Umsobomvu Wind Energy Facility – Eskom Infrastructure MTS

EDF Renewables

Avifaunal Impact Assessment report

September 2018

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EXECUTIVE SUMMARY

EDF Renewables (hereafter EDF) previously obtained environmental authorization (2017) for a large wind farm and grid connection named Umsobomvu, located between Middleburg and Noupoort in the Eastern and Northern Cape provinces respectively. EDF now propose to split this wind farm into three authorisations: Umsobomvu Wind Farm; Coleskop Wind Farm; and the Eskom Infrastructure MTS (this application). EOH Coastal & Environmental Services (hereinafter referred to as EOH-CES) was appointed by EDF to undertake the amendment process. WildSkies Ecological Services (Pty) Ltd (Jon Smallie) conducted the pre-construction bird monitoring and the original impact assessment and was appointed to update the impact assessment report and split it into the three projects Umsobomvu, Coleskop, and Eskom Infrastructure MTS. This report assesses the 'Eskom Infrastructure MTS' project.

Pre-construction bird monitoring was conducted on site across four seasons, and comprised a total of 64 days on site by a team of two observers, plus several extra days surveying sensitive areas, and a specialist site visit. A total of 142 bird species were recorded on site. Bird species richness on site peaked in spring and summer. Forty small terrestrial bird species were recorded on site by walked transects, and 13 species of large terrestrials and raptors were recorded by drive transects. Three breeding pairs of Verreaux's Eagle were found to be occupying territories on site. Ten target bird species were recorded flying on site (7 raptors, 2 large terrestrials and 1 water bird). Overall, flight activity was relatively low on site, a total of 113 flight records being made across 288 hours of observation. Most flight activity on site (once VP1 is excluded) was that of Rock Kestrel, followed by Verreaux's Eagle, Jackal Buzzard and Booted Eagle. Large terrestrials were recorded flying only once each (Blue Crane and Ludwig's Bustard). The target bird species flight data was used to create a spatial 'collision risk index' for the site. Key patterns that emerge from this index include: that most flight risk on site is associated with Verreaux's Eagle; that most Verreaux's Eagle flight takes place close to (within 1 to 1.5km) the nest; and that Verreaux's Eagle flight activity is distributed unevenly around nests (i.e. not circular) apparently following steep topography and rock lines.

The above information was used to assess the risk that the proposed Eskom Infrastructure MTS poses to each of the target bird species. Two species emerge at being of highest risk should the proposed facility be built: Verreaux's Eagle; and Ludwig's Bustard. The formal assessment of impacts, according to standard criteria supplied by EOH-CES resulted in the following findings:

- Destruction of bird habitat is anticipated to be of MEDIUM significance pre-mitigation. Adherence to the recommendations of this report, in particular the sensitivity map, will reduce this to LOW significance.

- Disturbance if birds, particularly breeding Verreaux's Eagles could be of HIGH significance, but can be mitigated to LOW significance through adherence to the sensitivity map and other recommendations.
- Collision of birds with power lines is judged to be of HIGH significance. This can be mitigated to LOW significance.
- Nesting of birds on power line infrastructure once operational will be of LOW significance.
- Electrical faulting caused by birds on 400kV lines will be of LOW significance.
- The contribution that the Umsobomvu Eskom Infrastructure MTS facility will make to the cumulative impacts of wind farms on birds in this area is judged to be of LOW significance.
- The preferred option for the 400kv loop in power lines Option A, followed by Option B. we recommend against the use of Option C.

At a national level the site could be classified as being in a medium sensitivity area. On site, two levels of sensitivity or constraint were identified. High sensitivity areas should not receive any new infrastructure, and include: eagle breeding site buffer areas; a buffer of 200m from all ridge edges (diameter of turbine rotor plus some extra leeway); steep mountain sides; valleys; and drainage lines. Medium sensitivity areas consist of buffers around dams on site. The Medium sensitivity areas are softer buffer areas, which can accept some infrastructure depending on the site specific context of the dam (including its size).

The following recommendations are made for the management of risk to avifauna at this site:

- No infrastructure should be built in the areas identified as HIGH sensitivity in this report.
- A final avifaunal walk through should be conducted prior to construction to ensure that all the avifaunal aspects have been adequately managed and to ground truth the final layout of all infrastructure. This will most likely be done as part of the site specific Environmental Management Plan. This will also allow the development of specific management actions for the Environmental Control Officer during construction and training for relevant on site personnel if necessary.
- To mitigate for collision of the relevant species with the overhead line it is recommended that the earth wires on all spans 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 (Ludwig'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 and earth wires 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. Eskom Transmission has a guideline for this work and this should be followed. 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.

- The mitigation for bird nesting on pylons and bird caused electrical faulting are reactive and should only be applied if these issues become significant once the facility is operational.

If these recommendations are adhered to, this project can proceed in our opinion.

REPORT REVIEW & TRACKING

Document title	Umsobomvu Wind Energy Facility – Eskom Infrastructure MTS Avifaunal Impact Assessment Report	
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SPECIALIST DETAILS

Professional registration

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)

Investigator:	Jon Smallie (*Pri.Sci.Nat)*
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Fields of Expertise:	Ecological Science
Registration:	Professional Member

Professional experience

Jon Smallie has been involved in bird interactions with energy infrastructure for 15 years. During this time he has completed impact assessments for more than 100 projects, many of which involved overhead power lines. A full Curriculum Vitae can be supplied on request.

Declaration of Independence

The specialist investigator (WildSkies Ecological Services) declares 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 and Liabilities

- This report is based on four seasons of pre-construction bird monitoring on site, and other available information and data related to the site to be affected.
- 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.
- 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 September 2018 by Jon Smallie, in his capacity as avifaunal specialist for this project.

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1 INTRODUCTION

EDF Renewables (hereafter EDF) previously obtained environmental authorization (2017) for a large wind farm and grid connection named Umsobomvu, located between Middleburg and Noupoort in the Eastern and Northern Cape provinces respectively. EDF now propose to split this wind farm into three authorisations: Umsobomvu Wind Farm; Coleskop Wind Farm; and the Eskom Infrastructure MTS (this application).

EOH Coastal & Environmental Services (hereinafter referred to as EOH-CES) was appointed by EDF to undertake the amendment process. WildSkies Ecological Services (Pty) Ltd (Jon Smallie) conducted the pre-construction bird monitoring and the original impact assessment and was appointed to update the impact assessment report and split it into the three projects Umsobomvu, Coleskop, and Eskom Infrastructure MTS. This report deals with the Eskom Infrastructure MTS component.

Typically a power line and substation of this nature can be expected to impact on avifauna as follows: disturbance of birds during construction and operation; habitat destruction during construction and maintenance of the facility and associated infrastructure; and collision and electrocution of birds on electrical infrastructure. The pre-construction bird monitoring carried out on site over four seasons collected the data required to assess the likelihood and significance of each of these impacts.

Topographically the site is considered mountainous and is varied in vegetation with open grassland on the higher ground, and thornveld in the lower lying and steeper areas. This presents a diverse habitat for use by birds and we can expect a high diversity of bird species to utilise the site. An approximate total of 254 bird species could occur in the broader area, based on what has been recorded in the study area by the first and second bird atlas projects (http://mybirdpatch.adu.org.za/). Pre-construction bird monitoring recorded a total of 142 species on the site itself. This is a relatively good diversity of species, reflecting the diversity of habitats in the broader study area. A total of 22 bird species which could occur on site are considered regionally threatened (Taylor *et al*, 2015). Many of the recorded threatened species are important with respect to overhead power lines and substations. The large terrestrial species (i.e. Ludwig's Bustard *Neotis ludwigii,* Kori Bustard *Ardeotis kori,* Blue Crane *Anthropoides paradiseus,* Secretarybird *Sagittarius serpentarius,* Blue Korhaan *Eupodotis caerulescens* and Karoo Korhaan *Eupodotis vigorsii)* as well as the water dependent species (i.e. Black Stork *Ciconia nigra*, Greater Flamingo *Phoenicopterus ruber*, Lesser Flamingo *Phoenicopterus minor)*, raptors (Black Harrier *Circus maurus* and African Marsh-Harrier *Circus ranivorus)* and the large Martial Eagle *Polemaetus bellicosus,* Tawny Eagle *Aquila rapax* and Verreaux's Eagle *Aquila verreauxii* are all believed to be likely to collide with power lines and in some cases be susceptible to electrocution.

1.1 Description of the proposed project

The proposed facility will consist of the following:

- MTS Substation Area
  - New position at 31°21'21.95"S; 24°49'21.88"E.
  - Substation Area to be increased to 600m x 600m.
  - Description to include the IPP Substation portion within the MTS Substation area.

- 400kV overhead line to added to this EA – 1km.
  - 100m Corridor for the 400kV line, Loop-in Loop out on to the 400kV Hydra-Poseidon 2 line.

There is no alternative site for consideration for the substation. Alternatives exist for the 400kV loop in lines (A, B &C – see Figure 1).

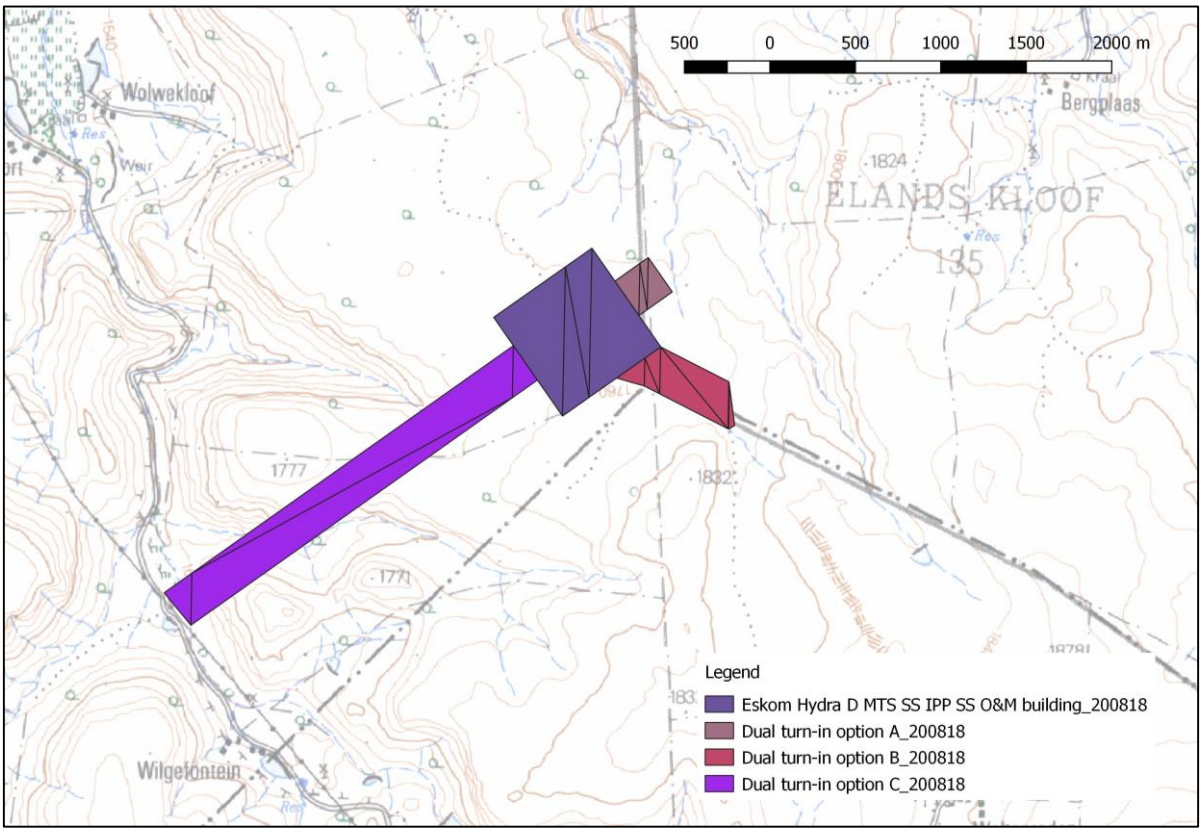

Figure 1. The layout of the proposed Umsobomvu Wind Energy Facility – Eskom Infrastructure MTS.

1.2 Background to power lines and birds

Collision with power lines is a well-known conservation problem for many birds and for some species it can be a significant source of mortality (Bevanger 1998, Erickson *et al.* 2005, Drewitt & Langston 2008, Shaw *et al.* 2010, Jenkins *et al.* 2011). The reasons for collisions are complex, with each case involving a variety of biological, topographical, meteorological and technical factors (Bevanger 1994). Although all birds have the potential to be affected by collisions, those most heavily impacted are generally large, flocking species which fly often, with waterfowl, gamebirds, cranes, bustards and storks usually among the most frequently reported casualties (Bevanger 1998, Janss 2000, Jenkins *et al.* 2010). The large body size of such species mean that they have limited maneuverability in the air and are less able to take necessary evasive action to avoid colliding with power lines (Bevanger 1998).

In South Africa, incidentally discovered mortality incidents reported by Eskom staff, conservationists and the general public are collated in the Central Incident Register, which is maintained by the Eskom-Endangered Wildlife Trust Strategic Partnership (Eskom-EWT). These data, together with those from more systematic power line surveys near De Aar (Anderson 2002), in the Overberg (Shaw *et al.* 2010) and across the Karoo (Jenkins *et al.* 2011, Shaw 2013) highlight the high levels of large terrestrial bird mortality caused by existing power lines in this country. Particularly affected are Red-listed birds including cranes, bustards, storks, Secretarybirds, flamingos and vultures, which are generally long-lived and slow to reproduce (Shaw 2013). These species have not evolved to cope with high adult mortality, with the result that consistent mortality in this age group over an extended period could seriously affect a population's ability to sustain itself in the long or even medium term. The cumulative effects of collisions together with other anthropogenic threats to these species (e.g. habitat destruction, disturbance) are unknown over the long term.

Mitigating bird collisions with power lines typically involves the installation of line marking devices on the cables in order to make them more visible to approaching birds. Worldwide, a variety of marking devices are used, but very few have been adequately field-tested (Jenkins *et al.* 2010). Great uncertainty remains about which are best, as they vary enormously in effectiveness between species and in different conditions (van Rooyen & Ledger 1999, Anderson 2002). Generally though, marking seems to be fairly effective, with a recent meta-analysis showing a 78% decrease in mortality rates on marked lines (Barrientos *et al.* 2011).

The reason for this apparently low efficacy is likely to be a result of the visual capacity of bustards. A recent South African study on Kori Bustards *Ardeotis kori*, Blue Cranes *Anthropoides paradiseus* and White Storks *Ciconia ciconia* demonstrated that these birds have a narrow field of frontal vision, so

when in flight, head movements in the vertical plane (pitching the head to look downwards, perhaps to look for other birds or foraging patches) will render the bird blind in the direction of travel and they will not see the power line at all (Martin & Shaw 2010). Similar visual constraints were subsequently found in *Gyps* vultures, including White-backed Vultures (Martin *et al.* 2012). Development of additional mitigation to draw the bird's attention to the marked line (which must still be marked, because the bird will see the markers if it is looking at the line) is a priority for future research for these groups of birds.

While collisions generally occur in hot-spots (i.e. many collisions, sometimes of multiple species in small areas) and are not spread evenly across the landscape, the factors describing these locations are still very difficult to understand. Landscape level GIS studies on Blue Cranes and Ludwig's Bustard in South Africa have failed to find useful contributory factors (Shaw *et al.* 2010, Shaw 2013). Some locations are clearly high risk for resident birds with predictable movement patterns, such as lines in close proximity to roosting dams for cranes.

During the construction phase of power lines and substations, a certain amount of *habitat destruction* and alteration takes place on the site. This happens with the construction of access roads, the clearing of the site itself and any associated infrastructure. The servitude also has to be maintained free of any natural vegetation, amongst other reasons to minimize the risk of fire. The destruction or alteration of natural habitat has an impact on birds breeding, foraging and roosting in close proximity to the site.

Similarly, the above mentioned construction and maintenance activities impact on birds through *disturbance*, particularly during breeding activities. The potential exists for the impact of disturbance to influence a greater area than the site itself. This site is relatively un-disturbed by other infrastructure for the most part. Given the presence of sensitive species such as Verreaux's Eagle breeding near the site, the impact of disturbance could be significant for this project.

Electrocution refers to the scenario whereby a bird bridges the gap between two phases or a phase and an earthed component thereby causing an electrical short circuit. The larger bird species such as vultures and eagles are particularly vulnerable to this impact, as obviously the larger the wingspan and other dimensions of a bird, the greater the likelihood of it being able to bridge the gap between hardware. On transmission lines such the proposed power line the impact of electrocutions is not possible due to the large clearances between phases and/or phases and earthed structures. This impact is not discussed further.

Raptors, large eagles, crows, Hadeda Ibises *Bostrychia hagedash* and Egyptian Geese *Alopochen aegyptiaca* have learnt to *nest on transmission towers*, and this has allowed them to breed in areas of the country where breeding would not previously have been possible due to limited nesting substrates (van Rooyen & Ledger 1999, de Goede & Jenkins 2001). This has probably resulted in a range expansion for some of these species, and large eagles such as Tawny, Martial and Verreaux's are now quite common inhabitants of transmission towers in the Karoo (e.g. de Goede & Jenkins 2001). Cape Vultures *Gyps africanus* and White-backed Vultures have also taken to roosting on power lines in certain areas in large numbers, while Lappet-faced Vultures are also known to use power lines as roosts, especially in areas where large trees are scarce (J. Smallie pers. obs.). At face value this appears a positive contribution that power lines can make to these species. However the situation is more complex in that nesting on the tower places the adults and young at much greater risk of collision with the overhead cables than would otherwise be the case. Due to the electrical faulting that these birds can cause on transmission towers, Eskom also sometimes wishes to remove nests in order to manage the risk of faulting, with negative effects for the birds if not correctly handled. The actual nesting of birds on the proposed new power line only becomes an issue if Eskom need to intervene with nesting and breeding activities. It is essential that all activities related to raptor nests be subject to Eskom Transmissions nest management guidelines, and to the relevant provincial and national legislation.

Birds are able to *cause electrical faults on transmission* power lines through their faeces and/or nest material. Large birds sitting above live conductors can cause flashovers when they produce long continuous 'streamers' of excrement which bridges the critical air gap, or through buildup of faeces on insulators to the point where the insulation is compromised and a fault occurs. Material used to build nests on towers can also intrude into the air gap and cause short circuits. With the abundance of large eagles in this study area, this interaction is a strong likelihood for the proposed power line.

2 METHODOLOGY

2.1 Terms of reference

The avifaunal specialist has conducted this assessment according to the terms of reference provided by EOH-CES for a study of this nature. The terms of reference are as follows:

- The existing environment must be described and the bird communities most likely to be impacted will be identified. Different bird micro-habitats must be described as well as the species associated with those habitats.
- Typical impacts that could be expected from the developments must be listed as well as the expected impact on the bird communities. Impacts must be quantified (if possible) and a full description of predicted impacts (direct and indirect) must be provided.
- Gaps in baseline data must be highlighted and discussed. An indication of the confidence levels must be given. The best available data sources must be used to predict the impacts including the results of the pre-construction monitoring and specialist studies that have been completed for previous EIA studies (if any) conducted at the site (or similar sites), and extensive use must be made of local knowledge, if available.
- The potential impact on the birds must be assessed and evaluated according to the requirements prescribed by the Environmental Assessment Practitioner.
- Practical mitigation measures must be recommended and discussed, including a post construction monitoring programme.
- Bird sensitive areas must be mapped in a sensitivity map for easy reference. Any no-go areas must be clearly indicated.

2.2 Project objectives

The aims of this study are as follows:

- To estimate the abundance of the priority species within the affected area. This will be used as a baseline against which to measure potential displacement and disturbance of these species due to the construction and operation of the project. This objective is reported on in Section 3.
- To document patterns of bird movement on site and flight behaviour that is relevant to understanding the risk of collision of these birds with the power lines once constructed. This objective is achieved in Section 3.

- To identify potential risks of interaction between avifauna and the facility once constructed. This is achieved in Sections 4 and 5.
- To develop management recommendations for the mitigation of these risks. This could include providing spatial input into the final design (including the siting of infrastructure), construction and management strategy of the development. This is presented in Section 7.
- To develop a framework or outline for post construction bird monitoring at this site. This is presented in Section 6.

2.3 General approach

This study followed the following general steps. The detailed methodology is presented in Section 2.7:

- An extensive review of available international literature pertaining to bird interactions with electrical facilities was undertaken in order to fully understand the issues involved and the current level of knowledge in this field.
- The various data sets listed below and the study area were examined to determine the likelihood of these relevant species occurring on or near the site.
- A pre-construction bird monitoring programme was conducted covering four seasons, in order to obtain the necessary data to make a more confident assessment of the impacts. This was conducted primarily for the wind energy facilities but findings are relevant to this current assessment.
- The potential impacts of the proposed facility on these species were described.
- Sensitive areas within the proposed site, where the above impacts are likely to occur, were identified using various GIS (Geographic Information System) layers and Google Earth.
- Recommendations were made for the management and mitigation of impacts.

2.4 Data sources used

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

- The Southern African Bird Atlas Project 1 and 2 datasets were consulted using the Animal Demography Unit's *MyBirdPatch* web-based platform that enables the collection and curatorship of bird lists, for any defined area (http://mybirdpatch.adu.org.za/). An approximate total of 254 species have been recorded in the broader area within which the project is proposed.

- The Important Bird & Biodiversity Areas report (IBBA - Barnes 1998, Marnewick *et al,* 2015) was consulted to determine the location of the nearest IBA's and their importance for this study. The Platberg-Karoo Conservancy (SA037) IBA is located within a 50km radius of the proposed site. This is discussed later in the report.
- The Co-ordinated Avifaunal Roadcount project (CAR – Young *et al*, 2003) data was consulted to obtain relevant data on large terrestrial bird report rates in the area where possible. The closest route, NK283 is located approximately 9.5 kilometres north-west of the Eskom Infrastructure MTS Substation location. Although this data would typically be useful for a project of this nature, pre-construction bird monitoring has collected far more comprehensive and site specific data, and this has been used in this report.
- The conservation status of all relevant bird species was determined using Taylor *et al* (2015) for regional and IUCN (2018) for global status.
- The latest vegetation classification of South Africa (Mucina & Rutherford, 2006) was consulted in order to determine which vegetation types occur on site.
- Google Earth Imagery was used extensively for planning purposes.
- Aerial photography from the Surveyor General was used.

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). Examples of species occurring on this site and listed for protection by TOPS are: Lesser Kestrel, Tawny Eagle, Martial Eagle; African Marsh-Harrier, Blue Crane, Kori Bustard, and Ludwig's Bustard.

The Northern Cape Nature Conservation Act 9 of 2009 is relevant, and provides protection for most bird species.

2.6 Limitations & assumptions

Typically a study of avifauna at a site such as this would be heavily dependent on secondary data sources such as those listed in Section 2.4. In this case however, a significant amount of primary data was collected on site – rendering the above data sources useful only for preliminary planning. Limitations of this study then apply more to the primary data collection methods. A potential limitation exists in the quality and skill levels of the observers used. The data obtained can only be as good as those people capturing it. Experience with the observer team used on this project has shown that their bird identification and data capture skills are excellent.

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, 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 vantage point counts, it is extremely unlikely that two observers sitting in position for three hours 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 and flight height more easily estimated. This is particularly relevant at the vantage points where a large eagle may be visible several kilometres away, but a smaller Rock Kestrel perhaps only within 800 metres. Similarly birds are spotted more easily closer to the observers. 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 this 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 selection of vantage point positions is often challenging, and this site was no different. Because of the topography, road access and large size of the site, it was difficult to provide optimal coverage.

The above limitations need to be stated as part of this study so that the reader fully understands the complexities. However they do not detract from the confidence that this author has in the findings of this study and subsequent management recommendations for this project. It has to be noted that the collection of vast amounts of data through pre-construction monitoring places us in a far better position to assess impacts than was the case 2-3 years ago when only a very short once off site inspection was typically conducted.

2.7 Data collection activities

2.7.1 Small terrestrial species

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. More common, similar species could provide early evidence for trends and point towards the need for more detailed future study. These smaller species may also be particularly vulnerable to displacement and habitat level effects. Sampling these species is aimed at establishing indices of abundance for small terrestrial birds in the study area. These counts should be done when conditions are optimal. In this case this means the times when birds are most active and vocal, i.e. early mornings. A total of 14 walked transects (WT) of approximately 1 kilometre each were established in areas that are representative of the bird habitats available on the main site. These transects were conducted at first light and all bird species seen or heard, and their position relative to the transect line were recorded. For more detail on the exact methods of conducting walked transects see Jenkins *et al* (2015).

2.7.2. Large terrestrial species & raptors

This is a very similar data collection technique to that above, the aim being to establish indices of abundance for large terrestrial species and raptors. These species are relatively easily detected from a vehicle, hence vehicle based transects (VT) 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. Five VTs counts were established along suitable roads on the site, totalling approximately 46.5 kilometres. These transects were each counted once on each site visit. For more detail on the exact methods of conducting vehicle based transects see Jenkins *et al* (2015).

2.7.3. Focal site surveys & monitoring

Any particularly sensitive sites such as wetlands, dams, cliffs, and breeding sites are typically identified and monitored on each site visit. The eight focal sites identified on this site are all related to eagle breeding sites and potential cliff nesting habitat.

2.7.4. Incidental observations

This monitoring programme comprises a significant amount of field time on site by the observers - much of it spent driving between the above activities. It is important to maximise the benefit from this time on site by recording any other relevant information observed. 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. Where patterns in these observations are identified this may lead to additional focal site surveys in future.

2.7.5. Direct observation of bird movements

The above efforts allow us to arrive at an estimate of the abundance or density of the relevant species on site. This will allow the identification of any displacement and disturbance effects on these species post construction. However in evaluating the likelihood of these species colliding with overhead obstacles, 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 to be conducted on site, and is elaborated on below.

The aim of direct observation is to record bird flight activity on site. An understanding of this flight behaviour will help explain any future interactions between birds and overhead obstacles. Spatial

patterns in bird flight movement may also be detected, which will allow for input into infrastructure placement. Direct observation was conducted through counts at six vantage points (VP) in the study area. These VP's provided coverage of a reasonable and representative proportion of the entire study area (total coverage being unnecessary and impractical given resource constraints). VP's 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 two kilometres. VP counts were conducted by two observers, seated at the VP, taking care not to make their presence overtly obvious as to effect bird behaviour. Birds were recorded 360° around observers. Data was collected during representative conditions, so the sessions were spread throughout the day, with each VP being counted over 'early to mid-morning', 'mid to late morning', 'early to mid-afternoon', and 'mid-afternoon to evening'. Each session was three hours in duration, resulting in a total of 12 hours of observation conducted at each vantage point on each site visit. A maximum of two VP sessions were conducted per day, to avoid observer fatigue compromising data quality. For more detail on the exact criteria recorded for each flying bird observed, see Jenkins *et al* (2015).

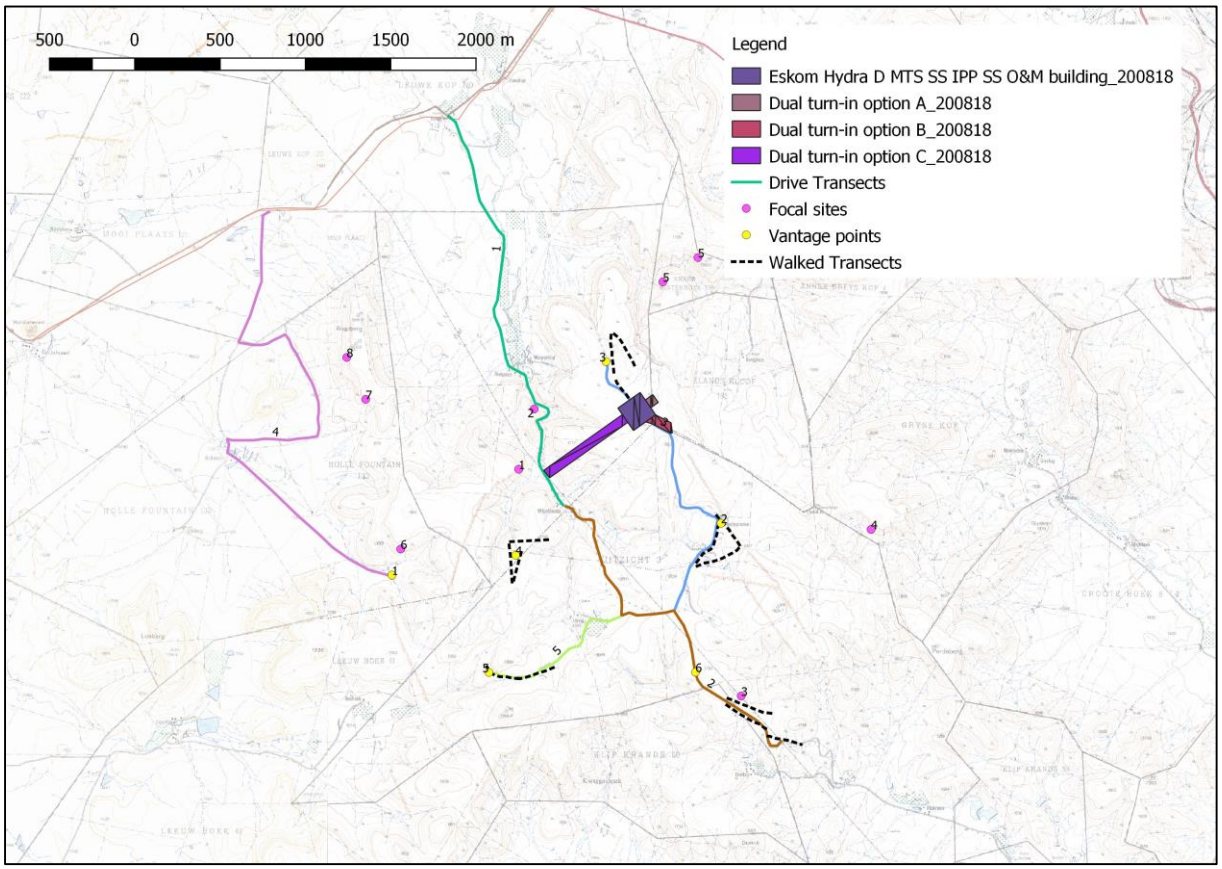

Figure 2. The layout of the pre-construction bird monitoring on the original Umsobomvu Wind Energy Facility site – relative to the proposed Eskom Infrastructure MTS project.

3 PRE CONSTRUCTION BIRD MONITORING RESULTS & DISCUSSION

The findings from the pre-construction bird monitoring programme have been reported on below. Since the original larger area was monitored as a unit, and birds are mobile, the larger original data set and analysis is stronger when applied to the current Eskom Infrastructure MTS. We have therefore reported on the full monitoring results except where specific findings differ notably between the three sites.

The monitoring programme has comprised of approximately 64 days on site by a skilled field team of two observers, and several additional days scouting new areas. The specialist has also conducted several site visits. The zone to be monitored was defined as approximately a buffer of two kilometres around the relevant properties, although drive transects extended further. Ideally this zone would encompass the likely range of all bird species likely to be affected by the project. However in the case of large birds of prey, and species such as cranes, bustards and Secretarybirds this could be tens of kilometres, and it is not considered feasible to monitor all of this.

3.1 Vegetation & habitat description

Vegetation is one of the primary factors determining bird species distribution and abundance in an area. The following description of the vegetation on the site (Mucina & Rutherford, 2006) focuses on the vegetation structure and not species composition. It is widely accepted within ornithological circles that vegetation structure is more important in determining bird species diversity. The affected area within which the proposed infrastructure is currently positioned is classified as “Besemkaree Koppies Shrubland” (Figure 3). The “Eastern Upper Karoo” vegetation type occurs in the low lying, flat areas of the project area.

Field work revealed that the site is varied in vegetation with some open grassland on the higher ground and thornveld in the lower lying and steeper areas. The relevance of this vegetation classification to the avifauna of the area is that a variety of habitat is provided, which can accommodate both the species mostly dependent on shorter grassland, and those dependent on the taller thicket and woodland. This is reflected in the species composition for the study area, shown in Table 1 below and in Appendix 7.

The vegetation description partially describes the habitat available and hence the species likely to occur in the study area. However, more detail is required in order to understand exactly where within the study area certain species will occur and how suitable these areas are for the relevant species. The habitats available to birds at a small spatial scale are known as micro habitats. These

micro habitats are formed by a combination of factors such as vegetation, land use, anthropogenic factors, topography and others. These micro habitats are typically important for judging the suitability of the site for relevant bird species. In this case the site is fairly uniform and there are few man made micro habitats such as dams or crop lands. The identified micro habitats on the Umsobomvu site are therefore: grassland, rivers and drainage lines, wetlands, dams, thornveld, rocky ridges, and stands of exotic trees. Examples of these are shown in Figure 4, and species likely to utilise each habitat are shown in Table 1.

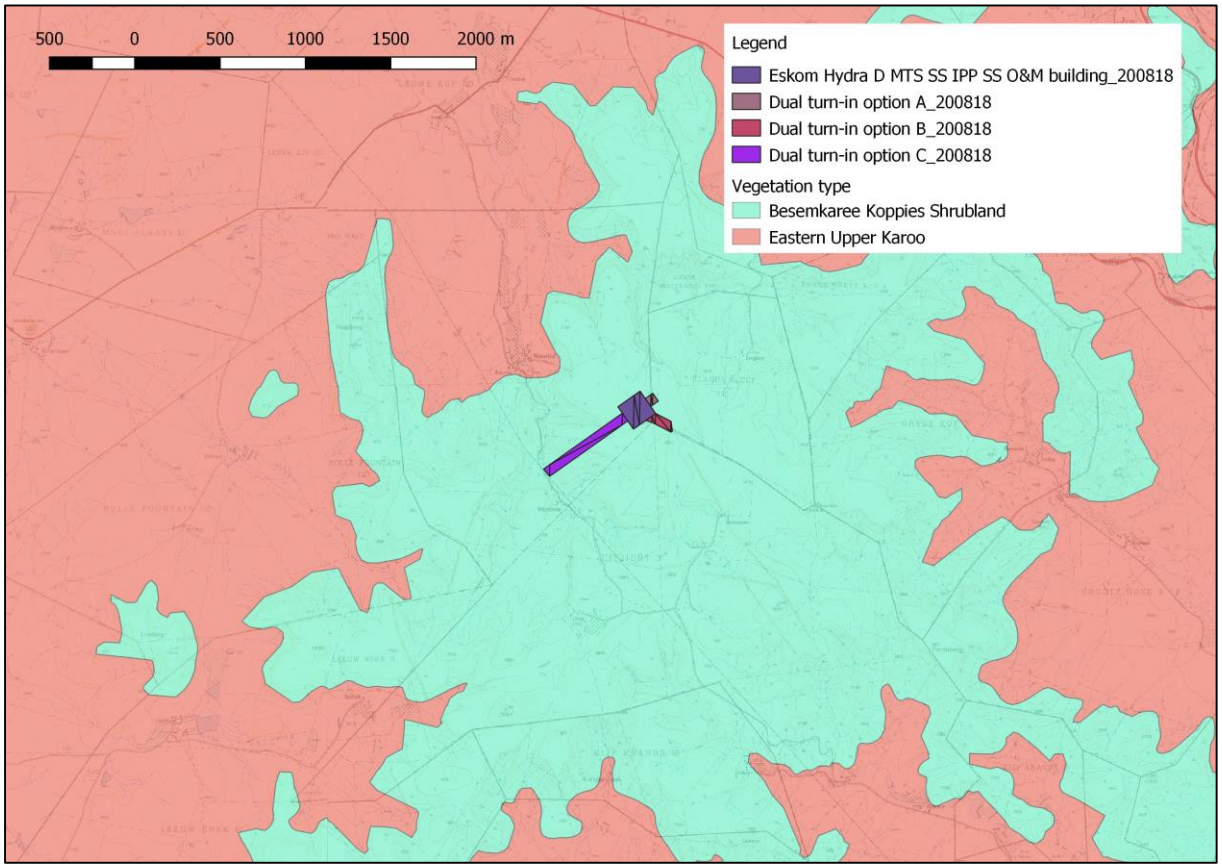

Figure 3. The vegetation composition of the Umsobomvu Wind Energy Facility – Eskom Infrastructure MTS site (Mucina & Rutherford, 2006).

Figure 4. Examples of bird micro habitats available on the Umsobomvu Wind Energy Facility – Eskom Infrastructure MTS site.

Note that this includes a far larger area than the current proposed site.

3.2 Target species list

A total of 29 target bird species were identified as being of particular relevance on this site (Table 1) and formed the focus of the monitoring programme and this final preconstruction monitoring report. In each case the species' regional (Taylor *et al,* 2015) and global (IUCN 2018) conservation status is presented, and whether it has been confirmed on the site. Each species' preferred micro habitat is also presented.

This group of target species comprises species from mostly the 'large terrestrial'; 'raptor'; and 'water bird' ecological groups. One additional species, the Grey-winged Francolin is classed as a gamebird. In general terms, we can expect all bird species to be vulnerable to disturbance and habitat destruction impacts, particularly those breeding on sites. The raptors and water birds are likely to be most susceptible to collision with overhead power lines. Large raptors could be susceptible to electrocution. The large terrestrials are generally expected to fly seldom, and low, but to be highly susceptible to collision when they do fly. These aspects are described in more detail later in this report.

The pre-construction bird monitoring programme recorded 19 of these target species on site, including 3 Endangered species (Martial Eagle, Tawny Eagle, and Ludwig's Bustard); and 3 Vulnerable species (Lanner Falcon, Secretarybird and Verreaux's Eagle). These species are discussed in more detail in Section 4.

Table 1. Target bird species for the Umsobomvu Wind Energy Facility – Eskom Infrastructure MTS pre-construction bird monitoring programme.

Common name	Taxonomic name	SABAP1	SABAP2	Regional status	Global status	TOPS list	Presence on Site	Preferred micro habitat
Stork, Black	*Ciconia nigra*	√	√	VU	LC	VU		Riverine, cliffs
Flamingo, Greater	*Phoenicopterus ruber*	√	√	NT	LC			Dams, pans
Flamingo, Lesser	*Phoenicopterus minor*	√		NT	NT			Dams, pans
Shelduck, South African	*Tadorna cana*	√	√				√	Dams, rivers
Secretarybird	*Sagittarius serpentarius*	√	√	VU	VU		√	Grassland, open woodland
Falcon, Lanner	*Falco biarmicus*	√	√	VU	LC		√	Generalist, open vegetation, cliffs
Falcon, Amur	*Falco amurensis*		√				√	Grassland
Kestrel, Rock	*Falco rupicolus*	√	√				√	Generalist
Kestrel, Lesser	*Falco naumanni*	√	√			VU	√	Generalist
Eagle, Verreaux's	*Aquila verreauxii*	√	√	VU	LC		√	Mountainous rocky areas
Eagle, Tawny	*Aquila rapax*	√		EN	LC	VU	√	Generalist
Eagle, Booted	*Aquila pennatus*	√	√				√	Generalist
Eagle, Martial	*Polemaetus bellicosus*	√	√	EN	VU	VU	√	Generalist
Snake-Eagle, Black-chested	*Circaetus pectoralis*		√					Generalist
Fish-Eagle, African	*Haliaeetus vocifer*		√					Open water sources
Buzzard, Jackal	*Buteo rufofuscus*	√	√				√	Generalist
Buzzard, Steppe	*Buteo vulpinus*	√	√				√	Generalist
Goshawk, Southern Pale Chanting	*Melierax canorus*						√	Generalist

Marsh-Harrier, African	*Circus ranivorus*	√		EN	LC	Protected		Grassland, wetland
Harrier, Black	*Circus maurus*	√		EN	EN			Grassland, wetland, Fynbos
Harrier-Hawk, African	*Polyboroides typus*	√	√				√	Generalist
Francolin, Grey-winged	*Scleroptila africanus*	√	√				√	Grassland
Crane, Blue	*Anthropoides paradiseus*	√	√	NT	VU	EN	√	Grassland, Karoo, dams
Bustard, Kori	*Ardeotis kori*	√		NT	NT	VU		Grassland, Open woodland
Bustard, Ludwig's	*Neotis ludwigii*	√	√	EN	EN	VU	√	Grassland, Karoo
Korhaan, Karoo	*Eupodotis vigorsii*	√	√	NT	LC		√	Grassland, Karoo
Korhaan, Blue	*Eupodotis caerulescens*	√	√	NT	NT	VU	√	Grassland, Karoo
Korhaan, Northern Black	*Eupodotis afra*	√					√	Karoo, grassland

Regional status = As per Taylor *et al,* 2015; Global status as per IUCN 2018.
EN = Endangered; VU = Vulnerable; NT = Near-threatened; LC = Least concern;

3.3 Small terrestrial species

A total of 40 small bird species were recorded by walked transects during this programme (see Appendix 1). Species richness peaked in Spring (33 species) and Summer (30 species). Lower species richness was recorded during winter and autumn (26 species each). The most abundant species on site as recorded by this method (and noting that more conspicuous species are more easily recorded) were Grey-backed Cisticola *Cisticola subruficapilla*, Cape Bunting *Emberiza capensis*, Pied Starling *Lamprotornis bicolor*, Lark-like Bunting *Emberiza impetuani* and Karoo Scrub-Robin *Erythropygia coryphaeus*. None of the species recorded by this method are Red Listed. Approximately 21 of the small species are Southern African endemics or near-endemics, with quite a few of these being Karoo endemics. These species are highlighted in Appendix 1.

This group of species will predominantly be at risk of habitat destruction or alteration, and disturbance on site if the facility is built.

3.4 Large terrestrial species & raptors

A total of 13 target bird species were recorded by Drive Transects (see Appendix 2). A slight peak in species richness was recorded in autumn (5 species), with 4 species being recorded in each of the remaining three seasons. The species recorded at the highest abundance was the Lesser Kestrel *Falco naumannii*, but this was recorded only in summer, as it is a migrant species. Other significant records include: Verreaux's Eagle (5 records of single birds); Cape Vulture *Gyps coprotheres* (1 record of 4 birds); and Booted Eagle *Hieraaetus pennatus* (2 records of single birds). Five of the thirteen species are Red Listed: Verreaux's Eagle (Vulnerable); Blue Crane (Near-threatened); Cape Vulture (Endangered); Lanner Falcon (Vulnerable) and Secretarybird (Vulnerable).

These large species are the species of most concern with regard to the risk posed by the proposed facility. Most of these species could be susceptible to collision with overhead power lines. This aspect is discussed in more detail in Section 3.6. Certain of these species also breed on site, such as most importantly the Verreaux's Eagle. Breeding species will be at risk of disturbance whilst breeding, displacement and habitat destruction. Young birds may also be at greater risk of collision with obstacles such as power lines.

3.5 Focal sites

A total of 8 Focal Sites were identified at the outset of this monitoring programme. All of these were identified as potential breeding habitat for raptors and other sensitive species. The location of these

sites can be seen in Figure 2. Focal Site 3 is a large nest on the Eskom Transmission Hydra/Poseidon 400kV power line running through site. The remaining 7 Focal Sites were all areas of cliff nesting habitat identified as having the potential to house breeding Verreaux's Eagles and other species. Each of these sites was visited at least once (but often several times) in each season, in order to survey the areas and determine whether any relevant bird species are nesting there. Details on the findings of each visit to these Focal Sites are presented in Appendix 3. The most important of these findings are described below:

- Focal Site 1 holds a Verreaux's Eagle nest. This nest was not used in the 2014 breeding season. It is believed that this nest could be an alternate nest (i.e. used by the same breeding pair of birds, in alternate seasons) to that at FS 2, due to its proximity (approx. 1.3km).
- At Focal Site 2 a pair of Verreaux's Eagle bred, with a chick being recorded on the nest during Spring.
- At Focal Site 3, only one record of a single adult Martial Eagle sitting on the power line approximately 800m from the nest was made during the year. It is concluded that this nest was not used this season, or in any seasons in the recent past.
- At Focal Site 4 a Verreaux's Eagle nest was located and a chick was seen on the nest during Spring.
- Focal Site 5 was determined to hold an old disused Hamerkop nest.
- At Focal Site 6 a Verreaux's Eagle chick was successfully raised and recorded as flying in Spring.
- At Focal Site 7 no large nests were recorded.
- At Focal Site 8 a Verreaux's Eagle nest was found, and one adult was recorded once in vicinity, but the nest did not appear to be used in the 2014 season.

In total then three pairs of Verreaux's Eagle were determined to be active on and near the proposed site. This is the most important avifaunal aspect uncovered by this body of work on site. There is a risk that breeding of these birds could be disturbed during either construction or operation of the facility, resulting in breeding failure (with consequent reduced recruitment of birds to the population) or even breeding site abandonment (with greater long term effects). The presence of breeding sites also theoretically heightens the risk of collision of birds. Adult flight activity is likely to be higher close to the nest due to seasonal nest building, breeding displays, mating, provisioning of chicks and other activities. Fledglings will also be susceptible to collision and electrocution whilst learning to fly before dispersing from the territory. The most common form of management of risk such as this is to avoid the construction of new infrastructure too close to these nests. These exclusion areas are commonly referred to as buffer areas, and are the subject of more discussion in Section 6.

3.6 Incidental observations

A total of 17 target bird species were recorded incidentally, comprising of 80 records of 136 individual birds (see Appendix 4). The species recorded most frequently was Verreaux's Eagle (15 records), followed by Jackal Buzzard *Buteo rufofuscus* (10 records) and Lesser Kestrel, Booted Eagle and Rock Kestrel *Falco rupicolus* (7 records each). Care must be taken not to attach too much importance to these sightings as they are not the product of systematic sampling and various biases exist in the data. An example of such a bias is that visibility is so much better for observers in the open areas, so we would expect more records there. Interestingly, two additional important species were recorded, despite not previously being identified as likely to occur in the area (Cape Vulture); or as likely target species (African Black Duck *Anas sparsa*).

In addition, where possible, eagle potential mammalian prey species were recorded in order to provide some insight into prey abundance distribution on site. A total of 11 records were made of 5 prey species: Rock Hyrax *Procavia capensis*; Bat-eared Fox *Otocyon megalotis*; Yellow Mongoose *Cynictis penicillata*; Ground Squirrel *Xerus inauris*; and Suricate *Suricata suricatta*. With the exception of 1 record, all these records were on the lower ground, and rocky slopes of the site, not on the top plateau. Although by no means a comprehensive study this does provide some indication that possibly prey is more abundant on the mountain sides and lower ground. This would support the finding in Section 3.6.2 that Verreaux's Eagle flight activity was far lower on the top flatter plateau.

Over the full year a total of 142 bird species were recorded on site by all data collection methods. This full data set is presented in Appendix 5. A peak in species richness was recorded in spring (114 species), followed by summer (104 species), autumn and winter each with 84 bird species. Of these 142 bird species, 9 are currently classified as Red Listed by Taylor *et al* (2015). These include 4 Endangered, 3 Vulnerable, and 2 Near-threatened species. Approximately 55 of the recorded species are endemic or near-endemic to southern Africa (Hockey *et al,* 2005), and approximately 11 can be considered Karoo endemics. These include the following species: Karoo Long-billed Lark *Certhilauda subcoronata*; Karoo Chat *Cercomela schlegelii*; Mountain Chat *Oenanthe monticola*; Ludwig's Bustard; Northern Black Korhaan *Afrotis afraoides*; Layard's Titbabbler *Sylvia layardi*; African Rock Pipit *Anthus crenatus*; Sickle-winged Chat *Cercomela sinuata*; Spike-heeled Lark *Chersomanes albofasciata* and Karoo Korhaan. An endemic species is one which is restricted to that area and is found nowhere else in the world, and a near endemic is mostly restricted to the area. South Africa has a high degree of endemism, with approximately 165 of the 960 species being endemic or near-endemic.

3.7 Direct observation of bird movements

3.7.1 Quantitative data analysis

Pre-construction bird monitoring recorded a total of 113 flight records of 10 target bird species (7 raptors, 2 large terrestrials and a water bird). Of these records, 109 were raptors, 2 of which were large terrestrials and 2 were water birds. Of a total of 96 three hour Vantage Point sessions, totaling 288 hours of observation, 50 sessions recorded no target bird species flight at all. These data are presented in Table 2.

For the following section, the data from Vantage Point 1 is excluded from the analysis, on the basis that Vantage Point 1 overlooks an active Verreaux's Eagle nest, on the lower ground away from the turbine layout, and is not comparable to the rest of the site (see Section 3.6.2).

Examination of the remaining data reveals that 61 records were made, including 57 raptors and the same 4 other species as above. Of the 80 observation sessions, 48 recorded no relevant flight activity. A peak in flight activity was recorded in summer (20 raptor records, 8 blank sessions), followed by autumn (17 raptor records, 13 blank sessions); Spring (13 raptor records, 11 blank sessions). The species recorded most frequently flying on site was Rock Kestrel, followed by Verreaux's Eagle and Jackal Buzzard. Booted Eagle, Lesser Kestrel and South African Shelduck *Tadorna cana* were also recorded multiple times, whilst the remaining species were recorded only once.

Table 2. Summary data of recorded target bird species flight activity on the Umsobomvu Eskom Infrastructure MTS site (excluding VP1).

Species	Ecological group	n	Total flight duration	Mean height above ground (m)	Mean flight duration
Rock Kestrel	Raptor	17	00:35:00	23.2	00:02:04
Verreaux's Eagle	Raptor	16	00:39:45	106.9	00:02:29
Jackal Buzzard	Raptor	10	00:25:00	83.5	00:02:30
Booted Eagle	Raptor	7	00:18:00	168.3	00:02:34
Lesser Kestrel	Raptor	5	00:21:30	17.0	00:04:18
SA Shelduck	Water bird	2	00:00:45	40.0	00:00:22
Blue Crane	Large terrestrial	1	00:03:00	600.0	00:04:00
Lanner Falcon	Raptor	1	00:12:00	20.0	00:12:00
Ludwig's Bustard	Large terrestrial	1	00:01:00	30.0	00:01:00
Martial Eagle	Raptor	1	00:02:00	30.0	00:02:00

3.7.2 Spatial data analysis

The resultant collision risk index data is presented in Figure 5, relative to the proposed project. These figures show the calculated collision risk index for target species at each vantage point. Each grid cell has been categorised and coloured according to the collision risk index for that cell. Darker colours represent greater collision risk.

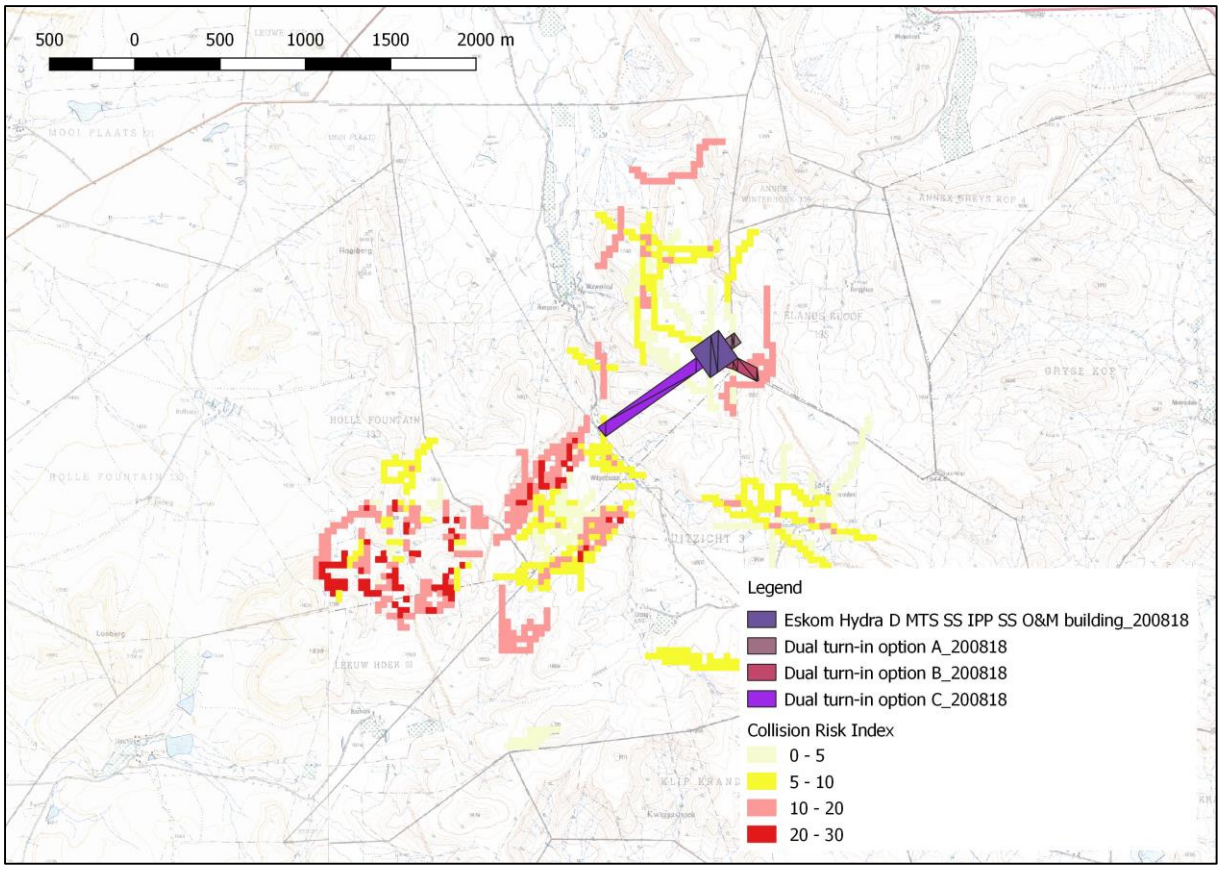

Figure 5. Collision risk index superimposed on the new Umsobomvu turbine layout resulting from the project split (all priority species).

Importantly, the collision risk over the areas where the 400kv overhead line is proposed is low.

4 SUMMARY OF PRIORITY BIRD SPECIES

The priority bird species for this proposed facility are best described in their respective families:

Accipitridae family:

Eagles are large, powerfully built raptors with a strong beak and head. Most eagles are larger than any other raptors, excluding vultures. Eagles' eyes are extremely powerful, having several times the visual acuity of humans, which makes them able to spot prey from long distances. Eagles in general are one of the groups of birds most affected by overhead power lines, through collision and electrocution. Their slow breeding and long lifespan also make them susceptible to mortality factors such as wind turbines (Drewitt & Langston 2008, Herera Alsina *et al* 2013).

Verreaux's Eagle

The Verreaux's Eagle has recently been up listed in conservation status to Vulnerable (Taylor *et al,* 2015) in recognition of the threats it is facing. Approximately 400 – 2 000 pairs exist in the Western, Northern and Eastern Cape (Hockey *et al*. 2005). These eagles can exist at quite high density compared to other eagle species, with some territories as small as 10km² in the Karoo (Davies, 2010 – www.africanraptors.org) and 10.3km² in the Matopos in Zimbabwe (Steyn, 1989). Davies found a range of territory size from 10 to 50km², with an average size of 24km² in the Karoo of South Africa, and nests were approximately 2 kilometres apart on average. The furthest recorded flight from the nest for food was 7 kilometres, although it is almost certain that they will fly further when required (Davies, 2010). Analysis of how much rock line was within 3 territories proved informative, with each pair defending approximately 52km of linear rock line (Davies 2010). In the Matopos in Zimbabwe territories ranged from 5.8 to 14km², with nests 1.3 to 4.5km apart (in Steyn, 1989). Some of these territories were roughly circular whilst others were irregular. This species tends to occupy remote mountainous areas largely unaffected by development. A pair can typically use several alternate nests in different seasons, varying from a few metres to 2.5km apart (in Steyn, 1989). Juveniles disperse from their home ranges 4 months after fledging and are not allowed to return to these territories by the adults. There is a suspected high mortality rate amongst juveniles due to the difficult in finding suitable territories.

This species is likely to be susceptible to three possible impacts: habitat destruction, disturbance, and collision with power lines. The species could also cause electrical faulting on the transmission power lines, and could nest on pylons (although natural cliff nesting substrate is not limited in the area. Mitigation of the risk to these eagles is discussed more in Section 6.

Otididae family:

Ludwig's Bustard

The Ludwig's Bustard is classified as Endangered by Taylor *et al* (2015) and its population and range has decreased over the last few decades due to habitat destruction and disturbance. This physically large species is highly vulnerable to collision with overhead power lines, and is also likely to be affected by disturbance and habitat destruction. Ludwig's Bustard is a wide-ranging bird endemic to the south-western region of Africa (Hockey *et al.* 2005). This species was listed as globally Endangered in 2010 because of potentially unsustainable collision mortality, exacerbated by the current lack of proven mitigation and the rapidly expanding power grid (Jenkins *et al.* 2011, BirdLife International 2013). Ludwig's Bustards are both partially nomadic and migratory (Allan 1994, Shaw 2013, Shaw *et al*, 2015), with a large proportion of the population moving west in the winter months to the Succulent Karoo. In the arid and semi-arid Karoo environment, bustards are also thought to move in response to rainfall, so the presence and abundance of bustards in any one area are not predictable. Therefore, collisions are also largely unpredictable, and vary greatly between seasons and years (Shaw 2013, *Shaw et al* 2015). While there is no evidence yet of population-level declines resulting from power line collision mortality, detailed range-wide power line surveys estimate that tens of thousands of bustards (from a total South African population of approximately 114,000 birds – Shaw *et al* 2015) die annually on the existing power grid in this country, which is of grave concern given that they are likely to be long-lived and slow to reproduce. It seems likely that there will be a threshold power line load at which population declines will become apparent, but it is not possible to accurately predict what this will be, and such effects will probably only be noticed when it is too late to do anything about it (Shaw 2013, Shaw *et al*, 2015). Therefore, extreme caution is necessary in the planning of any new power lines and other overhead infrastructure in the range of this species.

Allan and Anderson (2010) rated the Ludwig's Bustard as the second most threatened (of 11 species of bustard), after the Denham's Bustard. Ludwig's Bustard is likely to be susceptible to three possible impacts: habitat destruction, disturbance and collision with power lines.

5 IMPACT ASSESSMENT

The potential impacts of the proposed Umsobomvu Eskom Infrastructure MTS are as follows (see Table 4). These impacts have been formally assessed and rated according to the criteria (supplied by EOH-CES and shown in Appendix 1).

5.1 Destruction of bird habitat during construction of the facility

This impact is anticipated to be of MEDIUM significance pre mitigation, particularly on the basis of the breeding pairs of Verreaux's Eagles on site, and probable impacts on their territories. A certain amount of habitat destruction is inevitable for the construction of the MTS substation complex. However by adhering to the sensitivity map (Section 6) and other mitigation measures in this report, it is possible to reduce the significance of this impact to LOW.

5.2 Disturbance of birds

This is rated as HIGH significance, on account of the breeding pairs of Verreaux's Eagles on and near site. Mitigation is in the form of the sensitivity map in Section 6. Buffer areas have been identified around nest sites, within which no infrastructure should be built. In addition, it is recommended that the Option C for the loop in lines not be used as this will fall within one of the eagle nest buffer areas. By adhering to the recommendations of this report it is believed that this can be mitigated to LOW significance.

5.3 Collision of birds on overhead power lines

Collision of birds on overhead power lines on site is anticipated to be of HIGH significance. This impact can be mitigated successfully in our opinion to reduce the significance to LOW. The first and foremost approach to mitigation should be the selection of the shortest possible length of new overhead power line to be constructed, and the optimal route for this line. In this we recommend the use of Option A or B, but not C. To mitigate for collision of the relevant species with the overhead line it is recommended that the earth wires on all spans 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 (Ludwig'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 and earth wires 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. Eskom Transmission has a guideline for this work and this should be followed. 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.

5.4 Bird nesting on pylons

Certain bird species could start nesting on pylons once the facility is built. This is of LOW significance and remains at LOW after mitigation. The required mitigation is all reactive, if nests are found these must be managed according to provincial and national legislation and according to Eskom Transmission nest management guidelines.

5.5. Electrical faulting caused by birds

Some bird species present in the study area, such as the large eagles in particular could cause electrical faulting on the 400kV lines through their excreta. This is of LOW significance and will be mitigated reactively if it becomes a problem once the lines are operational.

Table 3. Formal assessment of impacts according to criteria supplied by EOH-CES (see Appendix 1 for details).

Phase	Impact description	Type	Extent	Magnitude	Duration	Probability	Confidence	Reversibility	Significance	Type post mitigation	Extent post mitigation	Magnitude post mitigation	Duration post mitigation	Probability post mitigation	Confidence post mitigation	Reversibility post mitigation	Significance post mitigation
Construction	Destruction or alteration of bird habitat	Negative – multiple species affected	Local	Medium	Long term	Definite	Certain	Irreversible	Medium	Negative	Local	Low	Long term	Definite	Certain	Irreversible	Low
Construction & operational	Disturbance of birds, particularly whilst breeding	Negative – particularly breeding Verreaux's Eagle	Local	Medium	Construction period	Probable	Unsure	Reversible	High	Negative	Local	Low	Construction period	Probable	Unsure	Reversible	Low
Operational	Collision of birds with overhead power lines	Negative – Ludwig's Bustard, Blue Crane, Verreaux's Eagle	Local-regional	Medium-high	Long term	Probable	Unsure	Irreversible	High	Negative	Local-regional	Low	Long term	Probable	Unsure	Irreversible	Low
Operational	Nesting of birds on pylons	Neutral - Eagles, kestrels, falcons, crows	Local-regional	Low	Long term	Possible	Possible	Reversible	Low	Neutral	Local-regional	Low	Long term	Possible	Possible	Reversible	Low
Operational	Electrical faulting	Negative for business-	Local-region	Low	Long term	Possible	Possible	Reversible	Low	Negative for	Local-region	Low	Long term	Possible	Possible	Reversible	Low

caused by birds	Eagles, herons etc	al	business	al

5.5 Cumulative Impacts of power lines on birds in this area

The proposed Umsobomvu Eskom Infrastructure MTS is situated in an area of the country where two large 400kv existing transmission power lines are placed. In our view the proposed new project will make a small contribution to the existing power line impacts on birds in the area, on account of the short length of new power line proposed (<3km depending on which route is selected).

6 SENSITIVITY ANALYSIS

The primary means of minimising the potential impacts identified for a facility such as the proposed is typically the optimal placement of the proposed infrastructure. In order to achieve this, a sensitivity or constraints analysis is prepared for the site. This has been done below in Sections 6.1 and 6.2.

Avifaunal sensitivity for a project of this nature may be viewed at two spatial levels:

6.1 National & regional level

At the national level two bird conservation initiatives are particularly relevant to this exercise: the BirdLife South Africa-Endangered Wildlife Trust "Avian wind farm sensitivity map for South Africa" (Retief *et al*, 2011, 2014); and the Important Bird and Biodiversity Areas (IBBA) programme of BirdLife South Africa (Barnes, 1998; Marnewick *et al,* 2015). The sensitivity map (Retief *et al*, 2011, 2014) consolidated multiple avifaunal spatial data sources for a list of priority species in order to categorise pentads (9 x 9 kilometre grid cells – as shown in Figure 6) across South Africa according to their risk of bird- wind farm interactions (in most cases quite similar to interactions with overhead power lines). The darker grid cells indicate higher risk and the lighter coloured cells indicate lower risk. It is clear from Figure 6 that the proposed site is mostly classed in the higher sensitivity categories. It should be noted that since the primary data sources used to develop this map were the SABAP1 and 2, the map is affected by how well the areas of the country were covered by atlasing effort. It is therefore possible that areas of seemingly low sensitivity are actually data deficient. Exercises such as this map will certainly be over ruled by actual data collected by pre-construction monitoring on site, but are useful to provide perspective at this level.

The closest IBBA to the Umsobomvu site is the Platberg Karoo Conservancy IBA, the boundary of which lines approximately 20 kilometres to the north-west of the proposed substation site. This IBBA was declared on the basis of it holding vital populations of two Globally Threatened species, the Lesser Kestrel and the Blue Crane. The Karoo population of Blue Crane is really the only strong population remaining on natural vegetation in southern Africa. Lesser Kestrels are known to roost in both De Aar and Phillipstown. Other important threatened species that the area is important for include Tawny and Martial Eagles, Kori and Ludwig's Bustard, Pallid and Black Harriers, Blue Korhaan, Greater Flamingo, Black Stork, Secretarybird, South African Shelduck and Lanner Falcon (Taylor *et al,* 2015). Although most of these threatened species are physically large, a host of small terrestrial species also call this area home, including: Karoo Long-billed Lark, Karoo Lark, Karoo Chat, Tractrac Chat, Sickle-winged Chat, Layards Titbabbler, Namaqua Warbler, Pale-winged Starling, and Black-

headed Canary. Many of these smaller species rely upon riverine woodland (e.g. Karoo Lark), thicket found mostly on slopes, and/or rocky slopes and outcrops (e.g. Karoo Long-billed Lark, Karoo Chat).

Based on these two data sources then, the Umsobomvu Eskom Infrastructure MTS site is in an area of moderate to high sensitivity at the national scale.

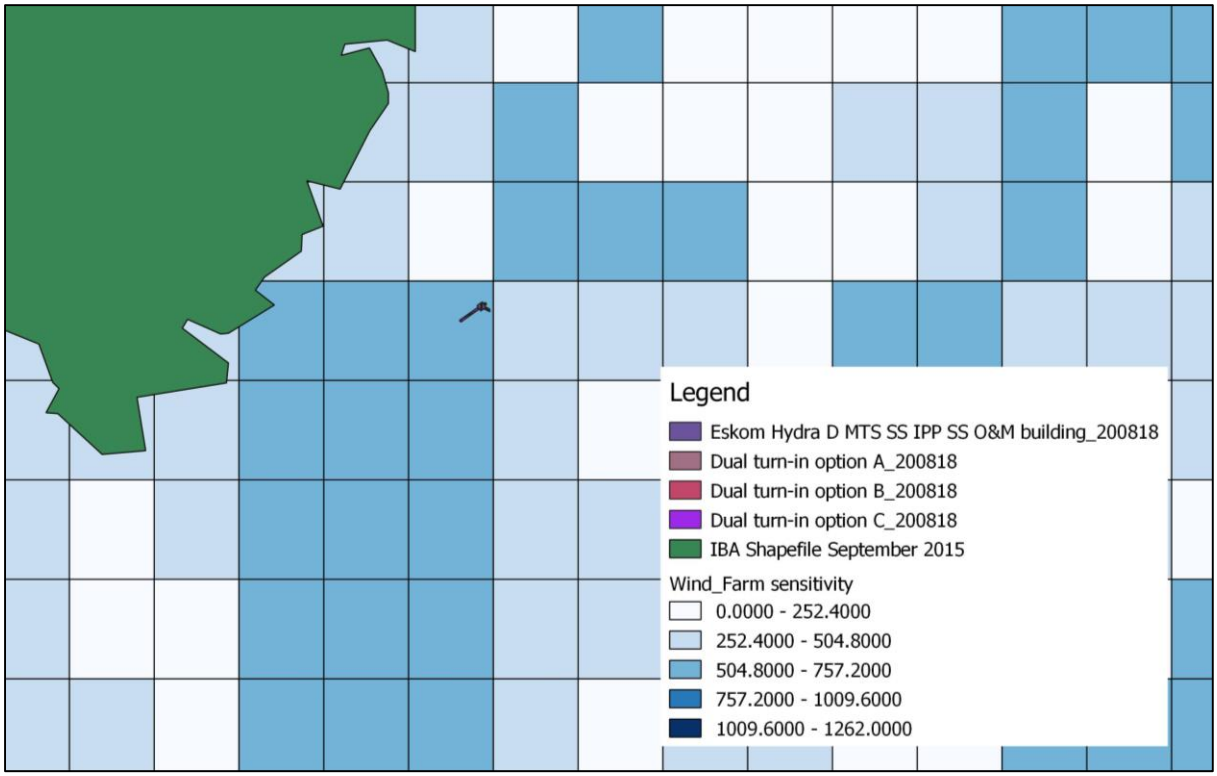

Figure 6. The proposed Umsobomvu Eskom Infrastructure MTS site relative to the Avian Wind Farm Sensitivity Map and Important Bird & Biodiversity Areas.

Dark colours indicate higher sensitivity or risk and light colours indicate lower sensitivity.

6.2 Local on- site constraints

On site, two categories of constraints were identified (Figure 7).

High sensitivity areas

HIGH sensitivity areas should not be impacted on through the placement of any new infrastructure. These areas have been identified on the basis of the below factors:

Eagle buffer areas

The avifaunal impact assessments for the proposed Umsobomvu 1 and Coleskop Wind Farms have determined high sensitivity areas based on Verreaux's Eagles breeding on and near site.

The detail on how these areas were identified is not repeated here, but the spatial areas are relevant to this assessment and are presented in Figure 7.

Medium sensitivity areas

MEDIUM sensitivity areas can accommodate roads, but no overhead power lines. These areas are around identified dams on site. Dams are important attractants to various bird species and collision risk will be heightened close to dams. A buffer of 500 metres around known dams was delineated. However, these dams vary considerably in size, the surrounding topography varies, and no regionally Red Listed species were found to be using these dams. These buffers can therefore be considered soft buffers and exceptions may be made for certain turbines within these areas, and for roads.

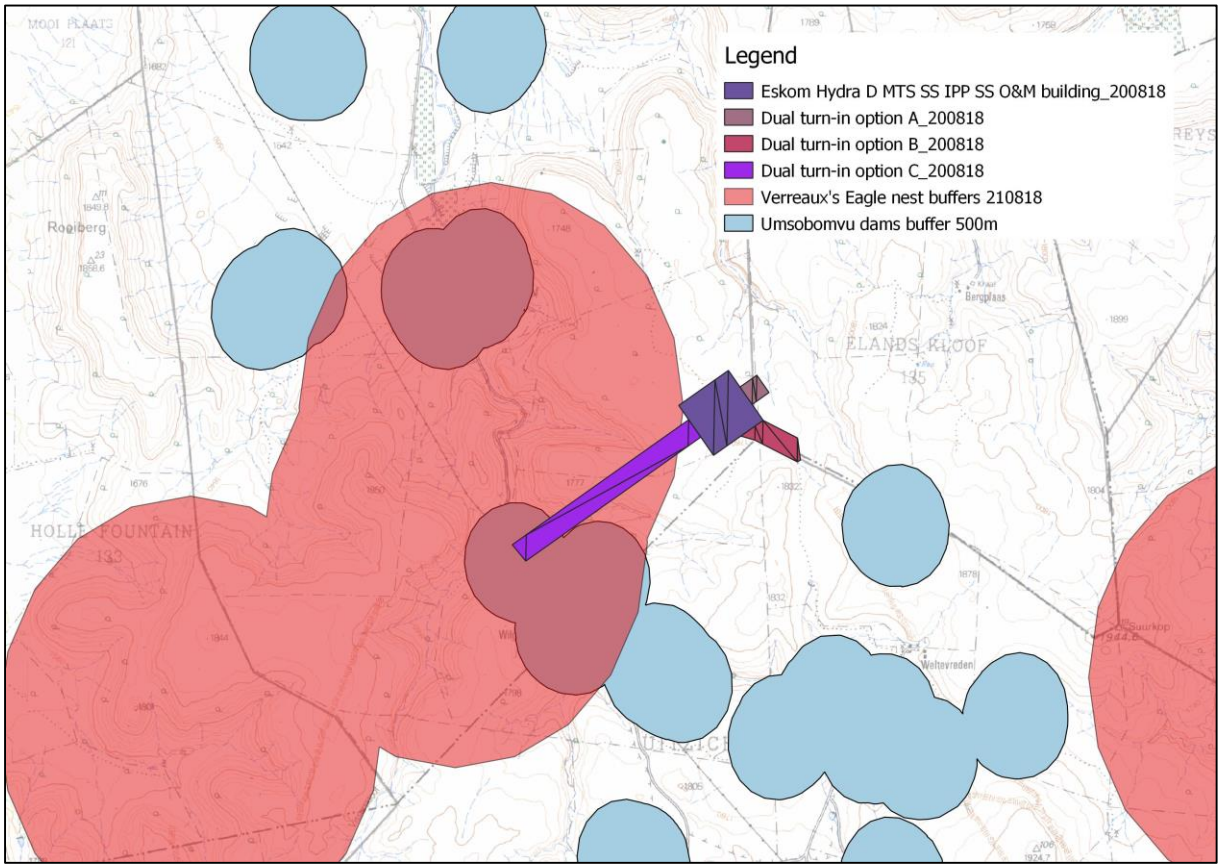

Figure 7. Avifaunal constraints map for the Umsobomvu Eskom Infrastructure MTS facility.

6.3 Comparison of alternatives

Three alternatives for the loop in 400kv line are presented for assessment. Our preference is for the shortest possible loop in, i.e. Option A – which is approximately 200m long, followed by Option B

which is 600m. We recommend against the Option C as it is approximately 2.5km long and passes through a high sensitivity area (Figure 7).

7 POST CONSTRUCTION BIRD MONITORING FRAMEWORK

The bird monitoring work done to date on the Umsobomvu site has established a baseline understanding of the distribution, abundance and movement of key bird species on and near the site. If the proposed wind farms (Umsobomvu and Coleskop) are authorized and constructed, the baseline information will need to be compared to data collected once the facility is operational. There will also be a need to measure the impacts of the facility on avifauna, particularly through collision mortality. A post construction bird monitoring programme has been designed and recommended in those facilities respective reports. It is recommended that if they go ahead the 400kv infrastructure be monitored as part of those programmes.

8 CONCLUSION & RECOMMENDATIONS

The main findings of this study are as follows:

- A total of 29 target bird species were identified at the outset of this programme on the basis of their conservation status and/or likely susceptibility to impacts of the proposed facility. This group of species comprises four ecological groups: raptors; large terrestrials; water birds; and a game bird. Of these 29 species, 19 were recorded on site including: 3 Endangered species (Taylor *et al*, 2015 – Martial Eagle, Tawny Eagle, Ludwig's Bustard); and 3 Vulnerable species (Lanner Falcon, Secretarybird, and Verreaux's Eagle).
- A total of 40 small bird species were recorded on site by walked transects. This species diversity peaked in spring and summer (33 and 30 species respectively), with lower species richness in winter and autumn. None of these species were Red Listed. Approximately 21 of these species are southern African endemic or near-endemics, with some being Karoo endemics.
- Thirteen large terrestrials and raptor species were recorded by drive transects, with a slight peak in species richness in autumn (5 species), and 4 species in each of the other seasons. The most abundant species recorded by this method was Lesser Kestrel, recorded only in summer as expected as it is a migrant.
- Over the full year a total of 142 bird species were recorded on site by all data collection methods. Spring showed the highest species richness (114 species) followed by Summer (104) and autumn and winter (84 species each). Approximately 55 of these species can be considered southern African endemic or near-endemic species.
- Three pairs of Verreaux's Eagle were found to breed on or near site during this study. This is certainly the most important avifaunal aspect uncovered by this study. Most of the site is mountainous, with good availability of cliffs and rock lines on the mountain slopes and in the valleys.
- Ten target bird species were recorded flying on site, including 7 raptors, 2 large terrestrials, and a water bird. The majority of recorded flight was that of raptors, particularly Verreaux's Eagle. Almost half of all recorded flights were at Vantage Point 1, of Verreaux's Eagle. At VP1 and elsewhere on site, the majority of Verreaux's Eagle flight was recorded close to (1 to 1.5km from) a nest site. Other species recorded flying relatively frequently on site included Rock Kestrel, Jackal Buzzard, Booted Eagle and Lesser Kestrel. Both these species spent most of their flight time at rotor height, placing them at risk of collision with turbines once built.

- The species determined to be at most risk if the facility is constructed are: Verreaux's Eagle; Rock Kestrel; Lesser Kestrel; Jackal Buzzard; and Ludwig's Bustard (at risk from overhead power lines predominantly).
- A spatial 'collision risk index' for the site was created from the above flight data. Collision risk was highest close to (approximately 1 to 1.5km) Verreaux's Eagle nests, and over the valleys and steep valley sides. Collision risk was low on the top plateau. Flight activity of Verreaux's Eagles is not evenly distributed around nest sites, but rather follows topography.
- In a national context, this site is believed to be in a position of moderate to high sensitivity for avifauna. On site, two categories of sensitivity or constraints for development have been identified: HIGH and MEDIUM. The high sensitivity areas are identified on the basis of Verreaux's Eagle breeding sites, ridge edges, valleys and drainage lines. It is recommended that no turbines or other infrastructure be placed within the HIGH sensitivity areas. MEDIUM sensitivity areas are identified on the basis of farm dams, and can be considered soft buffer areas.
- Formal assessment of the possible impacts of the proposed facility on birds (as per criteria supplied by EOH-CES) resulted in the following findings:
    - Destruction of bird habitat is anticipated to be of MEDIUM significance pre-mitigation. Adherence to the recommendations of this report, in particular the sensitivity map, will reduce this to LOW significance.
    - Disturbance if birds, particularly breeding Verreaux's Eagles could be of HIGH significance, but can be mitigated to LOW significance through adherence to the sensitivity map and other recommendations.
    - Collision of birds with power lines is judged to be of HIGH significance. This can be mitigated to LOW significance.
    - Nesting of birds on power line infrastructure once operational will be of LOW significance.
    - Electrical faulting caused by birds on 400kV lines will be of LOW significance.
    - The contribution that the Umsobomvu Eskom Infrastructure MTS facility will make to the cumulative impacts of wind farms on birds in this area is judged to be of LOW significance.
- The preferred option for the 400kv loop in power lines Option A, followed by Option B. we recommend against the use of Option C.

The following management recommendations are made for the management of risk to avifauna at this site:

- No infrastructure should be built in the areas identified as HIGH sensitivity in this report.

- A final avifaunal walk through should be conducted prior to construction to ensure that all the avifaunal aspects have been adequately managed and to ground truth the final layout of all infrastructure. This will most likely be done as part of the site specific Environmental Management Plan. This will also allow the development of specific management actions for the Environmental Control Officer during construction and training for relevant on site personnel if necessary.
- To mitigate for collision of the relevant species with the overhead line it is recommended that the earth wires on all spans 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 (Ludwig'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 and earth wires 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. Eskom Transmission has a guideline for this work and this should be followed. 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.
- The mitigation for bird nesting on pylons and bird caused electrical faulting are reactive and should only be applied if these issues become significant once the facility is operational.

If these recommendations are adhered to, this project can proceed in our opinion.

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APPENDIX 1. SMALL TERRESTRIAL BIRD SPECIES RECORDED ON THE UMSOBOMVU SITE DURING WALKED TRANSECTS

Southern African endemic or near endemics are shown in **bold.**

	Total			Autumn			Winter			Spring			Summer		
Total # Species	**49**			**26**			**26**			**33**			**30**		
# Target Species	**7**			**3**			**1**			**3**			**4**		
Species	**# Birds**	**# Records**	**#Birds/km**	**# Birds**	**# Records**	**#Birds/km**	**# Birds**	**# Records**	**#Birds/km**	**# Birds**	**# Records**	**#Birds/km**	**# Birds**	**# Records**	**#Birds/km**
Grey-backed Cisticola	133	87	2.60	37	24	2.89	29	19	2.27	33	21	2.58	34	23	2.66
Cape Bunting	131	75	2.56	29	22	2.27	31	16	2.42	29	18	2.27	42	19	3.28
Pied Starling	94	10	1.84	42	3	3.28	21	2	1.64	31	5	2.42			
Lark-like Bunting	86	5	1.68										86	5	6.72
Karoo Scrub-Robin	78	42	1.52	19	10	1.48	12	7	0.94	29	14	2.27	18	11	1.41
Bokmakierie	54	43	1.05	16	11	1.25	8	8	0.63	14	10	1.09	16	14	1.25
Layard's Tit-Babbler	49	29	0.96	17	9	1.33	11	9	0.86	16	8	1.25	5	3	0.39
Yellow Canary	46	8	0.90	2	1	0.16	30	4	2.34	3	1	0.23	11	2	0.86
Cape Longclaw	42	20	0.82	15	6	1.17	4	2	0.31	6	3	0.47	17	9	1.33
Speckled Pigeon	38	5	0.74	25	2	1.95	8	1	0.63				5	2	0.39
Barn Swallow	36	9	0.70										36	9	2.81
Greater Striped Swallow	33	13	0.64							23	7	1.80	10	6	0.78
Rufous-eared Warbler	30	23	0.59	9	7	0.70	11	9	0.86	9	6	0.70	1	1	0.08
Karoo Prinia	30	20	0.59	4	3	0.31	5	3	0.39	18	12	1.41	3	2	0.23
Speckled Mousebird	30	3	0.59	13	1	1.02	8	1	0.63	9	1	0.70			
Helmeted Guineafowl	22	1	0.43										22	1	1.72
Pied Crow	21	9	0.41	8	3	0.63	3	2	0.23	6	3	0.47	4	1	0.31
Common Waxbill	16	1	0.31							16	1	1.25			
Spike-heeled Lark	15	6	0.29							2	1	0.16	13	5	1.02

Rock Martin	14	6	0.27										14	6	1.09
Grey-winged Francolin	12	7	0.23							6	5	0.47	6	2	0.47
Eastern Clapper Lark	11	9	0.21				1	1	0.08	7	5	0.55	3	3	0.23
Long-billed Pipit	11	6	0.21	2	1	0.16	7	4	0.55	2	1	0.16			
African Red-eyed Bulbul	10	6	0.20	1	1	0.08	5	3	0.39	4	2	0.31			
White-necked Raven	10	6	0.20	3	2	0.23	4	2	0.31	3	2	0.23			
Cape Wagtail	9	7	0.18	3	2	0.23	5	4	0.39	1	1	0.08			
Pale-winged Starling	9	3	0.18	1	1	0.08	4	1	0.31	4	1	0.31			
Neddicky	8	4	0.16	3	2	0.23							5	2	0.39
Cape Turtle-Dove	7	6	0.14	1	1	0.08	2	1	0.16	4	4	0.31			
African Quailfinch	6	2	0.12										6	2	0.47
Blacksmith Lapwing	6	3	0.12	2	1	0.16	2	1	0.16	2	1	0.16			
Familiar Chat	6	5	0.12	2	2	0.16	4	3	0.31						
Three Banded Plover	6	1	0.12							6	1	0.47			
Hadeda Ibis	6	3	0.12				1	1	0.08	4	1	0.31	1	1	0.08
African Stonechat	5	3	0.10	2	1	0.16	2	1	0.16	1	1	0.08			
Ground Woodpecker	5	2	0.10	3	1	0.23							2	1	0.16
Acacia Pied Barbet	4	2	0.08							2	1	0.16	2	1	0.16
Black-throated Canary	4	1	0.08							4	1	0.31			
Cape Sparrow	4	2	0.08							2	1	0.16	2	1	0.16
Plain-backed Pipit	4	3	0.08							2	2	0.16	2	1	0.16
White-throated Canary	4	1	0.08				4	1	0.31						
African Pipit	3	3	0.06										3	3	0.23
Sickle-winged Chat	3	2	0.06							1	1	0.08	2	1	0.16
Southern Red Bishop	3	1	0.06	3	1	0.23									
Ant-eating Chat	2	2	0.04										2	2	0.16
Red-winged Starling	2	1	0.04										2	1	0.16
African Rock Pipit	1	1	0.02							1	1	0.08			
Common Fiscal	1	1	0.02	1	1	0.08									

Malachite Sunbird	1	1	0.02	1	1	0.08

APPENDIX 2. LARGE TERRESTRIAL & RAPTOR SPECIES RECORDED ON THE UMSOBOMVU SITE DURING DRIVEN TRANSECTS

	Total for year			Autumn			Winter			Spring			Summer		
# species	**13**			**5**			**4**			**4**			**4**		
Species	**# Birds**	**# Records**	**#birds/km**	**# Birds**	**# Records**	**#birds/km**	**# Birds**	**# Records**	**#birds/km**	**# Birds**	**# Records**	**#birds/km**	**# Birds**	**# Records**	**#birds/km**
Lesser Kestrel	26	5	0.56	0	0	0.00	0	0	0.00	0	0	0.00	26	5	0.56
Yellow-billed Duck	13	1	0.28	0	0	0.00	13	1	0.28	0	0	0.00	0	0	0.00
Northern Black Korhaan	9	7	0.19	2	2	0.04	2	2	0.04	4	2	0.09	1	1	0.02
Grey-winged Francolin	9	3	0.19	7	2	0.15	0	0	0.00	0	0	0.00	2	1	0.04
Verreaux's Eagle	5	5	0.11	4	4	0.09	0	0	0.00	1	1	0.02	0	0	0.00
Blue Crane	4	2	0.09	0	0	0.00	0	0	0.00	0	0	0.00	4	2	0.09
Cape Vulture	4	1	0.09	0	0	0.00	0	0	0.00	0	0	0.00	4	1	0.09
Rock Kestrel	3	3	0.06	1	1	0.02	0	1	0.00	0	0	0.00	2	1	0.04
Booted Eagle	2	2	0.04	0	0	0.00	1	1	0.02	1	1	0.02	0	0	0.00
Southern Pale Chanting Goshawk	2	2	0.04	0	0	0.00	0	0	0.00	0	0	0.00	2	2	0.04
Jackal Buzzard	1	1	0.02	1	1	0.02	0	0	0.00	0	0	0.00	0	0	0.00
Lanner Falcon	1	1	0.02	0	0	0.00	1	1	0.02	0	0	0.00	0	0	0.00
Secretarybird	1	1	0.02	0	0	0.00	0	0	0.00	1	1	0.02	0	0	0.00

APPENDIX 3. OBSERVATIONS MADE AT FOCAL SITES ON THE UMSOBOMVU SITE.

Season	Number of Visits	Species	Key Observations
FOCAL SITE 1			
Autumn	4	Verreaux's Eagle	Verreaux's Eagle nest on cliffs - no activity on nest Single adult perched on rock 70m W of the nest Two adults soaring along cliff N of the nest Single adult soaring along cliff N of the nest
Winter	1	None	Verreaux's Eagle nest on cliffs No activity on nest
Spring	2	None	Verreaux's Eagle nest on cliffs No activity on nest
Summer	2	None	Verreaux's Eagle nest on cliffs No activity on nest
FOCAL SITE 2			
Autumn	2	Verreaux's Eagle	4 nests on the cliff Single adult perched (roost) to right of the nest on the extreme left Single adult flew along the cliffs to the N of nest.
Winter	2	Verreaux's Eagle	Lots of droppings at nest. Single adult perched on nest No other activity observed during second visit to the nest
Spring	3	Verreaux's Eagle	Flew from NW to NE over top of mountain above nest Adult soars above nest over top of mountain, while chick sat on nest Chick on nest and looks healthy
Summer	3	Verreaux's Eagle	No birds - but chick calling Single adult flew from NW to SE along the cliffs opposite the nest While at VP 4 observed eagles soaring above the nest outside the perimeter of the VP Single adult soared from nest site up in Visserskloof and then went back again.
FOCAL SITE 3			
Autumn	2	Martial Eagle	Two nest on separate pylons - possibly Martial Eagle nests, No birds observed in the area
Winter	2	Martial Eagle	Two nest on separate pylons - possibly Martial Eagle nests, No birds observed in the area
Spring	3	Martial Eagle	2 nest on separate pylons Adult ME sat on pylon about 800 m NW of nests. Adult flew off pylon and soar towards SE with power line
Summer	4	Martial Eagle	No birds observed in the area
FOCAL SITE 4			
Autumn	1	None	Scan cliffs with scope, no nests or raptors observed.
Winter	1	None	Scan cliffs with scope, no nests or raptors observed.
Spring	2	Verreaux's Eagle	Scan cliffs further on and found a VE nest on a bush at about 31*22'36.9S 24*52'52.8E The chick looks healthy and about the age of chick @ FS 2 No adults seen - they probably hunt down stream to E of nest.
Summer	3	Verreaux's Eagle	While on VP 6 an adult VE flew in from N and continued along the powerline to SE Suspect that it is one of eagles associated with this FS
FOCAL SITE 5			
Autumn	2	None	No raptor nests observed No eagles observed

			Hamerkop nest
Winter	2	None	No raptor nests, or eagles observed Hamerkop nest
Spring	2	None	No raptor nests, or eagles observed Hamerkop nest
Summer	2	None	No raptor nests, or eagles observed Hamerkop nest
FOCAL SITE 6			
Autumn	2	Verreaux's Eagle	Nest building activity observed - both adults involved Birds take turns in tending to nest while the other hunts south of VP
Winter	2	Verreaux's Eagle	Frequent movement to and from the nest by both adults Predominant movements are to the S, E, SE and SW Female brought dassie to the nest (food provisioing)
Spring	2	Verreaux's Eagle	Male and Female movement to and from nest (N, S and W) Chick remained on nest 2014-10-14 fledgling and adult left the nest (soaring N to S)
Summer	2	Verreaux's Eagle	Other adult soaring E to W and back. Adult & fledgling returned from SE On observer arrival juvenile perched on cliffs close to nest. Juvenile left perch @ 06:14 and flew to edge of mountain where it perch till 07:51 No adult VE observations
FOCAL SITE 7			
Autumn	1	None	Scan cliffs with scope, no nest or raptors observed.
Winter	1	None	Scan cliffs with scope, no nest or raptors observed.
Spring	1	None	Scan cliffs with scope, no nest or raptors observed.
Summer	1	None	Scan cliffs with scope, no nest or raptors observed.
FOCAL SITE 8			
Autumn	1	None	Verreaux's Eagle nest on cliffs No raptors observed on the nest Saw two adults above nest hunting.
Winter	1	None	Single bird flew over top and other flew SE Scan cliff and nest along cliff No signs of occupation of nest & no eagles observed
Spring	1	None	No signs of occupation of nest & no eagles observed
Summer	1	None	No signs of occupation of nest & no eagles observed

APPENDIX 4. INCIDENTAL OBSERVATIONS RECORDED ON THE UMSOBOMVU SITE.

	Total		Autumn		Winter		Spring		Summer	
Species	# Birds	# Records	# Birds	# Records	# Birds	# Records	# Birds	# Records	# Birds	# Records
Grey-winged Francolin	27	5	8	2	0	0	8	2	11	1
Verreaux's Eagle	23	15	12	8	4	4	3	1	4	2
Lesser Kestrel	23	7	0	0	0	0	0	0	23	7
Jackal Buzzard	11	10	3	3	0	0	4	3	4	4
Booted Eagle	9	7	0	0	5	3	2	2	2	2
Rock Kestrel	7	7	2	2	0	0	3	3	2	2
Greater Kestrel	7	6	2	1	3	3	1	1	1	1
Southern Pale Chanting Goshawk	6	6	2	2	0	0	3	3	1	1
Secretarybird	4	3	0	0	3	2	0	0	1	1
Cape Vulture	4	1	0	0	0	0	0	0	4	1
Northern Black Korhaan	3	3	0	0	1	1	0	0	2	2
African Harrier-Hawk	2	2	1	1	0	0	1	1	0	0
Ludwig's Bustard	2	2	0	0	0	0	2	2	0	0
African Black Duck	2	1	0	0	2	1	0	0	0	0
Blue Crane	2	1	2	1	0	0	0	0	0	0
Amur Falcon	1	1	0	0	0	0	0	0	1	1
Black-shouldered Kite	1	1	0	0	0	0	1	1	0	0
Martial Eagle	1	1	1	1	0	0	0	0	0	0
Tawny Eagle	1	1	0	0	0	0	0	0	1	1

APPENDIX 5. SEASONAL BIRD SPECIES LIST FOR THE UMSOBOMVU SITE – FROM PRE-CONSTRUCTION BIRD MONITORING

1 denotes presence, not abundance

Common Name	*Scientific Name*	Cons status (Taylor *et al*, 2015)	Sthn Afr end/near end	Karoo endemic	Aut	Win	Spr	Sum
White-breasted Cormorant	*Phalacrocorax lucidus*						1	
Reed Cormorant	*Phalacrocorax africanus*				1		1	
Grey Heron	*Ardea cinerea*						1	
Black-headed Heron	*Ardea melanocephala*							1
Hamerkop	*Scopus umbretta*						1	1
African Sacred Ibis	*Threskiornis aethiopicus*				1	1	1	
Hadeda Ibis	*Bostrychia hagedash*				1	1	1	1
Egyptian Goose	*Alopochen aegyptiaca*				1	1	1	1
South African Shelduck	*Tadorna cana*		1		1	1	1	1
Yellowbilled Duck	*Anas undulata*				1	1	1	1
African Black Duck	*Anas sparsa*					1		1
Secretarybird	*Sagittarius serpentarius*	VU				1	1	1
Cape Vulture	*Gyps coprotheres*	EN	1					1
Black-shouldered Kite	*Elanus caeruleus*						1	
Verreaux's Eagle	*Aquila verreauxii*	VU			1	1	1	1
Tawny Eagle	*Aquila rapax*	EN						1
Booted Eagle	*Aquila pennatus*					1	1	1
Martial Eagle	*Polemaetus bellicosus*	EN			1		1	
Steppe Buzzard	*Buteo vulpinus*							1
Jackal Buzzard	*Buteo rufofuscus*		1		1	1	1	1
Southern Pale Chanting Goshawk	*Melierax canorus*		1		1	1	1	1
African Harrier-Hawk	*Polyboroides typus*				1	1	1	
Lanner Falcon	*Falco biarmicus*	VU						1
Amur Falcon	*Falco amurensis*							1
Rock Kestrel	*Falco rupicolus*				1	1	1	1
Greater Kestrel	*Falco rupicoloides*				1	1	1	1
Lesser Kestrel	*Falco naumanni*							1
Grey-winged Francolin	*Scleroptila africanus*		1		1		1	1
Helmeted Guineafowl	*Numida meleagris*				1	1	1	1
Blue Crane	*Anthropoides paradiseus*	NT	1		1	1	1	1
Ludwig's Bustard	*Neotis ludwigii*	EN	1	1			1	1
Karoo Korhaan	*Eupodotis vigorsii*	NT	1	1	1			
Three-banded Plover	*Charadrius tricollaris*					1	1	1
Crowned Lapwing	*Vanellus coronatus*				1		1	

Blacksmith Lapwing	*Vanellus armatus*			1	1	1	1
Common Greenshank	*Tringa nebularia*					1	1
Black-winged Stilt	*Himantopus himantopus*				1		
Spotted Thick-knee	*Burhinus capensis*			1	1	1	
Namaqua Sandgrouse	*Pterocles namaqua*	1			1	1	
Speckled Pigeon	*Columba guinea*			1	1	1	1
Red-eyed Dove	*Streptopelia semitorquata*				1	1	1
Cape Turtle-Dove	*Streptopelia capicola*			1	1	1	1
Laughing Dove	*Streptopelia senegalensis*			1	1	1	1
Namaqua Dove	*Oena capensis*					1	1
Diderick Cuckoo	*Chrysococcyx caprius*					1	
Spotted Eagle Owl	*Bubo africanus*					1	
White-rumped Swift	*Apus caffer*						1
Little Swift	*Apus affinis*					1	1
Alpine Swift	*Tachymarptis melba*				1	1	1
Speckled Mousebird	*Colius striatus*			1	1	1	1
White-backed Mousebird	*Colius colius*	1		1	1	1	1
Red-faced Mousebird	*Urocolius indicus*			1	1	1	1
Malachite Kingfisher	*Alcedo cristata*					1	
European Bee-eater	*Merops apiaster*					1	
African Hoopoe	*Upupa africana*				1	1	1
Acacia Pied Barbet	*Tricholaema leucomelas*	1		1	1	1	1
Crested Barbet	*Trachyphonus vaillantii*					1	1
Greater Honeyguide	*Indicator indicator*					1	
Ground Woodpecker	*Geocolaptes olivaceus*	1		1	1	1	1
Sabota Lark	*Calendulauda sabota*	1			1	1	
Spike-heeled Lark	*Chersomanes albofasciata*	1	1			1	1
Red-capped Lark	*Calandrella cinerea*						1
Large-billed Lark	*Galerida magnirostris*	1		1	1		1
Grey-backed Sparrowlark	*Eremopterix verticalis*	1					
Barn Swallow	*Hirundo rustica*					1	1
White-throated Swallow	*Hirundo albigularis*					1	1
Greater Striped Swallow	*Hirundo cucullata*	1				1	1
Rock Martin	*Hirundo fuligula*			1	1	1	1
Cape Crow	*Corvus capensis*			1	1		1
Pied Crow	*Corvus albus*			1	1	1	1
House Crow	*Corvus spendens*						
White-necked Raven	*Corvus albicollis*			1	1	1	1
Southern Grey Tit	*Parus afer*						1
Cape Penduline-Tit	*Anthoscopus minutus*	1		1			1
African Red-eyed Bulbul	*Pycnonotus nigricans*	1		1	1	1	1
Karoo Thrush	*Turdus smithi*	1	1	1	1	1	1
Cape Rock-Thrush	*Monticola rupestris*	1				1	

Short-toed Rock-Thrush	*Monticola brevipes*	1		1	1		
Mountain Wheatear	*Oenanthe monticola*	1		1	1	1	1
Capped Wheatear	*Oenanthe pileata*						1
Familiar Chat	*Cercomela familiaris*			1	1	1	1
Sickle-winged Chat	*Cercomela sinuata*	1	1		1	1	1
Karoo Chat	*Cercomela schlegelii*	1	1	1	1	1	
Anteating Chat	*Myrmecocichla formicivora*	1		1	1	1	1
African Stonechat	*Saxicola torquatus*			1	1	1	1
Cape Robin-Chat	*Cossypha caffra*			1	1	1	1
Karoo Scrub-Robin	*Cercotrichas coryphoeus*	1	1	1	1	1	1
Chestnut-vented Tit-Babbler	*Parisoma subcaeruleum*	1				1	1
Layard's Tit-Babbler	*Parisoma layardi*	1	1	1	1	1	1
Bar-throated Apalis	*Apalis thoracica*					1	
Long-billed Crombec	*Sylvietta rufescens*			1	1	1	1
Yellow-bellied Eremomela	*Eremomela icteropygialis*			1	1		1
Zitting Cisticola	*Cisticola juncidis*			1			
Desert Cisticola	*Cisticola aridulus*			1			1
Grey-backed Cisticola	*Cisticola cinnamomeus*	1		1	1	1	1
Levaillant's Cisticola	*Cisticola tinniens*					1	
Neddicky	*Cisticola fulvicapilla*			1		1	1
Karoo Prinia	*Prinia maculosa*	1		1	1	1	1
Rufous-eared Warbler	*Malcorus pectoralis*	1		1	1	1	1
Chat Flycatcher	*Bradornis infuscatus*	1		1		1	
Fiscal Flycatcher	*Sigelus silens*	1		1	1		1
Pririt Batis	*Batis pririt*	1		1		1	
Fairy Flycatcher	*Stenostira scita*	1		1	1	1	1
African Paradise-Flycatcher	*.Terpsiphone viridis*					1	1
Cape Wagtail	*Motacilla capensis*			1	1	1	1
African Pipit	*Anthus cinnamomeus*			1	1	1	1
Long-billed Pipit	*Anthus similis*			1	1	1	1
Plain-backed Pipit	*Anthus leucophrys*			1		1	1
Buffy Pipit	*Anthus vaalensis*					1	
African Rock Pipit	*Anthus crenatus*	1	1	1	1	1	
Cape Longclaw	*Macronyx capensis*	1		1	1	1	1
Common Fiscal	*Lanius collaris*			1	1	1	1
Southern Boubou	*Laniarius ferrugineus*	1				1	
Southern Tchagra	*Tchagra tchagra*	1		1			
Bokmakierie	*Telophorus zeylonus*	1		1	1	1	1
Common Starling	*Sturnus vulgaris*					1	1
Pied Starling	*Spreo bicolor*	1		1	1	1	1
Wattled Starling	*Creatophora cinerea*			1			
Red-winged Starling	*Onychognathus morio*			1	1	1	1
Pale-winged Starling	*Onychognathus nabouroup*	1		1	1	1	

Malachite Sunbird	*Nectarinia famosa*				1	1	1
Southern Double-collared Sunbird	*Cinnyris chalybeus*	1		1	1	1	
Cape White-Eye	*Zosterops virens*	1		1	1	1	1
House Sparrow	*Passer domesticus*			1	1	1	1
Cape Sparrow	*Passer melanurus*	1		1	1	1	1
Southern Grey-headed Sparrow	*Passer diffusus*				1	1	1
Cape Weaver	*Ploceus capensis*	1			1		
Southern Masked Weaver	*Ploceus velatus*			1	1	1	1
Southern Red Bishop	*Euplectes orix*			1	1	1	1
Common Waxbill	*Estrilda astrild*			1	1	1	1
African Quailfinch	*Ortygospiza atricollis*						1
Pin-tailed Whydah	*Vidua macroura*					1	1
Black-throated Canary	*Crithagra atrogularis*	1			1	1	1
Cape Canary	*Serinus canicollis*	1		1	1	1	1
Black-headed Canary	*Serinus alario*					1	1
Yellow Canary	*Crithagra flaviventris*	1		1	1	1	1
White-throated Canary	*Crithagra albogularis*	1		1	1	1	1
Cape Bunting	*Emberiza capensis*	1		1	1	1	1
Lark-like Bunting	*Emberiza impetuani*	1		1		1	1
Northern Black Korhaan	*Afrotis afraoides*	1	1	1	1	1	1
Eastern Clapper Lark	*Mirafra fasciolata*			1	1	1	1
Karoo Long-billed Lark	*Certhilauda subcoronata*	1	1			1	1
	Total	**55**	**11**	**84**	**84**	**114**	**106**

APPENDIX 6. BIRD SPECIES LIST FOR THE UMSOBOMVU SITE – SOUTHERN AFRICAN BIRD ATLAS PROJECT 1 & 2

Common Name	Scientific Name	SABAP 1	SABAP 2
Apalis, Bar-throated	*Apalis thoracica*		x
Avocet, Pied	*Recurvirostra avosetta*	x	x
Barbet, Acacia Pied	*Tricholaema leucomelas*	x	x
Barbet, Crested	*Trachyphonus vaillantii*		x
Batis, Pririt	*Batis pririt*	x	x
Bee-eater, European	*Merops apiaster*	x	x
Bishop, Southern Red	*Euplectes orix*	x	x
Bittern, Little	*Ixobrychus minutus*		x
Bokmakierie, Bokmakierie	*Telophorus zeylonus*	x	x
Boubou, Southern	*Laniarius ferrugineus*		x
Bulbul, African Red-eyed	*Pycnonotus nigricans*	x	x
Bunting, Cape	*Emberiza capensis*	x	x
Bunting, Cinnamon-breasted	*Emberiza tahapisi*	x	x
Bunting, Golden-breasted	*Emberiza flaviventris*	x	x
Bunting, Lark-like	*Emberiza impetuani*	x	x
Bustard, Kori	*Ardeotis kori*	x	
Bustard, Ludwig's	*Neotis ludwigii*	x	x
Buzzard, Jackal	*Buteo rufofuscus*	x	x
Buzzard, Steppe	*Buteo vulpinus*	x	x
Canary, Black-headed	*Serinus alario*	x	x
Canary, Black-throated	*Crithagra atrogularis*	x	x
Canary, Brimstone	*Crithagra sulphuratus*	x	
Canary, Cape	*Serinus canicollis*	x	x
Canary, White-throated	*Crithagra albogularis*	x	x
Canary, Yellow	*Crithagra flaviventris*	x	x
Chat, Anteating	*Myrmecocichla formicivora*	x	x
Chat, Familiar	*Cercomela familiaris*	x	x
Chat, Karoo	*Cercomela schlegelii*	x	x
Chat, Sickle-winged	*Cercomela sinuata*	x	x
Chat, Tractrac	*Cercomela tractrac*	x	
Cisticola, Cloud	*Cisticola textrix*	x	x
Cisticola, Desert	*Cisticola aridulus*	x	x
Cisticola, Grey-backed	*Cisticola subruficapilla*	x	x
Cisticola, Levaillant's	*Cisticola tinniens*	x	x
Cisticola, Zitting	*Cisticola juncidis*	x	x
Cliff-Swallow, South African	*Hirundo spilodera*	x	x

Coot, Red-knobbed	*Fulica cristata*	x	x
Cormorant, Reed	*Phalacrocorax africanus*	x	x
Cormorant, White-breasted	*Phalacrocorax carbo*	x	x
Courser, Double-banded	*Rhinoptilus africanus*	x	x
Crane, Blue	*Anthropoides paradiseus*	x	x
Crombec, Long-billed	*Sylvietta rufescens*	x	x
Crow, Cape	*Corvus capensis*	x	x
Crow, Pied	*Corvus albus*	x	x
Cuckoo, Diderick	*Chrysococcyx caprius*	x	x
Cuckoo, Great Spotted	*Clamator glandarius*	x	
Cuckoo, Jacobin	*Clamator jacobinus*	x	
Cuckoo, Red-chested	*Cuculus solitarius*	x	x
Darter, African	*Anhinga rufa*	x	x
Dove, Laughing	*Streptopelia senegalensis*	x	x
Dove, Namaqua	*Oena capensis*	x	x
Dove, Red-eyed	*Streptopelia semitorquata*	x	x
Dove, Rock	*Columba livia*	x	x
Drongo, Fork-tailed	*Dicrurus adsimilis*	x	x
Duck, African Black	*Anas sparsa*	x	x
Duck, White-faced	*Dendrocygna viduata*		x
Duck, Yellow-billed	*Anas undulata*	x	x
Eagle, Booted	*Aquila pennatus*	x	x
Eagle, Martial	*Polemaetus bellicosus*	x	x
Eagle, Tawny	*Aquila rapax*	x	
Eagle, Verreaux's	*Aquila verreauxii*	x	x
Eagle-Owl, Cape	*Bubo capensis*	x	
Eagle-Owl, Spotted	*Bubo africanus*	x	x
Egret, Cattle	*Bubulcus ibis*	x	x
Egret, Great	*Egretta alba*	x	
Egret, Little	*Egretta garzetta*	x	x
Eremomela, Karoo	*Eremomela gregalis*	x	
Eremomela, Yellow-bellied	*Eremomela icteropygialis*	x	x
Falcon, Amur	*Falco amurensis*		x
Falcon, Lanner	*Falco biarmicus*	x	x
Falcon, Peregrine	*Falco peregrinus*		x
Finch, Red-headed	*Amadina erythrocephala*	x	x
Fiscal, Common	*Lanius collaris*	x	x
Fish-Eagle, African	*Haliaeetus vocifer*		x
Flamingo, Greater	*Phoenicopterus ruber*	x	x
Flamingo, Lesser	*Phoenicopterus minor*	x	
Flycatcher, Chat	*Bradornis infuscatus*	x	x

Flycatcher, Fairy	*Stenostira scita*	x	x
Flycatcher, Fiscal	*Sigelus silens*	x	x
Flycatcher, Spotted	*Muscicapa striata*	x	x
Francolin, Grey-winged	*Scleroptila africanus*	x	x
Francolin, Orange River	*Scleroptila levaillantoides*	x	
Goose, Egyptian	*Alopochen aegyptiacus*	x	x
Goose, Spur-winged	*Plectropterus gambensis*	x	x
Goshawk, Gabar	*Melierax gabar*	x	x
Goshawk, Southern Pale Chanting	*Melierax canorus*	x	x
Grassbird, Cape	*Sphenoeacus afer*	x	
Grebe, Black-necked	*Podiceps nigricollis*		x
Grebe, Great Crested	*Podiceps cristatus*	x	
Grebe, Little	*Tachybaptus ruficollis*	x	x
Greenbul, Sombre	*Andropadus importunus*	x	
Greenshank, Common	*Tringa nebularia*	x	x
Guineafowl, Helmeted	*Numida meleagris*	x	x
Hamerkop, Hamerkop	*Scopus umbretta*	x	x
Harrier, Black	*Circus maurus*	x	
Harrier-Hawk, African	*Polyboroides typus*		x
Heron, Black-headed	*Ardea melanocephala*	x	x
Heron, Grey	*Ardea cinerea*	x	x
Honeyguide, Greater	*Indicator indicator*	x	x
Hoopoe, African	*Upupa africana*	x	x
House-Martin, Common	*Delichon urbicum*	x	
Ibis, African Sacred	*Threskiornis aethiopicus*	x	x
Ibis, Glossy	*Plegadis falcinellus*	x	x
Ibis, Hadeda	*Bostrychia hagedash*	x	x
Jacana, African	*Actophilornis africanus*	x	
Kestrel, Greater	*Falco rupicoloides*	x	x
Kestrel, Lesser	*Falco naumanni*	x	x
Kestrel, Rock	*Falco rupicolus*	x	x
Kingfisher, Brown-hooded	*Halcyon albiventris*	x	x
Kingfisher, Giant	*Megaceryle maximus*	x	x
Kingfisher, Malachite	*Alcedo cristata*	x	x
Kingfisher, Pied	*Ceryle rudis*	x	
Kite, Black-shouldered	*Elanus caeruleus*	x	x
Korhaan, Black	*Eupodotis afra*	x	
Korhaan, Blue	*Eupodotis caerulescens*	x	x
Korhaan, Karoo	*Eupodotis vigorsii*	x	x
Korhaan, Northern Black	*Afrotis afraoides*		x
Lapwing, Blacksmith	*Vanellus armatus*	x	x

Lapwing, Crowned	*Vanellus coronatus*	x	x
Lark, Agulhas Clapper	*Mirafra marjoriae*	x	
Lark, Agulhas Long-billed	*Certhilauda brevirostris*	x	
Lark, Barlow's	*Calendulauda barlowi*	x	
Lark, Benguela Long-billed	*Certhilauda benguelensis*	x	
Lark, Cape Clapper	*Mirafra apiata*	x	x
Lark, Cape Long-billed	*Certhilauda curvirostris*	x	
Lark, Clapper	*Mirafra apiata*	x	
Lark, Eastern Clapper	*Mirafra fasciolata*	x	x
Lark, Eastern Long-billed	*Certhilauda semitorquata*	x	x
Lark, Karoo	*Calendulauda albescens*	x	
Lark, Karoo Long-billed	*Certhilauda subcoronata*	x	x
Lark, Large-billed	*Galerida magnirostris*	x	x
Lark, Longbilled	*Mirafra curvirostris*	x	
Lark, Melodious	*Mirafra cheniana*	x	x
Lark, Red-capped	*Calandrella cinerea*	x	x
Lark, Sabota	*Calendulauda sabota*	x	x
Lark, Spike-heeled	*Chersomanes albofasciata*	x	x
Longclaw, Cape	*Macronyx capensis*	x	x
Marsh-Harrier, African	*Circus ranivorus*	x	
Martin, Brown-throated	*Riparia paludicola*	x	x
Martin, Rock	*Hirundo fuligula*	x	x
Masked-Weaver, Southern	*Ploceus velatus*	x	x
Moorhen, Common	*Gallinula chloropus*	x	x
Mousebird, Red-faced	*Urocolius indicus*	x	x
Mousebird, Speckled	*Colius striatus*	x	x
Mousebird, White-backed	*Colius colius*	x	x
Neddicky, Neddicky	*Cisticola fulvicapilla*	x	x
Night-Heron, Black-crowned	*Nycticorax nycticorax*	x	x
Nightjar, Fiery-necked	*Caprimulgus pectoralis*	x	
Nightjar, Rufous-cheeked	*Caprimulgus rufigena*	x	x
Ostrich, Common	*Struthio camelus*	x	x
Owl, Barn	*Tyto alba*	x	x
Palm-Swift, African	*Cypsiurus parvus*		x
Paradise-Flycatcher, African	*Terpsiphone viridis*	x	x
Penduline-Tit, Cape	*Anthoscopus minutus*		x
Petronia, Yellow-throated	*Petronia superciliaris*	x	
Pigeon, Speckled	*Columba guinea*	x	x
Pipit, African	*Anthus cinnamomeus*	x	x
Pipit, African Rock	*Anthus crenatus*	x	x
Pipit, Buffy	*Anthus vaalensis*	x	x

Pipit, Long-billed	*Anthus similis*	x	x
Pipit, Plain-backed	*Anthus leucophrys*	x	x
Plover, Kittlitz's	*Charadrius pecuarius*	x	x
Plover, Three-banded	*Charadrius tricollaris*	x	x
Pochard, Southern	*Netta erythrophthalma*	x	
Prinia, Black-chested	*Prinia flavicans*	x	
Prinia, Drakensberg	*Prinia hypoxantha*	x	
Prinia, Karoo	*Prinia maculosa*	x	x
Prinia, Spotted	*Prinia hypoxantha*	x	
Quail, Common	*Coturnix coturnix*	x	x
Quailfinch, African	*Ortygospiza atricollis*	x	x
Quelea, Red-billed	*Quelea quelea*	x	x
Raven, White-necked	*Corvus albicollis*	x	x
Reed-Warbler, African	*Acrocephalus baeticatus*	x	x
Robin-Chat, Cape	*Cossypha caffra*	x	x
Rock-Thrush, Cape	*Monticola rupestris*	x	x
Rock-Thrush, Short-toed	*Monticola brevipes*		x
Roller, European	*Coracias garrulus*	x	x
Ruff, Ruff	*Philomachus pugnax*	x	
Sandgrouse, Namaqua	*Pterocles namaqua*	x	x
Sandpiper, Common	*Actitis hypoleucos*	x	x
Sandpiper, Green	*Tringa ochropus*		x
Sandpiper, Marsh	*Tringa stagnatilis*	x	
Sandpiper, Wood	*Tringa glareola*	x	x
Scrub-Robin, Karoo	*Cercotrichas coryphoeus*	x	x
Secretarybird	*Sagittarius serpentarius*	x	x
Seedeater, Streaky-headed	*Crithagra gularis*		x
Shelduck, South African	*Tadorna cana*	x	x
Shoveler, Cape	*Anas smithii*	x	x
Shrike, Red-backed	*Lanius collurio*		x
Snake-Eagle, Black-chested	*Circaetus pectoralis*		x
Snipe, African	*Gallinago nigripennis*	x	x
Sparrow, Cape	*Passer melanurus*	x	x
Sparrow, Greyheaded	*Passer diffusus*	x	
Sparrow, House	*Passer domesticus*	x	x
Sparrow, Northern Grey-headed	*Passer griseus*	x	
Sparrow, Southern Grey-headed	*Passer diffusus*	x	x
Sparrow-Weaver, White-browed	*Plocepasser mahali*	x	x
Sparrowhawk, Black	*Accipiter melanoleucus*		x
Sparrowhawk, Rufous-chested	*Accipiter rufiventris*	x	x

Sparrowlark, Grey-backed	*Eremopterix verticalis*	x	x
Spoonbill, African	*Platalea alba*	x	x
Starling, Cape Glossy	*Lamprotornis nitens*	x	x
Starling, Common	*Sturnus vulgaris*	x	x
Starling, Pale-winged	*Onychognathus nabouroup*	x	x
Starling, Pied	*Spreo bicolor*	x	x
Starling, Red-winged	*Onychognathus morio*	x	x
Starling, Wattled	*Creatophora cinerea*	x	x
Stilt, Black-winged	*Himantopus himantopus*	x	x
Stint, Little	*Calidris minuta*	x	x
Stonechat, African	*Saxicola torquatus*	x	x
Stork, Black	*Ciconia nigra*	x	x
Stork, White	*Ciconia ciconia*	x	x
Sunbird, Amethyst	*Chalcomitra amethystina*	x	x
Sunbird, Dusky	*Cinnyris fuscus*	x	x
Sunbird, Malachite	*Nectarinia famosa*	x	x
Sunbird, Southern Double-collared	*Cinnyris chalybeus*	x	x
Swallow, Barn	*Hirundo rustica*	x	x
Swallow, Greater Striped	*Hirundo cucullata*	x	x
Swallow, Pearl-breasted	*Hirundo dimidiata*		x
Swallow, White-throated	*Hirundo albigularis*	x	x
Swamp-Warbler, Lesser	*Acrocephalus gracilirostris*	x	x
Swift, African Black	*Apus barbatus*	x	x
Swift, Alpine	*Tachymarptis melba*	x	x
Swift, Common	*Apus apus*		x
Swift, Horus	*Apus horus*	x	
Swift, Little	*Apus affinis*	x	x
Swift, White-rumped	*Apus caffer*	x	x
Teal, Cape	*Anas capensis*	x	x
Teal, Red-billed	*Anas erythrorhyncha*	x	x
Tern, White-winged	*Chlidonias leucopterus*	x	
Thick-knee, Spotted	*Burhinus capensis*	x	x
Thrush, Karoo	*Turdus smithi*	x	x
Thrush, Olive	*Turdus olivaceus*	x	
Tit, Ashy	*Parus cinerascens*	x	
Tit, Grey	*Parus afer*	x	x
Tit-Babbler, Chestnut-vented	*Parisoma subcaeruleum*	x	x
Tit-Babbler, Layard's	*Parisoma layardi*	x	x
Turtle-Dove, Cape	*Streptopelia capicola*	x	x
Wagtail, Cape	*Motacilla capensis*	x	x

Warbler, Namaqua	*Phragmacia substriata*	x	x
Warbler, Rufous-eared	*Malcorus pectoralis*	x	x
Warbler, Willow	*Phylloscopus trochilus*	x	x
Waxbill, Common	*Estrilda astrild*	x	x
Weaver, Cape	*Ploceus capensis*	x	x
Wheatear, Capped	*Oenanthe pileata*	x	x
Wheatear, Mountain	*Oenanthe monticola*	x	x
White-eye, Cape	*Zosterops pallidus*	x	
White-eye, Cape	*Zosterops virens*	x	x
White-eye, Orange River	*Zosterops pallidus*	x	
Whydah, Pin-tailed	*Vidua macroura*	x	x
Woodpecker, Cardinal	*Dendropicos fuscescens*	x	x
Woodpecker, Ground	*Geocolaptes olivaceus*	x	x

APPENDIX 7. METHOD OF ASSESSING THE SIGNIFICANCE OF POTENTIAL ENVIRONMENTAL IMPACTS

This section outlines the proposed method for assessing the significance of the potential environmental impacts outlined above. As indicated, these include both operational and construction phase impacts.

For each impact, the EXTENT (spatial scale), MAGNITUDE and DURATION (time scale) would be described. These criteria would be used to ascertain the SIGNIFICANCE of the impact, firstly in the case of no mitigation and then with the most effective mitigation measure(s) in place. The mitigation described in the EIAR would represent the full range of plausible and pragmatic measures but does not necessarily imply that they would be implemented.[1]

The tables on the following pages show the scale used to assess these variables, and defines each of the rating categories.

CRITERIA	CATEGORY	DESCRIPTION
Extent or spatial influence of impact	**Regional**	Beyond a 10 kilometre radius of the candidate site.
	Local	Within a 10 kilometre radius of the candidate site.
	Site specific	On site or within 100 m of the candidate site.
Magnitude of impact (at the indicated spatial scale)	**High**	Natural and/ or social functions and/ or processes are *severely* altered
	Medium	Natural and/ or social functions and/ or processes are *notably* altered
	Low	Natural and/ or social functions and/ or processes are *slightly* altered
	Very Low	Natural and/ or social functions and/ or processes are *negligibly* altered
	Zero	Natural and/ or social functions and/ or processes remain *unaltered*
Duration of impact	**Construction period**	Up to 3 years
	Short Term	Up to 5 years after construction
	Medium Term	5-15 years after construction
	Long Term	More than 15 years after construction

The SIGNIFICANCE of an impact is derived by taking into account the temporal and spatial scales and magnitude. The means of arriving at the different significance ratings is explained below**.**

SIGNIFICANCE RATINGS	LEVEL OF CRITERIA REQUIRED
High	• High magnitude with a regional extent and long term duration • High magnitude with either a regional extent and medium term duration or a local extent and long term duration • Medium magnitude with a regional extent and long term duration
Medium	• High magnitude with a local extent and medium term duration • High magnitude with a regional extent and construction period or a site specific extent and long term duration • High magnitude with either a local extent and construction period duration or a site specific extent and medium term duration • Medium magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Low magnitude with a regional extent and long term duration
Low	• High magnitude with a site specific extent and construction period duration • Medium magnitude with a site specific extent and construction period duration • Low magnitude with any combination of extent and duration except site specific and construction period or regional and long term • Very low magnitude with a regional extent and long term duration
Very low	• Low magnitude with a site specific extent and construction period duration • Very low magnitude with any combination of extent and duration except regional and long term
Neutral	• Zero magnitude with any combination of extent and duration

Once the significance of an impact has been determined, the PROBABILITY of this impact occurring as well as the CONFIDENCE in the assessment of the impact, would be determined using the rating systems outlined below. It is important to note that the significance of an impact should always be considered in concert with the probability of that impact occurring. Lastly, the REVERSIBILITY of the impact is estimated using the rating system outlined below.

PROBABILITY RATINGS	CRITERIA
Definite	Estimated greater than 95 % chance of the impact occurring.
Probable	Estimated 5 to 95 % chance of the impact occurring.
Unlikely	Estimated less than 5 % chance of the impact occurring.

CONFIDENCE RATINGS	CRITERIA
Certain	Wealth of information on and sound understanding of the environmental factors potentially influencing the impact.
Sure	Reasonable amount of useful information on and relatively sound understanding of the environmental factors potentially influencing the impact.

Unsure	Limited useful information on and understanding of the environmental factors potentially influencing this impact.