Albany Wind Energy Facility

EDF Renewables (South Africa)

Avifaunal Impact Assessment

January 2020

WildSkies ecological services

REPORT REVIEW & TRACKING

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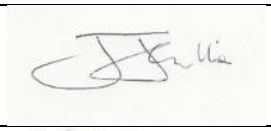
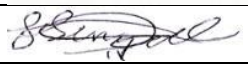
Lead author	Jon Smallie – SACNASP 400020/06	
Internal review	Luke Strugnell – SACNASP 400181/09	

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EXECUTIVE SUMMARY

EDF Renewables (South Africa) plans to develop a wind energy facility named Albany Wind Energy Facility, situated just east of Grahamstown in the Eastern Cape. The project will consist of up to 66 wind turbines according to the layout provided. In addition to the turbines the facility will also comprise of roads and underground electrical cabling linking turbines, an on-site substation and office, and an overhead grid connection power line to the Eskom grid.

In accordance with the best practice guidelines in this regard (Jenkins *et al,* 2015) WildSkies Ecological Services (Pty) Ltd was appointed to conduct four seasons of pre-construction bird monitoring on site. This data collection was carried out during 2016 and 2017. EOH-Coastal and Environmental Services (EOH-CES) was then appointed to conduct the necessary environmental impact assessments for the proposed project and subsequently appointed WildSkies Ecological Services to conduct this avifaunal impact assessment, based on the above mentioned pre-construction bird monitoring.

Key findings from this programme of monitoring are as follows:

- A total of 211 bird species were recorded on site with a peak in species diversity in spring (150 species).
- Fifty-five species from the list of 210 species identified by Retief *et al* (2011, 2014) as high risk species for wind farms were recorded on the Albany site.
- Twenty-eight of these 54 bird species were identified as priority target bird species for this study. Twelve of these are Red Listed, comprising 4 'Endangered', 5 'Vulnerable' and 3 'Near-threatened' species.
- Walked transects on site recorded 62 small passerine species, with a peak of 43 species in summer. One of these species was Red Listed, the European Roller *Coracias garrulus* (Near-threatened).
- Drive transects on site recorded 8 species, none of which are Red Listed.
- Nineteen target bird species were recorded flying on site, with 95% of flight activity made up by raptors. This included 7 regionally Red Listed species: Martial Eagle *Polemaetus bellicosus*, Black Harrier *Circus maurus* and Yellow-billed Stork *Mycteria ibis* (Endangered); Denham's Bustard, *Neotis denhami*, Lanner Falcon *Falco biarmicus* and Secretarybird *Sagittarius serpentarius* (Vulnerable); and Blue Crane *Anthropoides paradiseus* (Near-threatened).
- Based on abundance and flight data collected on site, we conclude that 6 of the 28 target species will be at medium or high risk if the proposed wind farm is constructed and operated. These species are: Martial Eagle; Jackal Buzzard; Rock Kestrel *Falco rupicolus*; Secretarybird; Denham's Bustard and Blue Crane.

- In order to mitigate for these risks, we have identified areas of the site that should be avoided with new infrastructure.

Based on the avifaunal community on site, we draw the following conclusions with respect to the significance of impacts on avifauna:

- Construction of the facility will result in a certain amount of destruction and removal of natural vegetation which was previously available to avifauna for use. This impact is anticipated to be of MODERATE NEGATIVE significance pre mitigation. The required mitigation is to adhere to the sensitivity map contained in this report. This will reduce the significance to LOW NEGATIVE.
- Disturbance of birds is rated as LOW NEGATIVE significance, on account of there being no known breeding sites of sensitive bird species on or near site. No specific mitigation is required.
- Once operational the facility could displace certain birds from the area, or cause them to fly further to get around the facility. Displacement of birds is judged to be of LOW NEGATIVE significance pre mitigation. No specific mitigation is required.
- Birds in flight on the site could collide with operational turbine blades, thereby being killed or seriously injured. Collision of birds with turbines is judged to be of MODERATE NEGATIVE significance pre mitigation. The significance of this impact can be reduced to LOW NEGATIVE significance by adhering to the sensitivity map in Section 7, and by providing a contingency mitigation budget in the operational phase to allow adaptive management of impacts that arise. If such a situation arises possible necessary mitigation measures could include: further research into the problem (including possibly bird tracking studies); human based turbine shutdown on demand; habitat alteration; bird deterrence from site; and any others identified as feasible at the time.
- Birds could perch on the pylons/towers of the overhead power line and be at risk of electrocution if the design is not bird friendly. Birds in flight could collide with the overhead cables, particularly the earth wire. Collision and electrocution of birds on overhead power lines on site is anticipated to be of HIGH NEGATIVE significance. Both of these impacts can be mitigated successfully in our opinion to reduce the significance to LOW NEGATIVE. To mitigate for collision of the relevant species, it is recommended that the overhead cables on the spans identified as high risk be fitted with the best available (at the time of construction) Eskom approved anti bird collision line marking device. In the case of bird electrocution, the power line must be built on an Eskom approved bird-friendly pole structure which provides ample clearance between phases and phase-earth to allow large birds (such as eagles) to perch on them in safety. In addition, none of the on-site power line between turbines and between turbines and the site substation should be built above ground. The only above ground power line should be the grid connection power line (See Section 6).

We recommend that this wind farm can be developed with acceptable levels of risk to birds.

SPECIALIST DETAILS

Professional registration & experience

The Natural Scientific Professions Act of 2003 aims to "Provide for the establishment of the South African Council of Natural Scientific Professions (SACNASP) and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith." "Only a registered person may practice in a consulting capacity" – Natural Scientific Professions Act of 2003 (20(1)-pg 14)

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Declaration of independence

The specialist investigators declare that:

- We act as independent specialists for this project.
- We consider ourselves bound by the rules and ethics of the South African Council for Natural Scientific Professions.
- We do not have any personal or financial interest in the project except for financial compensation for specialist investigations completed in a professional capacity as specified by the Environmental Impact Assessment Regulations, 2006.
- We will not be affected by the outcome of the environmental process, of which this report forms part of.
- We do not have any influence over the decisions made by the governing authorities.
- We do not object to or endorse the proposed developments, but aim to present facts and our best scientific and professional opinion with regard to the impacts of the development.

- We undertake to disclose to the relevant authorities any information that has or may have the potential to influence its decision or the objectivity of any report, plan, or document required in terms of the Environmental Impact Assessment Regulations, 2006.

Terms & Liabilities

- The Precautionary Principle has been applied throughout this investigation.
- Additional information may become known or available during a later stage of the process for which no allowance could have been made at the time of this report.
- The specialist investigator reserves the right to amend this report, recommendations and conclusions at any stage should additional information become available, particularly from Interested and Affected Parties.
- Information, recommendations and conclusions in this report cannot be applied to any other area without proper investigation.
- This report, in its entirety or any portion thereof, may not be altered in any manner or form or for any purpose without the specific and written consent of the specialist investigator as specified above.
- Acceptance of this report, in any physical or digital form, serves to confirm acknowledgment of these terms and liabilities.

Signed in January 2020 by Jon Smallie in his capacity as avifaunal specialist.

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1. INTRODUCTION

EDF Renewables (South Africa) plans to develop a wind energy facility named Albany Wind Energy Facility, situated just east of Grahamstown in the Eastern Cape.

In accordance with the best practice guidelines on this matter (Jenkins *et al*, 2015) EDF (previously InnoWind) commissioned pre-construction bird monitoring on this site. WildSkies Ecological Services was contracted for this purpose and collected data on site covering four seasons in 2016-17. EOH-Coastal and Environmental Services (EOH-CES) was then appointed to conduct the necessary environmental impact assessments for the proposed project and subsequently appointed WildSkies Ecological Services to conduct this avifaunal impact assessment.

The site is located on a ridge line that runs west-east. The N2 highway also runs atop this ridge, and much of the natural vegetation has been transformed by alien wattle trees. Indigenous forest does remain in the south facing valleys, and some open grassland areas remain on the highest ground and in the far west.

Figure 1 shows the position of the proposed site in the broader landscape.

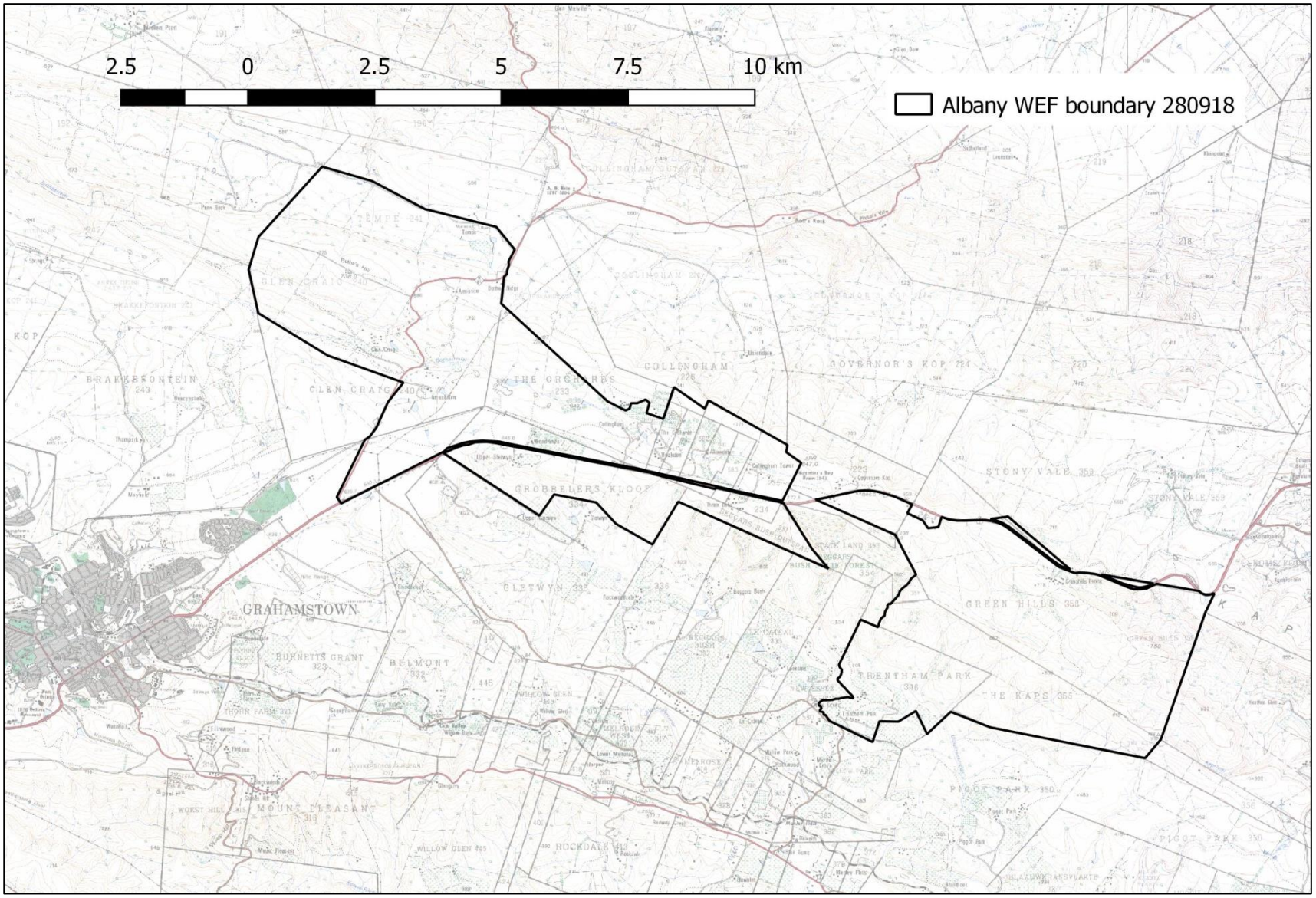

Figure 1. The proposed Albany Wind Energy Facility location.

2. METHODS

2.1. Objectives

The objectives of this assessment were as follows:

- To estimate the abundance, distribution and movement of the priority bird species within the wind farm area as a baseline to measure potential displacement due to the construction and operation of the wind farm.
- To document patterns of bird movement on site and flight behaviour that are relevant to understanding the risk of collision of these birds with wind turbines and power lines once constructed.
- To inform the final design, construction and management strategy of the facility.

More detail on the aims of the specific data collection activities is provided below under the relevant sections.

2.2. General approach

This programme was implemented over four seasons in order to capture as much as possible of various forms of variation in conditions on site. Site visits were conducted in the following periods: late May-early June 2016 (autumn); August 2016 (winter); October 2016 (spring) and February 2017 (summer). In addition to these data collection site visits, several less formal site visits were conducted by the specialist. Capturing multiple years of variation would be preferable, but a full cycle of four seasons is considered an appropriate compromise, taking practical and resource constraints into account. All data capture activities were conducted by a pair of observers working together at all times. There are a number of reasons for working in pairs, including the fact that much of the data capture requires birds to be spotted/detected first and two pairs of eyes and ears are far better than one. It also ensures that even while data is being captured onto datasheets at least one pair of eyes and ears is still focused on birds. The team was equipped with a suitable vehicle, binoculars, camera, GPS (Global Positioning System), spotting scope, clipboards and relevant maps and datasheets. All data was captured onto standard paper datasheets, and then captured electronically into Microsoft Excel each evening, to ensure that data is still fresh in the observers' minds when typed up. Data was then emailed (electronic) and couriered (hard copy) to the specialist for analysis and storage.

The layout of the pre-construction bird monitoring data collection activities on site is shown in Figure 2.

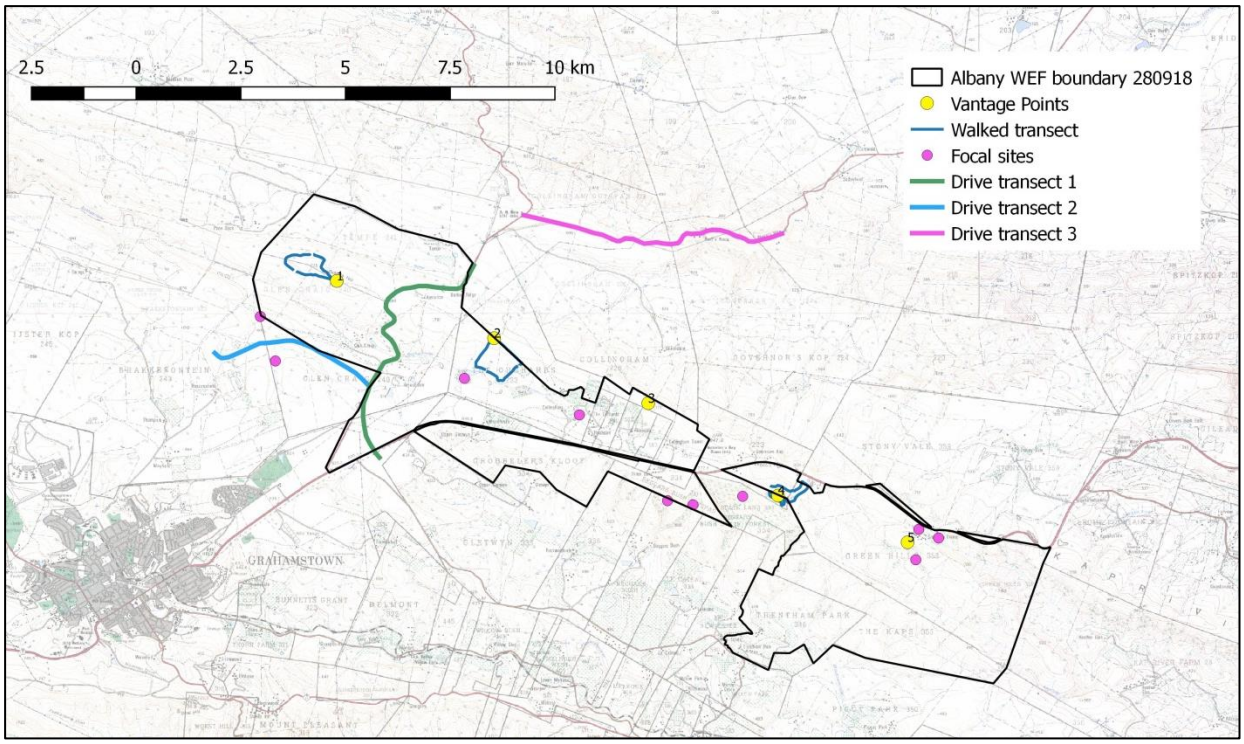

Figure 2. General overview of the Albany wind farm site with avifaunal vantage points, drive transects, focal sites and walk transects.

2.3. Background to bird interactions with wind farms

The interaction between birds and wind farms first documented was that of birds killed through collisions with turbines, dating back to the 1970's. Certain sites in particular, such as Altamont Pass – California, and Tarifa – Spain, killed a lot of birds and focused attention on the issue. However it appears that sites such as these are the exception rather than the rule, with most facilities causing much lower fatality rates (Kingsley & Whittam, 2005; Rydell et al 2012). With time it became apparent that there are actually four ways in which birds can be affected by wind farms: collisions – which is a direct mortality factor; disturbance – particularly whilst breeding; habitat alteration or destruction (less direct); and displacement and barrier effects (various authors including Rydell *et al* 2012). Whilst the impacts of habitat alteration and disturbance are probably fairly similar to that associated with other forms of development, collision and the displacement and barrier effects are unique to wind energy.

Associated infrastructure such as the grid connection power line also has the potential to impact on birds.

2.3.1 Collision of birds with turbine blades

Without doubt the impact of collision has received the most attention to date amongst researchers, operators, conservationists, and the public.

The two most common measures for collision fatality used to date are number of birds killed per turbine per year, and number of birds killed per megawatt installed per year. Rydell *et al* (2012) reviewed studies from 31 wind farms in Europe and 28 in North America and found a range between 0 and 60 birds killed per turbine per year, with a median of 2.3. European average bird fatality rates were much higher at 6.5 birds/turbine/year compared to the 1.6 for North America. These figures include adjustment for detection (the efficiency with which monitors detect carcasses in different conditions) and scavenger bias (the rate at which birds are removed by scavengers between searches). These are important biases which must be accounted for in any study of mortality.

In South Africa, Ralston-Paton, Smallie, Pearson & Ramalho (2017) reviewed the results of operational phase bird monitoring at 8 wind farms ranging in size from 9 to 66 turbines and totalling 294 turbines (or 625MW). Hub height ranged from 80 to 115m (mean of 87.8m) and rotor diameter from 88 to 113m (mean of 102.4m). The estimated fatality rate at the wind farms (accounting for detection rates and scavenger removal) ranged from 2.06 to 8.95 birds per turbine per year. The mean fatality rate was 4.1 birds per turbine per year. This places South Africa within the range of fatality rates that have been reported for North America and Europe.

The composition of the bird fatalities by family group was as follows: Unknown 5%; Watefowl 3%; Waterbirds other 2%; Cormorants & Darters 1%; Shorebirds, lapwings and gulls 2%; Large terrestrial birds 2%; Gamebirds 4%; Flufftails & coots 2%; Songbirds 26%; Swifts, swallows & martins 12%; Pigeons & doves 2%; Barbets, mousebirds & cuckoo's 1%; Ravens & crows 1%; Owls 1%; and Diurnal raptors 36%.

Threatened species killed included Verreaux's Eagle *Aquila verreauxii* (5), Martial Eagle (2), Black Harrier (5), and Blue Crane (3). Although not Red Listed, a large number of Jackal Buzzard fatalities (24) were also reported. No fatalities were reported for a number of species predicted to be vulnerable to the impacts of wind energy.

2.3.2 Loss or alteration of habitat during construction

The area of land directly affected by a wind farm and associated infrastructure is relatively small. As a result in most cases, habitat destruction or alteration in its simplest form (removal of natural vegetation) is unlikely to be of much significance. However fragmentation of habitat can be an important factor for some smaller bird species. Construction and operation of a wind farm results in an influx of human activity to areas often previously relatively uninhabited (Kuvlesky *et al* 2007). This disturbance could cause certain birds to avoid the entire site, thereby losing a significant amount of habitat (Langston & Pullan, 2003). In addition to this, birds are aerial species, spending much of their time above the ground. It is therefore simplistic to view the amount of habitat destroyed as the terrestrial land area only.

Ralston *et al* (2017) did not review habitat destruction or alteration. From our own work to date, we

have recorded a range of habitat destruction on 6 wind farms from 0.6 to 4% (mean of 2.4%) of the site area (defined by a polygon drawn around the outermost turbines and other infrastructure) and 6.9 to 48.1ha (mean of 27.8ha) of aerial space.

2.3.3. Disturbance of birds

Disturbance effects can occur at differing levels and have variable levels of effect on bird species, depending on their sensitivity to disturbance and whether they are breeding or not. For smaller bird species, with smaller territories, disturbance may be absolute and the birds may be forced to move away and find alternative territories, with secondary impacts such as increased competition. For larger bird species, many of which are typically the subject of concern for wind farms, larger territories mean that they are less likely to be entirely displaced from their territory. For these birds, disturbance is probably likely to be significant only when breeding. Effects of disturbance during breeding could include loss of breeding productivity; temporary or permanent abandonment of breeding; or even abandonment of nest site.

Ralston-Paton *et al* (2017) found no conclusive evidence of disturbance of birds at the sites reviewed. It may be premature to draw this conclusion after only one year as effects are likely to vary with time (Stewart *et al*, 2007) and statistical analysis was not as in depth as desired.

2.3.4. Displacement & barrier effects

A barrier effect or displacement occurs when a wind energy facility acts as a barrier for birds in flight, which then avoid the obstacle and fly around it. This can reduce the collision risk, but will also increase the distance that the bird must fly. This has consequences for the birds' energy balance. Obviously the scale of this effect can vary hugely and depends on the scale of the facility, the species territory and movement patterns and the species reaction.

Ralston-Paton *et al* (2017) reported that little conclusive evidence for displacement of any species was reported for the 8 wind farms in South Africa, although once again this is an early conclusion.

2.3.5. Associated infrastructure

Infrastructure associated with wind energy facilities also has the potential to impact on birds, in some cases more than the turbines themselves. Overhead power lines pose a collision and possibly an electrocution threat to certain bird species (depending on the pole top configuration). Furthermore, the construction and maintenance of the power lines will result in some disturbance and habitat destruction. New access roads, substations and offices constructed will also have a disturbance and habitat destruction impact. Collision with power lines is one of the biggest single threats facing birds in southern

Africa (van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of water birds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001). Unfortunately, many of the collision sensitive species are considered threatened in southern Africa. The Red List species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). The larger bird species are most affected since they are most capable of bridging critical clearances on hardware.

Ralston-Paton *et al* (2017) did not review power line impacts at the 8 sites. Our own experience has been of relatively few power line impacts, although monitoring of power lines has been much less frequent (quarterly) than at turbines (weekly).

2.3.6. Mitigation

Realistic possible mitigation measures for turbine collision include: increasing turbine visibility (For example through painting turbine blades; restriction of turbines during high risk periods; automated turbine shutdown on demand; human based turbine shutdown on demand; bird deterrents – both audible and visual; habitat management; and offsets. Most of these suggested mitigation measures are largely untested, impractical or unlikely to be implemented by the operator post construction.

Mitigation for habitat destruction consists typically of avoiding sensitive habitats during layout planning. A certain amount of habitat destruction is unavoidable.

For disturbance, mitigation takes the form of allowing sufficient spatial and temporal protection for breeding sites of sensitive species.

Mitigation of power line impacts is relatively well understood and effective, and is described in more detail later in this report.

The primary means of mitigating bird impacts therefore remains correct siting, both of the entire facility, and of the individual turbines themselves. Whichever mitigation measures are identified as necessary, this should be informed by a thorough pre and post construction bird monitoring programme.

2.3.7. Contextualising wind energy impacts on birds

Several authors have compared causes of mortality of birds (American Bird Conservancy, 2012; Sibley

Guides, 2012; National Shooting Sports Foundation 2012; Drewitt & Langston 2008) in order to contextualise possible mortality at wind farms. In most of these studies, apart from habitat destruction which is the number one threat to birds (although not a direct mortality factor) the top killers are collision with building windows and cats. Overhead power lines rank fairly high up, and wind turbines only far lower down the ranking. These studies typically cite absolute number of deaths and rarely acknowledge the numerous biases in this data. For example a bird that collides with a high rise building window falls to a pavement and is found by a passer-by, whereas a bird colliding with a wind turbine falls to the ground which is covered in vegetation and seldom passed by anyone. Other biases include: the number of windows; kilometres of power line; or cats which are available to cause the demise of a bird, compared to the number of wind turbines. Biases aside the most important short coming of these studies is a failure to recognise the difference in species affected by the different infrastructure. Species such as those of concern at wind farms, and particularly Red List species in South Africa are unlikely to frequent tall buildings or to be caught by cats. Since many bird species are already struggling to maintain sustainable populations, we should be striving to avoid all additional, new and preventable impacts on these species, and not permitting these impacts simply because they are smaller than those anthropogenic impacts already in existence.

2.4. Data sources

Various existing data sources have been used in the design and implementation of this programme, including the following:

- The Southern African Bird Atlas Project data (SABAP1 - Harrison *et al*, 1997) for the relevant quarter degree squares covering the site, and the Southern African Bird Atlas Project 2 data, available at the pentad level (http://sabap2.adu.org.za/v1/index.php).
- The conservation status of all relevant bird species was determined using Taylor *et al* (2015)
- The latest vegetation classification of South Africa (Mucina & Rutherford, 2006) was consulted in order to determine which vegetation types occur on site.
- Aerial photography and topographic maps from the Surveyor General were used for planning purposes.
- The 'Avian Wind Farm Sensitivity Map: Criteria and procedures used. (Retief *et al,* 2011, update 2014).
- Best-practice Guidelines for assessing and monitoring the impact of wind energy facilities on birds in Southern-Africa, third edition (Jenkins *et al,* 2015).
- Google Earth was used extensively to examine the study area on a desktop basis.
- The Important Bird & Biodiversity Areas programme was consulted (Marnewick *et al*, 2015).

- Information on important raptor breeding sites in the area was obtained from Mrs Lynette Rudman (local birder resident) and Mr Alan Stephenson (now resident in Dubai, information up to 2001). This is described in Section 3.2.3.

2.5. Relevant legislation

The legislation relevant to this specialist field and development include the following:

The Convention on Biological Diversity: dedicated to promoting sustainable development. The Convention recognizes that biological diversity is about more than plants, animals and micro-organisms and their ecosystems – it is about people and our need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live. It is an international convention signed by 150 leaders at the Rio 1992 Earth Summit. South Africa is a signatory to this convention.

An important principle encompassed by the CBD is the precautionary principle which essentially states that where serious threats to the environment exist, lack of full scientific certainty should not be used a reason for delaying management of these risks. The burden of proof that the impact will *not* occur lies with the proponent of the activity posing the threat.

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or Bonn Convention) aims to conserve terrestrial, aquatic and avian migratory species throughout their range. It is an intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme, concerned with the conservation of wildlife and habitats on a global scale. Since the Convention's entry into force, its membership has grown steadily to include 117 (as of 1 June 2012) Parties from Africa, Central and South America, Asia, Europe and Oceania. South Africa is a signatory to this convention.

The African-Eurasian Waterbird Agreement. The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is the largest of its kind developed so far under the CMS. The AEWA covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle, including many species of divers, grebes, pelicans, cormorants, herons, storks, rails, ibises, spoonbills, flamingos, ducks, swans, geese, cranes, waders, gulls, terns, tropic birds, auks, frigate birds and even the South African penguin. The agreement covers 119 countries and the European Union (EU) from Europe, parts of Asia and Canada, the Middle East and Africa.

The National Environmental Management – Biodiversity Act - Threatened Or Protected Species list (TOPS)

The Provincial Nature Conservation Ordinance (Nature Conservation Ordinance 19 of 1974) identifies very few bird species as endangered, none of which are relevant to this study. Protected status is

accorded to all wild bird species, except for a list of approximately 12 small passerine species, all corvids (crows and ravens) and all mousebirds.

The Civil Aviation Authority's regulations are relevant to the issue of lighting of wind energy facilities, and to painting turbine blades, both of which are relevant to bird collisions with turbine blades.

2.6. Limitations & assumptions

Certain biases and challenges are inherent in the methods that have been employed to collect data in this programme. It is not possible to discuss all of them here, and some will only become evident with time and operational phase data, but the following are some of the key points:

The presence of the observers on site is certain to have an effect on the birds itself. For example during walked transects, certain bird species will flush more easily than others (and therefore be recorded), certain species may sit undetected, certain species may flee, and yet others may be inquisitive and approach the observers. Likewise with the vantage point counts, it is extremely unlikely that two observers sitting in position for three hours at a time will have no effect on bird flight. Some species may avoid the vantage point position, because there are people there, and others may approach out of curiosity. In almost all data collection methods large bird species will be more easily detected, and their position in the landscape more easily estimated. This is particularly relevant at the vantage points where a large eagle for example may be visible several kilometres away, but a smaller Rock Kestrel perhaps only within 800 metres. A particularly important challenge is that of estimating the height at which birds fly above the ground. With no reference points against which to judge, it is exceptionally difficult and subjective. It is for this reason that the flight height data has been treated cautiously by this report, and much of the analysis conducted using flights of all height. With time, and data from multiple sites it will be possible to tease out these relationships and establish indices or measures of these biases.

The questions that one can ask of the data collected by this programme are almost endless. Most of these questions however become far more informative once post construction data has been collected and effects can be observed. For this reason some of the analysis in this report is relatively crude. The raw data has however been collected and will be stored until such time as more detailed analysis is possible and necessary.

It is well known that the 2016 period was a drought period in this study area (and most of the country). As a result there is a risk that the data collected may not be perfectly typical of conditions in the area. Given that pre-construction bird monitoring for wind farms samples one year, and the wind farm will operate for at least 20 years, we will always face this challenge of greater variability in environmental conditions occurring during the project lifespan than during the impact assessment of the project. In general we would expect the abundance of certain bird species to decrease in drought periods, so the

abundance data presented in this report should be considered a minimum.

The Albany site suffers from relatively bad visibility for bird surveys on account of the large amount of wattle plantation and other trees, and the location on the top of a narrow ridge with poor visibility downwards off the sides. The N2 was under construction during this programme making it particularly difficult and unsafe for bird observations. As a result there is a possibility that some bird flight activity may have been missed. The flight activity data presented in this report should therefore be viewed as the minimum. More importantly, missing large raptors in flight has the consequence of possibly missing clues to the location of breeding sites of these species. There is ample suitable nesting substrate for tree nesting species, and some limited cliff substrate for cliff nesters, on the southern side of the ridge. These areas are very difficult to survey comprehensively, and finding nests is challenging without seeing the birds in flight to and from the nest. There is therefore some risk that we have not detected important nest sites. We discuss how we have dealt with this challenge in Section 3.2.3 and 4.

An overarching limitation is that since it is the early days for wind energy in South Africa we have multiple and often quite different goals for this monitoring. This means that this programme has not been as focused as it would possibly be for a project being developed a few years into the future. Collecting diverse and substantial amounts of data is obviously an advantage on some levels, but perhaps may also dilute the focus.

2.7. Preparatory analysis

In preparation for this programme, the following steps have been taken by the authors:

2.7.1. Definition of the 'inclusive impact zone' (monitoring study area)

Due to their mobility, and the fact that one of the main possible impacts of the wind energy facility, that of bird collision, occurs whilst birds are mobile, the zone within which bird activity is relevant to the wind farm is potentially far larger than the wind farm itself. An important step in designing a monitoring programme is therefore defining this zone. Ideally this zone would encompass the likely range of all bird species likely to be affected by the wind farm.

2.7.2. Description of the study area

Vegetation and micro habitats are very important in understanding avifaunal abundance and likelihood of occurrence. Micro habitats are shaped by various factors, only one of which is vegetation type. Bird density, abundance and movement is determined largely by available micro habitats and since the monitoring programme is based upon sampling the study area, it is essential to characterise the study area in terms of the bird micro habitats available and their relative availability. Aerial photographs,

Google Earth imagery, and field work have been used to describe the available micro habitats on site.

2.7.3. Development of the target bird species list

Determining the target species for this study, i.e. the most important species to be considered, is a three step process. Firstly, existing data on which species occur or could occur in the area at significant abundances, and the importance of the study area for those species is consulted. Secondly, the document "A briefing document on best practice for pre-construction assessment of the impacts of onshore wind farms on birds" (Jordan & Smallie, 2010) was consulted to determine which groups of species could possibly be impacted on by wind farms. This document summarises which taxonomic groups of species have been found to be vulnerable to collision with wind turbines in the USA, UK, EU, Australia and Canada. The taxonomic groups that have been found to be vulnerable in two or more of these regions are as follows: Pelicaniformes (pelicans, gannets, cormorants); Ciconiiformes (storks, herons, ibises, spoonbills); Anseriformes (swans, ducks, geese); Falconiformes (birds of prey); Charadriiformes (gulls, terns, waders); Strigiformes (owls); Caprimulgiformes (nightjars); Gruiformes (cranes, bustards, rails); Galliformes (pheasants, grouse, francolins); and Passeriformes (songbirds). In addition to Jordan & Smallie's summary, the recent document entitled "Avian Wind Farm Sensitivity Map for South Africa: Criteria and procedures used" (Retief, Diamond, Anderson, Smit, Jenkins & Brooks, 2011, updated 2014) classified all bird species in terms of their risk of interaction with wind energy. The methods used by this project (Retief *et al*, 2011, 2014) are far more thorough and comprehensive than is possible during the course of a monitoring programme such as this and are therefore a very useful reference. The third and final step is to consider the species conservation status or other reasons for protecting the species. This involved primarily consulting the Red List bird species (Taylor *et al*, 2015) and the IUCN 2017 Red List.

2.7.4. Determination of monitoring effort

Two factors were considered in determining the monitoring effort: the facility size (in hectares and turbine number); and the perceived avifaunal sensitivity of the site. The final chosen monitoring effort conforms to the best practice guidelines in this regard.

2.8. Data collection activities

The following sections describe the data collection activities on site.

2.8.1. Sample counts of small terrestrial species

Although not traditionally the focus of wind farm–bird studies and literature, small terrestrial birds are an important component of this programme. Due to the rarity of many of our threatened bird species,

it is anticipated that statistically significant trends in abundance and density may be difficult to observe in these species. More common, similar species could provide early evidence for trends and point towards the need for more detailed future study. Given the large spatial scale of wind farms, these smaller species may also be particularly vulnerable to displacement and habitat level effects. Sampling these species aims to establish abundance estimates for the small terrestrial birds in the study area. Since the aim is to count as close as possible to all of the birds in a given sample area, these counts were conducted when conditions were optimal. In this case this means the times when birds are most active and vocal, i.e. early mornings.

A total of 9 walked transects (WT) of 9.7km in total were established and conducted starting just after first light. These WT's were positioned to represent and sample the bird micro habitats available (Figure 2). During these transects, all bird species seen or heard, and their position relative to the transect line were recorded. Small terrestrial bird species abundance has been calculated into a 'bird per km of transect walked' index.

2.8.2. Counts of large terrestrial species & raptors

This is a very similar data collection technique to that above, the aim being to determine as close as possible to how many individuals of each species are present in a given area. Large terrestrial and raptor bird species are relatively easily detected from a vehicle hence 'drive transects' were conducted in order to determine the number of birds of relevant species in the study area. Detection of these large species is less dependent on their activity levels and calls, so these counts can be done later in the day.

Three VT's were established on suitable roads in the area (the N2 being deemed unsafe for observers to conducted drive transects, although perfectly located on site), ranging from 4 to 7 kilometres in length and with a total length of 18 kilometres (Figure 2). Each of these transects was conducted twice in each season.

2.8.3. Focal site surveys & monitoring

Ten Focal Sites (FS) were identified for this programme. Focal Sites 1 to 5 are farm dams, whist 6 to 10 are patches of indigenous forest which provide potential tree nesting substrate. The location of these Focal Sites is shown in Figure 2 and photographs of most of the focal sites are presented in Appendix 3.

2.8.4. Incidental observations

This monitoring programme comprises a significant amount of field time on site by the observers. A fair proportion of this time is spent driving between the above activities. As such it is important to record any other relevant information whilst on site. 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 were carefully plotted and documented.

2.8.5. Direct observation of bird movements

The above efforts in 2.8.1 to 2.8.4 allow us to arrive at an estimate of the abundance or density of the relevant species on site. This allows the identification of any displacement and disturbance effects on these species post construction.

However in evaluating the likelihood of these species colliding with turbine blades, their abundance is not sufficient. We also need to understand their flight behaviour. It is the flight behaviour which determines their exposure to collision risk. A bird which seldom flies, or typically flies lower than blade height is at lower risk than a frequent flier that typically flies at blade height. In order to gather baseline data on this aspect, direct observations of bird flight behaviour are required. This is the most time consuming and possibly the most important activity conducted on site, and is elaborated on below.

The aim of direct observation of flying birds is to quantify bird usage of the study area over time; and to record bird behaviour which may help explain any future interactions between birds and the facility. Direct observation was conducted through counts at 5 vantage points (VP) in the main site (Figure 2), which provide coverage of a reasonable and representative proportion of the entire study area. Vantage Points were identified using GIS (Geographic Information Systems), and then fine-tuned during the project setup, based on access and other information. Since these VP's aim at capturing both usage and behavioural data, they were positioned mostly on high ground to maximise visibility. The survey radius for VP counts was 2 kilometres. Vantage Point counts were conducted by two observers. Birds were recorded in a 360 degree arc of the observers. Data on bird flight should ideally be collected during representative conditions, so the sessions have been spread throughout the day, with each VP being counted over early to mid-morning, mid-morning to mid-afternoon, and mid-afternoon to evening. Each session was 4hrs long. Four hours is believed to be towards the upper limit of observer concentration span, whilst also maximising duration of data capture relative to travel time required in order to get to the VP's. A maximum of two VP sessions were conducted per day, to avoid observer fatigue compromising data quality.

One of the most important attributes of any bird flight event is its height above ground. Since it is possible that the turbine model (and hence the exact height of the rotor swept zone) could still change on this project, actual flight height has been estimated rather than assigning flight height to broad bands (such as proposed by Jenkins *et al* 2015). This 'raw' data will allow flexibility in assigning flight data to classes later on depending on final turbine specifications.

2.8.6. Control site

A control site was monitored to the south of the main site, and consisted of 1 vantage point, one driven transect and 3 walked transects. This is not directly relevant to the EIA and is not discussed further.

3. PRE-CONSTRUCTION BIRD MONITORING RESULTS & DISCUSSION

3.1. Preparatory analysis

3.1.1. Definition of the 'inclusive impact zone' (monitoring study area)

In the case of large birds of prey and large terrestrial species their home range or territories could be tens or even hundreds of kilometres, and it is not considered feasible to monitor all of this area surrounding the proposed wind farm. The area that was monitored is shown in Figure 2.

3.1.2. Description of the proposed facility

The proposed wind farm consists of:

- Temporary infrastructure including a site camp and a laydown area of approximately 30 m^2 per turbine (all to be rehabilitated post construction);
- Up to 66 wind turbines with a rotor diameter of up to 170 m, a hub height of up to 130 m and blade length of up to 85 m; each with an output of between 4 and 8MW
- Foundations (up to 550 m^2) for each wind turbines;
- A laydown area next to the locations of the proposed wind turbines (3,900 m^2 for crane hard-stand per turbine);
- 25 m^2 area for switchgear and/or transformer at each turbine;
- Internal access roads of between 8 m (during operation) and 14 m (during construction, to be part rehabilitated) wide to each turbine;
- Medium voltage cabling between turbines and the switching station, to be laid underground where technically feasible;
- Overhead medium voltage powerlines between turbine rows where necessary;
- Overhead power lines to connect the facility to the electrical grid;
- Existing roads will be used as far as possible. However, where required, internal access roads will be constructed between the turbines;
- Temporary Areas of 90 000m^2 for: A Batching plant, laydown facilities, concrete tower manufacturing and steel tower processing and construction compound.

The grid connection will consist of the following:

- Option 1 (preferred) - An up to 23 000m² IPP Substation (MV/132kV) which will include, battery storage and site office area, situated in the middle of the site.
- Two collector substations, each 10 000m², (Collector s/s West and Collector s/s East) will be constructed.
- The grid connection will be a LILO on the Pembroke-Albany 132kV line;
- All turbines will connect, via underground MV lines, either directly to the IPP substation or to a collector. Each collector will in turn connect to the IPP substation via MV or 132KV overhead line/s within the grid corridor.
- Grid corridor width is 500m wide to allow for manoeuvrability for the final line position within the corridor.
- The corridor from Collector s/s West to the main corridor is 170m in width with a flanking area to accommodate for the line turn in.
- Option 2 - direct connection, via the same corridors, to the Potential 132kV s/s adjacent to the Eskom Albany 132kV s/s, up to 23 000 m² which will include, battery storage and site office area, situated in the middle of the site.

3.1.3 Description of the study area

The study site is situated in a complex area of the country in terms of vegetation, with multiple vegetation types occurring in the landscape. The site itself is comprised of predominantly two main vegetation types (Mucina & Rutherford, 2006). These are the "Bhisho Thornveld" which covers the western half of the site, and "Suurberg Quartzite Fynbos" which covers most of the eastern half of the site. Small pockets of "Southern Mistbelt Forest" occur on the south facing slopes of the mountain along the site's southern boundary. "Suurberg Shale Fynbos" also occurs in the south, mostly off the site itself (see Figure 3). Most of the eastern parts of the site are in fact transformed by forestry and wattle invasion, whilst the western parts are more open and some functional grassland exists. This is shown in Figure 4. Figure 5 shows examples of the micro habitats available to avifauna on the site.

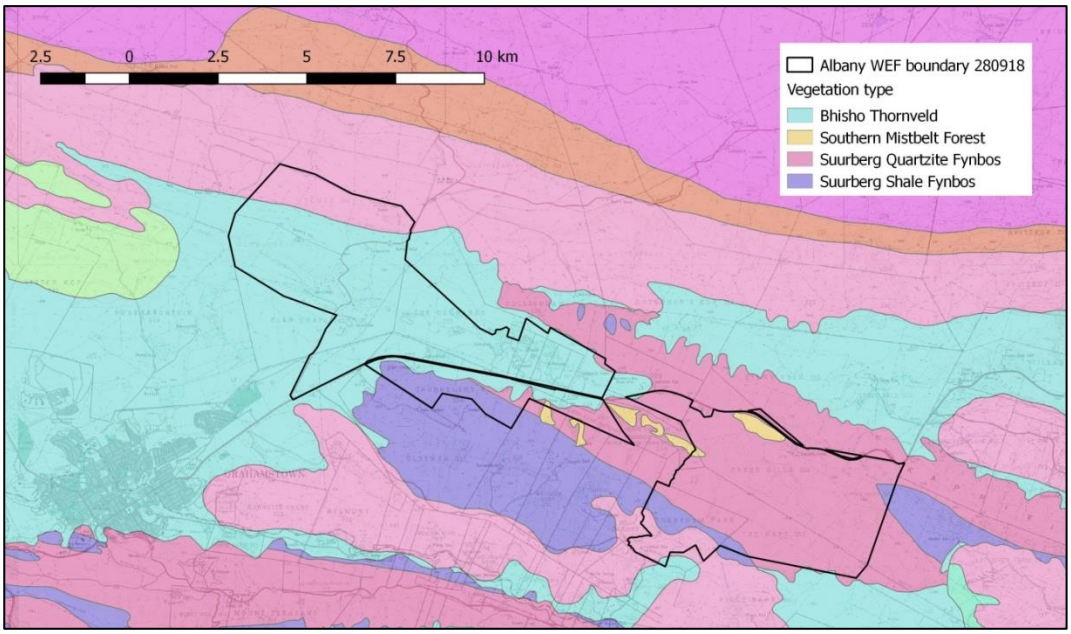

Figure 3. The vegetation classification for the Albany wind farm site (Mucina & Rutherford, 2006).

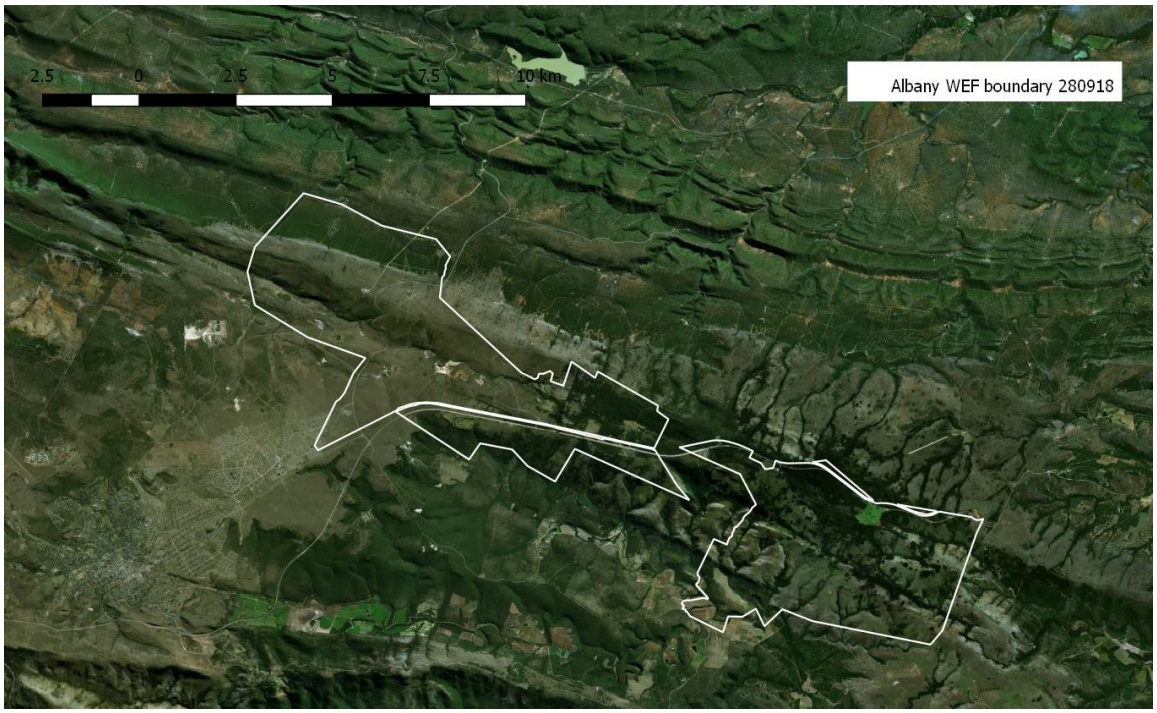

Figure 4. An aerial image of the site, demonstrating the extent of wattle plantation in the eastern half.

Figure 5. Typical micro-habitats available to birds in the broader Albany wind farm study area including: open areas, grassland, dams, wattle plantations.

3.1.4. Development of a target bird species list

The national list of priority species compiled for the sensitivity map (described above – Retief *et al*, 2011, and updated 2014) comprises 210 species. Fifty-five of these species were recorded on the Albany site during this programme. These species are shown in Appendix 1.

Table 1 below shows those 28 species which are either regionally Red Listed (Taylor *et al*, 2015) or otherwise of high priority, based on our experience on operational wind farms elsewhere in South Africa. In total 211 bird species were recorded on site by this monitoring programme. The sub set of species in Table 1 are termed the target species for this study and received the most attention throughout this report.

Certain of the species in Table 1 above have been included as target species in spite of being relatively common, non-threatened species in South Africa. These include Jackal Buzzard, Steppe Buzzard *Buteo vulpinus*, African Harrier-Hawk *Polyboroides typus*, and Rock Kestrel. They are included as their behaviour and/or morphology makes them likely candidates for interaction with wind energy facilities (see Retief *et al*, 2011, 2014) and our own experience to date monitoring operational wind farms across South Africa has shown them to be susceptible to collision (per sobs).

The species in Table 1 can be classified into broad ecological groupings. The *raptors* are the group for which there is most concern for turbine collisions, since they typically spend lots of time in flight. The *large terrestrials* are also well represented on site and include the bustards, cranes, Secretarybird, and storks. Although these species have historically proven highly susceptible to power line collisions, to date few have been recorded as turbine fatalities in South Africa (per sobs). The last group is the small passerines, represented by Striped Flufftail *Sarothrura affinis* and Knysna Woodpecker *Campethera notata*. These species are probably mostly susceptible to habitat destruction and disturbance factors during construction of the facility.

These species are described in more detail later in this report.

Table 1. Summary of target bird species for this study and their occurrence on the Albany wind farm site.

Common name	*Species name*	Cons status	TOPS	IUCN	Endemic /near	Retief	Aut.	Win.	Spr.	Sum.
African Marsh Harrier	*Circus ranivorus*	EN	P	LC		24			1	
Yellow-billed Stork	*Mycteria ibis*	EN		LC		9		1		
Black Harrier	*Circus maurus*	EN		VU	NE	6		1	1	1
Martial Eagle	*Polemaetus bellicosus*	EN	VU	VU		4	1	1		1
Striped Flufftail	*Sarothrura affinis*	VU		LC		85		1	1	
Crowned Eagle	*Stephanoaetus coronatus*	VU		NT		26			1	
Lanner Falcon	*Falco biarmicus*	VU		LC		23		1	1	1
Denham's Bustard	*Neotis denhami*	VU	P	NT		21				1
Secretarybird	*Sagittarius serpentarius*	VU		VU		12	1	1	1	1
European Roller	*Coracias garrulus*	NT		NT		132				1
Knysna Woodpecker	*Campethera notata*	NT		NT	NE	110		1		
Blue Crane	*Anthropoides paradiseus*	NT	VU	EN	NE	11			1	
African Goshawk	*Accipiter tachiro*					190				1
Rock Kestrel	*Falco rupicolus*					111	1	1	1	1
Rufous-breasted Sparrowhawk	*Accipiter rufiventris*					102	1	1	1	
Black Sparrowhawk	*Accipiter melanoleucus*					101			1	1
Forest Buzzard	*Buteo trizonatus*					100	1			
Spotted Eagle-Owl	*Bubo africanus*					98		1		
Black-shouldered Kite	*Elanus caeruleus*					94	1	1		1
Long-crested Eagle	*Lophaetus occipitalis*					84	1	1		1
African Harrier-Hawk	*Polyboroides typus*					83		1		1
Pale Chanting Goshawk	*Melierax canorus*					75	1	1		
Common Buzzard	*Buteo buteo*					69				1
Amur Falcon	*Falco amurensis*					68				1
Yellow-billed Kite	*Milvus migrans*					62		1	1	
Booted Eagle	*Aquila pennatus*			LC		55			1	
Peregrine Falcon	*Falco peregrinus*		VU			48		1		
Jackal Buzzard	*Buteo rufofuscus*					44	1	1	1	1

'1' denotes presence, not abundance. EN= Endangered; VU = Vulnerable; NT = near-threatened (Taylor *et al,* 2015).

3.2. Data collection

The findings have been reported on below in the relevant sections.

3.2.1. Sample counts of small terrestrial species

In total, 408 records of 618 birds were made on the walked transects through the year. These included 62 species, with a peak in species richness in summer (43 species) followed by winter (31 species), spring (29) and autumn (24). Table 2 shows the data for those species for which 10 or more individuals were recorded (the full data set is presented in Appendix 2). The index of birds per kilometre is relatively crude. However since this will be used primarily to compare the effects of the facility on these species post construction if the wind farm is built, this index is considered adequate at this stage. If more complex analysis is required during post construction monitoring in order to demonstrate effects, the raw data is available for this purpose.

One of the species recorded by this method is regionally Red Listed (Taylor *et al,* 2015), the European Roller (Near-threatened), a single bird recorded once. A number of species are considered endemic or near-endemic species (see Appendix 2). The most abundant species recorded on site were: Grey-backed Cisticola *Cisticola subruficapilla*; Bokmakierie *Telophorus zeylonus* (endemic); and Neddicky *Cisticola fulvicapilla*.

Spotting and identifying birds whilst walking is a significant challenge, particularly when only fleeting glimpses of birds are obtained. As such, there is variability between observers ability and hence the data obtained. The above data is therefore by necessity subjective to some extent. In order to control for this subjectivity, the same pair of observers has been used for the full duration of the project. Despite this subjectivity, and a number of assumptions that line transects rely on (for more details see Bibby *et al*, 2000), this field method returns the greatest amount of data per unit effort (Bibby *et al*, 2000) and was therefore deemed appropriate for the purposes of this programme. Likewise in an attempt to maximise the returns from available resources, the walked transects were located close to each Vantage Point. This systematic selection may result in some as yet unknown bias in the data but it has numerous logistical benefits.

3.2.2. Counts of large terrestrial species & raptors

A total of 8 relevant bird species were recorded across the 3 driven transects and four seasons. This included only 15 records of 16 individual birds. These data are summarised in Table 3. A peak in species richness was recorded in summer (5 species) with all other seasons recording 3 species. None of these species are Red Listed species. One endemic or near-endemic species was recorded by this method, the

Jackal Buzzard.

The most abundant species as recorded by this method was Jackal Buzzard, followed by Rock Kestrel, and then Steppe Buzzard.

3.2.3. Focal Site surveys

The results from Focal Sites 1 to 5 are presented in Appendix 3. A typical assortment of water fowl species was recorded at these sites, with Focal sites 1 and 2 holding most birds. There is nothing significant to discuss about these findings, until the facility is built and comparisons can be made. At Focal Sites 6 to 11 (FS11 added on third season) the most important findings were as follows:

- At FS6, an immature Martial Eagle recorded in summer. This is in the general vicinity of the historic nest site discussed below
- At FS11 a pair of Jackal Buzzard confirmed breeding

Due to the difficulty in locating raptor nests in this area (as described in Section 2.4) we asked several local birders if they were aware of any nests. Mr Alan Stephenson reported that prior to 2001 he was aware of three nests: a Martial Eagle; a Peregrine Falcon *Falco peregrinus*; and a Crowned Eagle *Stephanoaetus coronatus*. The location of these nests is shown in Figure 6. The Crowned Eagle nest is too far to be relevant to this site. We are reasonably confident that the Peregrine Falcon and Martial Eagle nests were not active during our monitoring programme nor in recent years, although we were unable to locate and visit the nests. In our opinion, this particular valley should be protected as far as possible in order: firstly to provide protection for this potential breeding habitat/refuge for multiple species including the above; secondly to take a precautionary approach in case the above nests are in active or become active in future; and thirdly since this is high collision risk area based on flight activity data (see Section 3.2.5). This is discussed more in Section 5.

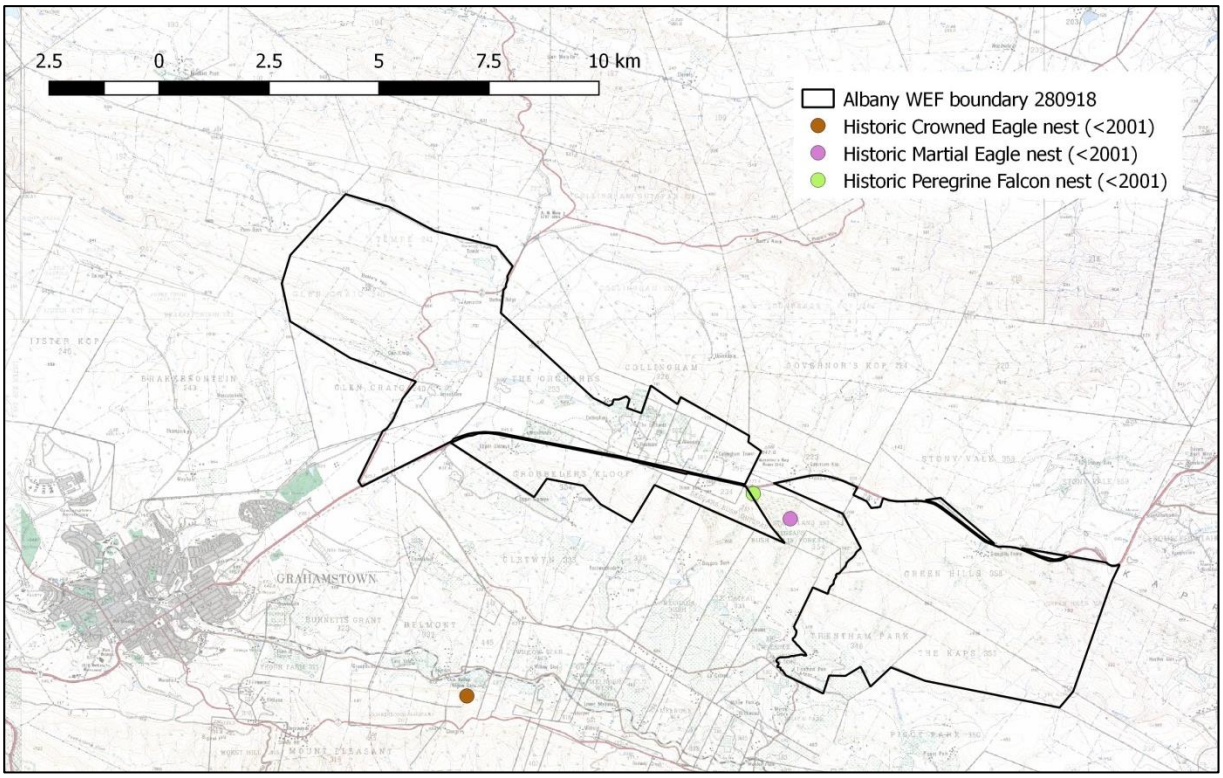

Figure 6. Location of historic raptor nests (as reported to us by Mr Alan Stephenson).

3.2.4. Incidental Observations

Nineteen target bird species were recorded as incidental observations (See Appendix 4). Six of these are Red Listed species (Taylor *et al*, 2015). African Marsh-Harrier *Circus ranivorus*; Black Harrier; and Martial Eagle are Endangered. Denham's Bustard and Secretarybird are Vulnerable, and Blue Crane is Near-threatened. The most abundant of the species recorded was Jackal Buzzard, followed by Rock Kestrel.

The location of these incidental records are shown in Figure 7. At this spatial scale there is a clear bias towards the roads that monitors drove frequently, with most incidental observations being of birds within a few hundred metres of these roads. This is one example of why this incidental data needs to be used with caution, as it is not the product of systematic or representative sampling methods. This data is therefore not discussed in depth here.

A total of 211 bird species were recorded on site during the year, with a peak in species richness in spring (150 species) and winter (144 species), followed by summer (141 species) and autumn (119 species). The full species list is shown in Appendix 1.

Table 2. Summary data of small passerine bird species for which 10 or more individuals were recorded on walked transects on the Albany site (the full dataset is presented in Appendix 2).

Common name	Scientific name	Endemic/near	Retief et al	Full year		
			Transect length	**38.8**		
			# species	**62**		
				birds	**records**	**birds/km**
	All species			618	408	15.93
	Endemics/near			46	35	1.19
Grey-backed Cisticola	*Cisticola subruficapilla*			65	51	1.68
Bokmakierie	*Telophorus zeylonus*			56	28	1.44
Neddicky	*Cisticola fulvicapilla*			38	29	0.98
Cape Longclaw	*Macronyx capensis*		178	31	21	0.80
Malachite Sunbird	*Nectarinia famosa*			31	25	0.80
African Stonechat	*Saxicola torquatus*			28	19	0.72
Sombre Greenbul	*Andropadus importunus*			28	16	0.72
Dark-capped Bulbul	*Pycnonotus tricolor*			26	16	0.67
Red-faced Mousebird	*Urocolius indicus*			26	4	0.67
Cape Turtle Dove	*Streptopelia capicola*			24	17	0.62
Common Fiscal	*Lanius collaris*			23	20	0.59
Southern Boubou	*Laniarius ferrugineus*			20	15	0.52
Karoo Prinia	*Prinia maculosa*	NE	157	17	11	0.44
Speckled Mousebird	*Colius striatus*			17	5	0.44
Cape Grassbird	*Sphenoeacus afer*	NE	156	15	14	0.39
Red-collared Widowbird	*Euplectes ardens*			14	3	0.36
Barn Swallow	*Hirundo rustica*		127	12	8	0.31
Rufous-naped Lark	*Mirafra africana*			12	9	0.31
Hadeda Ibis	*Bostrychia hagedash*			11	4	0.28

Table 3. Summary of large terrestrial and raptor species data recorded through driven transects on the Albany site.

Common name	Scientific name		Full year			Autumn			Winter			Spring			Summer		
		Transect length	**144**			**36**			**36**			**36**			**36**		
		# species	**8**			**3**			**3**			**3**			**5**		
		Retief *et al* 2014	**birds**	**rec**	**Birds /km**	**birds**	**rec**	**Birds /km**	**birds**	**rec**	**Birds /km**	**birds**	**rec**	**Birds /km**	**birds**	**rec**	**Birds /km**
	All species		16	15	0.11	3	3	0.08	4	3	0.11	2	2	0.06	7	7	0.19
Pale Chanting Goshawk	*Melierax canorus*	75	1	1	0.01	1	1	0.03									
Rock Kestrel	*Falco rupicolus*	111	3	3	0.02	2	2	0.06				1	1	0.03			
Black-shouldered Kite	*Falco rupicolus*	94	1	1	0.01				1	1	0.03						
Jackal Buzzard	*Buteo rufofuscus*	44	7	6	0.05				3	2	0.08	1	1	0.03	3	3	0.08
Black Sparrowhawk	*Accipiter melanopterus*	101	1	1	0.01										1	1	0.03
Booted Eagle	*Aquila pennatus*	55	1	1	0.01										1	1	0.03
Steppe Buzzard	*Buteo buteo*	69	2	2	0.01										2	2	0.06

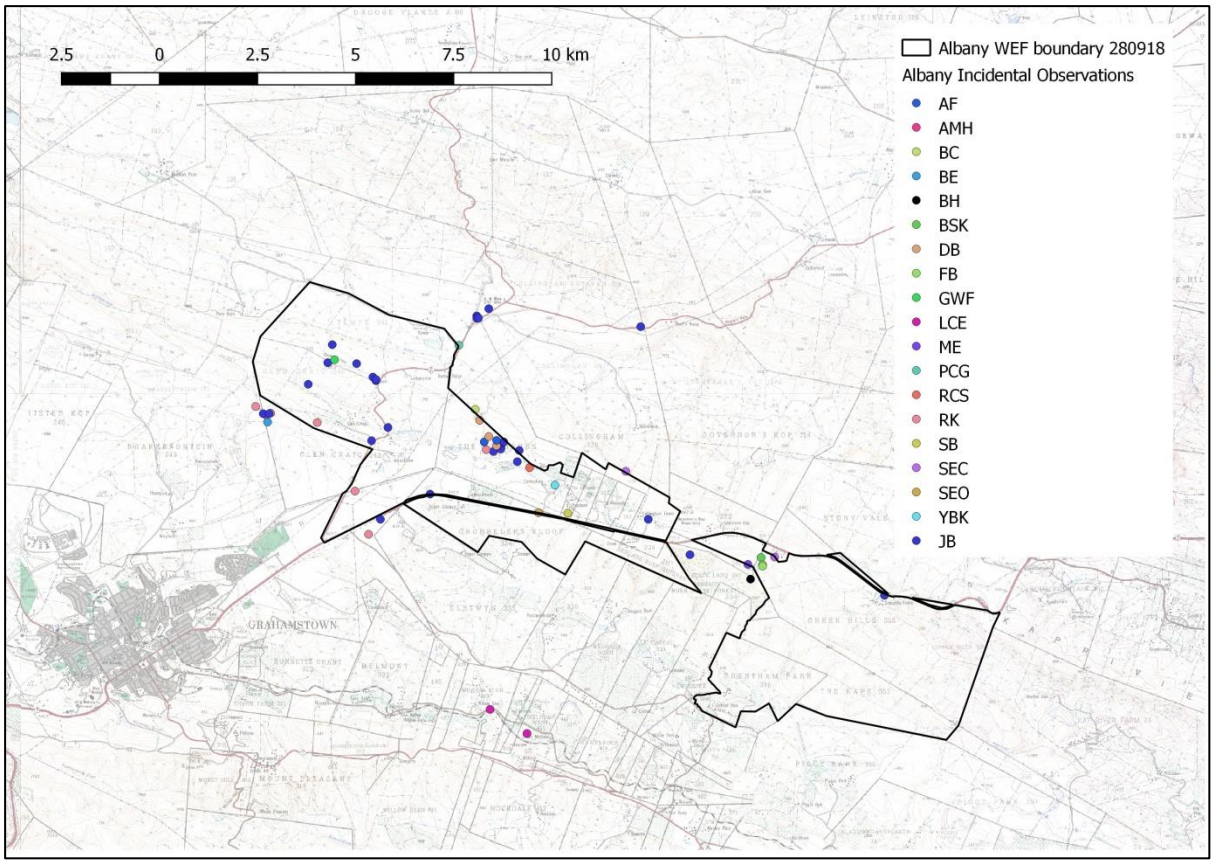

Figure 7. The location of all Incidental Observations of target species on the Albany site.

AF-Amur Falcon; AMH-African Marsh-Harrier; BC-Blue Crane; BE-Booted Eagle; BH-Black Harrier; BSK-Black-shouldered Kite; DB-Denham's Bustard; FB-Forest Buzzard; GWF-Grey-winged Francolin; LCE-Long-crested Eagle; ME-Martial Eagle; PCG-Pale Chanting Goshawk; RCS-Rufous-chested Sparrowhawk; RK-Rock Kestrel; SB-Steppe Buzzard; SEC-Secretarybird; SEO-Spotted Eagle Owl; YBK-Yellow-billed Kite; JB-Jackal Buzzard.

3.2.5. Bird flight activity on site

Summary analysis

A total of 240 hours of bird flight observation were completed at the 5 Vantage Points on site during the year. In total, 19 target bird species were recorded flying on the site (15 raptors and 4 large terrestrials). In total 276 flight records were made, comprising 357 individual birds. Raptors comprised 261 (or 95%) of the records whilst large terrestrial species comprised 16 (or 5%). These data are summarised in Table 4.

Seven of the recorded species are regionally Red Listed according to Taylor *et al* (2015). Black Harrier, Martial Eagle, and Yellow-billed Stork are "Endangered". Denham's Bustard, Lanner Falcon, and Secretarybird are "Vulnerable", and Blue Crane is "Near-threatened".

Bird flight frequency

The most frequently recorded species was Jackal Buzzard, with 169 records (or 61% of all records), comprising 238 birds. The next most frequently recorded species was Rock Kestrel, with 35 records for 36 birds. Martial Eagle was recorded flying on site 15 times and Secretarybird 11 times.

Table 4. Target bird species recorded during vantage point counts at the Albany site.

Common name	Scientific name	Cons stat	Endemic /near	Birds	Rec	Mean height
African Goshawk	*Accipiter tachiro*			2	2	20.50
African Harrier-Hawk	*Polyboroides typus*			2	2	105.71
Amur Falcon	*Falco amurensis*			1	1	30.00
Black Harrier	*Circus maurus*	EN	NE	6	6	19.33
Black Sparrowhawk	*Accipiter melanoleucus*			1	1	30.00
Blue Crane	*Anthropoides paradiseus*	NT	NE	1	1	104.00
Booted Eagle	*Hieraaetus pennatus*			8	8	133.32
Denham's Bustard	*Neotis denhamii*	VU		7	2	80.00
Forest Buzzard	*Buteo trizonatus*			7	7	127.08
Jackal Buzzard	*Buteo rufofuscus*		E	238	169	89.69
Lanner Falcon	*Falco biarmicus*	VU		2	2	50.00
Long-crested Eagle	*Lophaetus occipitalis*			2	1	57.50
Martial Eagle	*Polemaetus bellicosus*	EN		16	15	144.56
Rock Kestrel	*Falco rupicolus*			36	35	59.26
Rufous-breasted Sparrowhawk	*Accipiter rufiventris*			3	2	56.00
Secretarybird	*Sagittarius serpentarius*	VU		13	11	111.97
Steppe Buzzard	*Buteo buteo*			8	8	101.65
Yellow-billed Kite	*Milvus parasitus*			3	2	110.00
Yellow-billed Stork	*Mycteria ibis*	EN		1	1	30.00

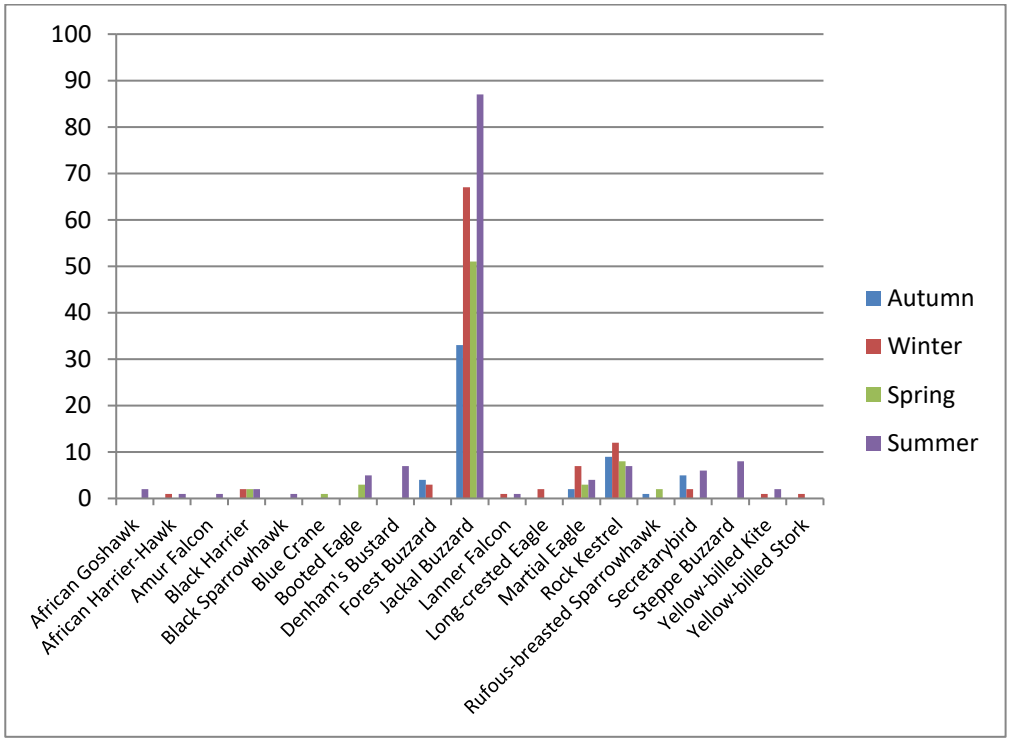

Figure 8. Seasonal numbers of bird flights recorded for each species at the Albany site.

Bird flight seasonality

Figure 8 presents a summary of the seasonality of target bird species flight data. Most species except for the summer migrants were well represented across the majority of seasons.

Bird flight height

Table 4 presents the mean flight height for each of the species. This is calculated simplistically as the mean of the height of all records. No weighting is given to how much time was spent at each height. Fourteen of the recorded species had a mean flight height within the proposed rotor zone of 47.5 to 212.5m above ground. The remaining species predominantly flew below the rotor zone. If all else is equal we expect those species which flew predominantly at rotor height to be most at risk of collision.

As described elsewhere in this report, the estimation of a birds' height above ground whilst in flight is an inherently subjective process. The flight height data should therefore be used with some caution.

Bird passage rates

Generally speaking we expect those species which fly more often to be more susceptible to turbine collision. In order to calculate crude passage rates for each species, we assumed that the 2km radius around vantage points was approximately equal to the maximum distance over which sightings were made, and that the coverage was approximately circular. This meant that at each vantage point an area of 12.57km² was sampled ($A = \pi r^2$). Secondly, we assumed that the area of the wind farm directly presenting a collision risk is described by the area of each turbines rotor zone x # turbines. As described elsewhere, we assumed a turbine model of 165m rotor diameter, and the current proposed layout of 66 turbines (layout to be refined based on other specialists input, most likely fewer turbines will be built). This equates to a wind farm collision risk area of 141 124.23m² or 1.411km² (66 x 21 382.46m²). Thirdly, we assumed that the survey areas around each of the five vantage points was a representative sample of the area in which built turbines will operate. Fourthly we assumed that species passage rates calculated from our four seasons of sampling can be reasonably extrapolated to annual passage rates (by multiplying hourly passage rates by 12 x 365 in the case of resident species and 12 x 365 x 0.5 in the case of migrants). We also assumed a 98% avoidance rate for these birds, i.e. 2% of birds passing through the rotor zone would collide with blades (as recommended by Scottish Natural Heritage guidance for species for which no established avoidance rate is available, www.project-gpwind.eu). Finally we used all recorded flights of all heights above ground for this analysis. This was done on the basis that all flight represents some risk, particularly given that species flight behaviour may change once wind turbines are operational, and that estimation of bird height above ground is subjective. The final coarse passage rates can be seen in Table 5.

Table 5. Bird species crude passage rates and crude predicted fatality at the Albany site.

				Full year					
Common name	**Scientific name**	**Cons stat**	**Endemic/near**	**Birds**	**Rec**	**Hourly passage rate at VP**	**Annual passage rate at VP**	**Annual passage rate through rotor zone**	**Annual fatality rate (98% avoidance)**
			All species	357	276	1.4875	6405.75	713.03	14.26
African Goshawk	*Accipiter tachiro*			2	2	0.01	36.50	4.10	0.08
African Harrier-Hawk	*Polyboroides typus*			2	2	0.01	36.50	4.10	0.08
Amur Falcon	*Falco amurensis*			1	1	0.00	9.13	0.51	0.01
Black Harrier	*Circus maurus*	EN	NE	6	6	0.03	109.50	12.29	0.25
Black Sparrowhawk	*Accipiter melanoleucus*			1	1	0.00	18.25	2.05	0.04
Blue Crane	*Anthropoides paradiseus*	NT	NE	1	1	0.00	18.25	2.05	0.04
Booted Eagle	*Hieraaetus pennatus*			8	8	0.03	146.00	16.39	0.33
Denham's Bustard	*Neotis denhamii*	VU		7	2	0.03	127.75	14.34	0.29
Forest Buzzard	*Buteo trizonatus*			7	7	0.03	127.75	14.34	0.29
Jackal Buzzard	*Buteo rufofuscus*		E	238	169	0.99	4343.50	487.65	9.75
Lanner Falcon	*Falco biarmicus*	VU		2	2	0.01	36.50	4.10	0.08
Long-crested Eagle	*Lophaetus occipitalis*			2	1	0.01	36.50	4.10	0.08
Martial Eagle	*Polemaetus bellicosus*	EN		16	15	0.07	292.00	32.78	0.66
Rock Kestrel	*Falco rupicolus*			36	35	0.15	657.00	73.76	1.48
Rufous-breasted Sparrowhawk	*Accipiter rufiventris*			3	2	0.01	54.75	6.15	0.12
Secretarybird	*Sagittarius serpentarius*	VU		13	11	0.05	237.25	26.64	0.53
Steppe Buzzard	*Buteo buteo*			8	8	0.03	73.00	4.10	0.08
Yellow-billed Kite	*Milvus parasitus*			3	2	0.01	27.38	1.54	0.03
Yellow-billed Stork	*Mycteria ibis*	EN		1	1	0.00	18.25	2.05	0.04

The above calculations yielded an overall predicted facility collision fatality of 14.26 birds, including most importantly 9.75 Jackal Buzzards. It is important to repeat that this is a very crude collision risk model and its value is mostly in comparison with other sites and projects. The absolute numbers of predicted fatalities should be used with caution.

3.2.6. Spatial patterns of bird flight activity on site

Figure 9 shows the spatial location of the recorded flight paths for all species and all seasons. There is a strong pattern of flight activity being aggregated close around each vantage point. Unfortunately this is partly due to the poor visibility from vantage points on this site, as described elsewhere in this report.

Certain higher risk areas on site are however evident in Figure 9. The strongest of these are: immediately west and south-west of Vantage Point 1; over the 'Beggars Bush valley close to Vantage Point 4; and immediately south-east of Vantage Point 5. The turbine layout mostly avoids these high risk areas. Some turbines are in positions where birds flew, such as turbines 16, 17 and 31. Most of this flight activity was that of Jackal Buzzard. The management of this aspect is discussed in more detail in Section 7.1.2.

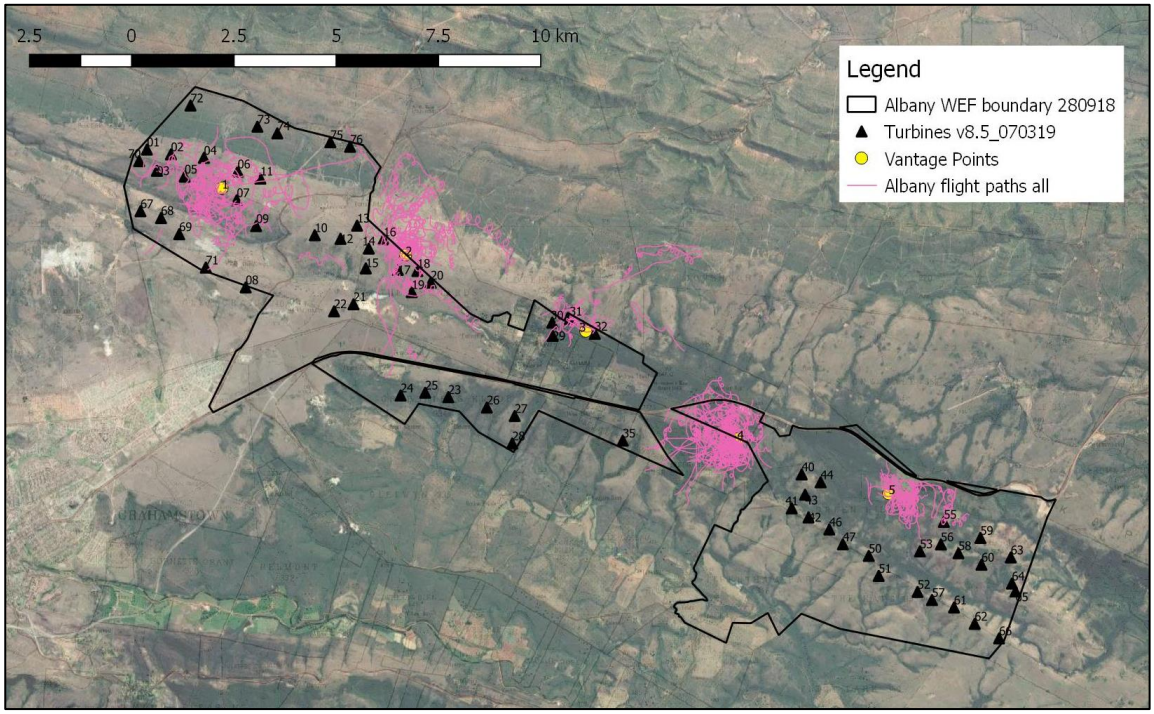

Figure 9. The recorded fight paths for all target bird species and all seasons at the Albany site.

Figure 10 shows only the regionally Red Listed species flight paths individually. Species which frequent more open habitat such as: Blue Crane; Denham's Bustard, Secretarybird and Black Harrier flew mostly on the western side of the site. Martial Eagle flew almost entirely over the 'Beggars' Bush' valley close to Vantage Point 4.

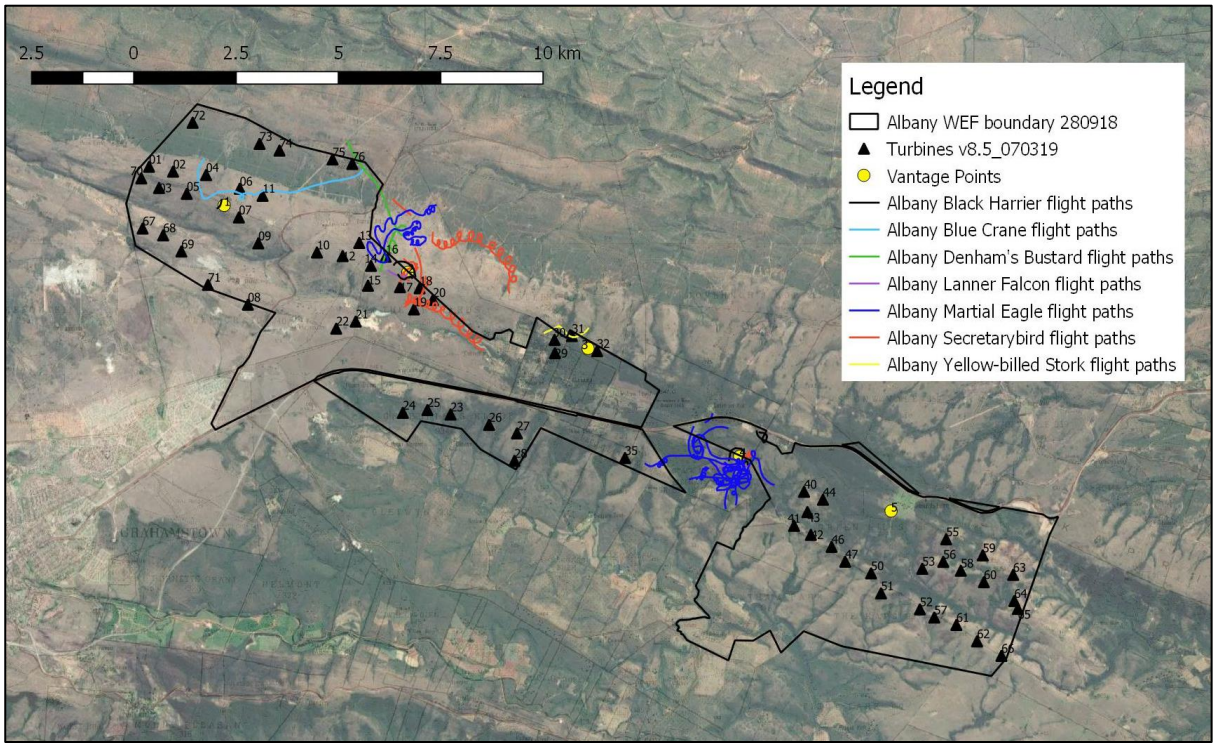

Figure 10.The recorded flight paths for regionally Red List bird species at the Albany site.

4. SUMMARY OF RISK POSED TO AVIFAUNA

This section presents a qualitative assessment of the risk of each type of impact occurring for each of the key target species (those species in Table 1) if the proposed wind energy facility is built. This assessment has been made on the basis of the data collected on site during this programme, reported on in Section 3.

The proposed facility could pose risk to avifauna in 5 main ways: collision with turbines; collision with or electrocution on power lines; habitat destruction during construction; disturbance during construction and operation; and displacement from the site once operational.

Overall, we judge that the impact of collision with turbines will be of medium significance. Flight activity on site is high, but mostly by non-Red Listed species, which reduces the significance. Collision and electrocution of birds on overhead power lines will be of medium significance in our view, although we are not yet aware of where exactly the grid connection power line will run. Habitat destruction and displacement from site will be of relatively low significance, since much of the vegetation on site is transformed or degraded. Disturbance of birds during construction and operation of the facility could be of high significance for Jackal Buzzard if not mitigated, since it breeds on site. Likewise for Martial Eagle if found to breed on or near site.

A discussion of those species most particularly at risk and already classified as regional Red list species (or otherwise of particularly conservation concern) at this site follows:

Martial Eagle

The Martial Eagle is classified as globally Near-threatened, and regionally Endangered (Taylor *et al* 2015, BirdLife International 2013). This species has been killed through collision with wind turbines at other operational wind farms in South Africa (Ralston-Paton *et al*, 2017) and can therefore be expected to be susceptible to this risk. At the Albany site we have recorded the species flying quite frequently over the site, including an immature bird. No breeding displays or other flight behaviour indicative of a nest nearby have been observed. However, we did obtain information on the location of a historic nest (Stephenson pers comm) in the 'Beggars Bush' valley adjacent to site. Given that we cannot establish any information indicating that this nest was used subsequent to the 1980's we have considered this breeding territory as unoccupied.

In our view the impacts of collision with turbines and of disturbance whilst breeding could be of high significance if these birds breed near site at some point in future. We have dealt with this risk in a cautious manner, as described in Section 5.

Black Harrier

The conservation status of the endemic Black Harrier has recently been re-appraised across its' limited world distribution and been reclassified as Endangered in both South Africa (Taylor *et al,* 2015). Fynbos destruction and fragmentation are known to be the main causes of decline, but limited genetic variation now adds to the concern over this species. Additional mortality factors due to operational wind farms (Smallie 2015; Ralston-Paton, Smallie, Pearson & Ramalho, 2017) in its tiny breeding range in South Africa mean that this species is now more threatened than ever.

This species was recorded flying 6 times on the Albany site, in all cases solitary birds. In our view these were birds passing through the area. No behaviour indicative of breeding or roosting was recorded. We can expect occasional visiting harriers on this site.

Considering the habitat available we consider this species to be at low risk at this site.

Mitigation of risk for occasional visiting birds is very difficult as this is a wandering species which can cover vast areas whilst foraging. If birds were found breeding on or near site, mitigation could take the form of the identification of a suitable no go buffer area around this breeding site in order to provide protection for these birds. At this stage we have not identified a confirmed nest site.

Secretarybird

Secretarybird is classified as Vulnerable by Taylor *et al* (2015), having been upgraded from Near-threatened previously. This upgrade was as a result of having undergone more than 30% population reduction in the last ten years. The population in the region is estimated at less than 10 000 birds. Habitat loss is the biggest threat to this species. It is also very susceptible to collision with overhead power lines. We suspect it may be vulnerable to collision with wind turbines. At the Albany site, we have recorded it flying quite frequently (11 records). We consider it likely that a pair of Secretarybird is resident in the area, although we did not find a nest.

We judge this species to be at medium risk, primarily through habitat destruction, and to a lesser extent collision risk. This is a difficult species to mitigate for as it is wide ranging, and typically solitary or in pairs, so determining patterns of preferred areas or flight paths is not easy. If a nest is found on or near site disturbance of birds whilst breeding could be a factor.

Denham's Bustard

The Denham's Bustard is classified as Vulnerable by Taylor *et al* (2015) and its population and range has decreased over the last few decades due to habitat destruction and disturbance. Allan & Anderson (2010) adjudged the Denham's Bustard to be the topmost priority amongst bustards for conservation attention, on account of it facing the widest range of known threats. This classification was too early to consider wind turbines as a threat. The southern African population of this species is estimated at < 5 000 birds

(Allan 2003, in Hockey *et al*, 2005). In 1984 the Eastern Cape population was estimated at 100-200 birds (Brooke, 1984) and there does not appear to be a more recent estimate. This species is typically seen in higher densities in transformed habitats towards the west of the country, rather than in the natural grassland more prevalent in the east of South Africa and the Albany area. In the Eastern Cape to our knowledge, it is common only in the Kouga area around Humansdorp and St Francis Bay. At the Albany site 2 flight records were made of 3 and 4 birds respectively. We estimate that up to 5 birds spend part of the year on and near the site.

Denham's Bustard is likely to be susceptible to four possible impacts: habitat destruction, disturbance, displacement and collision with turbine blades and power lines. At a recently constructed wind farm elsewhere in Denham's Bustard range, the number of displaying male bustards did not appear to decrease when comparing pre and during wind farm construction monitoring results (although note that during construction monitoring was only started after road preparation) (Ralston-Paton *et al*, 2017). There may have been a slight displacement of the bustard lek area further away from turbines after they were constructed, which may indicate a slight spatial displacement effect (Ralston-Paton *et al*, 2017).

In terms of collisions this species is well known to be vulnerable to collision with overhead power lines (amongst other sources, Shaw, 2009). Although an overhead cable is very different to a wind turbine blade, this does give us cause to believe that they could be at risk of collision with the turbines. Raab *et al* (2009) however state that up until their publication no known instance of collision of Great Bustard with wind turbine exists (2009), probably because they fly too low. We have not recorded any turbine fatalities for this species at the two operational sites we have monitored for a year or more in the species' range (per sobs).

We conclude that this species is at low to medium risk at the Albany site.

Blue Crane

The Blue Crane is classed as Near-threatened by Taylor *et al* (2015). It is almost endemic to South Africa (A small population exists in Namibia) and is our national bird. It has the most restricted range of any of the 15 crane species worldwide. The population is estimated at a minimum of 25 000 birds (Taylor *et al*, 2015), but only about 2 600 of these birds exist in the 'eastern grasslands' sub population, of which the Albany birds form part. It is this eastern grasslands population that is under most pressure, mostly due to the transformation of grassland habitat by human activities.

This species is highly susceptible to collision with overhead power lines, and more recently has been recorded as turbine collision fatalities (Ralston-Paton *et al,* 2017). We have recorded this species flying on site only once. Based on this, and records by other data collection methods, we estimate that 2-4 birds reside in the broader Albany area, with the potential for 1-2 breeding pairs on and near site (Although we did not confirm any breeding sites).

We conclude that this species is at low to medium risk at the Albany site.

Jackal Buzzard

The Jackal Buzzard is a fairly common species throughout South and on this site where at least one pair probably resides in the broader area. It is a generalist in terms of habitat, although does favour shorter vegetation. It hunts mostly in flight, meaning that a large proportion of its time is spent flying, and thereby at some risk of collision with vertical obstacles. On this site this species has been recorded frequently by all data collection methods and one nest location has been confirmed. Due to its relatively common status this anticipated risk does not carry as much significance as it would if the species were Red Listed.

This species is likely to be susceptible to four possible impacts: habitat destruction, disturbance, displacement and collision with turbine blades and power lines. Early observations on constructed wind farms under monitoring indicate that this species is highly susceptible to collision with turbines (pers. obs, & Ralston-Paton *et al*, 2017.). The most appropriate mitigation for this species is to site turbines correctly out of the areas that it prefers flying and to provide spatial protection for it at the breeding site. However this species flies widely throughout the site.

We conclude that this species is at high risk but this will of medium significance.

Rock Kestrel

The Rock Kestrel is a relatively common species throughout most of South Africa. It can forage over most open habitat types but breeds in cliff terrain, although it has also been recorded breeding on man-made structures, such as Eskom transmission lines. Kestrels are a group of birds that distinguishable by their flight behaviour. They typical hover approximately 10 to 30 metres above the ground whilst hunting and swoop down onto prey. Importantly kestrels do not require moving air or wind to fly, being able to fly even in stationary air. This has implications for their wind turbine collision risk profile, as they can occur and hunt almost anywhere on a site, and in any conditions. This species has been recorded flying frequently and for long durations on the Albany site. Its flight behaviour, alternating hovering with soaring makes it theoretically highly susceptible to collision with turbines. It is considered likely to breed on or near the site, although no nests have been found so far.

This species is likely to be susceptible to four possible impacts: habitat destruction, disturbance, displacement and collision with turbine blades and power lines. Early observations on constructed wind farms under monitoring indicate that this species is highly susceptible to collision with turbines (pers. obs.). This is a difficult species to mitigate for as it can forage almost anywhere over the site.

We conclude that this species is at high risk but that this will of medium significance due to its' common

status.

Additional species

Several additional species are worthy of mention. Booted Eagle *Hieraaetus pennatus*, Forest Buzzard *Buteo trizonatus*, Steppe Buzzard, and Peregrine Falcon all flew quite frequently on site and are likely to be at risk of collision with wind turbines. Striped Flufftail was recorded on site, and flufftails have been recorded as wind turbine collision fatalities elsewhere in SA (pers.obs; Ralston-Paton *et al*, 2017).

5. IMPACT ASSESSMENT

The potential impacts of the proposed Albany WEF and associated infrastructure are as follows. These impacts have been formally assessed and rated according to the criteria (supplied by EOH-CES and shown in Appendix 5).

5.1 Destruction of bird habitat during construction of the facility

Cause & comment

Construction of the facility will result in a certain amount of destruction and removal of natural vegetation which was previously available to avifauna for use. This impact is anticipated to be of MODERATE NEGATIVE significance pre mitigation. The area is also significantly disturbed by various human activities including: the N2 highway; pipelines; roads; power lines; and general farming practices.

Mitigation measures

Adhere to the sensitivity map (Section 6).

Significance statement

IMPACT 1: Habitat destruction					
IMPACT	**EFFECT**			**RISK OR LIKELIHOOD**	**OVERALL SIGNIFICANCE**
	TEMPORAL SCALE	**SPATIAL SCALE**	**SEVERITY OF IMPACT**		
Without Mitigation	Long Term	Study Area	Moderately severe	Definite	**MODERATE -**
With Mitigation	Long Term	Study Area	Slight -	Definite	**LOW -**
No-Go Alternative	Long Term	Study Area	Slight -	Definite	**LOW -**
Cumulative	Long Term	Study Area	Moderately severe	Definite	**MODERATE -**

5.2 Disturbance of birds

Cause & comment

This is rated as LOW NEGATIVE significance, on account of there being no known breeding sites of sensitive bird species on or near site.

Mitigation measures

Nothing specific required. Adhere to sensitivity map.

Significance statement

IMPACT 1: Disturbance of birds					
IMPACT	EFFECT			RISK OR LIKELIHOOD	OVERALL SIGNIFICANCE
	TEMPORAL SCALE	SPATIAL SCALE	SEVERITY OF IMPACT		
Without Mitigation	Short Term	Study Area	Moderately severe	Probable	**LOW -**
With Mitigation	Short Term	Study Area	Slight -	Probable	**LOW -**
No-Go Alternative	Short Term	Study Area	Slight -	Probable	**LOW -**
Cumulative	Short Term	Study Area	Moderately severe	Probable	**MODERATE -**

5.3 Displacement of birds from the site and barrier effects

Cause & comment

Once operational the facility could displace certain birds from the area, or cause them to fly further to get around the facility. Displacement of birds is judged to be of LOW NEGATIVE significance pre mitigation.

Mitigation measures

Nothing specific required. Adhere to sensitivity map.

Significance statement

IMPACT 1: Displacement of birds					
IMPACT	EFFECT			RISK OR LIKELIHOOD	OVERALL SIGNIFICANCE
	TEMPORAL SCALE	SPATIAL SCALE	SEVERITY OF IMPACT		
Without Mitigation	Long Term	Study Area	Slight -	Probable	**LOW -**
With Mitigation	Long Term	Study Area	Slight -	Probable	**LOW -**
No-Go Alternative	Long Term	Study Area	Slight -	Probable	**LOW -**
Cumulative	Long Term	Study Area	Moderately severe	Probable	**MODERATE -**

5.4 Collision of birds with turbine blades

Cause & comment

Birds in flight on the site could collide with operational turbine blades, thereby being killed or seriously injured. Collision of birds with turbines is judged to be of MODERATE NEGATIVE significance pre mitigation.

Mitigation measures

The significance of this impact can be reduced to LOW NEGATIVE significance by adhering to the

sensitivity map in Section 6, and by providing a contingency mitigation budget in the operational phase to allow adaptive management of impacts that arise. The most likely of these is that of Black Harrier, which could possibly be at risk of collision in certain years when conditions are right for them on site. If such a situation arises possible necessary mitigation measures could include: further research into the problem; human based turbine shutdown on demand; habitat alteration; bird deterrence from site; and any others identified as feasible.

Significance statement

IMPACT 1: Collision of birds with turbine blades					
IMPACT	**EFFECT**			**RISK OR LIKELIHOOD**	**OVERALL SIGNIFICANCE**
	TEMPORAL SCALE	**SPATIAL SCALE**	**SEVERITY OF IMPACT**		
Without Mitigation	Long Term	Study Area	Moderately severe -	Possible	**MODERATE -**
With Mitigation	Long Term	Study Area	Slight -	Possible	**LOW -**
No-Go Alternative	Long Term	Study Area	Slight -	Possible	**LOW -**
Cumulative	Long Term	Study Area	Moderately severe	Possible	**MODERATE -**

5.5 Cumulative Impacts of wind energy facilities on birds in this area

The proposed Albany Wind Energy Facility is situated in an area of the country where we are aware of one other wind farm authorised and one site is operational. These sites are as follows:

- Grahamstown Plan8 Wind Energy Facility. Authorised – approximately 22 turbines
- Waainek Wind Energy Facility. Operational – 8 turbines.

In such areas, where multiple facilities may be built, it is important to consider the overall or cumulative impact of these facilities on birds. Consideration of each project in isolation may not adequately judge the effect that projects will have on avifauna when combined.

The International Finance Corporation (IFC) recognises Cumulative Impact Assessment (CIA) and management as essential in risk management. However, CIA is also "One of the biggest risk management challenges currently facing project developers in emerging markets…". Challenges include: a lack of basic baseline data, uncertainty associated with anticipated developments, limited government capacity, and absence of strategic regional, sectoral, or integrated resource planning schemes. Considerable debate exists as to whether CIA should be incorporated into good practice of Environmental and Social Impact Assessment, or whether it requires a separate stand-alone process. As a minimum, according to the IFC, developers should assess whether their projects could contribute to cumulative impacts or be impacted

upon by other projects. The IFC recommend that developers conduct a Rapid Cumulative Impact Assessment (RCIA) either as part of the EIA or separately. This RCIA should follow 6 steps: 1 & 2 – scoping; 3 - baseline determination; 4 - assessment of the contribution of the development under evaluation to the predicted cumulative impacts; 5 - evaluation off the significance of predicted cumulative impacts to the viability or sustainability of the affected environmental components; 6 - design and implementation of mitigation measures to manage the development's contribution to the cumulative impacts and risks (see the "Good Practice Handbook - Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets". International Finance Corporation).

The IFC step wise approach is useful to follow for this study, and has been elaborated on below:

Steps 1 & 2: The Albany study has achieved these through the scoping of issues and identification of aspects worthy of attention. It is assumed that these aspects will be similar on the other project sites in similar topography and vegetation.

Step 3: This has been conducted on a 'per species' basis in Section 4.

Step 4: requires a judgment of the contribution that the Scarlet Ibis site makes to the predicted cumulative impacts. In our opinion, with respect to the key species listed as most important for this area, the Albany site makes a large contribution to impacts in the area, on account of its small size (area and number of turbines).

Step 5: The overall cumulative effect of wind energy facilities on birds in this area, is likely to be of MODERATE NEGATIVE significance prior to mitigation in our opinion.

Step 6: It is recommended that each project within this broader area ensures that no effort is spared in mitigating impacts on avifauna. It is hoped that if each project provides sufficient mitigation, the overall cumulative impact can be reduced.

6. IMPACT OF GRID CONNECTION POWER LINE

Collision & electrocution on overhead power lines

Infrastructure associated with wind energy facilities also has the potential to impact on birds, in some cases more than the turbines themselves. Overhead power lines pose a collision and possibly an electrocution threat to certain bird species (depending on the pole top configuration). Furthermore, the construction and maintenance of the power lines will result in some disturbance and habitat destruction. New access roads, substations and offices constructed will also have a disturbance and habitat destruction impact. Collision with power lines is one of the biggest single threats facing birds in southern Africa (van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of water birds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001). Unfortunately, many of the collision sensitive species are considered threatened in southern Africa. The Red List species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). The larger bird species are most affected since they are most capable of bridging critical clearances on hardware.

Cause & comment

Birds could perch on the pylons/towers of the overhead power line and be at risk of electrocution if the design is not bird friendly. Birds in flight could collide with the overhead cables, particularly the earth wire. Collision and electrocution of birds on overhead power lines on site is anticipated to be of HIGH NEGATIVE significance.

Mitigation measures

Both of these impacts can be mitigated successfully in our opinion to reduce the significance to LOW NEGATIVE. In both cases the first and foremost approach to mitigation should be the selection of the shortest and most sensible possible length of new overhead power line to be constructed and the optimal route for this line. To mitigate for collision of the relevant species, it is recommended that the conductors on the high bird collision risk sections of the line (preliminary in Figure 12 but to be confirmed by avifaunal walk through of final layout) be fitted with the best available (at the time of construction) Eskom approved anti bird collision line marking device. This should preferably be a dynamic device, i.e. one that moves as it is believed that these are more effective in reducing collisions, especially for bustards (see Shaw 2013), which are one of the key species (Denham's Bustard) in this area. It is recommended that a durable device be used as this area is clearly prone to a lot of strong wind and dynamic devices may be susceptible to mechanical failure. It will be either EDF or Eskom's responsibility

to ensure that these line marking devices remain in working order for the full lifespan of the power line, as we cannot afford to have significant numbers of bird collisions on this new line. It is important that these devices are installed as soon as the conductors are strung, not only once the line is commissioned, as the conductors pose a collision risk as soon as they are strung. The devices should be installed alternating a light and a dark colour to provide contrast against dark and light backgrounds respectively. This will make the overhead cables more visible to birds flying in the area. Note that 100% of the length of each span needs to be marked (i.e. right up to each tower/pylon) and not the middle 60% as some guidelines recommend. This is based on a finding by Shaw (2013) that collisions still occur close to the towers or pylons. It is also recommended that the stay wires on the met masts on site be installed with these devices as soon as possible.

In the case of bird electrocution, the power line must be built on an Eskom approved bird-friendly pole structure which provides ample clearance between phases and phase-earth to allow large birds to perch on them in safety.

Significance statement

IMPACT 1: Collision & electrocution of birds on overhead power lines					
IMPACT	**EFFECT**			**RISK OR LIKELIHOOD**	**OVERALL SIGNIFICANCE**
	TEMPORAL SCALE	**SPATIAL SCALE**	**SEVERITY OF IMPACT**		
Without Mitigation	Long Term	Study Area	Severe -	Probable	**HIGH -**
With Mitigation	Long Term	Study Area	Slight -	Possible	**LOW -**
No-Go Alternative	Long Term	Study Area	Slight -	Probable	**LOW -**
Cumulative	Long Term	Study Area	Severe -	Probable	**MODERATE -**

7. MITIGATION OF THE IDENTIFIED RISKS TO AVIFAUNA

7.1. Spatial mitigation of avifaunal risk – avifaunal sensitivity mapping

The primary means of mitigating risk of wind energy facilities to birds is through spatial planning, both at the landscape level and the micro siting of turbines on site.

7.1.1. Landscape level sensitivity mapping

The "Avian Wind Farm Sensitivity map for South Africa" (Retief *et al,* 2011) was consulted to determine the sensitivity of the Albany site in national terms. Figure 11 shows that the site falls mostly in an area identified as low sensitivity. The exception is the far western most parts of the site which are classified as slightly higher sensitivity. For a full discussion on the methods used in producing this map see Retief *et al,* (2011).

The South African Important Bird and Biodiversity Area (IBBA) data was also consulted. There are no IBBA's close to the proposed site.

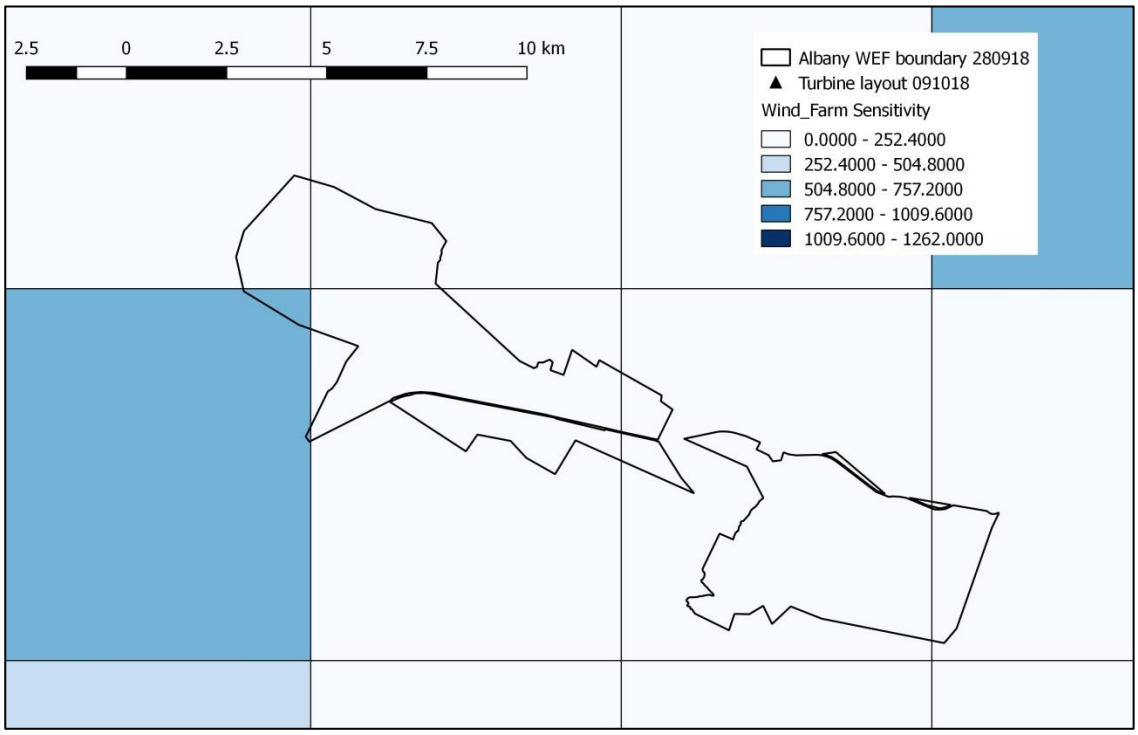

Figure 11. The position of the Albany site in terms of the "Avian wind farm sensitivity map" (Retief *et al*, 2011). Darker colours indicate higher avifaunal sensitivity.

7.1.2. On -site sensitivity mapping

Risk of wind turbines and associated infrastructure to birds is most typically mitigated for (pre-construction) by avoiding construction in high risk areas. We have described the risk to all key bird

species elsewhere in this report, but consolidate this information in Figure 12. The following factors were considered in the creation of this map:

- The location of the confirmed Jackal Buzzard breeding site. This has been allocated a 500m buffer no go area to mitigate for collision and disturbance impacts.
- The 'Beggars Bush' valley. This area has been buffered by 500m to provide additional protection for this sensitive area.
- The 'Green Hills' valley sensitive area. No buffer is recommended for this area based on current data, but it is recommended that as much separation as possible be maintained between turbines and the valley edge.
- The drainage line and dams that run centrally through the site from east to west have been identified as a potential flight path and buffered by 250m.
- Four areas have been identified as 'Collision risk areas' on site based on flight activity data collected.

None of the proposed infrastructure is in conflict with these above described constrained areas (Figure 12).

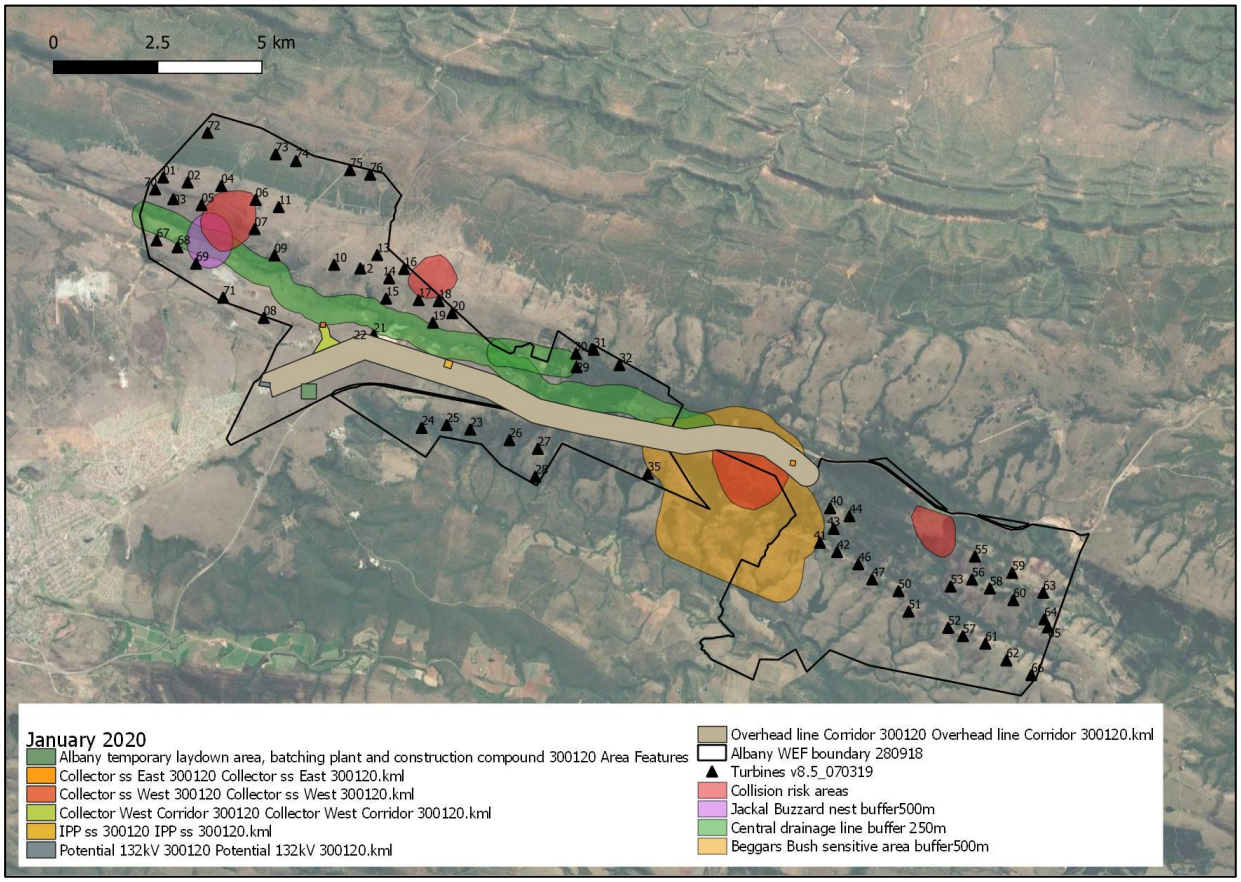

Figure 12. Consolidated avifaunal risk map for the Albany site.

In addition to the above identified constraints, several general principles should be adhered to with the layout:

- No turbines should be placed closer to the southern edge of the ridge line than current locations. The southern facing slopes are all sensitive habitat and topography that is used by birds in flight.
- No turbines should be placed with 250-300m of dams and major drainage lines.

8. CONCLUSION & RECOMMENDATIONS

This report presents the findings of the full years' worth of bird monitoring on site. These data are used to inform the impact assessment. Key findings include:

- A total of 211 bird species were recorded on site with a peak in species diversity in spring (150 species).
- Fifty-five species from the list of 210 species identified by Retief *et al* (2011, 2014) as high risk species for wind farms were recorded on the Albany site.
- Twenty-eight of these 54 bird species were identified as priority target bird species for this study. Twelve of these are Red Listed, comprising 4 'Endangered', 5 'Vulnerable' and 3 'Near-threatened' species.
- Walked transects on site recorded 62 small passerine species, with a peak of 43 species in summer. One of these species was Red Listed, the European Roller (Near-threatened).
- Drive transects on site recorded 8 species, none of which are Red Listed.
- A Jackal Buzzard nest site was found in the west of the site, and it is suspected that Martial Eagle could breed in the 'Beggars Bush' valley as they did breed there historically and birds were recorded regularly by our programme, although with no indications of breeding behaviour.
- Nineteen target bird species were recorded flying on site, with 95% of flight activity made up by raptors. This included 7 Red Listed species: Martial Eagle, Black Harrier and Yellow-billed Stork (Endangered); Denham's Bustard, Lanner Falcon and Secretarybird (Vulnerable); and Blue Crane (Near-threatened).
- Based on abundance and flight data collected on site, we conclude that 6 of the 28 target species will be at medium or high risk if the proposed wind farm is constructed and operated. These species are: Martial Eagle; Jackal Buzzard; Rock Kestrel; Secretarybird; Denham's Bustard and Blue Crane.
- In order to mitigate for these risks, we have identified areas of the site that should be avoided with new infrastructure.

Based on the avifaunal community on site, we draw the following conclusions with respect to the significance of impacts on avifauna:

- Construction of the facility will result in a certain amount of destruction and removal of natural vegetation which was previously available to avifauna for use. This impact is anticipated to be of MODERATE NEGATIVE significance pre mitigation. The required mitigation is to adhere to the sensitivity map contained in this report. This will reduce the significance to LOW NEGATIVE.

- Disturbance of birds is rated as LOW NEGATIVE significance, on account of there being no known breeding sites of sensitive bird species on or near site. No specific mitigation is required.
- Once operational the facility could displace certain birds from the area, or cause them to fly further to get around the facility. Displacement of birds is judged to be of LOW NEGATIVE significance pre mitigation. No specific mitigation is required.
- Birds in flight on the site could collide with operational turbine blades, thereby being killed or seriously injured. Collision of birds with turbines is judged to be of MODERATE NEGATIVE significance pre mitigation. The significance of this impact can be reduced to LOW NEGATIVE significance by adhering to the sensitivity map in Section 7, and by providing a contingency mitigation budget in the operational phase to allow adaptive management of impacts that arise. If such a situation arises possible necessary mitigation measures could include: further research into the problem (including possibly bird tracking studies); human based turbine shutdown on demand; habitat alteration; bird deterrence from site; and any others identified as feasible at the time.
- Birds could perch on the pylons/towers of the overhead power line and be at risk of electrocution if the design is not bird friendly. Birds in flight could collide with the overhead cables, particularly the earth wire. Collision and electrocution of birds on overhead power lines on site is anticipated to be of HIGH NEGATIVE significance. Both of these impacts can be mitigated successfully in our opinion to reduce the significance to LOW NEGATIVE. To mitigate for collision of the relevant species, it is recommended that the overhead cables on the spans identified as high risk be fitted with the best available (at the time of construction) Eskom approved anti bird collision line marking device. In the case of bird electrocution, the power line must be built on an Eskom approved bird-friendly pole structure which provides ample clearance between phases and phase-earth to allow large birds (such as eagles) to perch on them in safety. In addition, none of the on-site power line between turbines and between turbines and the site substation should be built above ground. The only above ground power line should be the grid connection power line (See Section 6).

We recommend that this wind farm can be developed with acceptable levels of risk to birds.

9. ACKNOWLEDGEMENTS

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10. REFERENCES

Allan, D.G. & Anderson, M.D. 2010. Assessment of the threats faced by South African bustards. Unpublished BirdLife South Africa report.

Allan, D. G. 2003. Abundance sex ratio, breeding and habitat of Stanley's Bustard *Neotis denhami stanleyi* in western South Africa. Durban Museum, Novit 28: 1-10.

Baisner, A.J., Andersen, J.L., Findsen, A., de Granath, S.W.Y., Madsen, K.O. & Desholm, M. 2010. Minimising collision risk between migrating raptors and marine wind farms: development of a spatial planning tool. Environmental Management 46, 801-808

Beilfuss, RD, Dodman, T., & Urban, E.K. 2007. The status of cranes in Africa in 2005. Ostrich 78: 175-184.

Brooke, R.K. 1984. South African Red Data Book – Birds. South African Natural Science Programme Report 97: 1-213

Bibby, C.J., Burgess, N.D., Hill, D.A., & Mustoe, S. 2000. Bird Census Techniques. Academic Press, London.

Curtis, O.E., Simmons, R.E., Jenkins, A.R., 2007. Black Harrier Circus maurus of the Fynbos biome, South Africa, a threatened specialist or an adaptable survivor. Bird Conservation International. 14: 233-245.

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

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

IUCN. 2015. Red List of birds.

Jenkins, A.R., Van Rooyen, C.S., Smallie, J., Harrison, J.A., Diamond, M., Smit-Robbinson, H.A. & Ralston, S. 2015. "Best practice guidelines for assessing and monitoring the impact of wind energy facilities on birds in southern Africa" Unpublished guidelines

Jordan, M., & Smallie, J. 2010. A briefing document on best practice for pre-construction assessment of the impacts of onshore wind farms on birds. Endangered Wildlife Trust, Unpublished report.

Marnewick MD, Retief EF, Theron NT, Wright DR, Anderson TA. 2015. Important Bird and Biodiversity

Areas of South Africa. Johannesburg: BirdLife South Africa.

Mucina, L., & Rutherford, C. 2006. The Vegetation of South Africa, Lesotho and Swaziland, South African National Biodiversity Institute, Pretoria.

Mundy, P.J., Ledger, J.A., Friedman, R. & Piper, S.E. 1992. The Vultures of Africa. Acorn Books & Russell Friedman Books, Randburg.

Ralston-Paton, S., Smallie, J., Pearson, A., & Ramalho, R. 2017. Wind energy's impacts on birds in South Africa: a preliminary review of the results of operational monitoring at the first wind farms of the Renewable Energy Independent Power Producer Procurement Programme Wind Farms in South Africa. In preparation.

Retief, E, Anderson, M., Diamond, M., Smit, H., Jenkins, A. & Brooks, M. 2011. Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures used.

Shaw, J.M. 2009. The End of the Line for South Africa's National Bird? Modelling Power Line Collision Risk for the Blue Crane. Master of Science in Conservation Biology. Percy FitzPatrick Institute of African Ornithology

Southern African Bird Atlas Project 2. In progress, 2015. www.sabap2.adu.org.za

Taylor, M. R, Peacock, F., & Wanless, R. 2015. The 2015 Eskom Red Data Book of Birds of South Africa, Lesotho & Swaziland.

Websites:
www.sabap2.adu.org.za. The Second Southern African Bird Atlas Project. In progress.
www.iucnredlist.org.

APPENDIX 1. BIRD SPECIES LISTS FOR THE ALBANY SITE.

"1" denotes presence, not abundance

Common name	*Species name*	Cons status	TOPS	IUCN 2019	Endemic /near	Retief 2014	Autumn	Winter	Spring	Summer
African Black Duck	*Anas sparsa*						1			
African Black Swift	*Apus barbatus*							1	1	1
African Darter	*Anhinga rufa*							1		
African Dusky Flycatcher	*Muscicapa adusta*						1	1	1	1
African Firefinch	*Lagonosticta rubricata*						1	1	1	1
African Goshawk	*Accipiter tachiro*					190				1
African Green Pigeon	*Treron calvus*							1		
African Harrier-Hawk	*Polyboroides typus*					83		1		1
African Hoopoe	*Upupa africana*						1	1	1	1
African Marsh Harrier	*Circus ranivorus*	EN	P			24			1	
African Olive Pigeon	*Columba arquatrix*								1	1
African Paradise Flycatcher	*Terpsiphone viridis*								1	1
African Pipit	*Anthus cinnamomeus*						1	1	1	1
African Rail	*Rallus caerulescens*						1	1	1	1
African Reed Warbler	*Acrocephalus baeticatus*								1	1
African Sacred Ibis	*Threskiornis aethiopicus*						1	1	1	1
African Snipe	*Gallinago nigripennis*						1	1		1
African Spoonbill	*Platalea alba*						1	1		
African Stonechat	*Saxicola torquatus*						1	1	1	1
African Swamphen	*Porphyrio madagascariensis*						1	1	1	
Alpine Swift	*Tachymarptis melba*							1		
Amethyst Sunbird	*Chalcomitra amethystina*						1		1	1
Amur Falcon	*Falco amurensis*					68				1
Ant-eating Chat	*Myrmecocichla formicivora*									1

Barn Swallow	*Hirundo rustica*					127				1
Bar-throated Apalis	*Apalis thoracica*						1	1	1	1
Black Crake	*Amaurornis flavirostris*								1	1
Black Harrier	*Circus maurus*	EN		EN	NE	6		1	1	1
Black Saw-wing	*Psalidoprocne holomelaena*							1	1	1
Black Sparrowhawk	*Accipiter melanoleucus*					101			1	1
Black-backed Puffback	*Dryoscopus cubla*						1	1	1	1
Black-collared Barbet	*Lybius torquatus*						1	1	1	1
Black-crowned Tchagra	*Tchagra senegalus*								1	
Black-headed Heron	*Ardea melanocephala*					141	1	1	1	
Black-headed Oriole	*Oriolus larvatus*						1	1	1	1
Black-shouldered Kite	*Elanus caeruleus*					94	1	1		1
Blacksmith Lapwing	*Vanellus armatus*					159	1	1	1	
Black-winged Stilt	*Himantopus himantopus*						1	1		1
Blue Crane	*Anthropoides paradiseus*	NT	VU	VU	NE	11			1	
Blue-mantled Crested Flycatcher	*Trochocercus cyanomelas*							1		
Bokmakierie	*Telophorus zeylonus*						1	1	1	1
Booted Eagle	*Aquila pennatus*					55			1	
Brimstone Canary	*Crithagra sulphuratus*						1	1		1
Brown-backed Honeybird	*Prodotiscus regulus*								1	
Brown-hooded Kingfisher	*Halcyon albiventris*						1	1	1	1
Brown-throated Martin	*Riparia paludicola*						1	1	1	1
Buff-streaked Chat	*Oenanthe bifasciata*				E	87		1		1
Burchell's Coucal	*Centropus burchellii*									1
Cape Batis	*Batis capensis*						1	1	1	1
Cape Bunting	*Emberiza capensis*						1	1		1
Cape Canary	*Serinus canicollis*						1	1	1	1
Cape Clapper Lark	*Mirafra apiata*				E	122		1		
Cape Crow	*Corvus capensis*						1	1	1	1
Cape Eagle-Owl	*Bubo capensis*					43	1			

Cape Glossy Starling	*Lamprotornis nitens*					1	1	1	1
Cape Grassbird	*Sphenoeacus afer*			NE	156	1	1	1	1
Cape Longclaw	*Macronyx capensis*				178	1	1	1	1
Cape Penduline Tit	*Anthoscopus minutus*						1	1	
Cape Robin-Chat	*Cossypha caffra*					1	1	1	1
Cape Rock Thrush	*Monticola rupestris*			E	119	1	1	1	1
Cape Shoveler	*Anas smithii*					1	1	1	1
Cape Sugarbird	*Promerops cafer*			E	152	1	1	1	
Cape Teal	*Anas capensis*					1		1	1
Cape Turtle Dove	*Streptopelia capicola*					1	1	1	1
Cape Wagtail	*Motacilla capensis*					1	1	1	1
Cape Weaver	*Ploceus capensis*			E	182			1	
Cape White-eye	*Zosterops virens*			E	183	1	1	1	1
Cardinal Woodpecker	*Dendropicos fuscescens*						1		1
Chestnut-vented Tit-Babbler	*Parisoma subcaeruleum*					1	1		1
Chinspot Batis	*Batis molitor*					1		1	
Chorister Robin-Chat	*Cossypha dichroa*					1	1		
Collared Sunbird	*Hedydipna collaris*						1		
Common Buzzard	*Buteo buteo*				69				1
Common Fiscal	*Lanius collaris*					1	1	1	1
Common Greenshank	*Tringa nebularia*						1	1	1
Common Moorhen	*Gallinula chloropus*						1	1	1
Common Quail	*Coturnix coturnix*						1	1	1
Common Sandpiper	*Actitis hypoleucos*								1
Common Starling	*Sturnus vulgaris*					1	1	1	
Common Waxbill	*Estrilda astrild*					1	1	1	1
Croaking Cisticola	*Cisticola natalensis*								1
Crowned Eagle	*Stephanoaetus coronatus*	VU	NT		26			1	
Crowned Hornbill	*Tockus alboterminatus*						1		
Dark-backed Weaver	*Ploceus bicolor*						1	1	

Dark-capped Bulbul	*Pycnonotus tricolor*						1	1	1	1
Denham's Bustard	*Neotis denhami*	VU	P	NT		21				1
Diderik Cuckoo	*Chrysococcyx caprius*								1	
Eastern Clapper Lark	*Mirafra fasciolata*									1
Eastern Long-billed Lark	*Certhilauda semitorquata*				E	123		1		
Egyptian Goose	*Alopochen aegyptiaca*					162	1	1	1	1
Emerald-spotted Wood Dove	*Turtur chalcospilos*						1	1	1	
European Roller	*Coracias garrulus*	NT				132				1
Familiar Chat	*Cercomela familiaris*						1	1	1	1
Fiscal Flycatcher	*Sigelus silens*				NE	187	1	1	1	1
Forest Buzzard	*Buteo trizonatus*					100	1			
Forest Canary	*Crithagra scotops*								1	1
Fork-tailed Drongo	*Dicrurus adsimilis*						1	1	1	1
Giant Kingfisher	*Megaceryle maximus*								1	
Golden-breasted Bunting	*Emberiza flaviventris*								1	
Goliath Heron	*Ardea goliath*								1	
Greater Double-collared Sunbird	*Cinnyris afer*				E	171	1	1	1	1
Greater Honeyguide	*Indicator indicator*								1	
Greater Striped Swallow	*Hirundo cucullata*								1	1
Green Wood-hoopoe	*Phoeniculus purpureus*							1	1	1
Green-backed Camaroptera	*Camaroptera brachyura*							1		1
Grey Heron	*Ardea cinerea*						1	1	1	1
Grey Sunbird	*Cyanomitra veroxii*						1	1	1	
Grey-backed Cisticola	*Cisticola subruficapilla*						1	1	1	1
Grey-headed Bushshrike	*Malaconotus blanchoti*						1	1	1	
Grey-winged Francolin	*Scleroptila africanus*					79				1
Gurney's Sugarbird	*Promerops gurneyi*				NE	174	1	1		
Hadeda Ibis	*Bostrychia hagedash*						1	1	1	1
Hamerkop	*Scopus umbretta*					118		1		
Hartlaub's Gull	*Larus hartlaubii*						1			

Helmeted Guineafowl	*Numida meleagris*						1	1		1
Jackal Buzzard	*Buteo rufofuscus*					44	1	1	1	1
Karoo Prinia	*Prinia maculosa*				NE	157	1	1	1	1
Karoo Scrub Robin	*Cercotrichas coryphoeus*						1	1	1	1
Klaas's Cuckoo	*Chrysococcyx klaas*									1
Knysna Turaco	*Tauraco corythaix*						1	1	1	1
Knysna Woodpecker	*Campethera notata*	NT		NT	NE	110		1		
Lanner Falcon	*Falco biarmicus*	VU				23		1	1	1
Laughing Dove	*Streptopelia senegalensis*						1	1	1	
Lazy Cisticola	*Cisticola aberrans*						1		1	1
Lesser Honeyguide	*Indicator minor*								1	
Lesser Striped Swallow	*Hirundo abyssinica*									1
Lesser Swamp Warbler	*Acrocephalus gracilirostris*						1	1	1	1
Levaillant's Cisticola	*Cisticola tinniens*							1	1	1
Little Grebe	*Tachybaptus ruficollis*						1	1	1	1
Little Rush Warbler	*Bradypterus baboecala*							1	1	1
Long-billed Crombec	*Sylvietta rufescens*						1			
Long-crested Eagle	*Lophaetus occipitalis*					84	1	1		1
Long-tailed Widowbird	*Euplectes progne*						1		1	
Malachite Sunbird	*Nectarinia famosa*						1	1	1	1
Martial Eagle	*Polemaetus bellicosus*	EN	VU	VU		4	1	1		1
Mocking Cliff Chat	*Thamnolaea cinnamomeiventris*						1		1	1
Neddicky	*Cisticola fulvicapilla*						1	1	1	1
Olive Bushshrike	*Telophorus olivaceus*								1	1
Olive Thrush	*Turdus olivaceus*						1	1	1	1
Olive Woodpecker	*Dendropicos griseocephalus*						1	1	1	
Pale Chanting Goshawk	*Melierax canorus*					75	1	1		
Pearl-breasted Swallow	*Hirundo dimidiata*					150	1			
Peregrine Falcon	*Falco peregrinus*		VU			48		1		
Pied Crow	*Corvus albus*						1	1	1	1

Pied Starling	*Spreo bicolor*			E	116	1		1	
Pin-tailed Whydah	*Vidua macroura*					1		1	1
Plain-backed Pipit	*Anthus leucophrys*							1	1
Purple Heron	*Ardea purpurea*				163			1	
Red-billed Teal	*Anas erythrorhyncha*					1	1	1	1
Red-chested Cuckoo	*Cuculus solitarius*							1	
Red-collared Widowbird	*Euplectes ardens*							1	1
Red-eyed Dove	*Streptopelia semitorquata*					1	1	1	1
Red-faced Mousebird	*Urocolius indicus*					1	1	1	1
Red-fronted Tinkerbird	*Pogoniulus pusillus*					1	1	1	1
Red-knobbed Coot	*Fulica cristata*					1	1	1	1
Red-necked Spurfowl	*Pternistis afer*					1	1	1	1
Red-throated Wryneck	*Jynx ruficollis*					1	1		1
Red-winged Francolin	*Scleroptila levaillantii*					1	1		
Red-winged Starling	*Onychognathus morio*					1	1	1	1
Reed Cormorant	*Phalacrocorax africanus*					1	1	1	
Rock Dove	*Columba livia*					1	1	1	1
Rock Kestrel	*Falco rupicolus*				111	1	1	1	1
Rock Martin	*Hirundo fuligula*					1	1		
Ruff	*Philomachus pugnax*							1	1
Rufous-breasted Sparrowhawk	*Accipiter rufiventris*				102	1	1	1	
Rufous-naped Lark	*Mirafra africana*						1	1	1
Secretarybird	*Sagittarius serpentarius*	VU	VU		12	1	1	1	1
Sombre Greenbul	*Andropadus importunus*					1	1	1	1
South African Shelduck	*Tadorna cana*					1	1	1	1
Southern Black Flycatcher	*Melaenornis pammelaina*						1	1	
Southern Boubou	*Laniarius ferrugineus*					1	1	1	1
Southern Double-collared Sunbird	*Cinnyris chalybeus*			E	184	1	1	1	1
Southern Grey-headed Sparrow	*Passer diffusus*							1	1
Southern Masked Weaver	*Ploceus velatus*						1	1	1

Southern Pochard	*Netta erythrophthalma*					1		
Southern Red Bishop	*Euplectes orix*						1	1
Southern Tchagra	*Tchagra tchagra*		E	129	1			
Speckled Mousebird	*Colius striatus*				1	1	1	1
Speckled Pigeon	*Columba guinea*				1	1		
Spectacled Weaver	*Ploceus ocularis*				1		1	
Spotted Eagle-Owl	*Bubo africanus*			98		1		
Spotted Thick-knee	*Burhinus capensis*							1
Spur-winged Goose	*Plectropterus gambensis*					1	1	1
Streaky-headed Seedeater	*Crithagra gularis*				1	1	1	1
Striped Flufftail	*Sarothrura affinis*	VU		85		1	1	
Swee Waxbill	*Coccopygia melanotis*				1	1	1	1
Tambourine Dove	*Turtur tympanistria*					1	1	1
Tawny-flanked Prinia	*Prinia subflava*					1		1
Terrestrial Brownbul	*Phyllastrephus terrestris*					1	1	1
Three-banded Plover	*Charadrius tricollaris*			140	1	1	1	1
Village Weaver	*Ploceus cucullatus*					1	1	1
Wailing Cisticola	*Cisticola lais*					1	1	
Western Cattle Egret	*Bubulcus ibis*			189	1	1	1	1
White-breasted Cormorant	*Phalacrocorax lucidus*					1	1	1
White-browed Scrub Robin	*Cercotrichas leucophrys*				1	1	1	
White-faced Whistling Duck	*Dendrocygna viduata*				1		1	1
White-necked Raven	*Corvus albicollis*				1	1	1	1
White-rumped Swift	*Apus caffer*						1	1
White-throated Swallow	*Hirundo albigularis*					1	1	1
Willow Warbler	*Phylloscopus trochilus*						1	1
Wing-snapping Cisticola	*Cisticola ayresii*						1	1
Wood Sandpiper	*Tringa glareola*					1	1	1
Yellow Bishop	*Euplectes capensis*				1		1	1
Yellow-billed Duck	*Anas undulata*				1	1	1	1

Yellow-billed Egret	*Egretta intermedia*				1			
Yellow-billed Kite	*Milvus migrans*			62		1	1	
Yellow-billed Stork	*Mycteria ibis*	EN	LC	9		1		
Yellow-breasted Apalis	*Apalis flavida*				1			
Yellow-fronted Canary	*Crithagra mozambicus*				1	1	1	1
Yellow-throated Petronia	*Petronia superciliaris*						1	
Zitting Cisticola	*Cisticola juncidis*					1		

APPENDIX 2. SMALL PASSERINE BIRD SPECIES RECORDED BY WALKED TRANSECTS AT ALBANY.

Endemics and near-endemics in italics. Only one species, European Roller is Red Listed (Near-threatened).

Common name	Scientific name	Retief *et al* 2014	Full year			Autumn			Winter			Spring			Summer		
		Transect length	**38.8**			**9.7**			**9.7**			**9.7**			**9.7**		
		# species	**62**			**24**			**31**			**29**			**43**		
			birds	**rec**	**Birds /km**	**birds**	**rec**	**Birds /km**	**birds**	**rec**	**Birds /km**	**birds**	**rec**	**Birds /km**	**birds**	**rec**	**Birds /km**
	All species		**618**	**408**	**15.93**	**86**	**58**	**7.22**	**146**	**108**	**14.33**	**172**	**103**	**17.73**	**214**	**139**	**22.06**
	Endemics/near		**46**	**35**	**1.19**	**4**	**3**	**0.41**	**13**	**10**	**1.34**	**10**	**9**	**1.03**	**19**	**13**	**1.96**
African Dusky Flycatcher	*Muscicapa adusta*		1	1	0.03				1	1	0.10						
African Pipit	*Anthus cinnamomeus*		5	4	0.13							2	2	0.21	3	2	0.31
African Stonechat	*Saxicola torquatus*		28	19	0.72	11	7	1.13	7	6		7	4	0.72	3	2	0.31
Amethyst Sunbird	*Chalcomitra amethystina*		6	5	0.15	1	1	0.10				5	4	0.52			
Barn Swallow	*Hirundo rustica*	127	12	8	0.31										12	8	1.24
Bar-throated apalis	*Apalis thoracica*		6	3	0.15							2	1	0.21	4	2	0.41
Black-headed Oriole	*Oriolus larvatus*		1	1	0.03										1	1	0.10
Bokmakierie	*Telophorus zeylonus*		56	28	1.44	6	3	0.62	21	11	2.16	18	9	1.86	11	5	1.13
Burchell's Coucal	*Centropus burchellii*		1	1	0.03										1	1	0.10
Cape Clapper Lark	*Mirafra apiata*	122	*1*	*1*	*0.03*				*1*	*1*	*0.10*						
Cape Glossy starling	*Lamprotornis nitens*		6	3	0.15	2	1	0.21	3	1	0.31				1	1	0.10
Cape Canary	*Serinus canicollis*		6	2	0.15							6	2	0.62			
Cape Grassbird	*Sphenoeacus afer*	156	*15*	*14*	*0.39*				*3*	*3*	*0.31*	*3*	*3*	*0.31*	*9*	*8*	*0.93*
Cape Longclaw	*Macronyx capensis*	178	31	21	0.80	10	6	1.03	5	3	0.52	10	7	1.03	6	5	0.62
Cape Robin-Chat	*Cossypha caffra*		6	6	0.15	1	1	0.10	3	3	0.31	1	1	0.10	1	1	0.10
Cape Sugarbird	*Promerops cafer*	152	*3*	*3*	*0.08*	*1*	*1*	*0.10*	*1*	*1*	*0.10*	*1*	*1*	*0.10*			
Cape Turtle-dove	*Streptopelia capicola*		24	17	0.62	6	3	0.62	13	9	1.34	2	2	0.21	3	3	0.31

Cape Wagtail	*Motacilla capensis*		2	2	0.05	1	1	0.10							1	1	0.10
Cape White-eye	*Zosterops virens*	183	*5*	*3*	*0.13*							*1*	*1*	*0.10*	*4*	*2*	*0.41*
Cardinal Woodpecker	*Dendropicos fuscescens*		1	1	0.03										1	1	0.10
Common Fiscal	*Lanius collaris*		23	20	0.59	4	4	0.41	5	5	0.52	7	4	0.72	7	7	0.72
Common Quail	*Coturnix coturnix*		1	1	0.03										1	1	0.10
Dark-capped Bulbul	*Pycnonotus tricolor*		26	16	0.67	1	1	0.10	4	3	0.41	6	4	0.62	15	8	1.55
Emerald-spotted Wood-Dove	*Turtur chalcospilos*		4	3	0.10				4	3	0.41						
European Roller	*Coracias garrulus*	132	1	1	0.03										1	1	0.10
Fork-tailed Drongo	*Dicrurus adsimilis*		5	4	0.13	2	1	0.21	1	1	0.10	1	1	0.10	1	1	0.10
Greater Double-collared Sun-bird	*Cinnyris afer*	171	*5*	*3*	*0.13*				*4*	*2*	*0.41*	*1*	*1*	*0.10*			
Green-backed Camaroptera	*Camaroptera brachyura*		3	3	0.08				1	1	0.10	1	1	0.10	1	1	0.10
Grey-backed Cisticola	*Cisticola subruficapilla*		65	51	1.68	10	6	1.03	21	17	2.16	22	19	2.27	12	9	1.24
Hadeda Ibis	*Bostrychia hagedash*		11	4	0.28	1	1	0.10						0.00	10	3	1.03
Helmeted Guineafowl	*Numida meleagris*		2	1	0.05										2	1	0.21
Karoo Prinia	*Prinia maculosa*	157	*17*	*11*	*0.44*	*3*	*2*	*0.31*	*4*	*3*	*0.41*	*4*	*3*	*0.41*	*6*	*3*	*0.62*
Lazy Cisticola	*Cisticola aberrans*		4	3	0.10										4	3	0.41
Little Rush-warbler	*Bradypterus baboecala*		1	1	0.03							1	1	0.10			
Knysna Turaco	*Tauraco corythaix*		1	1	0.03				1	1	0.10						
Malachite Sunbird	*Nectarinia famosa*		31	25	0.80	1	1	0.10	13	10	1.34	17	14	1.75			
Neddicky	*Cisticola fulvicapilla*		38	29	0.98	8	6	0.82	5	4	0.52	12	8	1.24	13	11	1.34
Olive Thrush	*Turdus olivaceus*		2	2	0.05										2	2	0.21
Pin-tailed Whydah	*Vidua macroura*		2	1	0.05										2	1	0.21
Red-collared Widowbird	*Euplectes ardens*		14	3	0.36										14	3	1.44
Red-eyed Dove	*Streptopelia semitorquata*		1	1	0.03	1	1	0.10									
Red-faced Mousebird	*Urocolius indicus*		26	4	0.67				3	2	0.31	23	2	2.37			
Red-throated Wryneck	*Jynx ruficollis*		5	4	0.13				2	2	0.21				3	2	0.31
Red-winged Francolin	*Scleroptila levaillantii*		2	2	0.05				2	2	0.21						
Red-winged Starling	*Onychognathus morio*		5	2	0.13				5	2	0.52						
Red-necked Spurfowl	*Pternistis afer*		3	2	0.08	1	1					2	1	0.21			
Rock Martin	*Hirundo fuligula*		1	1	0.03				1	1	0.10						
Rufous-naped Lark	*Mirafra africana*		12	9	0.31				3	3	0.31	3	2	0.31	6	4	0.62
Sombre Greenbul	*Andropadus importunus*		28	16	0.72	3	3		1	1	0.10				24	12	2.47
Southern Boubou	*Laniarius ferrugineus*		20	15	0.52	2	2		5	4	0.52	3	2	0.31	10	7	1.03

Speckled Mousebird	*Colius striatus*	17	5	0.44	5	1	1	1	0.10	9	1	0.93	2	2	0.21
Southern Double-collared Sunbird	*Columba guinea*	1	1	0.03									1	1	0.10
Southern Masked-weaver	*Ploceus velatus*	2	2	0.05									2	2	0.21
Streaky-headed Seedeater	*Crithagra gularis*	3	3	0.08	2	2				1	1	0.10			
Tawny-flanked Prinia	*Prinia subflava*	2	1	0.05			2	1	0.21						
Village Weaver	*Ploceus cucullatus*	1	1	0.03									1	1	0.10
Wailing Cisticola	*Cisticola lais*	8	5	0.21	3	2							5	3	0.52
Willow Warbler	*Phylloscopus trochilus*	2	2	0.05									2	2	0.21
Wing-snapping Cisticola	*Cisticola ayresii*	2	2	0.05									2	2	0.21
White-rumped Swift	*Apus caffer*	1	1	0.03						1	1	0.10			
Yellow Bishop	*Euplectes capensis*	3	2	0.08									3	2	0.31
Yellow-fronted Canary	*Crithagra mozambicus*	1	1	0.03									1	1	0.10

APPENDIX 3. PHOTOGRAPHS & RESULTS FROM FOCAL SITES AT ALBANY.

The results from FS1 to 5 (the dams) is presented below. Results from FS6 to 10 are discussed qualitatively in Section 3.2.3.

		Autumn		Winter				Spring				Summer	
Common name	**Scientific name**	**FS1**	**FS5**	**FS1(2)**	**FS2**	**FS4**	**FS5**	**FS1(2)**	**FS2(2)**	**FS3**	**FS4**	**FS1**	**FS2**
African Black Duck	*Anas sparsa*		2										
African Purple Swamphen	*Porphyrio madagascariensis*				1				1				
African Rail	*Rallus caerulescens*				4				2				3
African Sacred Ibis	*Threskiornis aethiopicus*	2		4	10			2				1	
African Snipe	*Gallinago nigripennis*	3		1								2	
Black Crake	*Amaurornis flavirostris*				2				8				4
Black-headed Heron	*Ardea melanocephala*		1										
Black-winged Stilt	*Himantopus himantopus*			5				45				8	
Cape Shoveler	*Anas smithii*	3			17			1	48			1	2
Cape Teal	*Anas capensis*			12	8			24	12			25	
Cattle Egret	*Bubulcus ibis*											21	
Common Greenshank	*Tringa nebularia*			1				1				1	
Common Moorhen	*Gallinula chloropus*				4				6				1
Common Sandpiper	*Actitis hypoleucos*											5	
Egyptian Goose	*Alopochen aegyptiaca*	2		4	4	2		21	3			12	3
Goliath Heron	*Ardea goliath*									1			
Grey Heron	*Ardea cinerea*	1										3	1
Hamerkop	*Scopus umbretta*						1						
Little Grebe	*Tachybaptus ruficollis*	2		1	90	1			63				28
Red-billed Teal	*Anas erythrorhyncha*			6	2			42	2			31	
Red-knobbed Coot	*Fulica cristata*	7		13	2			40	11			7	3
Reed Cormorant	*Phalacrocorax africanus*		1	2	1			1	2				
Ruff	*Philomachus pugnax*							1				1	
South African Shelduck	*Tadorna cana*			4				6	2	2	1	7	
Southern Pochard	*Netta erythrophthalma*				3								
Spur-winged Goose	*Plectropterus gambensis*												1

White-breasted Cormorant	*Phalacrocorax lucidus*		2	1		1	3			1
White-faced Duck	*Dendrocygna viduata*						2			
Wood Sandpiper	*Tringa glareola*		1			1			1	
Yellow-billed Duck	*Anas undulata*		5	18		8	22		6	57

APPENDIX 4. INCIDENTAL OBSERVATION DATA FOR THE ALBANY SITE.

Common name	Scientific name	Taylor *et al* 2015	Full year		Autumn		Winter		Spring		Summer	
			#birds	#records	#birds	#records	#birds	#records	#birds	#records	#birds	#records
		All species	77	68	18	17	13	13	16	14	30	24
		Red List species	13	11	0	0	1	1	5	4	7	6
African Marsh-Harrier	*Circus ranivorus*	EN	1	1					1	1		
Amur Falcon	*Falco amurensis*		4	2							4	2
Black Harrier	*Circus maurus*	EN	2	2							2	2
Black-shouldered Kite	*Elanus caeruleus*		4	3	3	2					1	1
Blue Crane	*Anthropoides paradiseus*	NT	2	1					2	1		
Booted Eagle	*Hieraaetus pennatus*		1	1					1	1		
Denham's Bustard	*Neotis denhami*	VU	5	4					1	1	4	3
Forest Buzzard	*Buteo trizonatus*		2	2	2	2						
Grey-winged Francolin	*Scleroptila africana*		2	1							2	1
Jackal Buzzard	*Buteo rufofuscus*		31	30	11	11	6	6	9	8	5	5
Long-crested Eagle	*Lophaetus occipitalis*		4	3							4	3
Martial Eagle	*Polemaetus bellicosus*	EN	1	1							1	1
Pale Chanting Goshawk	*Melierax canorus*		1	1			1	1				
Rock Kestrel	*Falco rupicolus*		9	8	2	2	3	3			4	3
Rufous-chested Sparrowhawk	*Accipiter rufiventris*		1	1			1	1				
Secretarybird	*Sagittarius serpentarius*	VU	2	2			1	1	1	1		
Spotted Eagle-Owl	*Bubo africanus*		1	1			1	1				
Steppe Buzzard	*Buteo buteo*		3	3							3	3
Yellow-billed Kite	*Milvus migrans*		1	1					1	1		

APPENDIX 5. IMPACT ASSESSMENT CRITERIA (EOH-CES)

The following standard rating scales have been defined for assessing and quantifying the identified impacts. This is necessary since impacts have a number of parameters that need to be assessed. The identified impacts have been assessed against the following criteria:

- Temporal scale;
- Spatial scale;
- Risk or likelihood;
- Degree of confidence or certainty;
- Severity or benefits; and the
- Significance.

The relationship of the issue to the temporal scale, spatial scale and the severity are combined to describe the overall importance rating, namely the significance of the assessed impact.

Table 1.1: Significance Rating Table.

TEMPORAL SCALE *(THE DURATION OF THE IMPACT)*	
Short term	Less than 5 years (Many construction phase impacts are of a short duration).
Medium term	Between 5 and 20 years.
Long term	Between 20 and 40 years (From a human perspective almost permanent).
Permanent	Over 40 years or resulting in a permanent and lasting change that will always be there.
SPATIAL SCALE *(THE AREA IN WHICH ANY IMPACT WILL HAVE AN AFFECT)*	
Localised	Impacts affect a small area of a few hectares in extent. Often only a portion of the project area.
Study area	The proposed site and its immediate surroundings.
Municipal	Impacts affect the Nelson Mandela Bay Metropolitan Municipality, or any towns within the municipality.
Regional	Impacts affect the wider area or the Eastern Cape Province as a whole.
National	Impacts affect the entire country.
International/Global	Impacts affect other countries or have a global influence.
LIKELIHOOD *(THE CONFIDENCE WITH WHICH ONE HAS PREDICTED THE SIGNIFICANCE OF AN IMPACT)*	
Definite	More than 90% sure of a particular fact. Should have substantial supportive data.
Probable	Over 70% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Only over 40% sure of a particular fact, or of the likelihood of an impact occurring.
Unsure/Unlikely	Less than 40% sure of a particular fact, or of the likelihood of an impact occurring.

Table 1.2: Impact Severity Rating.

Impact severity *(The severity of negative impacts, or how beneficial positive impacts would be on a particular affected system or affected party)*	
Very severe	***Very beneficial***
An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated. For example the permanent loss of land.	A permanent and very substantial benefit to the affected system(s) or party(ies), with no real alternative to achieving this benefit. For example the

	vast improvement of sewage effluent quality.
Severe	***Beneficial***
Long term impacts on the affected system(s) or party(ies) that could be mitigated. However, this mitigation would be difficult, expensive or time consuming, or some combination of these. For example, the clearing of forest vegetation.	A long term impact and substantial benefit to the affected system(s) or party(ies). Alternative ways of achieving this benefit would be difficult, expensive or time consuming, or some combination of these. For example an increase in the local economy.
Moderately severe	***Moderately beneficial***
Medium to long term impacts on the affected system(s) or party (ies), which could be mitigated. For example constructing a sewage treatment facility where there was vegetation with a low conservation value.	A medium to long term impact of real benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are equally difficult, expensive and time consuming (or some combination of these), as achieving them in this way. For example a 'slight' improvement in sewage effluent quality.
Slight	***Slightly beneficial***
Medium or short term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary. For example a temporary fluctuation in the water table due to water abstraction.	A short to medium term impact and negligible benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are easier, cheaper and quicker, or some combination of these.
No effect	***Don't know/Can't know***
The system(s) or party(ies) is not affected by the proposed development.	In certain cases it may not be possible to determine the severity of an impact.

Table 1.3: Overall Significance Rating.

OVERALL SIGNIFICANCE *(THE COMBINATION OF ALL THE ABOVE CRITERIA AS AN OVERALL SIGNIFICANCE)*	
VERY HIGH NEGATIVE	**VERY BENEFICIAL**
These impacts would be considered by society as constituting a major and usually permanent change to the (natural and/or social) environment, and usually result in severe or very severe effects, or beneficial or very beneficial effects. Example: The loss of a species would be viewed by informed society as being of VERY HIGH significance. Example: The establishment of a large amount of infrastructure in a rural area, which previously had very few services, would be regarded by the affected parties as resulting in benefits with VERY HIGH significance.	
HIGH NEGATIVE	**BENEFICIAL**
These impacts will usually result in long term effects on the social and/or natural environment. Impacts rated as HIGH will need to be considered by society as constituting an important and usually long term change to the (natural and/or social) environment. Society would probably view these impacts in a serious light. Example: The loss of a diverse vegetation type, which is fairly common elsewhere, would have a significance rating of HIGH over the long term, as the area could be rehabilitated. Example: The change to soil conditions will impact the natural system, and the impact on affected parties (such as people growing crops in the soil) would be HIGH.	
MODERATE NEGATIVE	**SOME BENEFITS**
These impacts will usually result in medium to long term effects on the social and/or natural environment. Impacts rated as MODERATE will need to be considered by society as constituting a fairly important and usually medium term change to the (natural and/or social) environment. These impacts are real but not substantial. Example: The loss of a sparse, open vegetation type of low diversity may be regarded as MODERATELY significant.	
LOW NEGATIVE	**FEW BENEFITS**
These impacts will usually result in medium to short term effects on the social and/or natural environment. Impacts rated as LOW will need to be considered by the public and/or the specialist as constituting a fairly unimportant and usually short term change to the (natural and/or social) environment. These impacts are not	

substantial and are likely to have little real effect. Example: The temporary changes in the water table of a wetland habitat, as these systems are adapted to fluctuating water levels. Example: The increased earning potential of people employed as a result of a development would only result in benefits of LOW significance to people who live some distance away.
NO SIGNIFICANCE
There are no primary or secondary effects at all that are important to scientists or the public. Example: A change to the geology of a particular formation may be regarded as severe from a geological perspective, but is of NO significance in the overall context.
DON'T KNOW
In certain cases it may not be possible to determine the significance of an impact. For example, the primary or secondary impacts on the social or natural environment given the available information. Example: The effect of a particular development on people's psychological perspective of the environment.

All feasible alternatives and the "no-go option" will be equally assessed in order to evaluate the significance of the "as predicted" impacts (prior to mitigation) and the "residual" impacts (that remain after mitigation measures are taken into account). The reason(s) for the judgement will be provided when necessary.