Spreeukloof Wind Farm

Part II Amendment– Avifaunal statement

July 2021

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1. Background

Rainmaker Energy Projects (Pty) Ltd received an Environmental Authorisation (EA) for the construction of the Spreeukloof Wind Energy Facility on a site near Molteno in the Eastern Cape Province (DEA ref: 12/12/20/1778/5) on 02 November 2012. The original EIA (which received environmental authorisation in May 2011) and associated specialist studies considered five wind energy facilities collectively referred to as the Dorper Wind Farm (DEA ref: 12/12/20/1778). The Dorper Wind Farm consisted of five phases: Dorper Wind Energy Facility, Loperberg Wind Energy Facility, Malabar Wind Energy Facility, Spinning Head Wind Energy Facility and Spreeukloof Wind Energy Facility. The authorisation for the Spreeukloof Wind Energy Facility was received following the application to amend the Dorper Wind Farm authorisation (i.e. splitting of the project into phases) for the broader facility. Subsequent amendments have been granted for the project as follows:

- DFFE Ref: 12/12/20/1778/5 (dated 20 May 2013): Amendment to the properties specified for the project, as well as turbine specification changes.
- DFFE Ref: 12/12/20/1778/5/AM3 (dated 13 June 2016): Amendment to the EA validity (extension)
- DFFE Ref: 12/12/20/1778/5/AM4 (dated 15 November 2018): Amendment to the EA validity (extension)

The EIA and amendment applications were conducted by Savannah Environmental (Savannah). The original avifaunal impact assessment for the full site was conducted by Avisense (2010). In 2012-13, WildSkies Ecological Services (WildSkies) was appointed by Savannah to conduct 12 months pre-construction bird monitoring at the full site (including all 5 phases). This monitoring was completed in July 2014 (WildSkies, 2014). This was in accordance with the requirement for such monitoring as per the best practice guidelines (Jenkins *et al,* 2011) (only put into practice after the original environmental authorisation). In the period 2015 to 2018 WildSkies also conducted operational phase bird monitoring at the operational Dorper Wind Farm, which is located adjacent to the planned Spreeukloof WEF.

The Spreeukloof project is intended to be bid into future rounds of the Department of Mineral Resources and Energy (DMRE) Renewable Energy Independent Power Producers Procurement (REIPPP) Programme, or similar suitable alternative programmes. There have been advancements to wind turbine technology since the issuing of the EA, and the turbines authorised in the EA are therefore no longer considered to be the most suitable in terms of production and economic considerations.

In this regard, Rainmaker Energy Projects (Pty) Ltd (the proponent) is now applying for a substantive amendment (Part II) towards amending the EA with the inclusion and amendment of the following:

i. Amendment of the turbine specifications, to be as follows:
    a. The increase of the rotor diameter from '125m' (authorised in 2013) to reflect as 'up to 176m', with a resulting blade length of 'up to 88m'.
    b. Update of the authorised range of the hub height from '120m' (authorised in 2013) to reflect as 'up to 120m'.
ii. A reduction in the authorised number of turbines from the currently authorised 21 turbines to 12 as per the revised layout.
iii. Update the layout as required to accommodate and reflect the removal of the respective turbines from the total authorised turbine number in amendment no. 2 above.
iv. Update of the project description to reflect the revised 132kV grid connection line location and substation locations for each of Loperberg, Malabar and Spreeukloof.
v. Update of the project description and listed activity description with specific inclusion of the location and capacity specification of the Eskom substation and 400kV grid line capacity, which was not previously explicitly included in the Spreeukloof EA but was assessed as part of the EIA.
vi. Removal of the specification of the facility capacity within the EA, to rather reflect the number of authorised turbines as per the revised layout.
vii. Extension of the Environmental Authorisation (EA) validity by an additional two year
viii. Amendment to the holder of the Environmental Authorisation.
ix. Amendment to the capacity of the Spreeukloof Wind Farm (applicable to Spreeukloof WEF application only).

These amendments are proposed in order to increase the efficiency of the facility and consequently the economic competitiveness thereof. No additional properties will be affected by the amendments as the proposed amendments are within the original authorised development footprint.

As per the Regulations (Chapter 5 Regulations 31 and 32 of the EIA Regulations of December (2014) as amended (2017)), Savannah is required to conduct a substantive amendment, which requires input/comparative specialist assessments (what was assessed in the EIAr and the current impacts based on the amendments proposed). WildSkies was appointed by Savannah in May 2021 for the purpose of assessing the avifaunal impacts of the proposed amendment.

The terms of reference for this avifaunal statement are as follows:

- Review original reports & data
- An assessment of all impacts related to the proposed changes;
- Detail the advantages and disadvantages associated with the changes;

- Conduct a comparative assessment for the impacts identified during the EIA Process (or more recent Part II amendment reports) and the impacts associated with the proposed amendments
- Determine whether the significance of impacts as previously assessed would change under the new proposed amendment. Sensitivity mapping will also be re-examined and amended if necessary
- Describe and explain any such changes
- If any change then recommend necessary mitigation
- Update mitigation measures based on what we have learnt in the industry subsequent to the original study
- Review additional avifaunal best practice guidelines which have been published subsequent to the original studies and advise on the requirements for the above four projects to comply with these guidelines. These guidelines include:
    - Best Practice Guidelines for birds & wind energy (2015)
    - Best practice Guidelines for Verreaux's Eagle & wind energy (2017)
    - Best Practice Guidelines for Cape Vulture & Wind Energy (2019)
- It is also noted that the conservation status of several key bird species has changed subsequent to the original assessment. This will need to be considered for this current assessment.

The assessment must be clear on whether each of the proposed changes to the EA will:

- Increase the significance of impacts originally identified in the EIA report or lead to any additional impacts; or
- Have a zero or negligible effect on the significance of impacts identified in the EIA report; or
- Lead to a reduction in any of the identified impacts in the EIA report.
- Whether any additional mitigation measures are required as introduced by the amendment proposal.

Figure 1 below shows the project layout which was previously authorised. Figure 2 shows the proposed new layout.

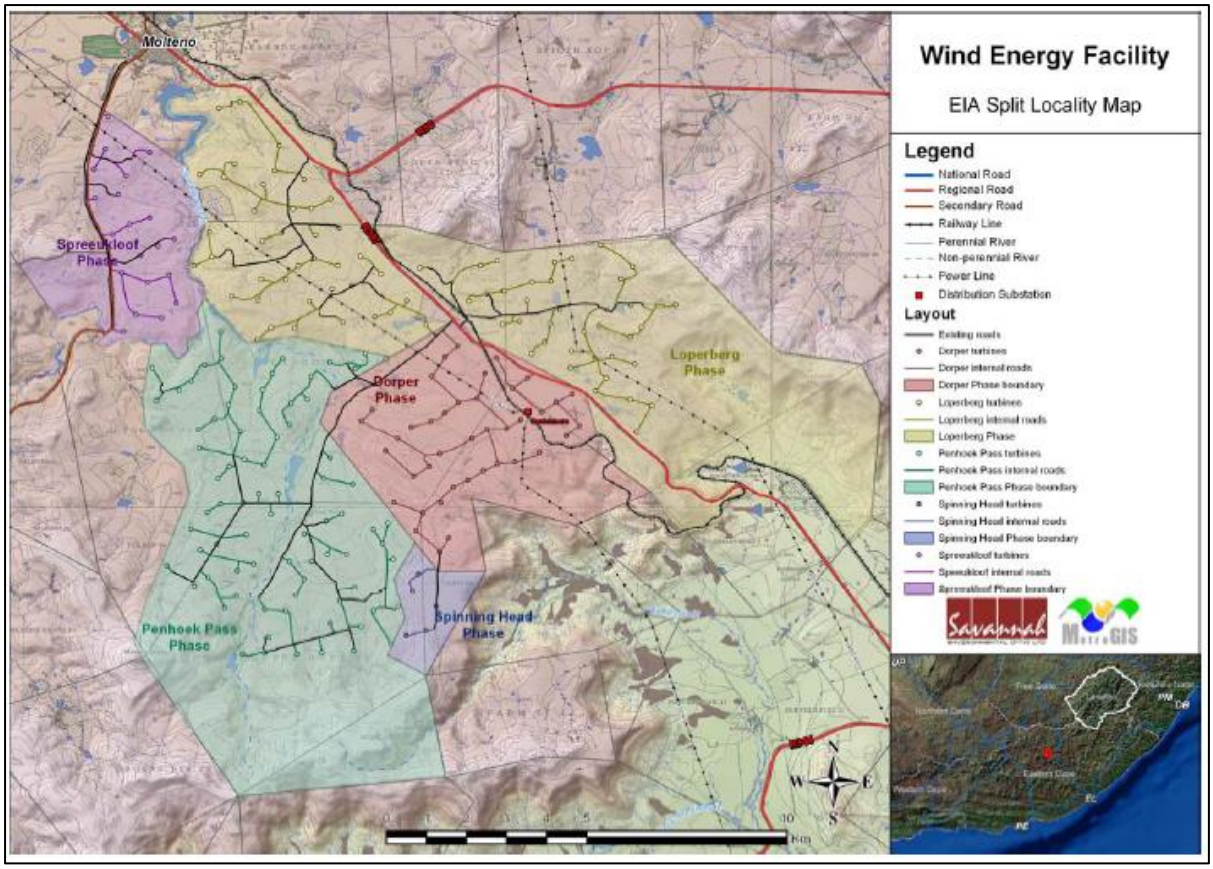


Figure 1. The original authorised layout.

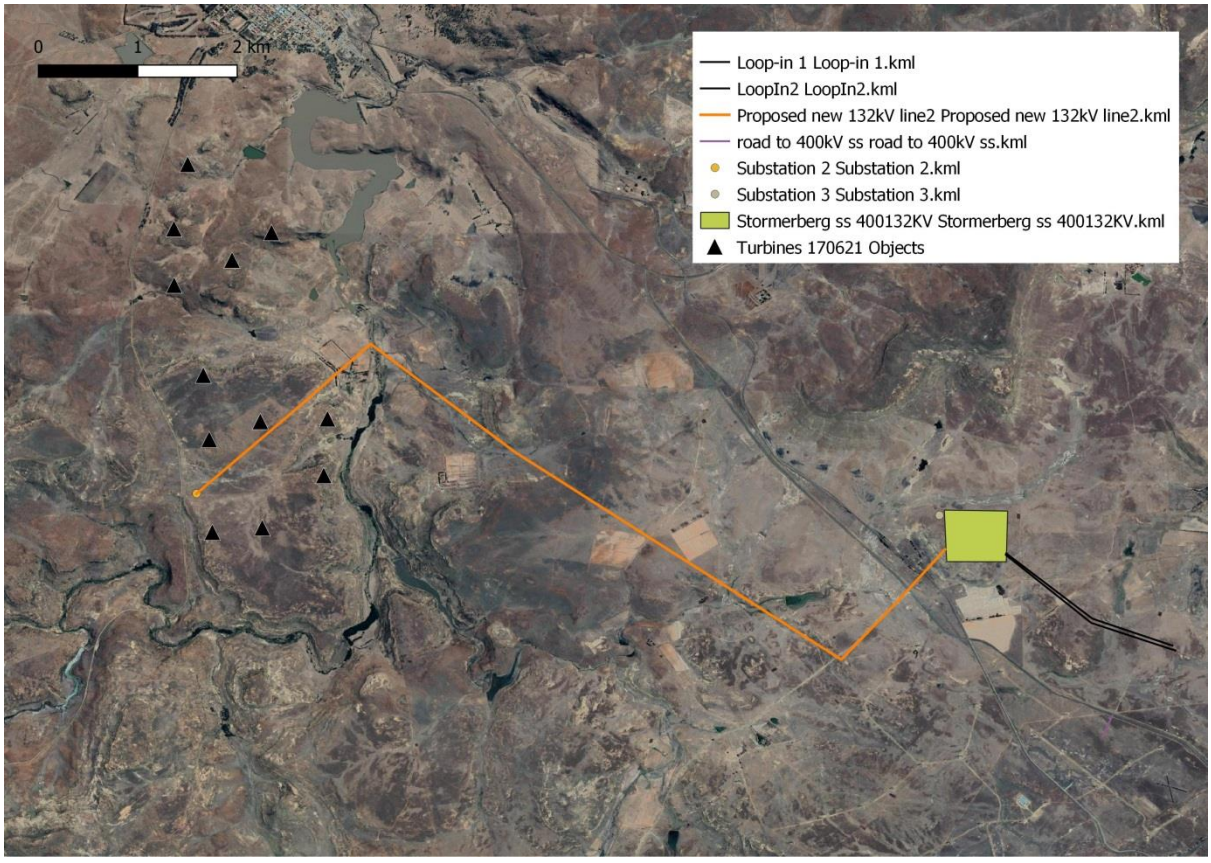


Figure 2. The proposed new layout

Notes:

1. This avifaunal statement is compiled with the knowledge that the project already has an environmental authorisation to go ahead in its original (and subsequent amended) form, and that the new proposed facility is an improvement on the old facility in terms of risks to birds (since the number of turbines has been reduced).
2. This assessment considers all new avifaunal information (unrelated to the actual proposed facility amendment) that we are aware of, in order to be thorough.

2. Original Impact Assessment findings

The original avifaunal impact assessment study (Avisense, 2010) made the following findings with respect to impact significance, using the methods and criteria contained in Appendix 1 (developed by Savannah).

Impacts of the proposed Wind Energy Facility are most likely to be manifest in the following ways:

(i) Mortality of Cape Vultures foraging in the area, using ridge lines targeted by the development for turbine placements as sources of slope lift, and colliding with the turbine blades or any new power lines associated with the facility.

(ii) Disturbance and displacement of resident/breeding large terrestrial birds (especially Denham's and Ludwig's Bustards, Blue Korhaan, Blue Crane and Grey-crowned Crane) from nesting and/or foraging areas by construction and/or operation of the facility, and /or mortality of these species in collisions with the turbine blades or associated new power lines while commuting between resource areas (croplands, nest sites, roost sites/wetlands).

(iii) Displacement of resident/visiting raptors (especially Cape Eagle Owl, Black Harrier, Verreaux's Eagle, Secretarybird, Lesser Kestrel and Lanner Falcon) from foraging areas by construction and/or operation of the facility, and /or mortality of these species in collisions with the turbine blades or associated new power lines while slope-soaring along the high-lying ridges or hunting in the valleys, or by electrocution when perched on power infrastructure.

(iv) Disturbance and displacement of resident/breeding Grassland endemics (including Drakensberg Rock-jumper, Melodious Lark and Yellow-breasted Pipit), by construction and/or operation of the facility.

It should be noted that potential impacts on avifauna may be somewhat lower than expected due to the fact that the area has been compromised by the existing transmission lines which traverse the site.

Mitigation of these impacts will be best achieved in the following ways:

(i) Minimising the disturbance impacts associated with the construction of the facility, by abbreviating construction time, scheduling activities around avian breeding and/or movement schedules (actual timing to be refined by the results of pre-construction monitoring), and lowering levels of associated noise.

(ii) Minimising habitat destruction caused by the construction of the facility by keeping the lay-down areas as small as possible, building as few temporary roads as possible, and reducing the final extent of developed area to a minimum.

(iii) Minimising the disturbance impacts associated with the operation of the facility, by abbreviating maintenance times, scheduling activities in relation to avian breeding and/or movement schedules (actual timing to be refined by the results of pre-construction monitoring), and lowering levels of associated noise.

(iv) Possibly excluding development from certain high-lying or high relief areas where Cape Vultures and other soaring species might be most likely to fly. A definitive decision on if and where to delineate exclusion zones in such situations to minimise collision risk for slope soaring birds cannot be made at this stage, in the absence of adequate information on how often, when, under what conditions, and expressly where Cape Vultures and other affected species use these ridges for cross-country flying. This will require additional observations to be done at the site (e.g. see pre-construction monitoring below)[1]. However, the turbine locations most likely to be affected would probably be those few within 500m of the escarpment drop-off along the southern periphery of the proposed development (Refer to Appendix 2). These high sensitivity avifaunal areas require further monitoring during all four seasons to provide more certainty regarding bird movements within these areas. This comprehensive monitoring should take place before development occurs within these areas. All other areas would only require bird monitoring once the facility is operational.

(v) Ensuring that all dead stock are removed from the land as soon as possible (and perhaps relocated to safe 'restaurant' area for vultures at least 20 km from the site), and that all landowners within a wide radius (>10 km) of the facility are asked to do the same. This should reduce the numbers of vultures attracted to the area and lower collision risk.

(vi) Painting one blade of each turbine black to maximise conspicuousness to oncoming birds.

(vii) Ensuring that lighting on the turbines is kept to a minimum, and is coloured (red or green) and intermittent, rather than permanent and white, to reduce confusion effects for nocturnal migrants.

(viii) Minimising the length of any new power lines installed, ensuring that all new lines are marked with bird flight diverters (Jenkins *et al.* 2010), and that all new power

infrastructure is adequately insulated and bird friendly in configuration (Lehman *et al.* 2007).

(ix) Carefully monitoring the local avifauna pre- and post-construction (see below), and implementing appropriate additional mitigation as and when significant changes are recorded in the number, distribution or breeding behaviour of any of the priority species listed in this report, or when collision or electrocution mortalities are recorded for any of the priority species listed in this report.

(x) Additional mitigation might include re-scheduling construction or maintenance activities on site, shutting down problem turbines either permanently or at certain times of year or in certain conditions, or installing a 'DTect' or similar radar tracking system to monitor bird movements and institute temporary shut-downs as and when required.

The latter is an expensive option, but will be requisite if the interface between vultures and turbines is deemed to be too frequent and too direct to avoid significant numbers of vulture fatalities. The size of the proposed facility may compromise the efficacy of this system, but intelligent application in identified, critical areas may be essential.

Construction phase impact assessment tables

(A) Disturbance

Nature: Noise, movement and temporary occupation of habitat during the building process. Likely to impact all birds in the area to some extent, but sensitive, sedentary and/or habitat specific species will most adversely affected.

	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Short (1)	Short (1)
Magnitude	High (8)	Moderate (6)
Probability	Definite (5)	Definite (5)
Significance	**55 (Medium)**	**45 (Medium)**
Status	Negative	Negative
Reversibility	Medium	High
Irreplaceable loss?	Possible	Probably not
Can impacts be mitigated?	Yes	

Mitigation: Abbreviating construction time, scheduling activities around avian breeding and/or movement schedules (actual timing to be refined by the results of pre-construction monitoring), lowering levels of associated noise, and reducing the size of the inclusive development footprint.

Cumulative impacts: Yes, if other wind energy developments are under construction at the same time.

Residual impacts: Some priority species may move away regardless of mitigation.

(B) Habitat loss

Nature: Destruction of habitat for priority species, either temporary – resulting construction activities peripheral to the built area, or permanent - the area occupied by the completed development.

	Without mitigation	With mitigation
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**65 (High)**	**55 (Medium)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss?	Possible	Probably not
Can impacts be mitigated?	Yes	

Mitigation: Minimising habitat destruction caused by the construction of the facility by keeping the lay-down areas as small as possible, building as few temporary roads as possible, and reducing the final extent of developed area to a minimum.

Cumulative impacts: Yes, further developments in the area will increase habitat losses.

Operational phase impact tables

(A) Disturbance

Nature: Noise and movement generated by operating turbines and maintenance activities is sufficient to disturb priority species, causing displacement from the area, adjustments to commute routes with energetic costs, or otherwise affecting nesting success or foraging efficiency.

	Without mitigation	With mitigation
Extent	Local (2)	Local (2)
Duration	Lifetime of the facility (4)	Lifetime of the facility (4)
Magnitude	Moderate (8)	Moderate (7)
Probability	Highly probable (4)	Highly probable (4)
Significance	**56 (Medium-High)**	**52 (Medium-High)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss?	Possible	Possible
Can impacts be mitigated?	Slightly	No

Mitigation: Abbreviating maintenance times, scheduling activities in relation to avian breeding and/or movement schedules (actual timing to be refined by the results of pre-construction monitoring), and lowering levels of associated noise.

Cumulative impacts: Considerable if more wind energy facilities developed in the same area.

Residual impacts: Some priority species may be permanently lost from the area.

(B) Mortality

Nature: Collision of priority species with the wind turbine blades and/or any new power lines, or electrocution of the same on new power infrastructure.

	Without mitigation	With mitigation
Extent	Regional (3)	Local (2)
Duration	Lifetime of the facility (4)	Lifetime of the facility (4)
Magnitude	High (8)	Low (4)
Probability	Highly probable (4)	Probable (3)
Significance	**60 (Medium-High)**	**30 (Medium)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss?	Yes	Possibly not
Can impacts be mitigated?	Yes	

Mitigation: Careful siting of turbines, marking power lines, bird friendly power hardware, monitoring priority bird movements and collisions, turbine management sensitive to these data – radar assisted if necessary.

Cumulative impacts: Yes, if more development takes place in the immediate area, habitat losses may increase exponentially.

Residual impacts: Some casualties may be incurred regardless of mitigation.

3. Proposed changes to facility

3.1. Proposed changes to turbine model

The turbine model is to be changed from a rotor diameter of 'up to 125m' to a rotor diameter of 'up to 176m'. The hub height remains the same at 'up to 120m'. This means that the rotor swept area will change from the previous 57.5m to 182.5m above ground to the new 32m to 208m above ground (if maximum hub height is used, which may not necessarily be the case).

Two aspects of the change in turbine model are relevant to assessing bird turbine collision risk: the change in height above ground at which the rotor will be; and the change in overall size of rotor. These are discussed in Sections 3.1.1 and 3.1.2 below.

3.1.1 Change in height above ground of rotor

For the purposes of this analysis we assume the largest turbine model within the range applied for, as a worst case scenario. The original authorised model would have had a rotor swept area from 57.5m to 182.5m above ground. The new proposed turbine would have a rotor swept area of 32m to 208m

above ground if the maximum hub height is used. Figure 3 below shows the two rotor swept area scenarios. The lower tip of the proposed new rotor drops by 15.5m. This is a slight disadvantage for avifauna as much of the typical bird flight is in the first 20-40m above the ground. Dropping the blade tip therefore slightly increases collision risk. Whichever hub height is used, the lower blade tip may not be lowered below 30m above ground.

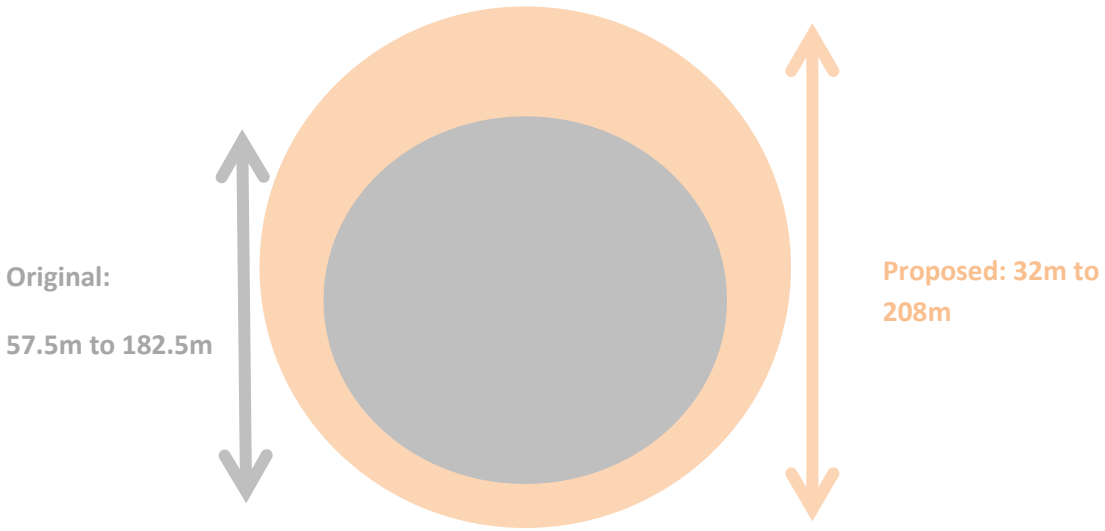


Figure 3. Indicative diagram of the original and proposed rotor swept areas. Not to scale.

3.1.2. Change in overall risk window presented by facility

The turbine model authorised originally had a maximum 125m rotor diameter and therefore presented a collision risk window of 12 271.85m² per turbine. The proposed change to a maximum 176m rotor diameter will increase the collision risk window presented by each turbine to 24 328.49m². This almost doubles the per-turbine collision risk window. The number of proposed turbines has however reduced from 21 to 12. The overall wind farm collision risk window would therefore increase from 257 708.85m² (21 x 12 271.85m²) to 291 941.88 (12 x 24 328.49m²). This represents an overall increase of 13.2%. This is also added to by the lower blade lowering as described in Section 3.1.1.

3.1. Proposed changes to facility layout

The original layout avoided all sensitive areas identified for avifauna (Avisense, 2010).

More recently than the EIA, the pre-construction bird monitoring (WildSkies, 2014) recommended:

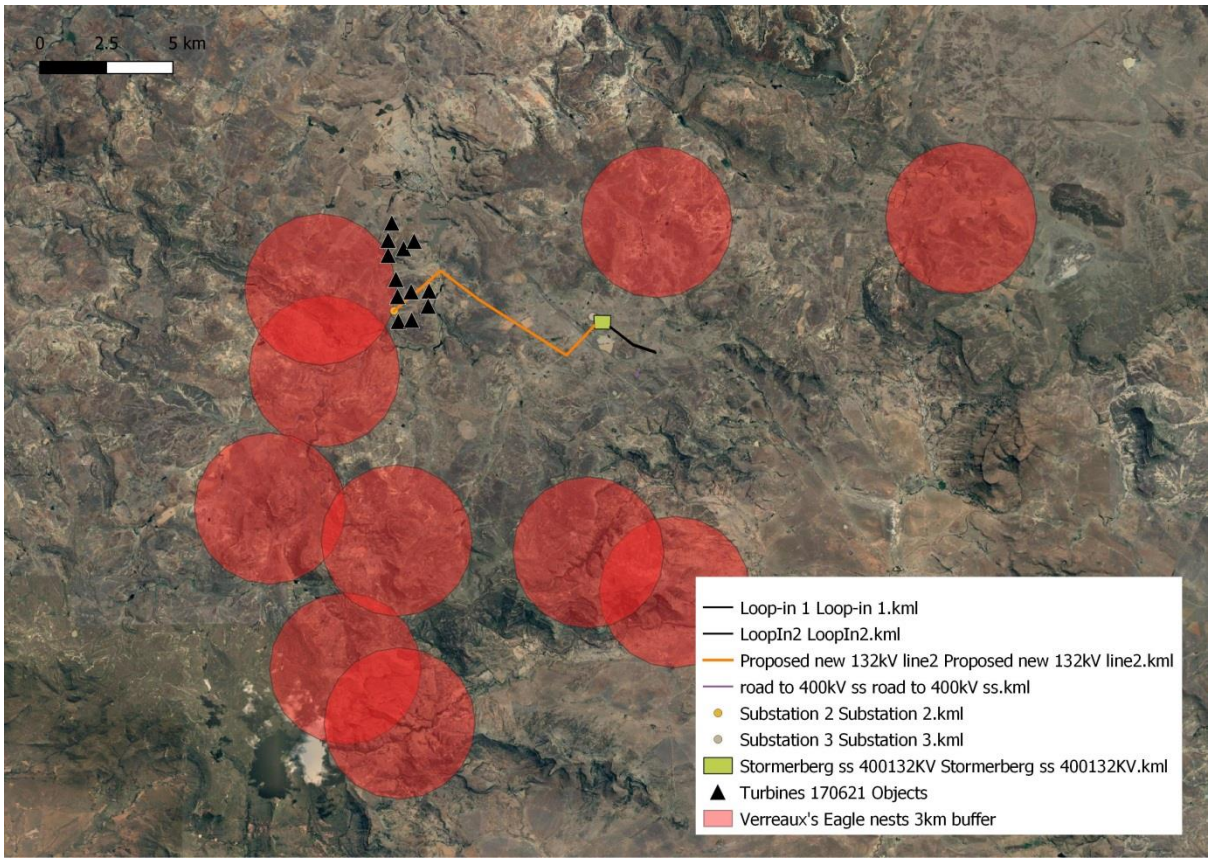
- No turbines or overhead power lines should be constructed within 250m of a wetland, dam, pan, or drainage line unless agreed to with the specialist in writing.

- No turbines should be placed within 250m from the edge of the main escarpment.

The new proposed amendment continues to avoid these areas. The proposed layout also avoids the necessary 3 kilometre Verreaux's Eagle nest buffers (Figure 4)(see Section 4).

Overall the new layout is better for avifauna as it uses almost half the number of turbines, with an associated decrease in the length of road, cabling and other associated infrastructure.

The slight change in power line routing due to the finalisation of the substation position makes no significant difference to the impact on avifauna and is therefore acceptable.



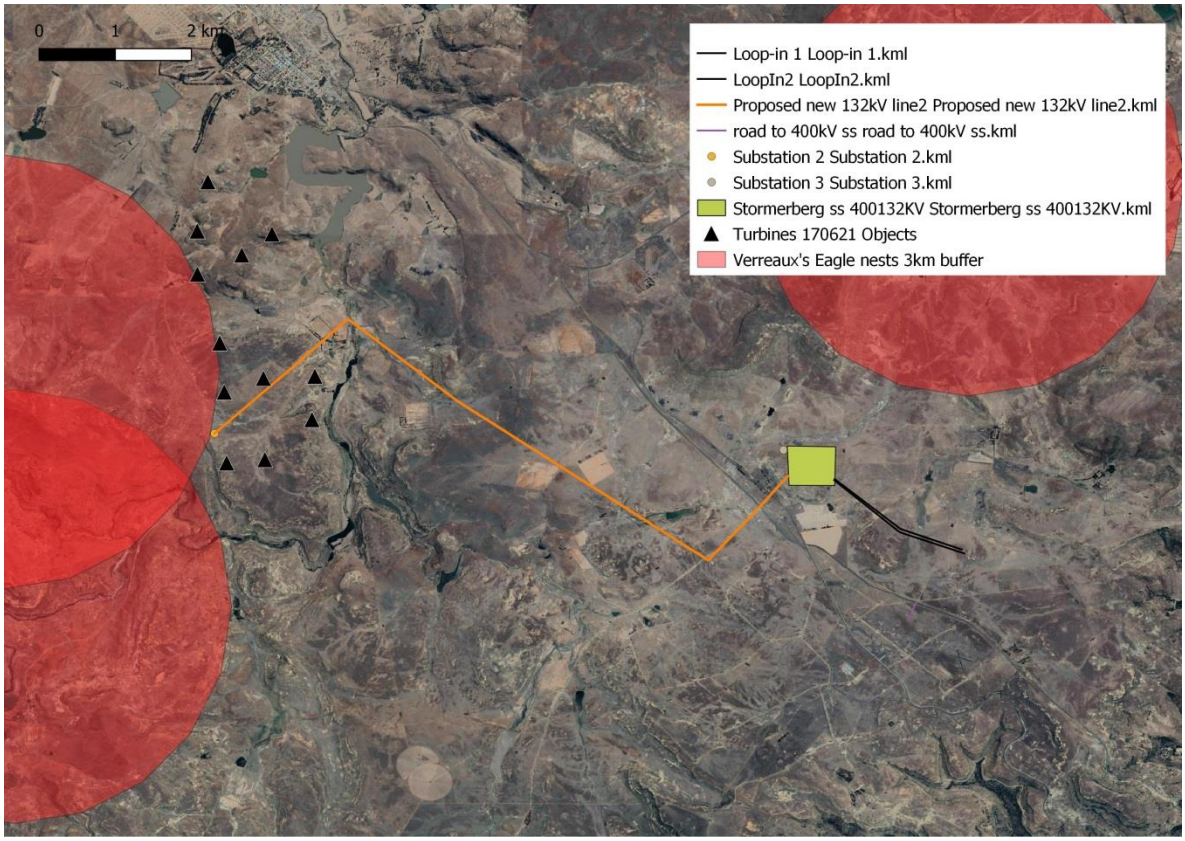


Figure 4. Avifaunal sensitivity

4. New avifaunal information

4.1. Best practice guidelines

Several best practice guidelines have been published subsequent to the original assessment. The implications of these for the proposed project are described below:

4.1.1. Overall best practice guidelines for birds and wind energy

The updated best practice guidelines (Jenkins *et al*, 2015) state that:

"If there is a significant gap (i.e. more than three years) between the completion of the initial pre-construction monitoring and impact assessment, and the anticipated commencement of construction, it may be advisable to repeat the pre-construction monitoring (or parts thereof) to assess whether there have been any changes in species abundance, movements and/or habitat use in the interim".

The Spreeukloof Wind Farm has exceeded this three year time frame (pre-construction monitoring having finished in 2014). However the project proponent has committed to implementing bird turbine

collision mitigation proactively from the start of operations based on the risk already identified and managed at the adjacent Dorper Wind Farm, rather than conducting another year of pre-construction monitoring. We support this approach.

4.1.2. Verreaux's Eagle best practice guidelines (Birdlife South Africa, 2017)

Subsequent to the original studies BirdLife South Africa has published species specific best practice guidelines for the Verreaux's Eagle (BirdLife South Africa, 2017). These guidelines state:

"Where a wind farm is proposed within potentially important Verreaux's Eagle habitat, BirdLife South Africa recommends the following:

1. *Wind turbines should be placed outside of the core territory of eagles to reduce the risk of collisions*.
    - We have plotted the known nests of Verreaux's Eagle relative to the Spreeukloof Wind Farm in Figure 4. The proposed layout avoids the prescribed 3km buffers around nest sites.

2. *Areas associated with increased flight activity and/or risky behaviour should also be avoided.*
    - See 1 above.

3. *Dedicated surveys must be conducted to identify potential nest sites.*
    - This was done by operational phase bird monitoring at Dorper Wind Farm during late 2015 (Jenkins & Du Plessis, 2015). The nine confirmed nest sites displayed in Figure 4 are the result of this survey. This requirement has therefore been achieved as the area surveyed for eagle nests for the Dorper facility includes the area which would need to be surveyed for the Spreeukloof facility.

4. *A buffer of 3km is recommended around all nests (including alternate nests). This is intended to reduce the risk of collisions and disturbance. This is a precautionary buffer and may be reduced (or increased) based on the results of rigorous avifaunal surveys, but nest buffers should never be less than 1.5km.*
    - This has been achieved - see Point 1 above.

5. *Vantage point surveys should be conducted for a minimum of 72 hours per vantage point per year.*
    - Pre-construction monitoring collected 48 hours of data per vantage point per year during pre-construction bird monitoring. In addition two years of operational phase bird monitoring was completed at the operational Dorper Wind Farm. The

Dorper Wind Farm is adjacent to the Spreeukloof Wind Farm, and so the data collected there is relevant to Spreeukloof.

6. *Field work must include surveys during the breeding season.*
    - This has been achieved.

7. *Surveys (including vantage point monitoring) should extend beyond the developable area.*
    - This was done by the 2015 survey. A larger area than just Spreeukloof was monitored since four projects were monitored at once (Dorper, Loperberg, Malabar & Spreeukloof).

8. *The relative extent and type of use of the site by eagles must be assessed.*
    - This has been achieved based on eagle flight data collected on site during pre-construction monitoring.

9. *Steps should be taken to avoid increasing the prey population (and thereby attracting eagles to the wind farm). For example excavated rocks and animal carcasses should be removed.*
    - The recommended mitigation measures in this regard have been strengthened.

10. *If it is suspected that a proposed wind farm may pose a significant risk to Verreaux's Eagles, the duration of pre-construction monitoring should be extended to two years, particularly where alternate nests are some distance apart and/or turbines are proposed in areas that may be associated with increased flight activity and/or risky behaviour.*
    - One year of pre-construction monitoring was conducted previously, and two years of operational phase bird monitoring were conducted at the operational Dorper Wind Farm. The Dorper Wind Farm is adjacent to the Spreeukloof Wind Farm, and so the data collected there is relevant to Spreeukloof.

11. *No construction activities (e.g. new roads) should be allowed within 1km of nests during the breeding season.*
    - This has been achieved through the buffer already imposed, and the mitigation recommendations made previously.

12. *Nests should be monitored for breeding activity throughout the lifespan of the wind farm (including during construction), but care must be taken to ensure that monitoring activities do not disturb breeding birds.*
    - This has been recommended as part of the mitigation contained in this current amendment report.

It is noted that these guidelines are currently being updated by BirdLife South Africa. The updated version requires either that the Verreaux's Eagle Risk Assessment (VERA) model to be run in order to identify required nest buffers, or that a minimum 5.2km buffer is used around nest locations, or at the very minimum 3.7km where robust data supports this. These guidelines are still under comment from stakeholders and may be subject to change. At this stage the Spreeukloof project has complied with the original published guideline requirements (BirdLife South Africa, 2017).

4.1.3. Cape Vulture guidelines (BirdLife South Africa, 2018)

Subsequent to the original assessment a set of guidelines has been developed by BirdLife South Africa for Cape Vultures and wind farms (BirdLife South Africa, 2018). The key points in these guidelines which are relevant to the Spreeukloof Wind Farm are:

1. *A buffer of approximately 50 km around all colonies, and regular or seasonal/occasional roosts should be considered as high to very high sensitivity.*
    - A seasonal Cape Vulture roost (Donkerhoek) is known to now be present approximately 22km from the proposed site (Figure 5). This roost was either not in use at all or was temporarily unoccupied at the time of the original assessment. We note that in 2013-2014 approximately 46 Cape Vultures were poisoned by a farmer in the Molteno district. This may have almost entirely removed the 'local' (bearing in mind the vast distances that these birds move) vulture population. In the more recent years 2017 to 2021 we have observed an increasing number of birds using this roost again, with a peak count of 121 birds present in February 2021 (pers obs). This has heightened the risk for this species colliding with turbines in this area (see Section 5 below).

2. *A buffer of approximately 18 km around breeding colonies should be considered as very high sensitivity.*
    - This is not relevant. The closest breeding colony is approximately 68km from site.

3. *The number of operational and potential wind farms within a radius of at least 100 km of the proposed wind farm should be considered, including the results of pre-construction and operational phase monitoring (where available).*
    - One such operational site (Dorper Wind Farm) exists and is described in Section 4.4.

4. *Avoidance of high sensitivity and particularly very high sensitivity areas is encouraged, but developers may decide to proceed with data collection to verify the risk. If a wind farm is proposed within high or very high sensitivity areas (i.e. if vultures are likely to occur regularly and/or there is a risk of cumulative negative impacts) data collection must extend beyond the minimum protocols recommend in the BirdLife South Africa/EWT Best Practice Guidelines*

(Jenkins et al. 2015). The duration of monitoring should be at least two years to allow for annual variation and increase statistical rigor. Surveys should include the pre-breeding season (late March to early May), and the breeding season (May to December). A minimum of 72 hours per vantage point per year should be surveyed, and site visits should be timed to account for as much seasonal variation as possible (i.e. a minimum of 6 site visits each year). All occupied and potential breeding colonies and roost sites within 50 km of the proposed wind farm must be monitored according to standard survey protocols. The use of technology to study the movements of vultures (e.g. radar, tracking devices, and/or wind current modelling) is strongly encouraged. The number of bird fatalities that might take place once the wind farm is operational should be estimated using a collision risk model (provided there is sufficient data from the site to support this). However, factors such as topography, bird behaviour, season, aggregation, wind direction and wind speed may also affect collision risk and should also be considered in the final assessment of risk. The risk of cumulative effects should be assessed.

- Forty-eight hours of data per vantage point per year was collected during pre-construction bird monitoring. In addition two years of operational phase bird monitoring was completed at the adjacent operational Dorper Wind Farm. The project proponent has committed to implementing bird turbine collision mitigation proactively from the start of operations based on the risk already identified and managed at the adjacent Dorper Wind Farm, rather than conducting another year of pre-construction monitoring.

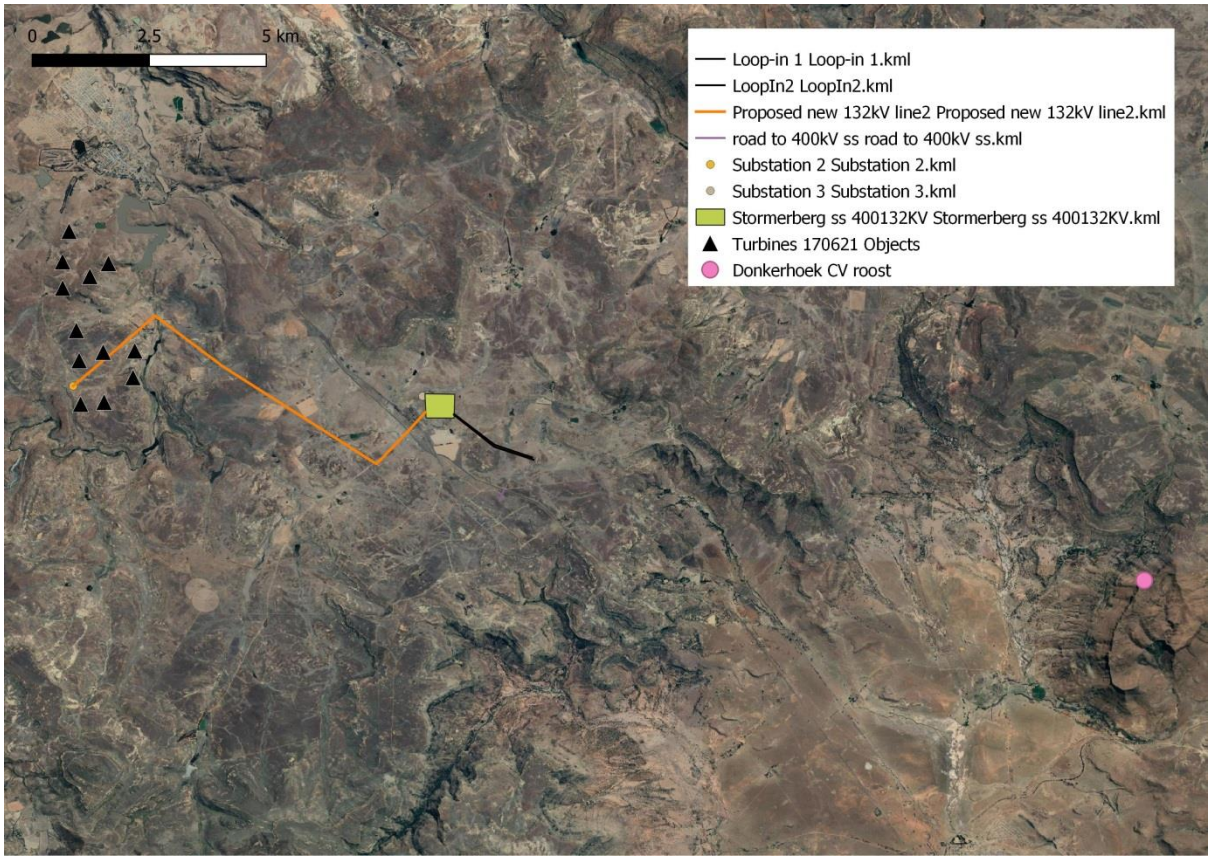


Figure 5. The Donkerhoek Cape Vulture roost site location (22km from site).

4.2. Lessons learnt at operational wind farms since the original assessment

Ralston-Paton, Smallie, Pearson and Ramalho (2017) reviewed the results from one year of post-construction (operational-phase) monitoring of birds at seven wind farms constructed under the first phase of the REIPPPP. A summary of the reviews' findings (those relevant to this project) is as follows:

Displacement, disturbance, avoidance of sites by birds

No conclusive evidence of displacement of bird species once turbines were constructed was found. A similar finding was made for disturbance and avoidance. Although some species observed during pre-construction were not observed during the operational phase, and vice versa, there was little conclusive evidence for displacement of priority species from any sites. This is however a relatively simplistic and short term conclusion and may change with more in depth and longer term analysis.

Turbine collision fatalities

In the first year of operation, 271 bird fatalities were recorded at the seven wind farms (285 turbines) that were regularly surveyed in accordance with the BirdLife South Africa/EWT Best Practice Guidelines. This represents an average of 0.95 birds per turbine per year (range 0.2 – 2 birds per turbine per year. When adjusted for searcher efficiency and carcass persistence the estimated fatality rates ranged from 2.1 to 8.6 birds per turbine per year, with a mean of 4.1.

Species were divided into broad groups and the number affected by collisions in each group is summarised in Figure 6 (extracted from Ralston-Paton *et al*, 2017). Raptors and passerines are two groups most affected, echoing patterns observed elsewhere in the world (Rydell *et al*., 2012).

Threatened species affected by collisions with wind turbines included Cape Cormorant (*Phalacrocorax capensis*, regionally Endangered), Blue Crane (*Anthropoides paradiseus*, Near Threatened), Martial Eagle (*Polemaetus bellicosus*, Endangered), Verreaux's Eagle (*Aquila verreauxii*, Vulnerable), Lanner Falcon (*Falco biarmicus*, Vulnerable), Striped Flufftail (*Sarothrura affinis*, Vulnerable) and Black Harrier (*Circus maurus*, Endangered) (Taylor *et al*. 2015). Although not currently threatened, the high number of Jackal Buzzard (*Buteo rufofuscus*) fatalities is also of note. This species is near endemic to South Africa.

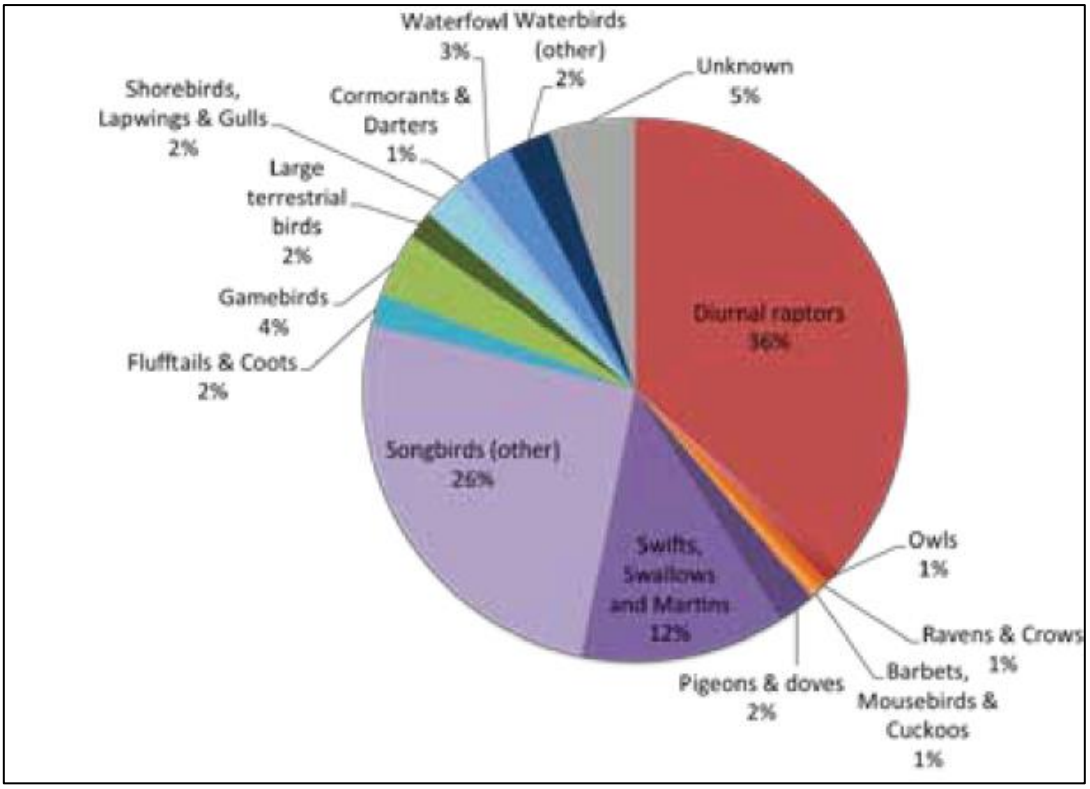


Figure 6. Summary of turbine collision fatalities by family (from Ralston-Paton *et al*, 2017).

Ralston-Paton *et al's* review included the first year of operational monitoring at the first 8 facilities. A more recent review was conducted by Perold *et al* (2020) of the bird fatality data across 20 operational wind farms between 2014 and 2018. The overall adjusted fatality rate was 4.6 birds/turbine/year. Thirty families and 130 bird species were affected. Diurnal raptors were killed most often (36% of carcasses, 23 species) followed by passerines (30%, 49 species), waterbirds (11%, 24 species), swifts (9%, six species), large terrestrial birds (5%, 10 species), pigeons (4%, six species) and other near passerines (1%, seven species). The species of most conservation concern killed include endangered Cape Vultures and Black Harriers, both of which are endemic to southern Africa.

We obtained permission from Dorper Wind Farm (DWF) to reference data collected by WildSkies at DWF once operational in the period mid-August 2014 to August 2018. Table 1 summarises the key findings during this period:

Table 1. Summary of operational phase findings at Dorper Wind Farm to date.

Period	Key findings
Year 1:Aug 2014 – Aug 2015	Recorded total of 43 bird fatalities, comprising at least 14 species. Unadjusted bird fatality rate of 0.97birds.turbine.year. Adjusted (for searcher efficiency and scavenger removal) fatality rate of 4.68birds/turbine/year. Recorded fatalities included most importantly 4 Verreaux's Eagle; 15 Amur Falcon; 2 Rock Kestrel; 2 Pale Chanting Goshawk; & 2 Blue Korhaan.
Year 2:Aug 2015 – Aug 2016	Recorded total of 24 bird fatalities from 17 species. Unadjusted bird fatality of 0.73birds/turbine/year. Adjusted fatality rate of 1.6birds/turbine/year. The most significant fatalities were 2 Amur Falcon; 2 Rock Kestrel; & 1 Jackal Buzzard. No further Verreaux's

	Eagle fatalities were recorded. Ongoing monitoring (2015 breeding season) of the 9 confirmed Verreaux's Eagle nests surrounding site show occupation & continued breeding at all sites.
Sep 2016 to August 2018	1 Martial Eagle fatality recorded in September 2016. 3 Cape Vulture fatalities were recorded in March, June & July 2017. No further Verreaux's Eagle fatalities. The local population of 9 Verreaux's Eagle nests has been monitored each breeding season (2016, 2017, & 2018) & breeding is continuing as per normal.

Fatality rates for the two key species for the four-year period August 2014 to August 2018 can be calculated as 0.025birds/turbine/year for Verreaux's Eagle (4 fatalities ÷ 40 turbines ÷ 4 years) and 0.019birds/turbine/year for Cape Vulture (3 fatalities ÷ 40 turbines ÷ 4 years).

If we assume all factors equal and multiply these fatality rates from DWF by the 12 turbines proposed at Spreeukloof Wind Farm the result is an estimated 0.3 Verreaux's Eagle and 0.2 Cape Vultures which could be killed at Spreeukloof Wind Farm through turbine collision per year.

It is clear that since the original assessment at the proposed site (where the susceptibility of species to turbine collisions was speculated) a number of species have proven to actually be susceptible.

The local Verreaux's Eagle breeding population was monitored for five seasons in 2015 to 2019. Breeding continued at most sites, with at least 6 to 8 of the 9 breeding territories being occupied and active each season, and some sites emerging over time as being possible alternate nests (i.e. not used every year). Large eagles such as Verreaux's typically do not breed every single year. In the Karoo, Davies (1994) found that 65% of pairs bred each season, with an overall production of 0.46 fledglings per year (n= 84 pair years). The local population seems then to be functioning as expected. This means that the fatalities that were recorded at Dorper Wind Farm do not appear to be impacting on the functioning of this local eagle population.

4.3. Changes to bird species conservation status

At the time of the original assessment (Avisense, 2010) the most recent regional Red List of birds was Barnes (2000). In the interim the regional Red List has been updated by Taylor *et al* (2015) and several key bird species present in the area have changed their status, mostly for the worse. The Global Red List (IUCN) has also been updated. Table 2 summarises this situation. Of the seventeen priority bird species listed, 9 have been upgraded in conservation status (i.e. are more threatened now), 3 have been downgraded and 5 are unchanged. Since Red List status is relevant to assessing the consequence of impacts, this change is relevant to the impact assessment in Section 5. Two of the species most significantly upgraded are Cape Vulture and Verreaux's Eagle – which are the two most important species for this assessment, as described in Section 4.1 of this report. Cape Vulture was upgraded from Vulnerable to Endangered both regionally and Globally, and Verreaux's Eagle was upgraded from

Least Concern to Vulnerable regionally. This means that any impacts on these species carry considerably more significance now than previously.

Table 2. Summary of changes to key bird species (as identified by Avisense 2010) regional (Barnes, 2000, Taylor *et al* 2015) and global (IUCN 2010, 2019) conservation status.

Common name	*Species name*	Original Regional /Global	Current Regional /Global	Comment
African Grass-Owl	*Tyto capensis*	VU/LC	VU/LC	Unchanged
Cape Eagle-Owl	*Bubo capensis*	LC/LC	LC/LC	Unchanged
Denham's Bustard	*Neotis denhami*	VU/NT	VU/NT	Unchanged
Blue Korhaan	*Eupodotis caerulescens*	NT/NT	LC/NT	Downgrade regionally, i.e. less threatened now
Grey Crowned Crane	*Balearica regulorum*	VU/VU	EN/EN	Upgrade to conservation status regionally & globally
Blue Crane	*Anthropoides paradiseus*	VU/VU	NT/VU	Downgrade regionally, i.e. less threatened now
Cape Vulture	*Gyps coprotheres*	VU/VU	EN/EN	Upgrade to conservation status regionally & globally
African Marsh-Harrier	*Circus ranviorus*	VU/LC	EN/LC	Upgrade regionally, unchanged globally
Black Harrier	*Circus maurus*	NT/VU	EN/EN	Significant upgrade to conservation status regionally & globally, i.e. more threatened now
Verreaux's Eagle	*Aquila verreauxii*	LC/LC	VU/LC	Significant upgrade to conservation status regionally
Martial Eagle	*Polemaetus bellicosus*	VU/NT	EN/EN	Upgrade to conservation status regionally & globally
Secretarybird	*Sagittarius serpentarius*	NT/VU	VU/EN	Upgrade to conservation status regionally
Lesser Kestrel	*Falco naumanni*	VU/LC	LC/LC	Downgrade regionally, i.e. less threatened now
Lanner Falcon	*Falco biarmicus*	NT/LC	VU/LC	Upgrade to conservation status regionally
Black Stork	*Ciconia nigra*	NT/LC	VU/LC	Upgrade to conservation status regionally
Drakensberg Rockjumper	*Chaetops auranticus*	LC/LC	LC/NT	Unchanged
Yellow-breasted Pipit	*Anthus chloris*	VU/LC	VU/VU	Unchanged

EN-Endangered; VU-Vulnerable; NT-Near-threatened; LC-Least Concern

4.4. Cumulative effects

When the original assessment was done the Dorper Wind Farm (all five phases) was the only proposed wind farm within 30 kilometres. However the four sub sections of the original proposed project (Dorper Wind Farm –operational; & Loperberg Wind Farm, Malabar Wind Farm & Spreeukloof Wind Farm - proposed) must now be considered cumulatively. The cumulative effect of these developments on birds has been described in Section 5.

5. Comparative impact assessment

Based on the information available to us now, our current assessment of the significance of impacts on avifauna is as follows. In each table the ratings which differ from the original are in shown in red text:

Construction phase

Table 3. Impact assessment for Disturbance of birds during construction.

Nature: **Disturbance of birds during construction activities**		
	Without mitigation	**With mitigation**
Extent	Local (2)	Local (2)
Duration	Short (1)	Short (1)
Magnitude	Moderate (6)	Moderate (6)
Probability	Definite (5)	Definite (5)
Significance	**45 (Medium)**	**45 (Medium)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: » A 3km radius circular no-go buffer must be implemented around each of the known Verreaux's Eagle nests. No new overhead infrastructure may be constructed within these areas. » An avifaunal walk through must be conducted by a suitably qualified and independent ornithologist for all components of the final facility layout to ensure that all avifaunal aspects have been adequately catered for. If WildSkies does this we believe it can be done desktop due to our high level of experience and familiarity with the site.		
Cumulative impacts: The cumulative impact on birds could be high if all planned facilities in this area are constructed.		
Residual Risks: If all recommended mitigation in both original and current avifaunal assessments is adhered to there should be no residual impact.		

This impact has reduced slightly in significance as compared to the original assessment. This is because we have learnt at operational wind farms around South Africa that most birds adapt to disturbance and recover quickly after construction. We have also implemented some avoidance by applying a no-go buffer of 3km around the most sensitive point receptors in this regard, i.e. the Verreaux's Eagle nest sites.

Table 4. Impact assessment for Habitat destruction during construction.

Nature: **Destruction of bird habitat**

	Without mitigation	With mitigation
Extent	Local (2)	Local (2)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Definite (5)	Definite (5)
Significance	**55 (Medium)**	**55 (Medium)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:

- A 3km radius circular no-go buffer must be implemented around each of the known Verreaux's Eagle nests. No new overhead infrastructure may be constructed within these areas.
- An avifaunal walk through must be conducted by a suitably qualified and independent ornithologist for all components of the final facility layout to ensure that all avifaunal aspects have been adequately catered for. If WildSkies does this we believe it can be done desktop due to our high level of experience and familiarity with the site.
- The facility must be monitored once operational in accordance with the most recent version of the best practice guidelines available at the time (Jenkins et al, 2015). A minimum of two years of monitoring must be completed, although if significant impacts are detected this will need to be extended. Fatality estimates should continue for the full life span of the facility. The results of this monitoring should feed into the adaptive management plan for the facility.
- The local population of Verreaux's Eagle must be monitored for the full lifespan of the wind farm to ensure that any population level impacts are measured. This will require 2-3 visits to each of the 9 known nests (and any new ones subsequently found) during breeding season each year by a suitably qualified independent ornithologist. This will measure breeding status and productivity and the overall health of this local population.

Cumulative impacts:
The cumulative impact on birds could be high if all planned facilities in this area are constructed.

Residual Risks:
It is not possible to fully mitigate habitat destruction since a certain amount is inevitable. There will be a residual impact of Medium significance.

This impact has reduced slightly in significance as compared to the original assessment. This is because we have learnt at operational wind farms around South Africa that most birds adapt to habitat destruction and recover quickly after construction. We have also implemented some avoidance by applying a no-go buffer of 3km around the most sensitive point receptors in this regard, i.e. the Verreaux's Eagle nest sites.

Operational phase

Table 5. Impact assessment for disturbance during operations.

Nature: **Disturbance of birds during operational phase**

	Without mitigation	With mitigation
Extent	Local (2)	Local (2)
Duration	Facility lifetime (4)	Facility lifetime (4)
Magnitude	Moderate (6)	Low (4)
Probability	Highly probable (4)	Improbable (2)
Significance	**Medium (48)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	Possible	Possible
Can impacts be mitigated?	Yes	

Mitigation:

- A 3km radius circular no-go buffer must be implemented around each of the known Verreaux's Eagle nests. No new overhead infrastructure may be constructed within these areas.
- An avifaunal walk through must be conducted by a suitably qualified and independent ornithologist for all components of the final facility layout to ensure that all avifaunal aspects have been adequately catered for. If WildSkies does this we believe it can be done desktop due to our high level of experience and familiarity with the site.
- The facility must be monitored once operational in accordance with the most recent version of the best practice guidelines available at the time (Jenkins et al, 2015). A minimum of two years of monitoring must be completed, although if significant impacts are detected this will need to be extended. Fatality estimates should continue for the full life span of the facility. The results of this monitoring should feed into the adaptive management plan for the facility.
- The local population of Verreaux's Eagle must be monitored for the full lifespan of the wind farm to ensure that any population level impacts are measured. This will require 2-3 visits to each of the 9 known nests (and any new ones subsequently found) during breeding season each year by a suitably qualified independent ornithologist. This will measure breeding status and productivity and the overall health of this local population.

Cumulative impacts:
The cumulative impact on birds could be high if all planned facilities in this area are constructed.

Residual Risks:
If all recommended mitigation in both original and current avifaunal assessments is adhered to there should be no residual impact.

This impact has reduced slightly in significance as compared to the original assessment as described above in terms of new avoidance measures applied to the project.

Table 6. Impact assessment for mortality during operational phase.

Nature:
Mortality of birds through collision with turbine blades and any overhead power line, and electrocution on power line.

	Without mitigation	With mitigation
Extent	Regional (3)	Regional (3)
Duration	Facility lifetime (4)	Facility lifetime (4)
Magnitude	High (8)	High (8)
Probability	Definite (5)	Probable (3)
Significance	**75 (High)**	**45 (Medium)**
Status (positive or negative)	Negative	Negative

Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes - partially	

Mitigation:

- A 3km radius circular no-go buffer must be implemented around each of the known Verreaux's Eagle nests. No new overhead infrastructure may be constructed within these areas.
- Whichever hub height is used, the lower blade tip may not be lowered below 30m above ground.
- An avifaunal walk through must be conducted by a suitably qualified and independent ornithologist for all components of the final facility layout to ensure that all avifaunal aspects have been adequately catered for. If WildSkies does this we believe it can be done desktop due to our high level of experience and familiarity with the site.
- At other operational wind farms it is suspected that ground burrowing small mammals such as Ground Squirrel found more favourable burrowing conditions along new road and hard stand verges on site, which resulted in an inflated prey base for eagles close to turbines, and consequent higher turbine collision risk. It is essential that the new wind farm does not create favourable conditions for such mammals in high risk areas. We therefore recommend that within the first year of operations a full assessment of this aspect be made by the ornithologist contracted for post construction monitoring. If such burrowing is found case specific solutions to exclude these mammals from areas close to turbines will need to be developed and implemented by the wind farm.
- A bird fatality threshold and adaptive management policy must be designed by an ornithologist for the site prior to the Commercial Operation Date (COD). This policy should form an annexure of the operational EMP for the facility. This policy should identify most importantly the number of bird fatalities of priority species which will trigger a management response, appropriate responses, and time lines for such a response. Fatalities of priority bird species are usually rare events (but with very high consequence) and it is difficult to analyse trends or statistics related to these fatalities as they occur. It is therefore important to have a threshold policy in place to assist management.
- A 'Cape Vulture Food Management Programme' must be implemented on site to ensure all dead livestock/wildlife on site are removed as soon as possible and made unavailable to vultures for feeding. This will also need to be implemented at any nearby operational facilities, so that a larger area is covered. This programme will reduce the amount of available vulture food on site and reduce vulture-turbine collision risk. This programme will require the deployment of a dedicated (i.e. no other tasks) and adequately resourced (transport, binoculars, GPS, cameras, training) team of staff to patrol the full site during all daylight hours. The co-operation of landowners will also be essential to ensure that reported carcasses are disposed of effectively. This programme must be operational by the time the first turbine blades are turning on site and should not wait for COD. A full detailed method statement or protocol must be designed by an ornithologist prior to COD. This protocol must be included in the EMP during operations.
- An observer led turbine Shutdown on Demand (SDOD) programme must be implemented at the facility from the start of operations (COD). This programme must consist of a suitably

qualified, trained and resourced team of observers present on site for all daylight hours 365 days of the year. This team must be stationed at vantage points with full visible coverage of all turbine locations. The observers must detect incoming priority bird species (Cape Vulture, Verreaux's Eagle & others to be identified when the programme is fully designed), track their flights, judge when they enter a turbine proximity threshold, and alert the control room to shut down the relevant turbine. A full detailed method statement or protocol must be designed by an ornithologist prior to COD. This protocol must be included in the EMP during operations. » The facility must be monitored once operational in accordance with the most recent version of the best practice guidelines available at the time (Jenkins et al, 2015). A minimum of two years of monitoring must be completed, although if significant impacts are detected this will need to be extended. Fatality estimates should continue for the full life span of the facility. The results of this monitoring should feed into the adaptive management plan for the facility. » The local population of Verreaux's Eagle must be monitored for the full lifespan of the wind farm to ensure that any population level impacts are measured. This will require 2-3 visits to each of the 9 known nests (and any new ones subsequently found) during breeding season each year by a suitably qualified independent ornithologist. This will measure breeding status and productivity and the overall health of this local population. » The Donkerhoek Cape Vulture roost must be surveyed monthly once the wind farm is operational for at least the first two years of operations, in order to better understand trends in vulture numbers at the roost and how this relates to collision risk at the wind farm. During the first two years of operations, wind farm staff must be trained and equipped to do this work so that they can continue with the monitoring beyond the first two years if deemed necessary by the avifaunal specialist based on the first two years' findings. » If the above mitigation measures do not adequately mitigate the risk and bird fatalities still exceed the identified thresholds these residual impacts will need to be off-set. The facility will need to address other sources of mortality of priority species in a measurable way (according to best practice) so as to compensate for residual effects on the facility itself.
Cumulative impacts: The cumulative mortality impact on birds will be high in this area if all three of the planned wind farms are constructed.
Residual Risks: There is a Medium residual impact after all mitigation has been applied as the risk of collisions cannot be entirely ruled out.

This impact has increased in significance under the amended scenario assessment. The primary reasons for this are as follows:

» Two key species which were previously 'suspected' to potentially be susceptible to turbine collision (Verreaux's Eagle & Cape Vulture) have subsequently proven to actually be susceptible to turbine collision and have also been upgraded in regional and global (vulture) conservation status, indicating that they require more protection than thought previously.

The numbers of roosting Cape Vultures at the nearby Donkerhoek roost are also on the increase in recent years which possibly increases the risk.

- It is noted that the overall collision risk window presented by the wind farm has also increased slightly with the new proposed amendment.

Cumulative effects

When the original avifaunal impact assessment was done (Avisense, 2010) and subsequent amendments, there were no other authorised wind farms in the vicinity (within 30km). The cumulative impacts of wind energy on birds was therefore of low significance. However, now there is the operational Dorper Wind Farm to consider. The impacts of Dorper Wind Farm on birds has been described in Section 4.2, and have been of concern for two species in particular, the Verreaux's Eagle and Cape Vulture. These are also the two species most at risk at the new proposed wind farm. The cumulative impacts of wind energy on birds (and particularly Verreaux's Eagle and Cape Vulture are therefore now of High significance. The contribution of the Spreeukloof wind farm to this significance is Low, since it represents about less than one quarter of all turbines operational or proposed in the area. It is essential that the mitigation measures recommended in this report are implemented effectively to ensure that the significance of this impact can be reduced to Medium or Low. These measures are detailed in Section 6.

Table 7. Cumulative impacts of wind energy on birds.

Nature: **Mortality of birds through collision with turbine blades and any overhead power line, and electrocution on power line.**		
	Without mitigation	**With mitigation**
Extent	Regional (3)	Regional (3)
Duration	Facility lifetime (4)	Facility lifetime (4)
Magnitude	High (8)	High (8)
Probability	Definite (5)	Probable (3)
Significance	**75 (High)**	**45 (Medium)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes - partially	
Mitigation: » Described above for each of the individual impacts, and detailed in Section 6.		
Residual Risks: There is a Medium residual impact after all mitigation has been applied as the risk of collisions cannot be entirely ruled out.		

To summarise, the difference between the original and current impact significance is as follows:

Table 8. Summary of original and current impact significance ratings.

Impact	Original (Avisense 2010) Pre mitigation/Post mitigation	Current (WildSkies 2021) Pre mitigation/Post mitigation	Nature of change
Construction phase			
Disturbance	55 Medium/45 Medium	45 Medium/45 Medium	Slight change downwards
Habitat destruction	65 High/55 Medium	55 Medium/55 Medium	Slight change downwards
Operational phase			
Disturbance	56 Medium/52 Medium	48 Medium/20 Low	Slight change downwards
Mortality	60 Medium-High/30 Low	75 High/45 Medium	Significant change upwards
Cumulative effects	Not rated but presumed Low	75 High/45 Medium	Significant change upwards

6. Mitigation measures

The original mitigation recommendations made by Avisense (2010) and WildSkies (2014) are largely still applicable and relevant. However there is a need to significantly add to these with new measures, due to the increase in significance of the risk of bird collision with turbines from Medium-High to High.

New additional mitigation measures to be added to the EMPr:

The recommended mitigation measures are described below. These mitigation measures must be included in the construction and operations Environmental Management Plan (EMP) for the project.

- A 3km radius circular no-go buffer must be implemented around each of the known Verreaux's Eagle nests. No new overhead infrastructure may be constructed within these areas.
- Whichever hub height is used, the lower blade tip may not be lowered below 30m above ground.
- An avifaunal walk through must be conducted by a suitably qualified and independent ornithologist for all components of the final facility layout to ensure that all avifaunal aspects have been adequately catered for. If WildSkies does this we believe it can be done desktop due to our high level of experience and familiarity with the site.
- Minimising the length of any new overhead power line built. None of the low voltage line connecting turbines should be above ground. Only the grid connection power line may be

above ground. The internal cables should be buried in trenches following roads (i.e. not on their own servitude through the veld).

- Any above ground power line must be fitted with bird flight diverters to mitigate collision risk and pylons must be built on Eskom approved vulture friendly designs. This applies to the full length of line. This applies to the full length of above ground line.
- At other operational wind farms it is suspected that ground burrowing small mammals such as Ground Squirrel found more favourable burrowing conditions along new road and hard stand verges on site, which resulted in an inflated prey base for eagles close to turbines, and consequent higher turbine collision risk. It is essential that the new wind farm does not create favourable conditions for such mammals in high risk areas. We therefore recommend that within the first year of operations a full assessment of this aspect be made by the ornithologist contracted for post construction monitoring. If such burrowing is found case specific solutions to exclude these mammals from areas close to turbines will need to be developed and implemented by the wind farm.
- A bird fatality threshold and adaptive management policy must be designed by an ornithologist for the site prior to the Commercial Operation Date (COD). This policy should form an annexure of the operational EMP for the facility. This policy should identify most importantly the number of bird fatalities of priority species which will trigger a management response, appropriate responses, and time lines for such a response. Fatalities of priority bird species are usually rare events (but with very high consequence) and it is difficult to analyse trends or statistics related to these fatalities as they occur. It is therefore important to have a threshold policy in place to assist management.
- A 'Cape Vulture Food Management Programme' must be implemented on site to ensure all dead livestock/wildlife on site are removed as soon as possible and made unavailable to vultures for feeding. This will also need to be implemented at any nearby operational facilities, so that a larger area is covered. This programme will reduce the amount of available vulture food on site and reduce vulture-turbine collision risk. This programme will require the deployment of a dedicated (i.e. no other tasks) and adequately resourced (transport, binoculars, GPS, cameras, training) team of staff to patrol the full site during all daylight hours. The co-operation of landowners will also be essential to ensure that reported carcasses are disposed of effectively. This programme must be operational by the time the first turbine blades are turning on site and should not wait for COD. A full detailed method statement or protocol must be designed by an ornithologist prior to COD. This protocol must be included in the EMP during operations.
- An observer led turbine Shutdown on Demand (SDOD) programme must be implemented at the facility from the start of operations (COD). This programme must consist of a suitably qualified, trained and resourced team of observers present on site for all daylight hours 365 days of the year. This team must be stationed at vantage points with full visible coverage of all turbine locations. The observers must detect incoming priority bird species (Cape Vulture,

Verreaux's Eagle & others to be identified when the programme is fully designed), track their flights, judge when they enter a turbine proximity threshold, and alert the control room to shut down the relevant turbine. A full detailed method statement or protocol must be designed by an ornithologist prior to COD. This protocol must be included in the EMP during operations.

- The facility must be monitored once operational in accordance with the most recent version of the best practice guidelines available at the time (Jenkins et al, 2015). A minimum of two years of monitoring must be completed, although if significant impacts are detected this will need to be extended. Fatality estimates should continue for the full life span of the facility. The results of this monitoring should feed into the adaptive management plan for the facility.
- The local population of Verreaux's Eagle must be monitored for the full lifespan of the wind farm to ensure that any population level impacts are measured. This will require 2-3 visits to each of the 9 known nests (and any new ones subsequently found) during breeding season each year by a suitably qualified independent ornithologist. This will measure breeding status and productivity and the overall health of this local population.
- The Donkerhoek Cape Vulture roost must be surveyed monthly once the wind farm is operational for at least the first two years of operations, in order to better understand trends in vulture numbers at the roost and how this relates to collision risk at the wind farm. During the first two years of operations, wind farm staff must be trained and equipped to do this work so that they can continue with the monitoring beyond the first two years if deemed necessary by the avifaunal specialist based on the first two years' findings.
- If the above mitigation measures do not adequately mitigate the risk and bird fatalities still exceed the identified thresholds these residual impacts will need to be off-set. The facility will need to address other sources of mortality of priority species in a measurable way (according to best practice) so as to compensate for residual effects on the facility itself.

7. Conclusion

Our findings with respect to the proposed amendment are as follows:

- The proposed amendment to the facility layout makes a slight positive difference to risk to birds, although not sufficient to alter the original impact assessment findings.
- The proposed amendment to the turbine model increases the per-turbine collision risk window but this is offset to some extent by the reduced number of turbines. The collision risk window of the wind farm as a whole is increased (by 13.2%).
- The proposed amendment to power line routing is acceptable and makes little difference to the risk to avifauna.

- The remaining amendments listed in Section 1 are administrative of nature and make no difference for avifauna. These amendments are therefore all acceptable. This includes the extension of validity of the EA.
- New information which has become available subsequent to the original assessment has made a significant difference to the rating of the impact of mortality of birds through collision with turbines. This impact has increased in significance from Medium-High to High under the amended scenario assessment. Two key species which were previously 'suspected' to potentially be susceptible to turbine collision (Verreaux's Eagle & Cape Vulture) have subsequently proven to actually be susceptible to turbine collision at operational wind farms and have also been upgraded in conservation status (Verreaux's Eagle from Least Concern to Vulnerable regionally; Cape Vulture from Vulnerable to Endangered regionally and globally), indicating that they require more protection than thought previously. This risk will need to be mitigated proactively from the start of operations (and earlier in some cases as described below).
- The cumulative impact of wind energy on birds in this area is now of High significance, mitigated to Medium if the recommendations of this report are adhered to.

The original mitigation recommendations made by Avisense (2010) and WildSkies (2014) are largely still applicable and relevant. However there is a need to significantly add to these with new measures, due to the increase in significance of the risk of bird collision with turbines from Medium-High to High.

The recommended mitigation measures are described below. These mitigation measures must be included in the construction and operations Environmental Management Plan (EMP) for the project.

- A 3km radius circular no-go buffer must be implemented around each of the known Verreaux's Eagle nests. No new overhead infrastructure may be constructed within these areas.
- Whichever hub height is used, the lower blade tip may not be lowered below 30m above ground.
- An avifaunal walk through must be conducted by a suitably qualified and independent ornithologist for all components of the final facility layout to ensure that all avifaunal aspects have been adequately catered for. If WildSkies does this we believe it can be done desktop due to our high level of experience and familiarity with the site.
- Minimising the length of any new overhead power line built. None of the low voltage line connecting turbines should be above ground. Only the grid connection power line may be above ground. The internal cables should be buried in trenches following roads (i.e. not on their own servitude through the veld).
- Any above ground power line must be fitted with bird flight diverters to mitigate collision risk and pylons must be built on Eskom approved vulture friendly designs. This applies to the full length of line. This applies to the full length of above ground line.

- At other operational wind farms it is suspected that ground burrowing small mammals such as Ground Squirrel found more favourable burrowing conditions along new road and hard stand verges on site, which resulted in an inflated prey base for eagles close to turbines, and consequent higher turbine collision risk. It is essential that the new wind farm does not create favourable conditions for such mammals in high risk areas. We therefore recommend that within the first year of operations a full assessment of this aspect be made by the ornithologist contracted for post construction monitoring. If such burrowing is found case specific solutions to exclude these mammals from areas close to turbines will need to be developed and implemented by the wind farm.
- A bird fatality threshold and adaptive management policy must be designed by an ornithologist for the site prior to the Commercial Operation Date (COD). This policy should form an annexure of the operational EMP for the facility. This policy should identify most importantly the number of bird fatalities of priority species which will trigger a management response, appropriate responses, and time lines for such a response. Fatalities of priority bird species are usually rare events (but with very high consequence) and it is difficult to analyse trends or statistics related to these fatalities as they occur. It is therefore important to have a threshold policy in place to assist management.
- A 'Cape Vulture Food Management Programme' must be implemented on site to ensure all dead livestock/wildlife on site are removed as soon as possible and made unavailable to vultures for feeding. This will also need to be implemented at any nearby operational facilities, so that a larger area is covered. This programme will reduce the amount of available vulture food on site and reduce vulture-turbine collision risk. This programme will require the deployment of a dedicated (i.e. no other tasks) and adequately resourced (transport, binoculars, GPS, cameras, training) team of staff to patrol the full site during all daylight hours. The co-operation of landowners will also be essential to ensure that reported carcasses are disposed of effectively. This programme must be operational by the time the first turbine blades are turning on site and should not wait for COD. A full detailed method statement or protocol must be designed by an ornithologist prior to COD. This protocol must be included in the EMP during operations.
- An observer led turbine Shutdown on Demand (SDOD) programme must be implemented at the facility from the start of operations (COD). This programme must consist of a suitably qualified, trained and resourced team of observers present on site for all daylight hours 365 days of the year. This team must be stationed at vantage points with full visible coverage of all turbine locations. The observers must detect incoming priority bird species (Cape Vulture, Verreaux's Eagle & others to be identified when the programme is fully designed), track their flights, judge when they enter a turbine proximity threshold, and alert the control room to shut down the relevant turbine. A full detailed method statement or protocol must be designed by an ornithologist prior to COD. This protocol must be included in the EMP during operations.

- The facility must be monitored once operational in accordance with the most recent version of the best practice guidelines available at the time (Jenkins et al, 2015). A minimum of two years of monitoring must be completed, although if significant impacts are detected this will need to be extended. Fatality estimates should continue for the full life span of the facility. The results of this monitoring should feed into the adaptive management plan for the facility.
- The local population of Verreaux's Eagle must be monitored for the full lifespan of the wind farm to ensure that any population level impacts are measured. This will require 2-3 visits to each of the 9 known nests (and any new ones subsequently found) during breeding season each year by a suitably qualified independent ornithologist. This will measure breeding status and productivity and the overall health of this local population.
- The Donkerhoek Cape Vulture roost must be surveyed monthly once the wind farm is operational for at least the first two years of operations, in order to better understand trends in vulture numbers at the roost and how this relates to collision risk at the wind farm. During the first two years of operations, wind farm staff must be trained and equipped to do this work so that they can continue with the monitoring beyond the first two years if deemed necessary by the avifaunal specialist based on the first two years' findings.
- If the above mitigation measures do not adequately mitigate the risk and bird fatalities still exceed the identified thresholds these residual impacts will need to be off-set. The facility will need to address other sources of mortality of priority species in a measurable way (according to best practice) so as to compensate for residual effects on the facility itself.

It is noted that this avifaunal statement is compiled with the knowledge that the project already has an environmental authorisation to go ahead in its original form and as amended subsequently), and that the new proposed facility is an improvement on the old facility in terms of risks to birds (since the number of turbines has halved). This assessment considers all new avifaunal information (unrelated to the actual proposed facility amendment) that we are aware of, in order to be thorough. It is the new information which has resulted in a change to the significance of bird collision with turbines, not the proposed amendment to the infrastructure. If the mitigation measures stipulated in this report are adhered to the proposed amendment is considered acceptable from an avifaunal perspective.

8. References

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

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Appendix 1. Impact Assessment methodology:

Direct, indirect and cumulative impacts of the issues identified through the EIA process, as well as all other issues identified due to the amendment must be assessed in terms of the following criteria:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  - medium-term (5–15 years) – assigned a score of 3;
  - long term (> 15 years) - assigned a score of 4; or
  - permanent - assigned a score of 5;
- The **consequences (magnitude)**, quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
- the **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
- the **status**, which will be described as either positive, negative or neutral.
- the degree to which the impact can be reversed.
- the degree to which the impact may cause irreplaceable loss of resources.
- the *degree* to which the impact can be *mitigated.*

The **significance** is calculated by combining the criteria in the following formula:
S = (E+D+M)P
S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

Assessment of impacts must be summarised in the following table format. The rating values as per the above criteria must also be included. The table must be completed and associated ratings for **each** impact identified during the assessment should also be included.

Example of Impact table summarising the significance of impacts (with and without mitigation) **when additional impact are identified**:

Nature: **[Outline and describe fully the impact anticipated as per the assessment undertaken]**		
	Without mitigation	**With mitigation**
Extent	High (3)	Low (1)
Duration	Medium-term (3)	Medium-term (3)
Magnitude	Moderate (6)	Low (4)
Probability	Probable (3)	Probable (3)
Significance	**Medium (36)**	**Low (24)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: "Mitigation", means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible. Provide a description of how these mitigation measures will be undertaken keeping the above definition in mind.		
Cumulative impacts: "Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities[1].		
Residual Risks: "Residual Risk", means the risk that will remain after all the recommended measures have been undertaken to mitigate the impact associated with the activity (Green Leaves III, 2014).		

Example of Impact table summarising the significance of impacts (with and without mitigation) **when the impact has increased or decreased**:

Nature of impact: **[Outline and describe fully the impact anticipated as per the assessment undertaken]**				
	Authorised		**Proposed amendment**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Low (1)	Low (1)	Low (1)	Low (1)
Duration	Permanent (5)	Permanent (5)	Permanent (5)	Permanent (5)

[1] Unless otherwise stated, all definitions are from the 2014 EIA Regulations (as amended on 07 April 2017), GNR 326.

Magnitude	Minor (2)	Minor (2)	Minor (2)	Minor (2)
Probability	Very improbable (1)	Very improbable (1)	Very improbable (1)	Very improbable (1)
Significance	**8 (Low)**	**8 (Low)**	**8 (Low)**	**8 (Low)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Very low	Very low	Very low	Very low
Irreplaceable loss of resources?	Yes	No	Yes	No
Can impacts be mitigated?	Yes		Yes	
Mitigation: "Mitigation", means to anticipate and prevent negative impacts and risks, then to minimise them, rehabilitate or repair impacts to the extent feasible. Provide a description of how these mitigation measures will be undertaken keeping the above definition in mind. **[PLEASE UNDERLINE ALL NEW MITIGATION MEASURES WHICH WERE NOT INCLUDED IN THE EIA].**				
Cumulative impacts: "Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity, that in itself may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities2.				
Residual Risks: "Residual Risk", means the risk that will remain after all the recommended measures have been undertaken to mitigate the impact associated with the activity (Green Leaves III, 2014).				

When assessing cumulative impacts, the following table format is to be utilized (completed with example content):

Nature: *Compromise ecological processes as well as ecological functioning of important freshwater resource habitats* Transformation of intact freshwater resource habitat could potentially compromise ecological processes as well as ecological functioning of important habitats and would contribute to habitat fragmentation and potentially disruption of habitat connectivity and furthermore impair their ability to respond to environmental fluctuations. This is especially of relevance for larger watercourses and wetlands serving as important groundwater recharge and floodwater attenuation zones, important microhabitats for various organisms and important corridor zones for faunal movement		
	Overall impact of the proposed project considered in isolation	**Cumulative impact of the project and other projects in the area**
Extent	Local (2)	Local / downstream (3)
Duration	Long term (4)	Long term (4)
Magnitude	Minor (3)	Moderate (5)
Probability	Improbable (2)	Probable (2)
Significance	**Low (16)**	**Low (26)**

[2] Unless otherwise stated, all definitions are from the 2014 EIA Regulations (as amended on 07 April 2017), GNR 326.

Status (positive or negative)	Negative	Negative
Reversibility	Moderate to Low	Moderate to Low
Irreplaceable loss of resources?	No	Limited loss of local resources
Can impacts be mitigated?	Yes	

Mitigation:

- All highly sensitive major ephemeral washes and their associated buffer areas must be regarded as No-Go areas for all construction activities apart from road construction/upgrading and lying of cables, and only where the use of existing access roads is not an option.
- The recommended buffer areas between the delineated freshwater resource features and proposed project activities must be maintained.
- Vegetation clearing to be kept to a minimum. No unnecessary vegetation to be cleared.
- The potential stormwater impacts of the proposed developments areas must be mitigated on-site to address any erosion or water quality impacts.
- Good housekeeping measures as stipulated in the EMPr for the project must be in place where construction activities take place to prevent contamination of any freshwater features.
- Where possible, infrastructure must coincide with existing infrastructure or areas of disturbance (such as existing roads).
- Disturbed areas must be rehabilitated through reshaping of the surface to resemble that prior to the disturbance and vegetated with suitable local indigenous vegetation.