ARCUS

Gunstfontein Wind Energy Facility: Updated Bird Impact Assessment

On behalf of

Savannah Environmental (Pty) Ltd

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Prepared By:

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1 INTRODUCTION

1.1 Background

It is understood that Gunstfontein Wind Farm (Pty) Ltd ('the Developer') received environmental authorisation (EA) in July 2016 for the construction of the Gunstfontein Wind Energy Facility (WEF), approximately 20 km south of Sutherland, Northern Cape Province.

Savannah Environmental Pty Ltd ('Savannah') conducted the Environmental Impact Assessment (EIA) study, which incorporated the findings of a specialist Avifaunal Impact Assessment report (BioInsight 2016) compiled by BioInsight (Pty) Ltd.

The Final Environmental Impact Report (FEIR) (Savannah, 2016) assessed a layout of 68 turbines each up to 4 MW capacity subject to a 200 MW cap on contracted capacity of the WEF. The EA approved a WEF of up to 200 MW and the authorised layout consists of up to 46 wind turbines each with a 140 m rotor diameter and a hub height of up to 120 m.

The Developer is proposing to amend the EA as follows:

- Increase in the hub height to up to 150m;
- Increase in the rotor diameter to up to 180m;
- Increase of the rated power of turbines to up to 6.5 MW per WTG;
- Potential increase to the WTG foundation area and laydown area; and
- Update to the facility layout as required (including revised turbine positions and an additional access road).

1.2 Terms of Reference

Arcus was appointed by Savannah to review the applicable bird information relating to the assessment of impacts for the Gunstfontein WEF, and then to re-assess the impacts based on the proposed changes to the project's technical specifications. More specifically the report must reflect:

- An assessment of all impacts related to the proposed change and based on current information and understanding of WEF impacts in South Africa;
- Advantages and disadvantages associated with the proposed change;
- A review of the updated project layout against the identified avifaunal sensitivities applicable to the project site; and
- Mitigation measures to ensure avoidance, management and mitigation of impacts.

2 METHODOLOGY

2.1 Document and Data Review

In order to understand the baseline avifauna environment as well as avifaunal issues relating to the project, Arcus reviewed the following documents, data and sources of information applicable to the Gunstfontein WEF:

- Savannah Environmental (2016). Final Environmental Impact Assessment Report: Gunstfontein Wind Energy Facility near Sutherland, Northern Cape Province.
- BioInsight (2016). Gunstfontein Wind Energy Facility-Bird Pre-Construction Monitoring and Specialist Impact Assessment Report 2013/2016. February 2016. This report was included as Appendix E of the FEIR.
- Smallie (2013). Gunstfontein Renewable Energy Project Wind and Solar Energy Facilities, Northern Cape. Avifaunal Impact Assessment - Scoping Phase report on behalf of Networx Eolos Renewables (Pty) Ltd. July 2013.
- Environmental Authorisation (EA) for the 200 MW Gunstfontein WEF dated 25 July 2016, register number: 14/12/16/3/3/2/826;

- The most recent data available online from the South African Bird Atlas Project 2 (SABAP2) of the Animal Demography Unit (ADU), University of Cape Town (UCT). These data were examined to identify if any additional relevant red data species[1], priority species[2] and/or raptors have been recorded in the area covering and surrounding the Gunstfontein WEF, following the completion of the abovementioned studies.

2.2 Literature Review

In order to understand the mechanism resulting in bird collisions with wind turbines, and a resultant potential change with an increased rotor diameter and increased hub height, a brief literature review on this topic was conducted.

A literature review was also conducted on the latest available information regarding observed/recorded avifaunal mortalities on WEFs in South Africa, and this included verbal consultation with BirdLife South Africa and other avifaunal specialists.

2.3 Impact Assessment

The applicable bird impacts, as identified and rated by BioInsight (2016), were evaluated and where applicable were re-rated using the same criteria used in the original assessment (Appendix I).

The re-rating was done by considering all applicable information which included: i) a literature review; ii) review of applicable documents; iii) the latest available information on WEF impacts on birds in South Africa; iv) the specialist's experience of monitoring at various operational WEFs; v) the specialist's knowledge of the avifauna and avifaunal micro-habitats in the vicinity of the project site having worked on a number of other project sites in the broader Sutherland area; and vi) the proposed changes to the Gunstfontein WEF layout and turbine specifications.

Where the significance of the impact ratings changed, or where new/additional impacts were identified, these were highlighted and the updated ratings presented in impact tables.

3 REVIEW RESULTS

3.1 Bird Pre-Construction Monitoring and Specialist Impact Assessment Report (BioInsight 2016)

BioInsight conducted long-term pre-construction bird monitoring on the Gunstfontein site over 12 months from December 2013 to November 2014. It is noted that this study related to a much larger study area, and approximately 50% of the site was discarded following this study. The key findings and results regarding the avifauna on the site can be summarised as follows:

- There was a high occurrence of waterbirds and "*Ciconids*", and an abundant waterbird community was present predominantly using the northern area of the site.
- The most abundant waterbird species were Red-knobbed Coot, Yellow-billed Duck, Spur-winged Goose and Greater Flamingo.
- Other sensitive waterbirds recorded were: African Sacred Ibis, Cape Shoveller, and South African Shelduck.

[1] Regional red data species with a status of Near-Threatened or higher as assessed in Taylor, M.R., Peacock, F., and Wanless, R.M. 2015. Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland.

[2] Species with a priority score of 170 or more, as calculated by Birdlife SA in the 2014 update: Retief, E.F, Diamond, M., Anderson, M.D., Smit, Dr. H.A., Jenkins Dr. A. & Brooks, M. 2011, updated 2014. Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures Used.

- Eight red data species were recorded on the site namely Martial Eagle, Black Harrier, Ludwig's Bustard, Black Stork, Verreaux's Eagle, Secretarybird, Greater Flamingo and Karoo Korhaan.
- Two endemic/range-restricted larks (Cape Clapper Lark and Large-billed Lark) were common on the site.
- Six potential breeding locations were recorded and monitored. One nest site was that of an unidentified "*Tern spp.*" at a waterbody, three were on cliffs (including two unconfirmed species and one Verreaux's Eagle site) and two on trees (including a suspected Martial Eagle nest and a suspected Secretarybird nest site).
- A Verreaux's Eagle nest was located, and although breeding of this species at this site was not confirmed, pairs were regularly observed in the surrounding area, indicating the possibility of breeding in future seasons.
- A total of 125 species within the WEF and "*surrounding area*", including 26 designated as "*sensitive species*" and 18 endemic or near-endemic species.
- A higher activity of passerine species was observed in spring, with the most frequent groups being cisticolas, flycatchers, Larks, buntings and shrikes. Sensitive passerine species were identified as Large-billed Lark, Cape Clapper Lark, Common Swift, and South African Cliff Swallow.
- Forty-two species of large birds or raptors were recorded, of which waterbirds, crows and ravens were the most abundant and active.
- Sensitive raptors recorded were: African Harrier Hawk, African Fish Eagle, Black Harrier, Black-chested Snake Eagle, Jackal Buzzard, Booted Eagle, Martial Eagle, Pale-chanting Goshawk, Secretarybird, Verreaux's Eagle, Greater Kestrel and Rock Kestrel.
- Both Martial Eagle and Verreaux's Eagle were recorded flying at rotor swept area (RSA) for relatively high proportions of time, as were Booted Eagle, Rock Kestrel, Southern Pale Chanting Goshawk and Jackal Buzzard.
- Raptor activity was highest in the escarpment area (i.e. above the steeper slopes and ridges), and it was stated that this area appears to be an important uplift feature for soaring birds and as a hunting ground for some "*Falcon*" species.
- During Vantage Point (VP) monitoring, the average number of "*contacts per hour*"[3] for Martial Eagle was one in each of summer, winter and spring.
- During VP monitoring, the average number of "contacts per hour" for Verreaux's Eagle was two in summer, 1.4 in winter and 1.0 in spring.
- Flight activity of Greater Flamingo was relatively high with VP monitoring recording an average of 2.5 contacts/hour in summer, 34 contacts/hour in autumn, 25 contacts/hour in winter and 9.1 contacts/hour in spring, although 81 % of all contact for this species were below RSA.
- The general area of the site was classified as having medium avifaunal sensitivity, with some focal areas of high sensitivity.
- A risk analysis was conducted which identified a set of high risk areas which were classified as no-go areas and mapped. These included natural renosterveld areas, main waterbodies, valleys, buffers of nest sites of key species and the escarpment areas.

3.2 Original Gunstfontein Bird Scoping report (Smallie 2013)

This report, compiled for the Gunstfontein site, was done as part of an earlier discontinued EIA process. The report was reviewed to obtain additional avifauna information to advise the updated impact assessment. One hundred and forty one bird species were identified as possibly being present on the site, which was described as a "*relatively low diversity of species*". The work (which included a short site visit) identified the following micro-habits: Karoo veld; pans and dams; drainage lines; escarpment; arable lands; and ridges.

[3] ~birds/hour. Each bird was considered a contact, thus one flight of a flock of five birds would represent five contacts.

The most important "*target species*" were identified as Ludwig's Bustard, Greater Flamingo, Martial Eagle, Verreaux's Eagle, Black Harrier, Jackal Buzzard and Grey-winged Francolin. Other relevant red data species or raptors indicated as being potentially present were Black Stork, Booted Eagle, African Fish Eagle, Spotted Eagle-owl, Rock Kestrel, Black-shouldered Kite, and Southern Pale Chanting Goshawk.

There was no significant additional avifaunal information (e.g. different key species) obtained from this report, above that presented and recorded by BioInsight (2016).

3.3 South African Bird Atlas Project Data

South African Bird Atlas Project Data (SABAP2) data were examined by Arcus to identify recent reporting rates for red data species, priority species and raptors recorded in six Pentads (Figure 1); four containing proposed turbine locations (3230_2035, 3230_2040, 3235_2035, and 3235_2040) and two from surrounding pentads (3225_2035 and 3230_2030).

A total of 15 priority species were recorded by the SABAP2 data considered, as well as two raptors that are not priority species (i.e. Rock Kestrel and Yellow-billed Kite) (Table 1). Five regional red data, priority species or raptors were recorded, including two classified as *Endangered* (Ludwig's Bustard and Martial Eagle), two as *Vulnerable* (Verreaux's Eagle and Lanner Falcon) and one as *Near-Threatened* (Greater flamingo).

Species considered in Table 1 with relatively high reporting rates and/or recorded across three or more pentads were: Spotted Eagle-owl; Verreaux's Eagle; Jackal Buzzard; Southern Pale Chanting Goshawk; Rock Kestrel; and Grey-winged Francolin. It is noted that although they were only each recorded in the two pentads considered, Martial Eagle and Greater Flamingo recorded relatively high reporting rates (i.e. 30%) in one pentad (3230_2040) covering the proposed turbine layout, although it is likely that these observations were of birds in a wetland, within the pentad but adjacent to the turbine layout.

Of the species identified in Table 1, four species (Black-shouldered Kite, Yellow-billed Kite, Lanner Falcon and Cape Eagle-owl) were not listed in the species list presented by BioInsight (2016) for birds recorded during pre-construction monitoring (Appendix II of their report). The possible presence of these species on the Gunstfontein site has therefore been considered in the updated impact assessment.

Table 1: Red Data Species, Priority Species and Raptors Recorded in the SABAP2 Pentad Squares (accessed 01/03/2019)

Species	**Regional Red Data Status**	**Priority Species Score**	**Reporting Rate (%)**					
			3230_ 2035	**3230_ 2040**	**3235_ 2035**	**3235_ 2040**	**3225_ 2035**	**3230_ 2030**
Total Species			*93*	*80*	*51*	*60*	*96*	*83*
Number of Cards Submitted			*26*	*10*	*3*	*4*	*62*	*34*
Spotted Eagle-owl	-	170	-	-	33.3	25	16.7	-
Cape Eagle Owl	-	250	7.7	-	-	-	-	-
Martial Eagle	EN	350	3.9	30	-	-	-	-
Verreaux's Eagle	VU	360	30.8	10	66.7	-	33.3	17.7
Black-chested Snake-Eagle	-	230	-	Inc.	-	Inc.	-	-
Jackal Buzzard	-	250	46.2	50	33.3	25	66.7	

Species	Regional Red Data Status	Priority Species Score	Reporting Rate (%)					
			3230_ 2035	3230_ 2040	3235_ 2035	3235_ 2040	3225_ 2035	3230_ 2030
Steppe Buzzard	-	210	Inc.	-	-	-	-	-
Southern Pale Chanting Goshawk	-	200	15.4	60	33.3	50	66.7	20.6
Rock Kestrel	-	-	57.7	50	33.3	75	50	14.7
Lanner Falcon	VU	300	Inc.	-	-	-	16.7	-
Ludwig's Bustard	EN	320	Inc.	-	-	-	-	-
Grey-winged Francolin	-	190	34.6	-	33.3	75	-	26.5
Greater Flamingo	NT	290	-	30	-	-	33.3	-
Booted Eagle	-	230	-	-	-	-	Inc.	2.9
Black-shouldered Kite	-	174	-	-	-	-	16.7	-
Yellow-billed Kite	-	-	-	-	-	-	16.7	-
African Harrier-Hawk	-	190	-	-	-	-	-	2.9

3.4 Literature Review

In South Africa, while post-construction monitoring is being conducted on the majority of operational WEF sites, publically available data and information of operational results is limited and restricted to information supplied to BirdLife SA and made available by them to the public in the form of a report (Ralston Paton *et al.* 2017), and a public presentation (BLSA 2017). Some additional information has been obtained by the specialist through consultation with peers and members of the Birds and Renewable Energy Specialist Group (BARESG), but there remain gaps in knowledge regarding the effects (and the significance thereof) that WEFs may have on certain aspects of a region's avifauna.

International experience, and results from South Africa have shown that birds can be impacted negatively by wind farms and that the severity of these impacts can differ drastically from site to site (Bose *et al.* 2018; Grünkorn *et al.* 2017; Ralston-Paton *et al.* 2017; Thaxter *et al*. 2017; Pers. Obs). Overall, it appears that severe impacts, such as the high mortality numbers of Golden Eagle observed at Altamont Pass in California (Hunt *et al.* 1998; Orloff & Flannery 1992) seem to be the exception rather than the rule, with the majority of facilities recording relatively moderate to low mortalities (Watson *et al.* 2018, Strickland *et al.* 2011; de Lucas *et al.* 2008; Erickson *et al.* 2001; Ralston-Paton *et al.* 2017). The effects of one poorly placed facility, or some poorly sited turbines within a facility, can however affect the population of certain species at a regional, national or even global level (Bellebaum *et al*. 2013; Dahl *et al.* 2012). Some key species have been collision mortality victims in South Africa and in 2017 Ralston-Paton *et al.* (2017) listed the following red data collision victims: Blue Crane (three), Verreaux's Eagle (five), Martial Eagle (two) and Black Harrier (five). These numbers have likely increased since publication of the report. Both of the eagle species were recorded relatively frequently (compared with other red data species) on the Gunstfontein site. Verreaux's Eagle has suffered more recent mortality, with at least 12 Verreaux's Eagle mortalities known at WEFs to date (Pers. Com BLSA). Some of these more recent moralities were due to power line electrocution at a WEF site in the Karoo (Pers. Com. BLSA & Chris van Rooyen). The specialist is aware of at least two more Blue Crane and two more Martial Eagle mortalities since the 2017 report (Pers. Com BLSA; Pers. Obs.).

Other raptors that have suffered relatively moderate to high levels of collision mortality in South Africa are Jackal Buzzard, Amur Falcon, Steppe Buzzard, Rock Kestrel, Black-shouldered Kite, Western Barn Owl, and Booted Eagle (Ralston-Paton *et al.* 2017; BLSA, 2017; Pers. Obs).

Large turbines are more efficient, therefore most modern wind developments for a given number of megawatts have fewer turbines with wider spacing. However, wider and longer blades produce greater vortices and turbulence in their wake as they rotate, posing a potential problem for bats (and some birds). Larger turbines have fewer rotations per minute but have similar blade tip speeds compared to the smaller turbines commonly used in older wind facilities (NWCC 2010). It is believed this difference may be partly responsible for the lower raptor collision rates observed at most wind facilities where larger turbines have been installed, but that the main reason is because fewer larger turbines are needed to produce the same energy as smaller turbines. NWCC (2010) does note though that because the transition to larger turbines has largely coincided with a number of other transitions in turbine technology and siting practice, it is difficult to separate the individual effects and thereby determine the degree to which turbine size affects raptor collision rates.

It is likely that the level of bird use and their behaviour at the site, as well as elevation and topography are more important factors to consider than turbine size and rotation speed when assessing potential collision risk (Watson *et al*. 2018).

In Spain, taller and higher elevation turbines were more likely to kill soaring birds than shorter turbines at lower elevations. In the US, repowering with fewer, taller, slower-moving turbines reduced collisions (Watson *et al*. 2018). Other studies (Barrios & Rodriguez, 2004; Stewart *et al.* 2007) also found that the size and alignment of turbines and rotor speed are likely to influence collision risk; however, physical structure is probably only significant in combination with other factors, especially wind speed, with moderate winds resulting in the highest risk. In fact, Barrios & Rodriguez (2004) found tower structure to have no effect on mortality, and that mortality may be directly related to abundance for certain species (e.g. Common Kestrel). They concluded that physical structures had little effect on bird mortality unless in combination with other factors. Somewhat conversely, De Lucas *et al*. 2008 found that turbine height and higher elevations may heighten the risk (taller/higher = higher risk), but that abundance was not directly related to collision risk, at least for Eurasian Griffon Vulture. De Lucas *et al.* 2008 stated "*All else being equal, more lift is required by a griffon vulture over a taller turbine at a higher elevation and we found that such turbines killed more vultures compared to shorter turbines at lower elevations*".

Howell *et al.*, 1997 found that the evidence to date from the Altamont Pass did not support the hypothesis that the larger RSA results in more mortalities. On the contrary it was found that the ratio of smaller to larger turbines rather than RSA was consistent with the mortality ratio, and that it appeared that the mortality occurred on a per-turbine basis, i.e. that each turbine simply presented an obstacle.

Barclay *et al.* 2007 reviewed data from North American wind energy facilities and found that diameter of turbine rotor did not influence the rate of bird or bat fatality. The height of the tower had no effect on bird fatalities per turbine, but bat fatalities increased exponentially with tower height.

Krijgsveld *et al.* 2009 found that collision risk of birds with larger multi-MW wind turbines is similar to that with smaller earlier-generation turbines, and much lower than expected based on the large rotor surface and high altitude-range of modern turbines. Smallwood *et al.* 2013 found that Red-tailed Hawk and all raptor fatality rates correlated inversely with increasing wind-turbine size. Everaert (2014) states "*Combined with the mortality rates of several wind farms in the Netherlands (in similar European lowland conditions near wetlands or other areas with water), no significant relationship could be found between* *the number of collision fatalities and the rotor swept area of the turbines. In contrast to more common landscapes, Hötker (2006) also found no significant relationship between mortality rate and the size of wind turbines near wetlands and mountain ridges."*

One would initially assume that a larger RSA would mean an increase in the risk of collision. In the case of Gunstfontein, the originally assessed 68 turbines with a rotor diameter of 140 m would have a combined RSA of approximately 1,046,778 m^2 (or ~104.7 ha). The EA however, only approved 46 turbines, which would have combined RSA of ~70.8 ha. The proposed amendment is for 46 turbines (in different positions) with increased rotor diameters of up to 180 m resulting in a total RSA of approximately 117.1 ha. Although there are 22 less turbines in the proposed amendment compared to the number of turbines assessed by BioInsight (2016), there is an increase in total RSA of approximately 12.4 ha. If one considers the approved number of turbines (46) and their associated specifications compared to the proposed number (46) with their increased rotor diameter, there is a substantial increase in total RSA of ~46.3 ha.

However, as can be seen from the above literature survey, most published findings indicate that rotor swept area is not a key factor in collision risk. Turbine dimensions seem to play a smaller role in the magnitude of collision risk in general, relative to other factors such as topography, turbine location, turbine numbers, species abundance, morphology and a species' inherent ability to avoid the turbines, and may only be relevant in combination with other factors, particularly wind strength and topography. The turbine numbers is likely to be a more important factor in the overall significance of the collision risk of a project.

4 IMPACT ASSESSMENT

BioInsight (2016), based on the findings of their pre-construction monitoring, identified and rated the following impacts on avifauna:

- Construction Phase: i) Destruction of natural vegetation; and ii) Disturbance and/or displacement effects.
- Operation Phase: i) Fatalities due to collisions with wind turbines; and ii) Disturbance and/or displacement effects.

This report now presents additional impacts and updated ratings of the impacts presented by BioInsight (2016). Impacts were rated for both 'Without Mitigation' and 'With Mitigation' scenarios and in specific relation to the revised 46 turbine layout, after examining this layout against the exclusion zones and sensitivities defined by BioInsight (2016) (Figure 1). Updated and more detailed mitigation as well as additional mitigation recommendations based upon the findings of this updated assessment are given in Section 5 below.

Table 2 provides a summary of the bird impacts as rated by BioInsight (2016) for the originally assessed layout and project description (i.e. the 68 turbine layout). Arcus determined whether the significance of each impact would change, and this is shown in the last column in Table 2 below. This determination of a change in significance was made by considering all applicable information which included: i) a literature review; ii) review of applicable documents; iii) the latest available information on WEF impacts on birds in South Africa; iv) the specialists experience of monitoring at various operational WEFs and V) the proposed changes to the Gunstfontein WEF layout and turbine specifications.

Furthermore, two additional potential impacts during operations have been identified and included in table 2, i.e. fatalities due to collisions with over-head power lines and fatalities due to electrocution. The significance of these two impacts are rated in the impact tables below.

Table 2: Summary of the Avifauna Impact Assessment from BioInsight (2016)

Phase	Impact	Significance Without-Mitigation	Significance With-Mitigation	Significance[4] will change (Y/N)
Construction	Destruction of natural vegetation / habitat alteration.	Medium (32)	Low (12)	N
	Disturbance and/or displacement effects due to construction works, noise, human presence and machinery movements.	Low (18)	Low (6)	N
Operation	Fatalities due to collision with operating wind turbines.	Medium (60)	Low (30)	Y
	Collision with powerlines*	Not rated	Not rated	Y
	Electrocutionᶲ	Not rated	Not rated	Y
	Disturbance and/or displacement effects due to human presence during maintenance activities.	Low (30)	Low (16)	N
N/A	Cumulative Impacts on Birds	Medium (60)	Low (30)	Y

**These impacts were not identified and rated by BioInsight (2016), with no clear explanation given.*

It was determined that the significance of the impacts of habitat alteration/destruction and disturbance and/or displacement (during both construction and operation) would not change. The impact ratings of fatalities due to collision with turbines and cumulative impacts have changed, and therefore updated impact rating tables for these impacts are provided below. A more detailed description follows of the new impacts identified, and those that have changed ratings.

4.1 Wind Turbine Collisions

For the following reasons it was found that there is a change in the significance rating of the potential impact of wind turbine collisions from Medium to High without mitigation, and from low to medium with mitigation:

- The potential height of the blade tips has increased substantially from a maximum of 190 m to a maximum of 240 m. This introduces additional uncertainty into the updated assessment as BioInsight (2016) based their assessment of the flight height 'within rotor height' on a smaller turbine. Therefore, various flights of key species, previously considered to be 'above rotor height' and therefore not at risk, may now fall within the risk area.
- The proposed amendments result in an increased RSA from that which was assessed by BioInsight, and an even larger increase from that which was approved.
- The monitoring data is over four years old, which introduces a level of uncertainty regarding the status quo of avifauna on the site.
- In 2016 limited information regarding actual impacts, particularly on eagles (e.g. Martial Eagle, Verreaux's Eagle and Booted Eagle), was available for consideration by BioInsight (2016). We now have had a number of mortalities caused by wind farms (and there on-site associated infrastructure) of these species and other priority species in South Africa (Ralston-Paton *et al.* 2017; Pers. Com BARESG; Pers. Obs.), This includes at least 12 Verreaux's Eagle mortalities (that have been confirmed) to date (Pers. Com BLSA), of which half have been caused by electrocutions.

[4] Refers to the actual numerical significance score, and not necessarily the significance category of Low/Medium/High

- BioInsight (2016) placed a protective 2 km No-go buffer around a Verreaux's Eagle nest site. More recent research has led to BLSA recommending a no-go buffer of 3 km in their Verreaux's Eagle guidelines[5].
- It was noted that in their text on page 73 when discussing direct fatality due to collision, BioInsight (2016) stated that "*The impact caused by wind turbine operation is considered to be of high significance although with the appropriate mitigation it can be reduced to medium significance impact*", which differs from their assessment of medium without mitigation and low with mitigation, given in the impact table (Table 11, page 76). We are in agreement with the text assessment as per the content included on page 73 of the 2016 BioInsight report.
- The 'with mitigation' score of 30 obtained by BioInsight was categorised as low. According to Savannah's assessment criteria (Appendix I), this should have been designated as medium.

The above considerations are somewhat counteracted by the lower number of turbine positions (46) that are now assessed, compared with the 68 assessed by BioInsight, however, in our opinion the updated impact assessment still results in an impact of medium significance with the implementation of mitigation.

It was found that the new layout predominantly adheres to the no-go areas given by BioInsight (2016). Therefore, this 'embedded design mitigation' was already considered in the 'Without Mitigation' rating. However, Figure 1 shows that one turbine (Gf48) is situated within a no-go area, while 24 turbines (Gf04, Gf09-Gf13, Gf15, Gf16, Gf19-Gf28, Gf31, Gf33, Gf36, Gf37, Gf40 and Gf46) are situated on the boundary of the no-go area. Turbine Gf48 must be removed from the no-go area, while all turbines must be situated at least 70 m back from the no-go boundary (and preferably 90 m back) in order to reduce the length of blade extending into the airspace above the no-go area. A 3 km No-go buffer should be placed around the Verreaux's Eagle nest site (NEGN03 in Appendix V of BioInsight, 2016) (Figure 1). All turbines should be located at least 70 m beyond the boundary of this buffer and turbines Gf26, Gf27, Gf31 and Gf40 must be relocated at least 70 m outside of the buffer area. Regarding the recommendation of a set-back of at least 70m from a no-go boundary, it must be noted that this is based on a worst case scenario of a rotor diameter of 180 m. Should a smaller rotor diameter be used, the turbines can be shifted close to the no-go boundary, so that no more than 20m of any blade extends into the sir space above a no-go area. The 'with mitigation assessment' assumes that these recommendations are implemented and the layout adjusted accordingly.

Table 3: Updated Impact Table for Wind Turbine Collisions

Nature: Fatalities due to collision with operating wind turbines				
	Authorised		**Proposed Amendment**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	2	1	3	2
Duration	5	5	5	5
Magnitude	8	4	8	6
Probability	4	3	5	3
Significance	**60 (Medium)**	**30 (Low[6])**	**80 (High)**	**39 (Medium)**
Status (positive or negative)	Negative	Negative	Negative	Negative
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceable loss of resources?	Possible	Possible	Possible	Possible

[5] BLSA, 2017. Verreaux's Eagle and Wind Farms. Guidelines for impact assessment, monitoring and mitigation. March 2017. BirdLife South Africa.

[6] Should be medium according to criteria used.

Can impacts be mitigated?	Yes	-	Yes	-

Mitigation:

- No turbines may be located within the no-go areas, including the 3 km Verreaux's Eagle nest buffer (Figure 1).
- All turbines must be situated at least 70 m back from the no-go boundary (and preferably 90 m back). This is based on the assumption that a turbine with the maximum specifications is installed. Should a smaller turbine be utilised, the setback distance to the no-go areas may be reduced slightly, which must be confirmed by the specialist during the pre-construction walkthrough and micro-siting process.
- Develop and implement a carcass search programme for birds as a minimum during the first two years of operation followed by year 5, 10, 15, 20 and 25, in line with or exceeding the applicable South African monitoring guidelines of the time.
- Develop and implement a 24 month post-construction bird activity monitoring program that mirrors the pre-construction monitoring surveys and is in line with (or exceeds) the applicable South African post-construction monitoring guidelines. This program must include thorough and on-going nest searches and nest monitoring.
- Conduct frequent and regular review of operation phase monitoring data (activity and carcass searching) and results by an avifaunal specialist. This review should also establish the requirement for continued monitoring studies (activity and carcass searching) throughout the operation and decommissioning phases of the development.
- If unacceptable impacts are observed (in the opinion of the bird specialist after consultation with BLSA, relevant stakeholders and an independent review), the specialist should conduct a literature review specific to the impact (e.g. collision and/or electrocution) and provide updated and relevant mitigation options to be implemented. Mitigations that may need to be implemented (and should be considered in the project's financial planning) include:
  - Onsite and off-site habitat management. A habitat management plan which aims to prevent an influx/increase in preferred prey items in the turbine area due to the construction and operation activities, while improving raptor habitat and promoting prey availability away from the site.
  - Using deterrent devices (e.g. visual and noise deterrents), deterrent and/or shutdown systems e.g. Automatic bird detectors (e.g. automated camera based monitoring systems – McClure *et al.* 2018) if commercially available; or Radar Assisted Shutdown on Demand (RASOD) to reduce collision risk.
  - Painting a turbine to make it more visible (subject to the requisite approvals being obtained from the applicable authorities e.g. CAA and DEA). Some success has been observed in reducing raptor mortalities in Norway using this method (Stokke *et al.* 2017).
  - Identify options to modify turbine operation (e.g. temporary curtailment or shut-down on demand) to reduce collision risk if absolutely necessary and if other methods have not had the desired results.

4.2 Over-head Power Line Collisions

While the impact assessment (section 4) in BioInsight (2016) has a heading "*Direct fatality due to collision mortality with wind turbines and power lines*" there is no impact rating/table for power line collisions.

Collisions with power lines are a well-documented threat to birds in southern Africa (van Rooyen 2004), and smaller Medium Voltage (MV) lines pose a higher threat of electrocution (if not mitigated) but can still be responsible for collisions. Collisions with overhead power lines occur when a flying bird does not see the cables, or is unable to take effective evasive action, and is killed by the impact or impact with the ground. Especially heavy-bodied birds such as bustards, cranes and waterbirds, with limited manoeuvrability are susceptible to this impact (van Rooyen 2004). Many of the collision sensitive species are also considered threatened in southern Africa (Taylor *et al.* 2015), and on the Gunstfontein site may include Greater Flamingo, Ludwig's Bustard, Black Stork, Karoo Korhaan and Southern Black Korhaan. Martial Eagle, Black Harrier and Verreaux's Eagle may also be prone to power line collisions. Ludwig's Bustard is probably of most concern, as it may be seasonally relatively abundant on the site and is known to be highly susceptible to power-line collision (Shaw

2013; Shaw *et al*. 2017), although mitigation has proven successful in some instances in the Northern Cape (pers. Com EWT)

It is noted that BioInsight (2016) did recommend that "*All power lines linking wind turbines to each other and to the internal substation should be buried. In cases where this is not feasible, lines must be fitted with bird flight diverters and bird flappers, especially visible during the night time*."

The proposed amendment and updated layout includes overhead MV power lines totalling approximately 9 km, which is similar to that of the previously assessed layout.

Table 4: Impact Table for Power Line Collisions

Nature: Fatalities due to collision with internal medium voltage overhead power lines linking wind turbines and the internal substation.				
	Authorised		**Proposed Amendment**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	NOT RATED		2	1
Duration			5	5
Magnitude			6	4
Probability			4	2
Significance			**52 (Medium)**	**20 (Low)**
Status (positive or negative)			Negative	Negative
Reversibility			Irreversible	Irreversible
Irreplaceable loss of resources?			Possible	Unlikely
Can impacts be mitigated?			Yes	-

Mitigation:

- Place power lines underground where possible, unless it is practically impossible to do so due to ecological, geological or topographical considerations, and confirmed by appropriate independent specialists.
- Place any new overhead power lines adjacent to existing power line or linear infrastructure (e.g. roads and fence lines) where possible;
- Any new overhead lines must avoid avifaunal no-go areas. Where this is practically impossible or ecologically undesirable, the valid reasons thereof must be discussed with the specialist, and the specialist must approve the section of line within any no-go area.
- Attach appropriate (i.e. as advised by an avifaunal specialist) marking devices (BFDs), which may include the need for nocturnal LED marking devices, on all spans of any new overhead power lines to increase visibility.
- Develop and implement a carcass search programme for birds during the first two years of operation, in line with or exceeding the applicable monitoring guidelines. This program must include monitoring of overhead power lines.

4.3 Electrocution

The potential impact of electrocution of birds resulting in mortality was not rated by BioInsight (2016).

Electrocution of birds from electrical infrastructure including overhead lines and substation components is an important and well documented cause of bird mortality, especially for raptors and storks (APLIC 1994; van Rooyen and Ledger 1999). Electrocution may also occur within newly constructed substations. Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). Electrocutions are generally more likely for larger species whose wingspan is able to bridge the gap such as eagles or storks. A few large birds (such as Black Stork, African Fish-eagle, Verreaux's Eagle and Martial Eagle), susceptible to electrocution (particularly in the absence of safe and mitigated structures) occur in the area. Electrocution is also possible on electrical infrastructure within the substation particularly for species such as crows and owls.

Table 5: Impact Table for Electrocution

Nature: Fatalities due to electrocution on power lines or within the substation.				
	Authorised		**Proposed Amendment**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	NOT RATED		2	1
Duration			5	5
Magnitude			6	4
Probability			4	1
Significance			**52 (Medium)**	**10 (Low)**
Status (positive or negative)			Negative	Negative
Reversibility			Irreversible	Irreversible
Irreplaceable loss of resources?			Possible	Unlikely
Can impacts be mitigated?			Yes	-
Mitigation: • Construction of electrical infrastructure must consider avifaunal sensitivity zones and avoid areas of higher sensitivities (i.e. no-go areas) where possible. • Place power lines underground where possible, unless it is practically impossible to do so due to ecological, geological or topographical considerations and confirmed by appropriate independent specialists. • Any new overhead power lines must be of a design that minimises electrocution risk by using adequately insulated 'bird friendly' structures, with clearances between live components of 1.8 m or greater and which provides a safe bird perch. A replica or 'mock up' of the exact pole structures (including bend point structures), or at least a 3D model simulation that specifically shows how the jumpers will be placed and insulated, must be examined and approved by the bird specialist in consultation with EWT.				

4.4 Cumulative Impacts

The mountainous areas south of Sutherland including around the Roggeveld and Komsberg Mountains, have attracted much focus from wind energy developers, and fall within a Renewable Energy Development Zone (REDZ). It is not surprising therefore that a number of wind energy applications (approximately 17) have been made within 50 km of the Gunstfontein WEF, in various stages of application or development.

Included in these are three projects that already have preferred bidder status in the Department of Energy's Renewable Energy Independent Power Producers Procurement Programme (REIPPPP), and are due for imminent construction, namely Roggeveld Wind Farm (140 MW), Soetwater Wind Farm (140 MW) and Karusa Wind Farm (140 MW). These projects are situated south of Gunstfontein at distances of approximately 30 km, 10 km and 20 km respectively.

BioInsight (2016) considered 10 developments in their cumulative assessment, including the Roggeveld, Soetwater and Karusa Wind Farms. It is noted that they rated the significance of cumulative impacts as Medium (60) without mitigation and Low (30) with mitigation. These are the same scores and ratings given to collisions with wind turbines for the Gunstfontein WEF alone, and a higher cumulative rating would be expected.

Furthermore there are now more applications, and there is now evidence of Verreaux's Eagle being susceptible to turbine and/or overhead power line impacts in South Africa from several WEFs. The updated significance of the cumulative impacts is rated high without mitigation and medium with mitigation. It must be noted that the with mitigation score of

56, is near to the threshold for a high significance (>60), and is therefore better described as being Medium-High.

Table 6: Updated Impact Assessment Table for Cumulative Impacts

Nature: Ratings for all impacts (i.e. turbine collisions, habitat destruction, disturbance and displacement, electrocution, collisions with power lines etc.)				
	Authorised		**Proposed Amendment**	
	Without Mitigation	**With Mitigation**	**Without Mitigation**	**With Mitigation**
Extent	2	1	4	3
Duration	5	5	5	5
Magnitude	8	4	9	6
Probability	4	3	5	4
Significance	**60 (Medium)**	**30 (Low[7])**	**90 (High)**	**56 (Medium)**
Status	Negative	Negative	Negative	Negative
Reversibility	Irreversible	Irreversible	Irreversible	Irreversible
Irreplaceable loss of resources?	Possible	Possible	Possible	Possible
Can impacts be mitigated?	Yes	-	Yes	-

Mitigation:

- All site specific recommendations and mitigations given for each impact, for all components of each project must be adhered to.
- Wherever possible, the project proponent should utilise the minimum number of turbines to meet the required MW output.
- While site specific mitigations can be given for the Gunstfontein WEF (as detailed in this report), it is difficult in the context of this report for the specialist to provide mitigations for the other projects considered for cumulative assessment. It is unlikely that the project proponent would have the authority to implement recommendations on land portions beyond those effected by the Gunstfontein project.
- Nonetheless, the specialists should still provide recommendations for the broader area, in the interest of ultimately reducing negative impacts. Therefore, it is recommended that the DEA follows up and ensures that all projects built in the region strictly adhere to all specialist recommendations, and that all final layouts are in line with the project's specific bird specialist's recommendations.
- Operational monitoring data (including that from the recommended operational programme for the Gunstfontein WEF) should be made available to appropriate agencies such as Bird Life SA and the Endangered Wildlife Trust, as well as avifaunal specialists through the BARESG, to promote more accurate and detailed cumulative assessments in the future.

Our confidence in the cumulative assessment above is medium to low. A detailed (and highly confident) significance rating of cumulative impacts would depend largely on knowledge unavailable at the time of writing such as:

- The final turbine layouts of all facilities;
- If turbine placement was informed by adequate pre-construction monitoring and nest surveys (in line with applicable guidelines) on these facilities, and to what extent these layouts were in line with specialist recommendations;
- The density of the key species (e.g. Verreaux's Eagle, Martial Eagle, Ludwig's Bustard, Black Stork) populations on the facilities (i.e. the regional population of these species), and their behaviour on the different sites.
- The species richness, abundance and behaviour of the avifaunal community within and around the various WEFs;
- Whether or not mitigation measures were recommended and implemented and are successful; and

[7] Should be medium according to criteria used.

- The number of facilities that will actually be constructed and the resultant mortality of birds at wind farms in the Sutherland area.

Conducting such a detailed cumulative impact assessment of all of these facilities together on a regional scale is beyond the scope of this specialist study and would need the input of all proponents and specialists working on the above mentioned projects. Such an assessment is best undertaken and commissioned by an appropriate regional or national agency/agencies in the context of strategic planning. In the scope of this study it is therefore difficult to say with medium-high or high confidence at this stage what the cumulative impact of all the proposed developments will be on birds. The extent of actual impacts on the region's avifauna will only become known once a few wind farms are developed in the Sutherland region and operational data becomes available, and regional population viability analysis have been conducted for key species. It must be noted that many of the developments considered may never be constructed. If all proposed projects that *are* built implement appropriate mitigation measures and adaptive management of impacts as well as post-construction monitoring programmes (in line with applicable guidelines) and share the information gained from these, then the overall significance of cumulative impacts may be reduced.

5 ADDITIONAL MITIGATION MEASURES

All mitigations given in tables 3- 5 above must be implemented by the developer, as well as those listed below. While Arcus was in general agreement with the mitigations provided by BioInsight (2016), some did not provide sufficient detail. Here follows relevant BioInsight (2016) mitigations, additional measures recommended as well as updated more relevant mitigations:

- High traffic areas and buildings such as offices, batching plants, storage areas etc. should where possible be situated in areas that are already disturbed and existing roads and farm tracks should be used where possible.
- The minimum footprint areas of infrastructure should be used wherever possible, including road widths and lengths.
- Environmental Control Officer (ECO) to oversee activities and ensure that the site specific environmental management plan (EMP) is implemented and enforced.
- Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final road and power line routes as well as the final turbine positions, to identify any nests/breeding activity of sensitive species, as well as any additional sensitive habitats within which construction activities may need to be excluded.
- Should priority species nests be located, a protective buffer may be applied, within which construction activities may need to be restricted during the breeding season for that species.
- Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a specialist and included within the EMP.
- The construction Phase ECO, and the on-site Environmental Manager (or Environmental Site Officer as the case may be) should have sufficient experience and knowledge of local avifauna to identify red data and priority bird species, as well as their nests. The ECO and Environmental Manager must then, during audits/site visits, make a concerted effort to look out for such breeding activities of red data species, and such efforts may include the training of construction staff (e.g. in Toolbox talks) to identify red data species, followed by regular questioning of staff as to the regular whereabouts on site of these species. If any nests or breeding locations for these species are located, the avifaunal specialist is to be contacted for further instruction.

- Construction and operation phase bird monitoring, in line with applicable guidelines, must be implemented and must include monitoring of all raptor nest sites for breeding success.
- Lighting on turbines to be of an intermittent and coloured nature rather than constant white light to reduce the possible impact on the movement patterns of nocturnal migratory species.
- As the pre-construction monitoring was completed in November 2014, the data set is now over four years old. The current best practise guidelines (Jenkins et al. 2015) indicate that additional monitoring may be advisable if there is a significant gap between the original assessment and the commencement of construction, to assess whether there have been any changes in species abundance, movements and/or habitat use in the interim. Furthermore, the Birdlife South Africa (BLSA) Verreaux's Eagle guidelines ('VE guidelines') are now applicable to this site. The main implications of this are that they recommend that VPs be monitored for 18 hours per season (i.e. 72 hours per year) and that a second year of monitoring is recommended should the site pose a significant risk to Verreaux's Eagle and should turbines be proposed in potentially sensitive areas. We therefore recommend that a pre-construction habitat survey and cliff-nest search (during the eagle breeding season) be undertaken to confirm the likelihood that there has been any change in key species abundance, movements and/or habitat use since the original assessment. This fieldwork can be done after the amendment decision, however the results of this fieldwork must inform the final turbine layout. The results of this fieldwork must also inform whether any additional long-term pre-construction monitoring is warranted to update the avifaunal baseline for operational comparison, and must inform the scope and duration of the monitoring (if required). Updated data sets will allow for more meaningful comparison with operational monitoring data, and the additional monitoring (if required) must also be used to advise the final micro-siting of the layout of the WEF where applicable, prior to any construction taking place.

6 CONCLUSION

Two potential impacts not assessed by BioInsight (2016) were identified, i.e. electrocution and collision with internal MV overhead power lines, both of which now have a significance rating of **Low** with mitigation. Following consideration of all new applicable information, including the updated layout (which includes revised turbine positions and an additional access road) and proposed project amendments, the impact of collision with turbines and cumulative impacts were both re-rated as being of **Medium** significance with mitigation.

Cumulative impacts remain a concern for the broader Sutherland area, with 17 proposed WEF projects in the region. If a number of these projects are built, it is likely that the cumulative impact of turbine collision will be medium to high, particularly on red data eagle species such as Verreaux's Eagle and Martial Eagle, and possibly also on Ludwig's Bustard. However, the extent of actual cumulative impacts on the region's avifauna will only become known once a few wind farms are developed in the Sutherland area and operational data becomes available, and regional population viability analysis have been conducted for key species.

All mitigation measures must be incorporated into the updated EMPr and implemented. This includes a thorough operation phase bird monitoring programme (in line with the guidelines applicable at the start of the operation phase) that must be implemented, and should start no later than the commercial operation date of the facility. This programme should feed back into an adaptive management strategy, which could include the need to shut down or curtail certain turbines should unacceptably high impacts be found.

It is the opinion of the specialist that the above amendments can only be authorised, subject to implementation of all mitigation measures and recommendations of this report, and the specialist viewing and approving a new amended overhead power line and turbine layout that takes into account our recommendations.

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APPENDIX I: IMPACT ASSESSMENT METHODOLOGY AND CRITERIA

The specialist report must include details which address the following:

- An assessment of all impacts related to the proposed change;
- Advantages and disadvantages associated with the proposed change;
- Measures to ensure avoidance, management and mitigation of impacts associated with such proposed change.

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.

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) <u>when additional impact are identified</u>:

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).

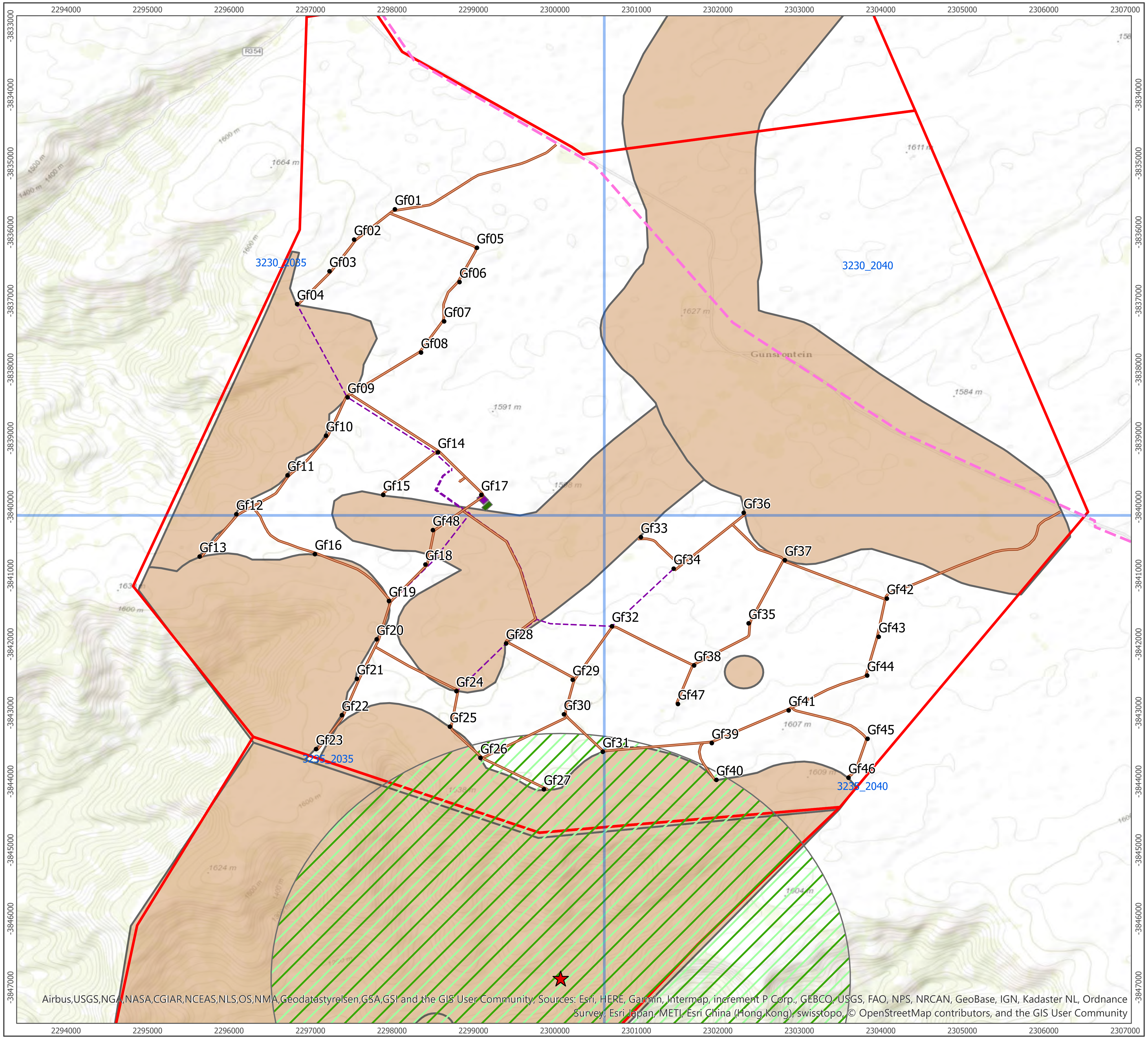
Example of Impact table summarising the significance of impacts (with and without mitigation) when the impact has increased or decreased:

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)
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:				

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

"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).

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



C:\Users\Jonathan Aronson\Documents\ArcGIS\Projects\Geoprocessing\Geoprocessing.aprx\2319-REP-003 Bird Sensitivity Map

ARCUS

- Site Boundary
- Proposed Turbine Layout
- Verreaux's Eagle nest
- MV Overhead
- Roads (New)
- Existing Transmission Line
- O&M Building and Laydown Area
- Substation
- Verreaux's Eagle 3 km Nest Buffer
- SABAAP2 Pentad
- Avifaunal No-Go Areas (BioInsight, 2016)

1:45 000 Scale @ A3

0 1 2 km

NORTH

Produced By: JA	Ref: 2319-REP-003
Checked By: MB	Date: 07/Mar/2019

Bird Sensitivity Map
Figure 1

Guntsfontein Wind Energy Facility
Updated Bird
Impact Assessment