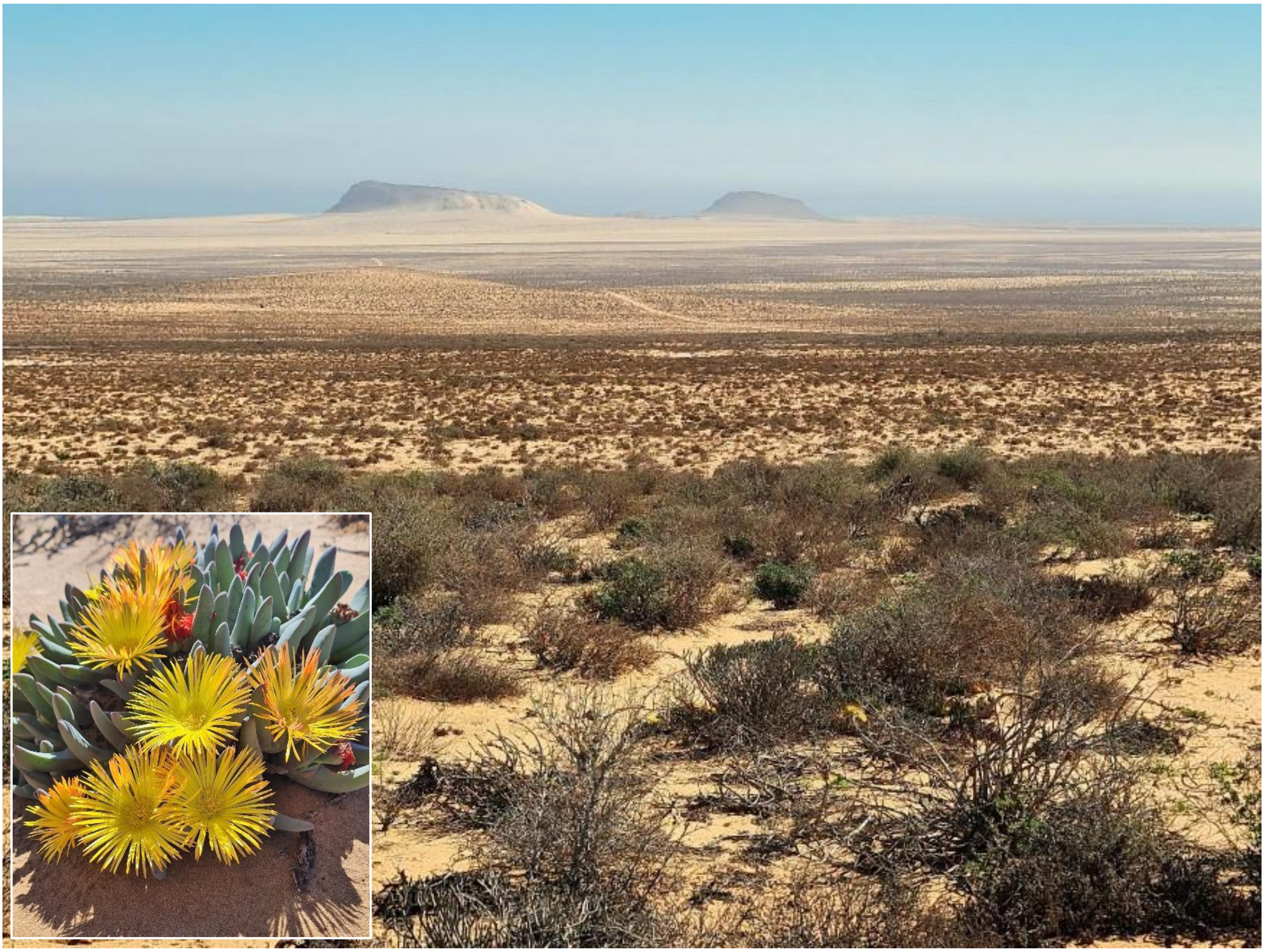
Richtersveld Wind Energy Facility, Northern Cape Province
Avian Amendment and Re-assessment, 2021



Prepared for

Richtersveld Wind Farm

BIRDS & BATS UNLIMITED

EXECUTIVE SUMMARY

The Richtersveld wind farm received an Environmental Authorisation in 2012 for a renewable energy facility on part of Korridor Wes Farm (Witbank (Farm 6/2) and Korridor Wes Farm (Rooibank (Farm 7/2). The authorization was for the placement of 70 turbines in an area of 120 km².

In 2021 the turbine dimensions and layout were adjusted requiring a re-assessment of the project's possible impacts. The number of turbines were reduced to 32 over a 49 km² area. The re-assessment also required an update of the baseline conditions to identify any changes to the receiving environment since the 2012/2013 assessment to ultimately adjust the impact assessment of the anticipated change in Project-induced avifaunal impacts. To support the amendment, a further site survey was undertaken over 3 days in September 2021.

The receiving environment became drier since the last visit in 2013 (when mean annual rainfall was 150% - 200% of the mean average precipitation (MAP), vs 25 – 75% of MAP in 2021).

That has coincided with:

- A reduction in the diversity of Priority bird species (from 16 to three in 2021);
- A reduction in the number of Red Data species present (from five species to zero in 2021); and
- A slight increase in spring reporting rates (from 0.32 birds/h in 2012-2013 to 0.59 birds/h in 2021).

In the previous avian assessment (Simmons and Martins, 2013) two areas of high risk were identified because of the high incidence of flight activity by Red Data species raptors and bustards on site. The new layout assessed as part of the amendment was proposing turbines in these areas:

- T4, T7, T12 (in high-risk area 1)
- T9, T21, T24, T25, T29, T30 (in high-risk area 2).

These turbine placements have all been re-positioned to avoid these areas.

An analysis of the expected change in avian fatalities arising from a change in the dimensions and numbers of turbines showed that 32 large (130-m hub height) turbines are expected to kill marginally (5.6%) more birds than 70 shorter (100-m hub height) turbines. This is an acceptable increase given that this is within the confidence limits provided by the modelled fatalities.

We do not expect birds to be displaced by noise or by the loss of habitat. However, some displacement will inevitably take place with human traffic and new roads on site.

Updated mitigation measures are proposed in the Environmental Management Plan section and must be implemented to ensure that the identified impacts are adequately mitigated, and that appropriate responses to any fatalities are initiated.

We as the avian specialist's suggest that the development may proceed with mitigation measures presented in this report and be accompanied by a rapid response to any Priority species deaths.

BACKGROUND

This specialist assessment for the Richtersveld Wind Energy Facility (WEF) in the coastal Northern Cape, south of Alexander Bay is required for the update of the avian baseline and to assess project modifications.

The authorised wind farm, east of *Visagiefontein* on farm 6/2 *Korridor Wes* (*Witbank*) comprises 32 wind turbines and covers approximately 49-km^2 (Figure 1). The original layout comprised 70 turbines over a much larger area.

Avian impacts of the authorised WEF, power lines, and substation were assessed in 2010 (Jenkins 2011). In 2013, a comprehensive 12-month avian assessment (Birds Unlimited 2013) found a small suite of endemic and Priority collision-prone species in the area that may be impacted by the proposed wind farm.

Birds & Bats Unlimited have, thus, been requested to undertake an avian assessment now that the turbine layout has been modified, and as a result of the duration that has lapsed since the last surveys were undertaken.

The aims in this 2021/2022 assessment are:

- To assess the significance of impact on avifauna:
  - Disturbance and displacement of Priority species (defined as the top 100 most collision-prone species in South Africa)
  - Habitat transformation / destruction
  - Mortalities through collisions / electrocution (power lines) and extent anticipated
  - Determine the possible change in fatalities as a result of the increased turbine dimensions revealed in June 2022.
- To survey the proposed WEF to determine if the receiving environment has changed with respect to avian communities.
- To assess any buffers, or no-go areas, to ensure they have been complied with for sensitive bird species.
- To report on any new risk areas that may have arisen since the full 12-month surveys were undertaken eight years ago.
- To assess the impact of the amended layout of the WEF (Table 1).
- To provide suggested measures for inclusion in an Environmental Management Plan.

The increased turbine dimensions revealed by RINA indicate the following changes:

Table 1: Changes in turbine dimensions proposed (June 2022) for the Richtersveld wind farm

Specification	Approved	Proposed	% Change
Hub height	100-m	130-m	30%
Rotor diameter	117-m	175-m	50%
Number of turbines	70	32	-54%
Output	Between 2MW and 3MW per turbine for a total project output of 225MW	7MW per turbine for a total project output of 224MW	No change

Fatality data and hub height ("Loss model")

Fatality hub height data of Loss et al. (2013) was obtained and statisticians (Drs Birgit Erni and Francisco Cervantes) from UCT's Department of Statistics, Ecology, and the Environment, were requested to model the American data beyond 80-m hub heights. To strengthen the forecast for fatalities beyond 80-m hub heights, and to make them applicable to South Africa, South African data was included (seven data points available from Ralston et al. 2017). These included two wind farms with 90-m and 95-m hub heights.

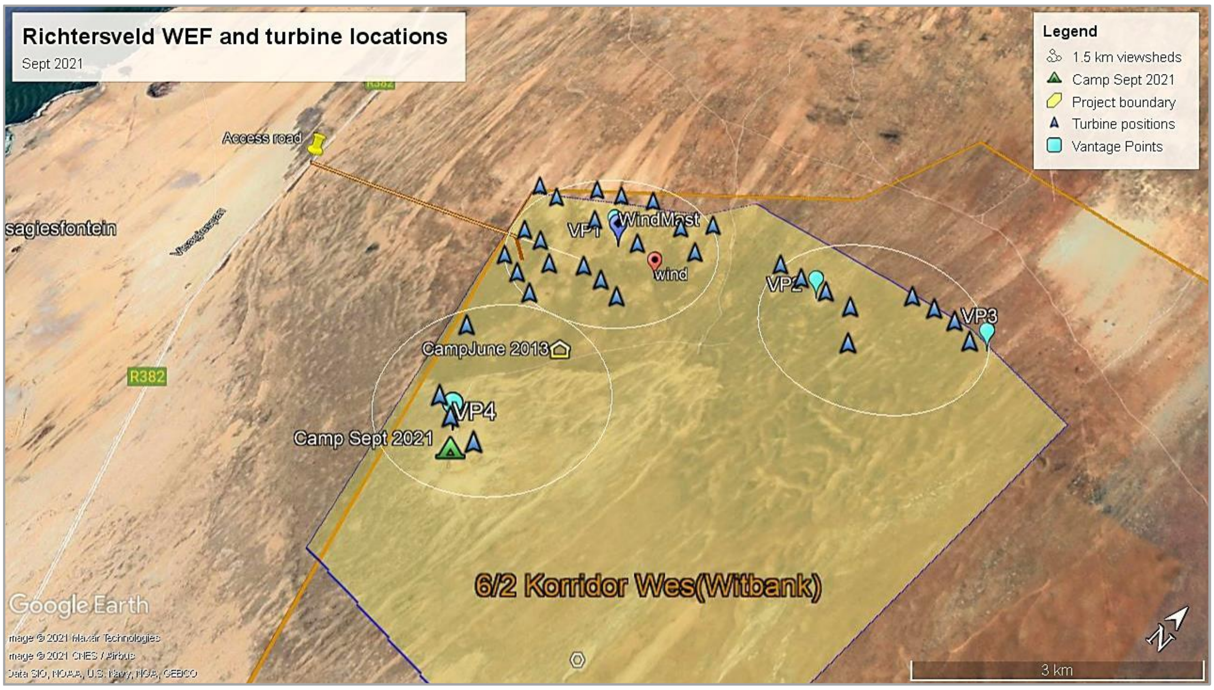


Figure 1: The Richtersveld wind farm with the turbine placements (= blue triangles) in relation to the Korridor Wes farm, near Kleinsee.

METHODS

Two observers (RE Simmons and M Martins) spent three days on site (10th, 11th, and 12th September 2021) re-visiting and making observations from all four of the 2013 Vantage Points, representative of the entire WEF. Shortsections of the power line were driven to cover additional areas required to assess bustard densities. The team also travelled along the periphery of the site, including under the pylons to the east, (checking for nests, carcasses, and perch hunters there) and spent one night on site to listen for nocturnal species on site.

A minimum of 2-hours were spent at each of the four VPs observing large Priority species. Priority species are defined as the top 100 most collision-prone species in South Africa that combine their conservation status with their likelihood of colliding with wind turbines (Ralston Paton et al. 2017).

Desktop studies assessing the possible change in expected avian fatalities were necessary following the increase in turbine dimensions.

We have focused mainly on the collision risk to the priority species, and less so on the negative effects of disturbance and habitat loss in driving birds away from developments. The reason is that the collision risk is easier to determine and while there is data showing the numbers of birds killed at different wind farms in South Africa (Perold et al. 2020), there is no systematic data on the effect of disturbance in South Africa. In addition, it is not expected that there will be a significant change in the previous impact assessment result pertaining to disturbance.

RESULTS

This section is divided into two parts, firstly we review the findings from the original avian monitoring in 2012/2013 and provide an update from the 2021 observations and then address the effect of the increased turbine dimensions on fatalities.

2012/2013

The 12-months monitoring of the site in 2012-2013, combined with desktop assessments from the Southern African Bird Atlas data (SABAP), uncovered the following:

- A total of 130 bird species were recorded from this coastal region of the Richtersveld, of which 51 are *endemic* or *near-endemic* (Jenkins 2011).

- In 332-hours of vantage point (VP) surveys we recorded a total of 1 290 birds and 62 species.
- Within this total 14 Priority species were recorded during the survey, of which five were Red Data species on site.
- These include Black Harriers *Circus maurus* (83% likelihood of occurring), Ludwig's Bustard *Neotis Ludwigii* (33%), Kori Bustard *Ardeotis kori* (17%), Lanner Falcon *Falco biarmicus* (83%), and Barlow's Lark *Calendulauda barlowi* (100%) based on six site visits
- Passage Rates of the Priority collision-prone species (excluding Barlow's Lark) in 2013 combined was medium at 0.67 flights/hour
- Two high-risk areas were identified on the site due to high Passage Rates of 1.3 birds/h (at the meteorological mast) and 0.93 birds/h on high ground to the east.

Spring 2021

In the 2021 spring site visit the area was drier with a few flowering plants in bloom, but few birds in song. Fog was apparent each evening and morning, and that cleared between 9-a.m. and 10-a.m.

The perception that the area was drier than previous visits was confirmed by two measures of long-term precipitation data for South Africa (Figures 1a and 1b) from the South African Weather Service. First, the Standardised Precipitation Index (SPI) (an index based on the probability of rainfall) shows below-average rainfall for the two-year period January 2019 to December 2020. Second, for the 3-months immediately before our site visit (Figure 1 b) the rainfall was also b

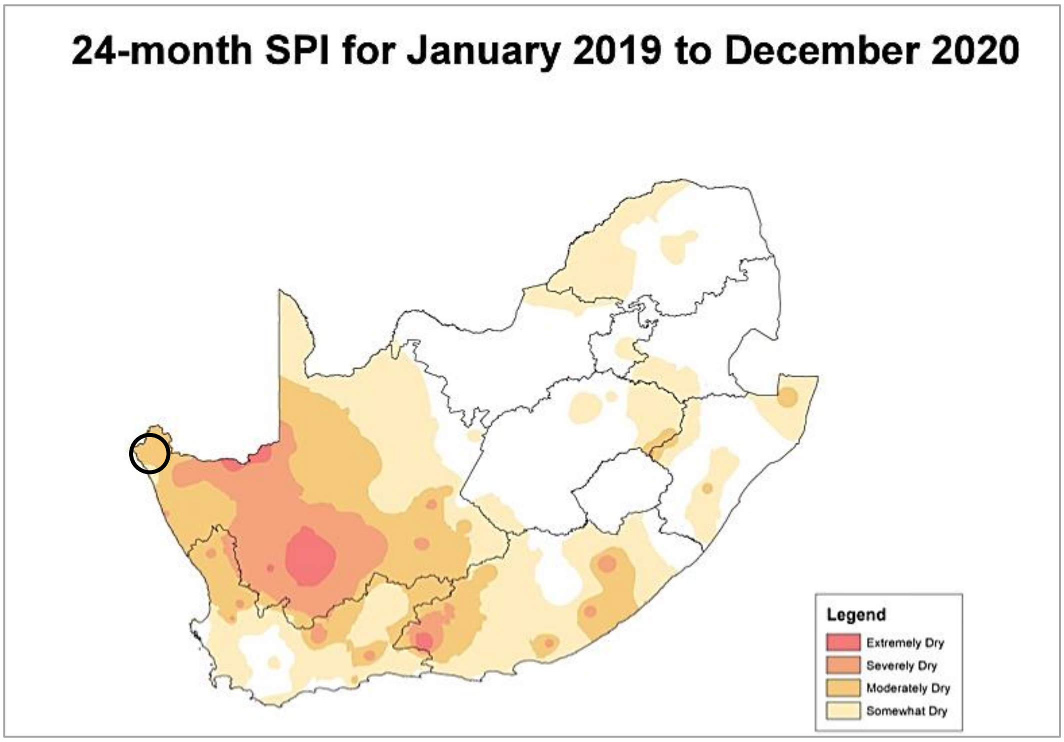


Figure 2a The South African Weather Service Annual state of climate report for 2020, showing the Standard Precipitation Index (SPI) for the 24-month period January 2019 to December 2020. This indicates that the Richtersveld area (circled), like most of western South Africa experienced below average rainfall over at least two years, prior to our 2021 visit. For the Richtersveld area this was described as Moderately Dry between 25% and 75% below average. https://www.weathersa.co.za/Documents/Corporate/Annual%20State%20of%20the%20Climate%202020_19032021121122.pdf

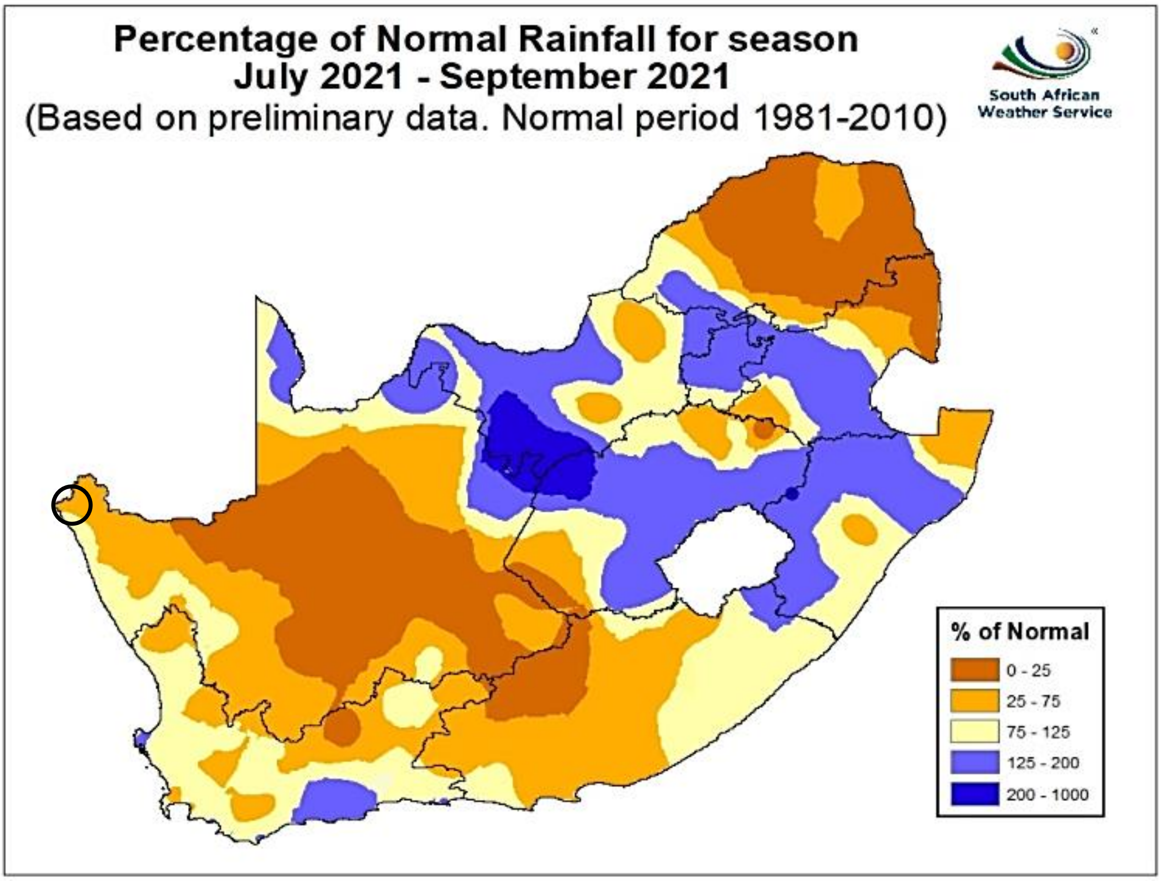


Figure 2b: The proportion of rainfall relative to the long-term mean for South Africa for the three months before our September 2021 visit (South African Weather Service https://www.weathersa.co.za/home/historicalrain). The Richtersveld area (circled) indicates that the area experienced below average rainfall (in the range 25% - 75% of Normal).

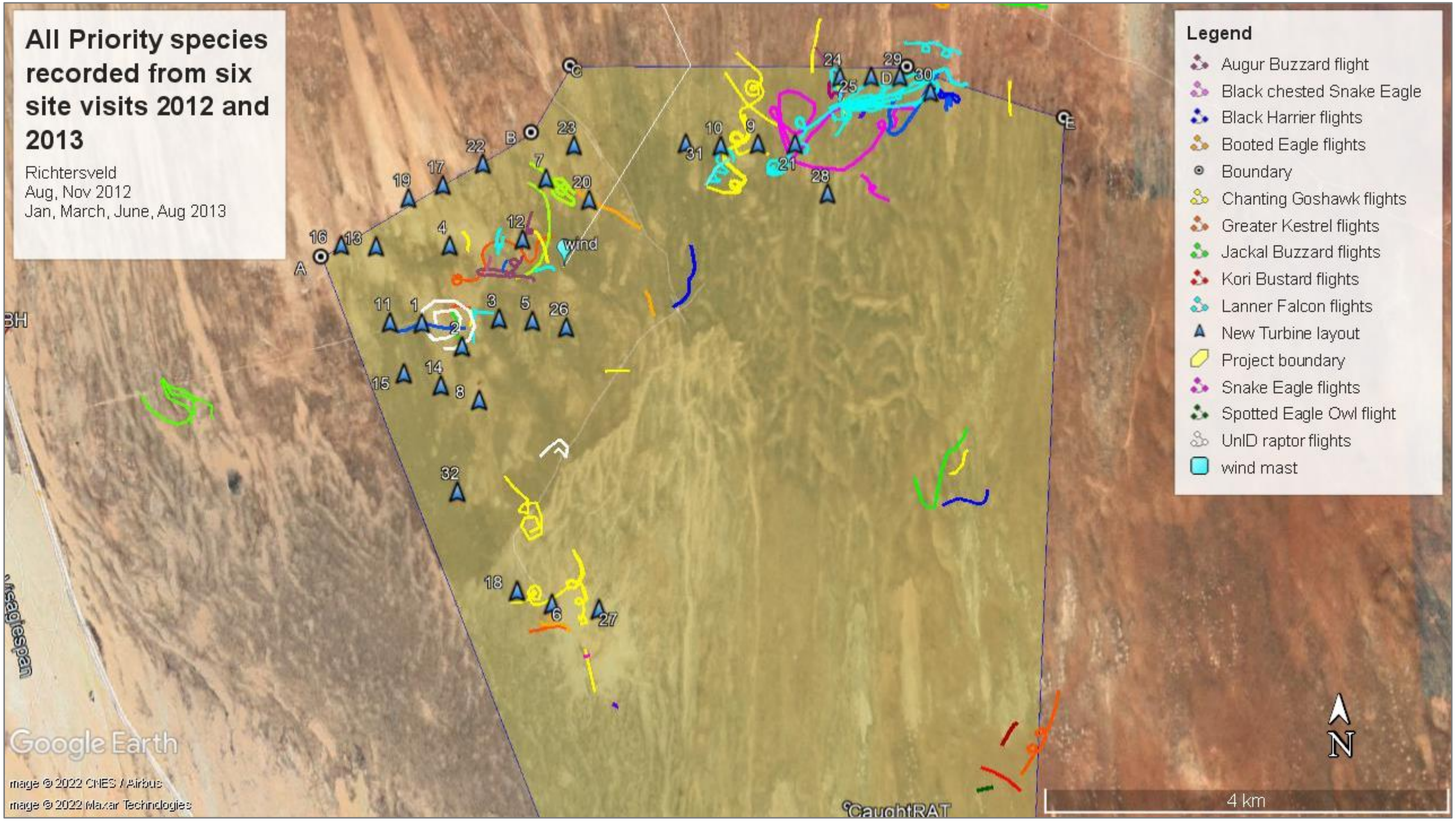


Figure 3: All flights of Priority birds recorded in 2012 and 2013 on the Richtersveld WEF from six site visits. Many more flights were recorded in this period than in 2021 and *Endangered* Black Harriers (= dark blue lines) and *Vulnerable* Lanner Falcons (= pale blue lines) were the main Red Data species found. Areas of high flight density occurred near the wind mast (top left) with a Passage Rate of 1.3 birds/h and the top right with a Passage Rate of 0.94 birds/hour (i.e., about 10 Priority birds per day). These were designated areas of high sensitivity (Simmons and Martins 2013).

Photo 1: A Pale Chanting Goshawk (*Melierax canorus*) nest with two eggs placed on a pylon tower within the study site, but distant from any turbine placements.

In 10.25-hours of Vantage Point observations, none of the Red Data species previously recorded were found on site in 2021. Driving surveys throughout the proposed WEF and night-time observations also resulted in no additional records of the three species of owls originally recorded in 2013.

This may have been the result of below average rainfall over the 24-month period from January 2019 to December 2020 and in the below average rainfall in the month (July-August 2021) immediately before our site visit (Figures 1a and 1b). Avian diversity in arid areas such as the Nama Karoo biome is closely linked with short- and long-term rainfall (Dean 2004, Seymour et al. 2015).

Similarly, only three (non-threatened) Priority species were encountered on the WEF in this spring visit. These included (Figure 3):

- Pale Chanting Goshawk *Melierax canorus* that are associated with, and breeding, on the pylons (Photo1).
- Greater Kestrels *Falco rupicoloides* that were courting around VP1 near the communication towers and will probably breed there; and
- Black-chested Snake-Eagle *Circaetus cinerescens* recorded once near the highest point of the WEF.

As such, the receiving environment has changed only to the extent reflected in a decrease in Red Data and Priority bird species, which may be as a result of climatic factors.

Note that the two Pale Chanting Goshawk nests on the pylons (Figure 1) to the east were not buffered because these are a common Priority species and there are, as yet, no records of goshawks being killed by wind turbines (Perold et al. 2020). This was one of two chanting goshawk nests within the site on pylons in September 2021. The other nest held a half-grown nestling. This power line is also used by other perching raptors such as Snake-Eagles (photo 2)

Photo 2: A Black-chested Snake Eagle lands on a tower in the study area. This raptor and other perch-hunting species frequently use the towers to hunt from.

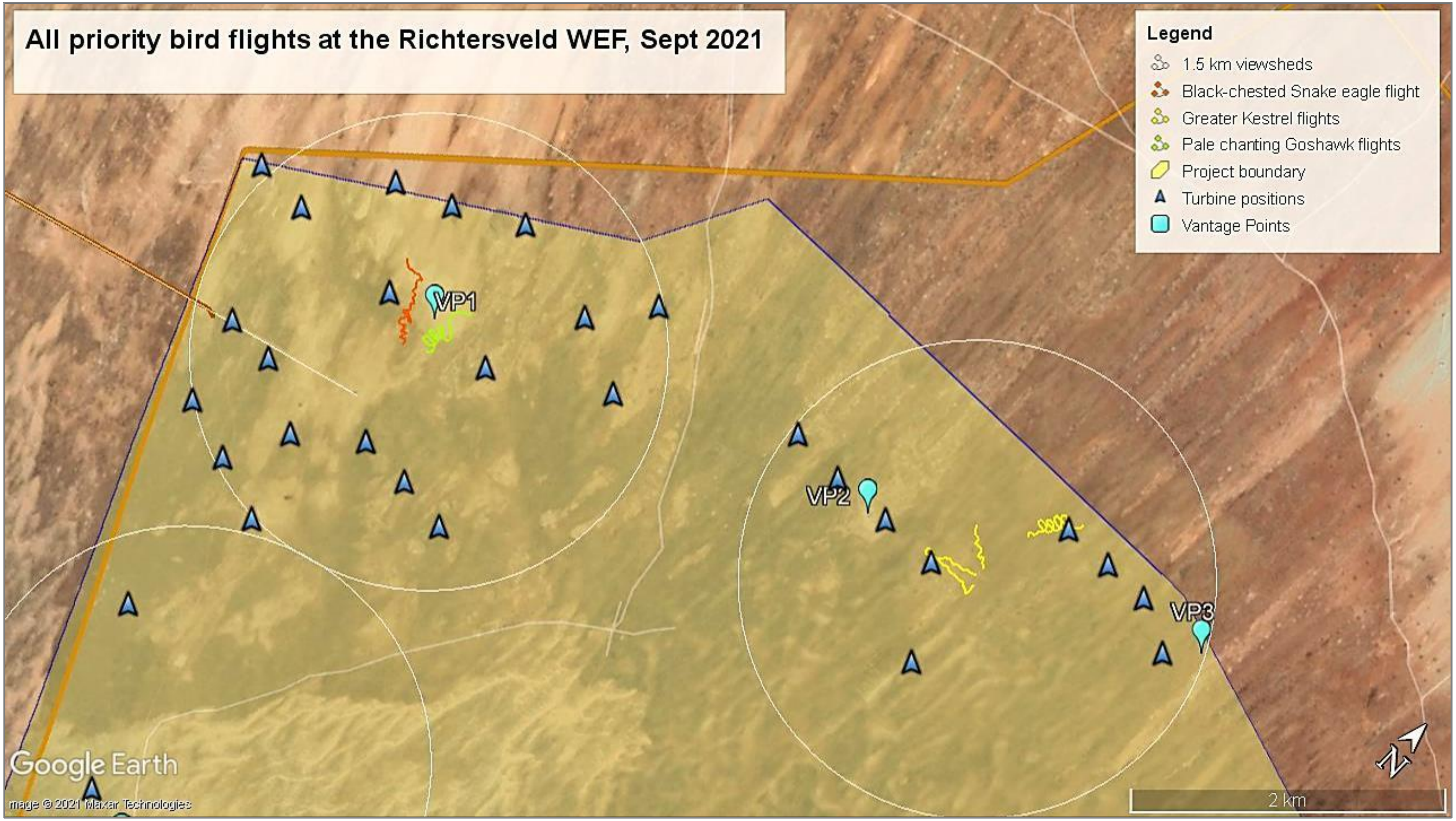


Figure 4: All flights of Priority birds recorded in September 2021 on the Richtersveld WEF over three days (in 10.25-hours of observation) in relation to the layout alternative at the time of the site visit (September 2021). The revised alternative (from March 2022) is shown below. Only three (non-threatened) Priority species were recorded including Greater Kestrels (=yellow lines), Pale chanting Goshawks (=green lines) and one flight of a Black-chested Snake-eagle (=orange line). The Passage Rate was 0.59 flights/hour. This is lower than the overall Passage Rate of Priority birds for the whole 12 months in 2012-2013 (0.67 flights/hour) but higher than in the Spring of 2012-2013 in these years (0.32 flights/hour).

2012-2013 Avian records in relation to revised layout alternatives

In the 2012 and 2013 monitoring two areas of high risk were identified (Simmons and Martins 2013) as shown in Figure 5. These were an area with multiple flights of Lanner Falcons, Greater Kestrels and Snake Eagles (at a Passage Rate of 1.3 birds/hour or about 13 Priority bird flights/day) and an area to the east with multiple flights of Lanner Falcons and Black Harriers (at a Passage Rate of 0.94 flights/hour).

These areas of high-risk were not apparent in 2021, based on significantly less data in a particularly dry period, so the data from the 2012-2013 flights are more relevant here. It was noted (Simmons and Martins 2013) that the high occurrence of raptors may have been explained by the large numbers of Whistling Rats (*Parotomys* species) that were observed being caught by Jackal Buzzards and Pale Chanting Goshawks during this period. These will return when the rains return which is why we have used the higher-rainfall data from 2012/13.

Superimposing these high-risk areas on to the previous 2021 layout, would have affected several turbines that were originally proposed as part of the amendment application (See Figure 5):

- T4, T7, T12 (in high-risk area 1)
- T9, T21, T24, T25, T29, T30 (in high-risk area 2).

These turbines have subsequently been repositioned by the client in June 2022, and the layout updated accordingly to that currently proposed and represented in Figure 6.

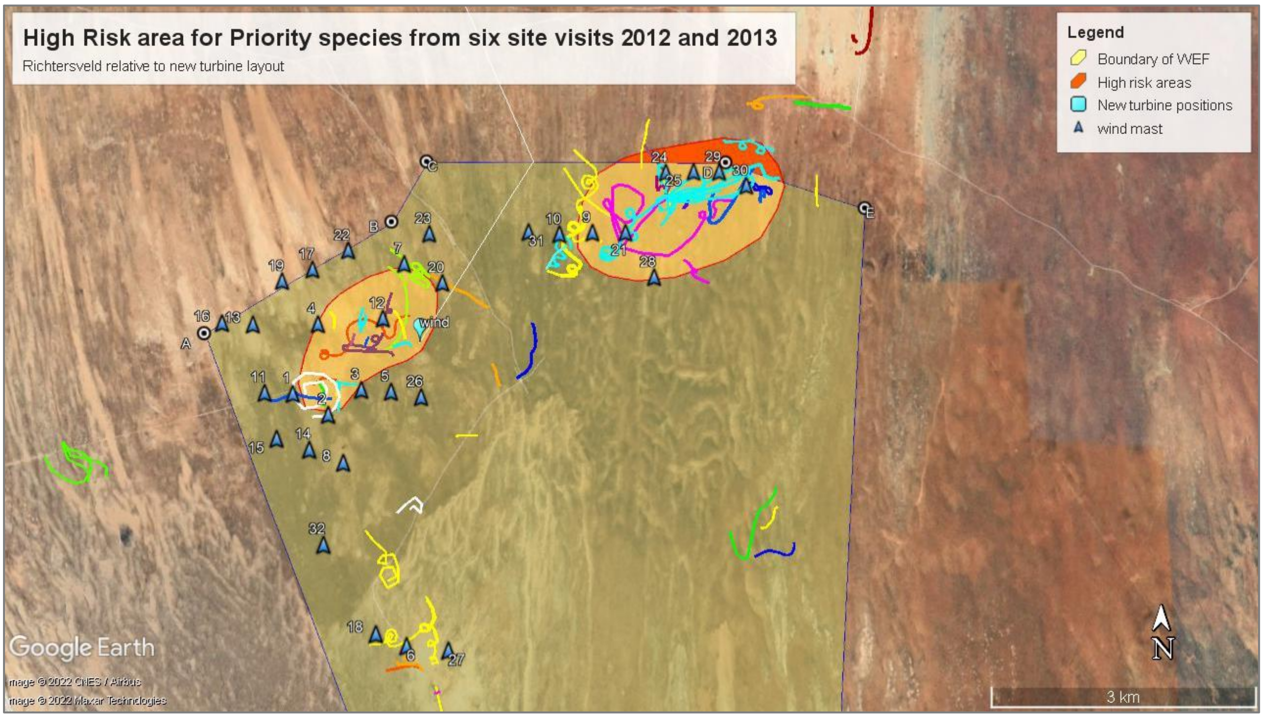


Figure 5: High Risk areas (orange polygons) identified from Priority bird flights recorded in 2012 and 2013 on the Richtersveld WEF. This is in relation to the turbine positions proposed in the first revision alternative of 2021. Many more flights were recorded in this period than in 2021 and included Red Data species such as Black Harriers (= dark blue lines) and Lanner Falcons (= pale blue lines). The two areas of high risk had Passage Rates of 1.3 birds/h (top left) and 0.94 Priority birds/h (top right). See Figure 6 indicating that the June 2022 re-location of these turbines.

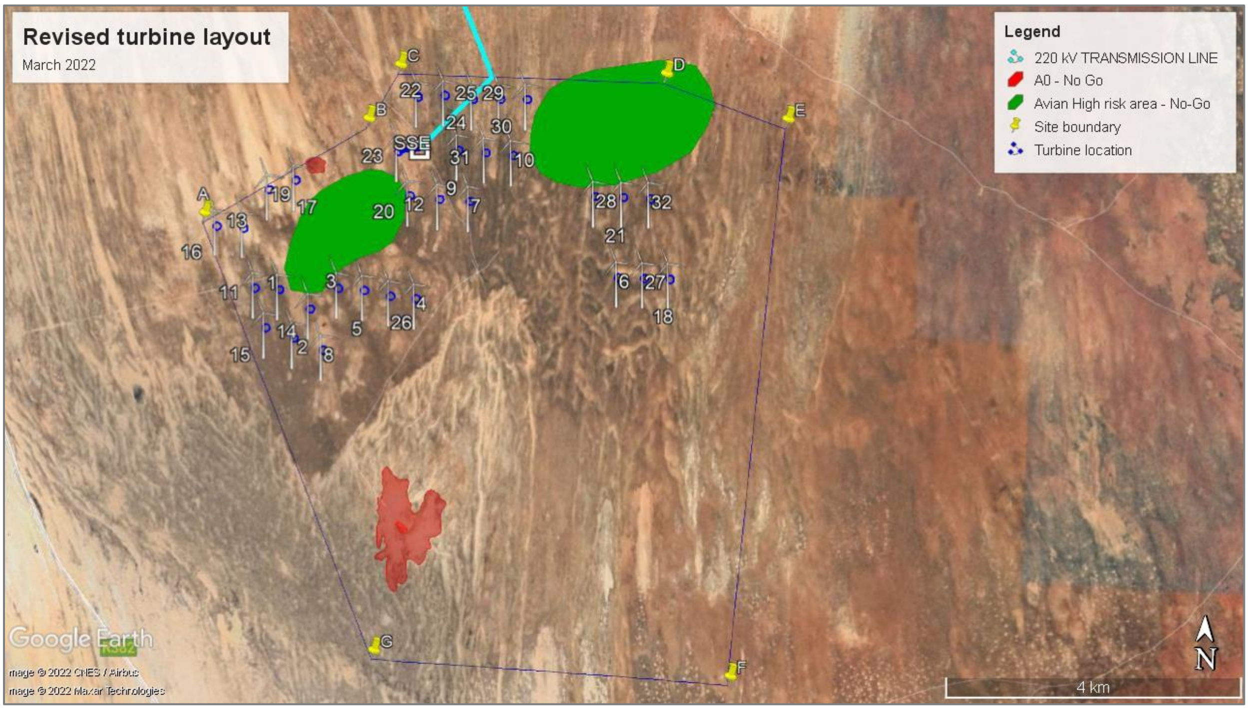


Figure 6: The amended layout alternative from June 2022 indicating that all proposed turbines are now re-positioned outside the high-risk avian areas

SIGNIFICANCE of IMPACTS

The anticipated impacts are assessed in this section and mitigation measures proposed to reduce expected impacts. Note that a significance table was not provided in our 2013 report, so it is difficult to compare 2013 with 2021 data.

The effect of increased turbine specifications on collision-risk was assessed by Loss et al (2013), who re-analysed all data from Barclay et al and new studies, (without the lattice towers that have been discontinued) and found:

- A significant effect of hub height on the number of avian mortalities for the 53 wind farm sites in the USA (Blade length could not be independently assessed because of statistical collinearity with hub height);
- In a model that included region and hub height, avian fatalities increased from about two birds/turbine/year at 40-m hub heights to 6.2 birds/turbine/year at 80-m hub height; and
- This represents a ~3-fold increase in mortalities between 40-m and 80-m hub height.

Thaxter et al. (2017) undertaking a world-wide assessment of traits that influence wind farm fatalities found:

- more fatalities of birds (and bats) were associated with taller turbines world-wide.
- The highest fatality rates were found with more small turbines (rather than a few large turbines) to produce the same overall power output.
- This would depend on the capacity of each turbine (they modelled up to a power capacity of 2.5 MW per turbine). We carry out this exercise below based on turbine size and number.
- In total, 57 bird species (including 31 Accipitriformes – birds of prey) of 362 sampled were identified as threatened by 'renewable energy'.

The results of the modelling of fatalities (Figure 7) indicate that avian fatalities are expected to *increase exponentially* at 1.3-fold from an average 9.1 fatalities/turbine (95% Confidence Interval 8 to 11) to 21 (95% Confidence Interval 11 to 42) fatalities/turbine/year as hub heights are increased from 100-m to 130-m.

These figures indicate a 130% increase in fatalities is expected on average ([9.1-21]/9.1) per turbine. However, at the same time, the number of turbines will decrease from the authorised 70 to a maximum of 32 – a 54 % reduction.

Does this offset the expected increase in avian fatalities? The answer is **almost** (Table 3). The forecast of total avian fatalities is 636 birds for the 70 shorter (100-m HH) turbines, but 672 birds for the 30 taller (130-m HH), turbines. This is 5.7% increase in fatalities over the shorter turbines. Confidence intervals are shown in Figure 7a.

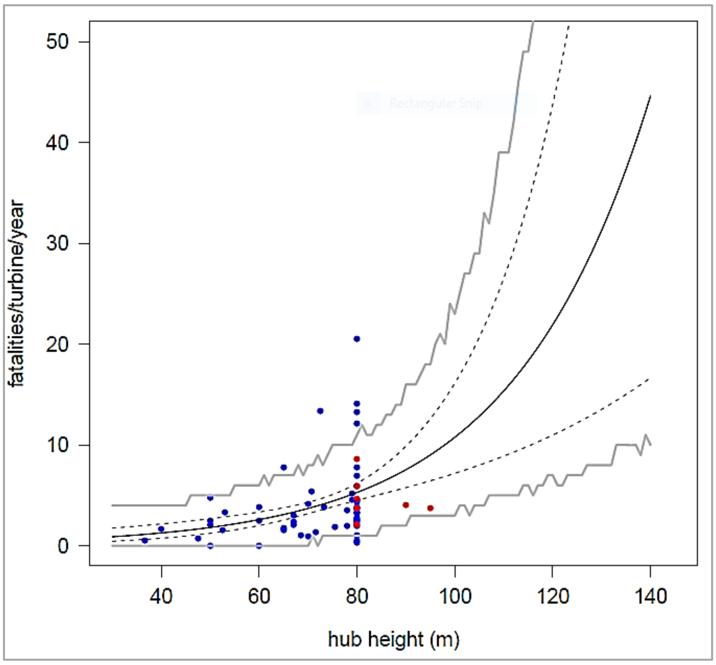


Figure 7a: Modelled data combining avian fatalities from the USA (Loss et al. 2013) and from South Africa (Ralston-Paton et al. 2017) and their relationship with hub height. 95% confidence limits are shown as dotted lines. The combined data and 95% confidence limits predict that on average 21 birds will be killed per year by 130-m-high turbines. This is about twice the number of birds predicted to be killed by the Authorised 100-m-high turbines. This predicted 2.3-fold increase is critical in forecasting the number of birds killed by the proposed number of turbines

Note: this is a statistical forecast and is not based on empirical data beyond 95 m hub heights. From Simmons, Cervantes-Peralta, Erni, Martins & Loss (2017).

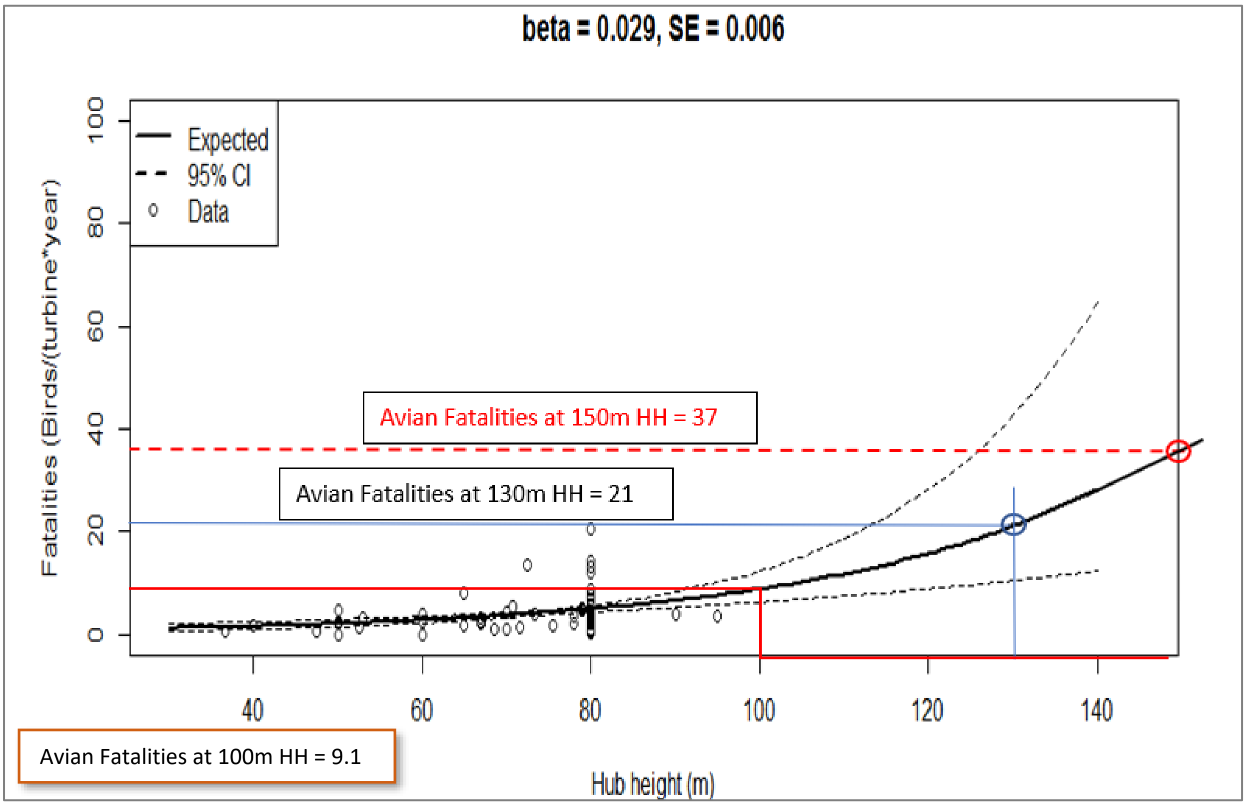


Figure 7b: Fatalities and hub height with South African data (n=7 farms) include two WEFs with hub heights of 90-m and 95-m. The dotted line represents the 95% confidence limits. Predicted fatalities are shown for the hub heights 100m (9.1 birds/turbine), 130-m (21 fatalities/turbine) and 150-m (37 fatalities/turbine).

Table 3: The combined effect of increased fatalities (due to taller turbines) and reduced impact (due to fewer turbines) on total avian fatalities. Based on average (and 95% confidence limits) forecasts from Figure 7b.

Hub height of authorised and proposed turbines	**Avian Fatalities per turbine (from Figure 7b)**		
	Forecast: Mean (95% CI)	With 70 **(small) turbines** Mean (95% CI)	With **32 (large) turbines** Mean (95% CI)
100-m hub height (authorised)	9.1 (7 to 13)	**636** (490-910)	-
130-m hub height (proposed)	21 (15 to 44)	-	**672** (480-1408)

This analysis indicates that the increase in height, but decrease in number of turbines, results in approximately an equal numbers of fatalities. There is a marginal increase of 5.6% in expected fatalities with the 32 taller turbines.

As this is within the confidence limits of the models presented here, and is not expected to substantially increase fatalities as long as the other recommendations are adhered to.
We have given data on expected changes in collisions of all birds, but displacement due to disturbance, and habitat loss may also occur.

Displacement has been recorded for some raptors species at South African wind farms for Martial Eagles *Polemaetus bellicosus* and is known for breeding pairs and fledglings hawks in the USA (Kolar and Bechard 2016). There is insufficient data from South Africa to know if other species may be displaced through disturbance.

For habitat loss it is unlikely to be a negative issue given the small footprint size of the roads and hard stands in relation to the total area of the wind farm.

An explanation of the impact assessment criteria applied by RINA is presented below:

An 'impact' is any change to a resource or receptor caused by the presence of a project component or by a project-related activity. Impacts can be negative or positive and are described in terms of their characteristics, including the impact's type and the impact's spatial and temporal features (namely extent, duration, scale and frequency). Impact characteristics are defined in the subsections below.

Type of Impact

- ✓ Direct: applies to an impact which can be clearly and directly attributed to a particular environmental or social parameter (e.g. dust generation directly affects air quality)
- ✓ Indirect: applies to impacts which may be associated with or subsequent to a particular impact on a certain environmental or social parameter (e.g. high levels of dust could entail nuisance and health effects to workers on site).
- ✓ Induced: applies to impacts that result from other activities (which are not part of the Project) that happen as a consequence of the Project.
- ✓ Cumulative: applies to impacts that arise as a result of an impact and effect from the Project interacting with those from another activity to create an additional impact and effect.

Duration of Impact

- ✓ Temporary - applies to impacts whose effects are limited to a period of less than 3 years, or only associated with Project pre-construction or construction phases.
- ✓ Short-term: applies to impacts whose effects are limited to a five-year period.
- ✓ Long-term: applies to impacts whose effects last longer than a period of five years, but limited to within the project lifetime.
- ✓ Permanent: applies to impacts whose effects last longer than the life of project – i.e. irreversible.

Extent of Impact

- ✓ On-site: impacts that are limited to the Project site.
- ✓ Local: impacts that are limited to the Project site and adjacent properties.
- ✓ Regional: impacts that are experienced at a regional scale.
- ✓ National: impacts that are experienced at a national scale.
- ✓ Trans-boundary/International: impacts that are experienced outside of Ghana.

Scale of Impacts

The scale of an impact is a quantitative measure, such as the size of the area damaged / impacted or the fraction of a resource that is lost / affected, etc. It is generally described using numerical values and units rather than assigned fixed designations.

Frequency of Impacts

The frequency of an impact the measure of the constancy or periodicity of an impact, described using numerical values or a qualitative description.

Likelihood

Likelihood is a measure of the degree to which the unplanned event (e.g. incidents, spills) is expected to occur. The likelihood of an unplanned event occurring is determined qualitatively, or when data is available, semi-quantitatively. Definitions of likelihood as applied in the ESIA are provided as follows:

- ✓ Unlikely: The event is unlikely but may occur at some time during normal operating conditions
- ✓ Possible: The event is likely to occur at some time during normal operating conditions.
- ✓ Likely: The event will occur during normal operating conditions (i.e. it is essentially inevitable).

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<u>Assessment of Impact Significance</u>

As far as possible, impacts will be quantified. Where it is not possible to quantify impacts, a qualitative assessment will be conducted using professional judgement, experience and available knowledge, and including the consideration of stakeholder views. Where there are limitations to the data, and/or uncertainties, these will be recorded in the relevant chapters, along with any assumptions made during the assessment.

To determine the significance of each impact, two overall factors are considered:

- ✓ **magnitude and nature** of impacts;
- ✓ the **importance and/or sensitivity** of the environmental as determined during the assessment of baseline conditions.

Magnitude of Impact

Once impacts are characterised (see section above) they are assigned a 'magnitude'. Magnitude is typically a function of some combination (depending on the resource / receptor in question) of the following impact characteristics:

- ✓ extent;
- ✓ duration;
- ✓ scale;
- ✓ frequency.

Magnitude (from small to large) is a continuum. Evaluation along the continuum requires professional judgement and experience. Each impact is evaluated on a case-by-case basis and the rationale for each determination is noted. Magnitude designations for negative effects are: negligible, small, medium and large. In the case of a positive impact, no magnitude designation is assigned as it is considered sufficient for the purpose of the impact assessment to indicate that the Project is expected to result in a positive impact.

In the case of impacts resulting from unplanned events, the same resource/receptor-specific approach to concluding a magnitude designation is used.The likelihood factor is also considered, together with the other impact characteristics, when assigning a magnitude designation.

Sensitivity of Receiving Parameter

In addition to characterising the magnitude of impact, the other principal step necessary to assign significance for a given impact is to define the sensitivity of the receptor. There are a range of factors to be taken into account when defining the sensitivity of the receptor, which may be physical, biological, cultural or human. As in the case of magnitude, the sensitivity designations themselves are universally consistent, but the definitions for these designations will vary on a resource/receptor basis. The universal sensitivity of receptor is set as either negligible, low, medium or high.

For ecological impacts, sensitivity is assigned as low, medium or high based on the conservation importance of habitats and species. Comment needs to be provided as to whether an irreplaceable loss of a resource is anticipated or not.

Assessing the Significance of Impacts
To assess the significance of an impact, the sensitivity of the receiving environmental is considered in association with the magnitude of the impact, according to the matrix shown in the table below.

Table 4: Matrix for Assessing Impacts Significance

Magnitude of Impact	Sensitivity of Receiving Receptor		
	Low	Medium	High
Negligible	Negligible	Negligible	Negligible
Low	Negligible	Minor	Moderate
Medium	Minor	Moderate	Major
High	Moderate	Major	Major

To calculate Magnitude of Impact of collisions of priority species we need to know the following:

- **Duration** (life time of wind farm) – long term
- **Extent** (regional as birds from outside boundaries can be negatively affected)
- **Scale** (~50 km^2) size of wind farm boundary
- **Frequency** (constant as turbines always operative)
- **Likelihood** (of impact occurring- highly likely)

The combination of the above parameters gives a Magnitude of the Impact score as **High** given the known impact of wind farms on priority bird species, and the long term (> 20 y) of the impacts.

Given that Priority species are known to be regularly killed by wind farms (Perold et al. 2019) their sensitivity to wind farms is, by definition, **High**. This is the "Receiving Receptor" part of the assessment in the table above.

According to the matrix table below (Table 5), the impacts are therefore likely to be **Major** before mitigation. That is, before the turbines were moved from the previous 2021 positions. After mitigation (Table 6), both the Magnitude and the "Receiving Receptor" move to **Medium**, giving a Significance impact score of **Moderate**.

Table 5: The impact significance assessment for all priority species predicted for the proposed Richtersveld WEF before mitigation: WEF operational phase

Magnitude of impact of proposed WEF before mitigation	Sensitivity of Priority species to wind farm		
	Low	Medium	**High**
Negligible	Negligible	Negligible	Negligible
Low	Negligible	Minor	Moderate
Medium	Minor	Moderate	Major
High	Moderate	Major	**Major**

Table 6. The impact significance of scores for all priority species predicted for the proposed Richtersveld WEF after mitigation: WEF operational phase

Magnitude of impact of proposed WEF after mitigation	Sensitivity of Priority species to wind farm		
	Low	**Medium**	**High**
Negligible	Negligible	Negligible	Negligible
Low	Negligible	Minor	Moderate
Medium	Minor	**Moderate**	Major
High	Moderate	Major	Major

Given the presence of several Red Data priority species (Black Harrier, Lanner Falcon) and several Least Concern Priority species (Jackal Buzzard, Chanting Goshawk), the mitigation measures must include the following:

- Re-positioning of the turbines outside all high risk areas (this has been undertaken by the developer)
- Operations monitoring for a two year period is required
- Should more than 1 red data species be killed by any turbine in 12 months' monitoring then either:
  - Shut down on Demand (SDOD), automated or observer-lead must be implemented within 2 months,
  - Or Striped (coloured blade) must be installed to increase the visibility of the blades (May et al. 2020).

Note that it is easier to install coloured blades from the outset, rather than painting a blade at a later stage, so the developer should ideally install these when constructing the wind farm. They have reduced the collision frequency of White-tailed eagles Haliaeetus albicilla in Norway to zero in an 8-year experiment, while other white-bladed turbines continue to kill eagles at a rate of 6 per year (May et al 2020, R May in litt).

CONCLUSIONS and RECOMMENDATIONS

The receiving environment become drier since the last visit in 2013, (when annual rainfall in the 3-month period July 2013 to September 2013 was 150-200% of the mean average precipitation (MAP), vs rainfall in the same 3-month period in 2021 which was 25-75% of MAP (SAWS https://www.weathersa.co.za/home/historicalrain) and that has coincided with:

- A reduction in the diversity of Priority bird species (from 16 to three in 2021);
- A reduction in the number of Red Data species present (from five species to zero in 2021);
- A slight increase in spring reporting rates (from 0.32 birds/h in 2012-2013 to 0.59 birds/h in 2021).

In the previous avian assessment (Simmons and Martins 2013) two areas of high risk were identified because of the high incidence of flight activity by the Red Data raptors and bustards on site.

These high-risk areas near the wind mast and to the east of the wind mast overlap with the previous alternative layout of 2021 and that precipitated a move of the following turbines:

- T4, T7, T12 (from high-risk area 1); and
- T9, T21, T24, T25, T29, T30 (from high-risk area 2).

All nine turbines have been re-positioned in light of the extensive avian data from 2012 and 2013. All now lie outside the designated high-risk areas (see Figures 5 and 6). This should substantially reduce risk to the Priority birds on site.

An analysis of the expected change in avian fatalities arising from a change in the dimensions and numbers of turbines showed that 32 large (130-m HH) turbines are forecast to kill marginally (5.6%) more birds than 70 shorter (100-m) turbines.

This is an acceptable increase given that this change lies within the 95% confidence limits provided by the modelled increase in fatalities arising from increased hub height.

An Environmental Management Plan must be implemented to ensure that the identified impacts are adequately mitigated, and that appropriate responses to any fatalities are initiated.

ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPr)

MONITORING PROGRAMME

The goals of a Monitoring Programme are to ensure that the mitigations recommended are adhered to, and to regularly survey the operational turbines for avian fatalities. These should be supervised by either the Environmental Control Officer (ECO) or a suitably qualified ornithologist who is responsible for supervising search teams and identifying remains of collision victims.

The search frequency should be undertaken such that a minimum of 70% of all turbines are searched over a 2-week period, at 3-4 turbines per day, with a search radius at the base of the turbines of 70-100-m depending on the hub height of the turbines (taller turbines require a larger search area). This must be undertaken year-round for two years.

Every fatality should be photographed with a live GPS reading next to it indicating the exact position. A fatality report should collate all deaths, species, and the turbines under which they occur at the end of 12 months, and the report should be made available to the managers with a copy sent to Birdlife South Africa's Renewable Energy division.

The monitoring of live birds is also important, particularly the Priority species. While only two nests are known of a Priority species in the Richtersveld WEF (both Pale Chanting Goshawks on the pylons running to the east of the site), nests of other Priority species must be reported, and monitored, if they are found on site. This should be undertaken in the construction and operational phases, by a qualified bird specialist and is best undertaken starting in winter for the larger species and then spring followed by summer (e.g., June, September, December). A short report should follow at the end of this period.

For very sensitive species (e.g., ground-nesting Black Harriers) this can be done remotely (i.e., by drone) to reduce disturbance. The qualified specialist must report:

(i) the activity **status of the nest** (active/inactive) and stage (eggs, nestling, success/failure);

(ii) special attention must be made for **flights near spinning turbines** (avoidance behaviour, attraction to, or impact by the blades); and

(iii) report any **deaths** detailing time, turbine number, behaviour, identity of the adult or juvenile, resident, or floater.

(iv) All deaths must be accompanied by photographs of the carcass *in situ*, with GPS point clearly marked.

MANAGEMENT and MITIGATION PROGRAMME (MMPr)

LANDOWNER MANAGEMENT

The Management and Mitigation Programme (MMPr) must be adaptive with a fast response time if it is found that Red Data species or other Priority species are being killed by the turbines. That response time should be within one month of the date of the fatality occurring. This applies to both the wind farm *and* the landowner's management practices. A suitably qualified avian specialist must be employed to identify avian carcasses to determine if they are Priority species, and thus whether mitigations are required.

The contract between the landowner and the developer is best presented as a stand-alone agreement, and not part of the Management Plan presented here.

It is strongly recommended that Richtersveld Wind Farm (Pty) Ltd add to the Landowner Lease Agreement that no Priority birds can be persecuted in any form. That is, either directly (shooting, trapping, nest removal) or indirectly (poisoning). A financial penalty must be instituted to back this up.

WIND-FARMER MANAGEMENT

The main goal of the wind farm Management Plan is to pro-actively seek solutions as soon as:

(i) short-term issues such as Red Data fatalities, due to impacts with turbines, come to light; or

(ii) long-term issues such as the displacement of eagles – or other species – are detected in the long-term.

To this end we suggest:

- Regular and systematic carcass searching must be implemented across the full site as laid out in the Best Practice guidelines (Jenkins et al. 2015).
- Since there are a relatively small number of turbines (32) it is suggested that that a minimum of 70% of all turbines are searched over a 2-week period, at 3-4 turbines per day, with a search radius at the base of the turbines of 70-100-m depending on the hub height of the turbines. This should follow the guidelines recommended by Birdlife South Africa (Jenkins et al. 2015).

PROGRAMME IN CASE OF BLACK HARRIER FATALITIES

Population viability assessments of Black Harrier populations in the Birdlife South Africa Black Harrier guidelines (Cervantes, Peralta et al. 2022) indicate that the global population is only 1 300 birds and highly sensitive to even one wind farm death of an adult bird.

Given that **eight** Black Harriers have been killed by South African wind farms up to April 2021 (Perold et al. 2020) and that the harriers regularly occur on the Richtersveld site, it is essential that monitoring is undertaken for at least 24 months.

Should the first tier of mitigation – turbines located <u>outside</u> recognised high-sensitivity areas – fail to reduce the collision-frequency of Red Data or Priority species (that is: just one, or more, Black Harrier fatality per turbine per year, or more than one other Red Data species killed at a turbine per year) then either:

(i) shut-down on demand (observer-driven or automated); or

(ii) striped-blade mitigation

must be enacted in a short time frame (of one month or less).

Given the multiple tiers of mitigation already put in place from extensive observation and modelling of this population, fatalities are not expected. However, experience has shown that even WEFs with no record of certain species passing through the farm before construction can experience avian fatalities.

Thus, the adaptive response recommended for Richtersveld Wind Farm (Pty) Ltd is to:

(i) Investigate, over 12 months, which turbines are responsible for more than one eagle or raptor death.

(ii) Investigate weather conditions at the times of the deaths.

(iii) Investigate the time and seasons when most deaths occur (this has been found to peak in October-November when adult harriers are providing food for their young, and soar into the blade-swept zone to gain height (Simmons et al. 2020)).

(iv) If patterns emerge from a statistical assessment of the factors involved, then additional mitigation measures – in the form of shutting down individual problem turbines at specified times of day in specified seasons and weather conditions – is recommended.

As an example:

o if turbine *WTG(n)* is found to have caused the deaths of two Black Harriers over a 12-month period at the Richtersveld WEF, and

o other deaths are recorded between *10:00 and 13:00* (within the Richtersveld WEF, or at other WEFs around

o South Africa), in the month of *October,* during windy and misty conditions, then

o We recommend that WWTG(n) is shut down temporarily from 10:00 to 13:00 on any October day in which such weather conditions prevail. At all other times the turbine can function as normal.

We recommended that Richtersveld Wind Farm (Pty) Ltd, makes fatality data available to Birdlife South Africa (to contribute to a national fatality data base).

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