
Some level of monitoring over small species and/or non-threatened but ecologically pivotal species will be required.		The methodology implemented considers recording all the species of "large birds", not only the target or sensitive species identified, systematically during vantage point, vehicle transect surveys and as incidental observations during all the dislocations in the area. It also considers recording all small bird species during the walked transects survey. On the final report two types of analysis will be conducted, one considering all bird species and another one considering only priority species.	Bioinsight's methodological approach allows the undertaking of several parallel analyses, at different levels of detail, considering species at various levels of priority. Therefore the complexity of the priority species lists may be variable for the different analysis carried out.

Recommendations from Guidelines	EIA Report Requirements	Methodological approach at Blue WEF	Further information/Justification
Monitoring data should be generated for both the broader impact zone of the proposed WEF and for one or more comparable reference sites, which should match the range of habitats and topography of the proposed WEF site, present similar bird communities, be at least half the size and be as close as possible to the development area.		The immediate surroundings of the wind energy facility are considered as Control areas (distance more than 1000m from wind turbine location), and used to compare possible changes in the calculated parameters. Similarly, a reference site for the small bird community was defined in an area considered adequate for this objective and with the main objective to conduct a similar analysis as described above.	The use of distant reference areas that would be necessarily different is avoided, while information on reference sites is collected. A Before-After Control-Impact is to be applied over these areas in subsequent phases of the development giving information about the variation of the distribution of flying birds in relation to turbine's position, thus achieving the desired Before-After comparison.
Ideally, field workers should operate in pairs.		The field teams always included two experienced observers.	This also allowed to conduct 360° coverage vantage point, allowing one observer to follow one species and the other to keep surveying the sampling area; one technician is still observing while the other is writing or driving, different approaches to any decision process and increased safety.
Sampling methods and sample sizes may be determined as much by what is practically possible as by what is required for statistical rigor.			Bioinsight always try to implement a cost-effective approach with the available budget and support their assessments with statistical analysis, reporting in every moment the methodologies followed and the limitations and assumptions.
Vantage points			
Overview of as much of development area as possible during vantage point surveys. Ideally these should be spaced a maximum of 2 km apart (SNH 2005).		A total of 5 vantage points were set up to monitor the area under influence of the wind turbines, including the areas considered as controls.	

Recommendations from Guidelines	EIA Report Requirements	Methodological approach at Blue WEF	Further information/Justification
Guarantee coverage of 180° in the development direction from the vantage points. If possible take note of birds "behind" the observers, but not loosing quality looking forward.		Vantage point surveys cover 360° (180º covered by each observer)	The methodological approach implemented consisted on several years of experience in monitoring wind farms in Europe and that have proven to be effective and providing objective results to access potential impacts from the wind development and to inform on the layout sensitivity or necessary adjustments to minimize impacts in higher collision areas. Vantage point surveys covered a 360° radius. All the vantage points were conducted with two experienced and therefore the coverage of the 360° is guaranteed, as one observer may be looking in one direction (covering 180°) while the other is observing the opposite. This methodology have the added advantage of covering more area in relation to be focusing on only 180º area, where observers may be not detecting important observations, which may contribute to an inadequate assessment of the site sensitivity.
Perform VP from before dawn to midday, or from midday to after dusk. Alternatively, watches can be divided in three hour shifts (early morning, midday, late afternoon).		The 5 vantage point were surveyed at last once each survey at different time of the day (once in the morning, once during midday and once in the afternoon each survey) and three times per season. This methodology aimed to accomplish a minimum 9 hours of observation per vantage point per season, ideally three hours during each time of the day.	The aim was to obtain representative samples different day periods for each vantage point. Times of high activity such as dusk and dawn and times of low activity, midday (see Hardey *et al.* 2009).
One full day of counts should be completed at each vantage point for each site visit (considering the last point, where three shifts of three hours are proposed, a total minimum of 9 hours are recommended).			Consecutive observation hours in a single day are not independent from each other and for this reason are not suitable for most statistical analysis (see Morrison *et al.*, 2008; Thompson, 2012; Strickland *et al.*, 2011). Obtaining independent samples (in different days) requires an increase in the general effort (mainly due to the required observer's dislocations to and from the site) but allows the application of statistical analysis and modelling certain parameters. This is important because raw observations can be biased due to several factors, such as different visibilities across habitats, different detection rates along different distances or particular meteorological conditions. Statistical analysis can be performed to determine factors that could

Recommendations from Guidelines	EIA Report Requirements	Methodological approach at Blue WEF	Further information/Justification
			explain the occurrence of abundant or high risk flights, that allow modelling and extrapolation of their probability of occurrence within the whole study area (see for example Strickland *et al*., 2011 or Johnson *et al*., 2000). Besides, as the exact time of each observation in recorded, this data can be transformed to any other number of observation/time ratio, for comparing with other projects. The approach implemented at Blue WEF also covers greater amount of terrain (a total of 5 were set up) and undertakes greater amounts of visits to the site (a total of 12 visits will conducted, opposing to the minimum requirement of 4 visits per year).
Estimation of these variables for priority species: time spent flying over the proposed development area, relative use of different parts of the development area, proportion of time spent at rotor height, flight activity of other bird species.		Bioinsight's method records these and other variables, such as flight trajectories, behaviour and flight height.	The methodology approach implemented includes recording all of these variables and other considered important for the potential collision risk and site sensitivity assessment (*e.g.* flight trajectories, location and GIS representation, duration, behaviour and flight height).
Data gathered this way may be used for modelling collision risk		Our methodology includes the determination of a potential collision risk factor for most large species and particularly for priority species. In the final report a more complete analysis will be presented considering all the data collected during the pre-construction monitoring.	
Walked transects			
The recommended method for passerine and other small birds sampling is walked transects. Another acceptable ways to measure small bird densities are fixed point counts and checklist surveys.		The methodology implemented to survey the small bird communities considered walked transects.	

Recommendations from Guidelines	EIA Report Requirements	Methodological approach at Blue WEF	Further information/Justification
The length, number and distribution of these transects on each site may vary according to site size, habitat diversity, and the richness and relative significance of the small terrestrial avifauna. Ideally, all the major habitat types present should be sampled approximately in proportion to their availability on site. Transects should be positioned at varying distances away from the proposed turbine arrays to maximize the value of the data in comparison with post-construction survey results.		10 walking transects where considered (each approx. 1000m long): 5 of them within the influence area of the wind energy facility (1000 m buffer area around the wind turbines) and 5 at a Control site (outside the 1000 m buffer area).	For analytical purposes, transects were divided into sections of 200 meters. Thus, a higher number of sampling sections were available for hypothesis testing, and habitat relationships were more accurate (Buckland *et al*., 1993; Bibby *et al*., 2000; Brotons *et al*., 2007; Carrascal *et al*., 2008). To avoid pseudo replication only one section, from every two sections, are considered in the analysis (Hulbert, 1984; Sutherland, 2006). In this way, sections used were located at least 200 m away from each other.
Transects should be walked slowly and carefully, and work should commence from as soon as it is light enough to see clearly in the early morning and extend only until mid-morning, avoiding the warmer middle of the day when birds are less active and vocal, and hence less conspicuous (Bibby *et al.* 2000). If it is not possible to compress all transects into this time period, it is important to otherwise standardize for time of day in project design and/or subsequent data analysis to minimize the possible effect of this factor on survey results. As a general rule, transects should not be walked in adverse conditions, such as heavy rain, strong winds or thick mist.		Surveys started after sunrise and were performed during the early morning (the first 3 h after sunrise) avoiding the warmer periods of the day.	
Perpendicular distances to detected birds should be measured and either Distance methods or fixed band width methods should be applied to calculate densities		Distance to birds was measured in five different bands (0-10, 10-25, 25-5-, 50-75, 75-100, >100).	Detection rates vary between different groups of birds and Distance methods require a minimum amount of contacts for them being reliable. Therefore if enough amount of contacts are recorded for a certain group, and it is considered relevant for the monitoring it would be analyzed using these methods. Otherwise a fixed band width method will be used, which usually works well for comparative studies.
Vehicle transects			

Recommendations from Guidelines	EIA Report Requirements	Methodological approach at Blue WEF	Further information/Justification
Populations of large terrestrial birds should be estimated on each visit either by means of an "instantaneous" absolute count or by means of vehicle-based transects. The amount of vehicle-based transects will be conditioned by the availability of roadways but as far as possible they will be directed to include a representative cross section of habitats on site. They should be undertaken in general compliance with the road counts protocols described for terrestrial species (Young *et al*. 2003) and raptors (Malan 2009).		1 vehicle transect was set up at the development site (length of approximately 30 km). Transect was conducted by two expert observers, one driving slowly and the other recording all the contacts seen or heard. During each linear transect the total number of birds observed was counted and recorded.	The purpose of the survey was to provide a measure of abundance and richness of the species observed (large terrestrial birds and raptors). At the same time, this information complements that obtained from the vantage point surveys, and aids in the detection of species less prone to flying.
Focal sites surveys			
Any areas deemed likely to support nest sites for key raptor species or large terrestrial species should be surveyed using documented protocols. All such sites should be mapped and checked in every visit.		The cliff lines, electric poles, storage tanks and other features susceptible for supporting nesting sites of sensitive species were surveyed from the vantage points, vehicle transects and other specific spots. The nesting locations found were visited in following surveys and the information regarding its occupancy and breeding success of the species present was noted.	
The major wetlands on and close to the development area should be identified, mapped and surveyed for water birds on each visit to the site, using the standard protocols set out by the CWAC initiative (Taylor *et al*. 1999).		All the wetlands were mapped and inspected. However within the WEF area no major wetlands of relevance to the bird community were found.	
Incidental observations			

Recommendations from Guidelines	EIA Report Requirements	Methodological approach at Blue WEF	Further information/Justification
All other, incidental sightings of priority species (and particularly those suggestive of breeding or important feeding or roosting sites or flight paths) within the broader study area should be carefully plotted and documented. These could include details of nocturnal species (especially owls) heard calling at night.		All contacts of raptors and large terrestrial birds were recorded as incidental observations, if made outside the systematic observations.	

bioinsight
SOUTH AFRICA

LOOKING
DEEP INTO
NATURE

info@bioinsight.co.za

www.bioinsight.co.za