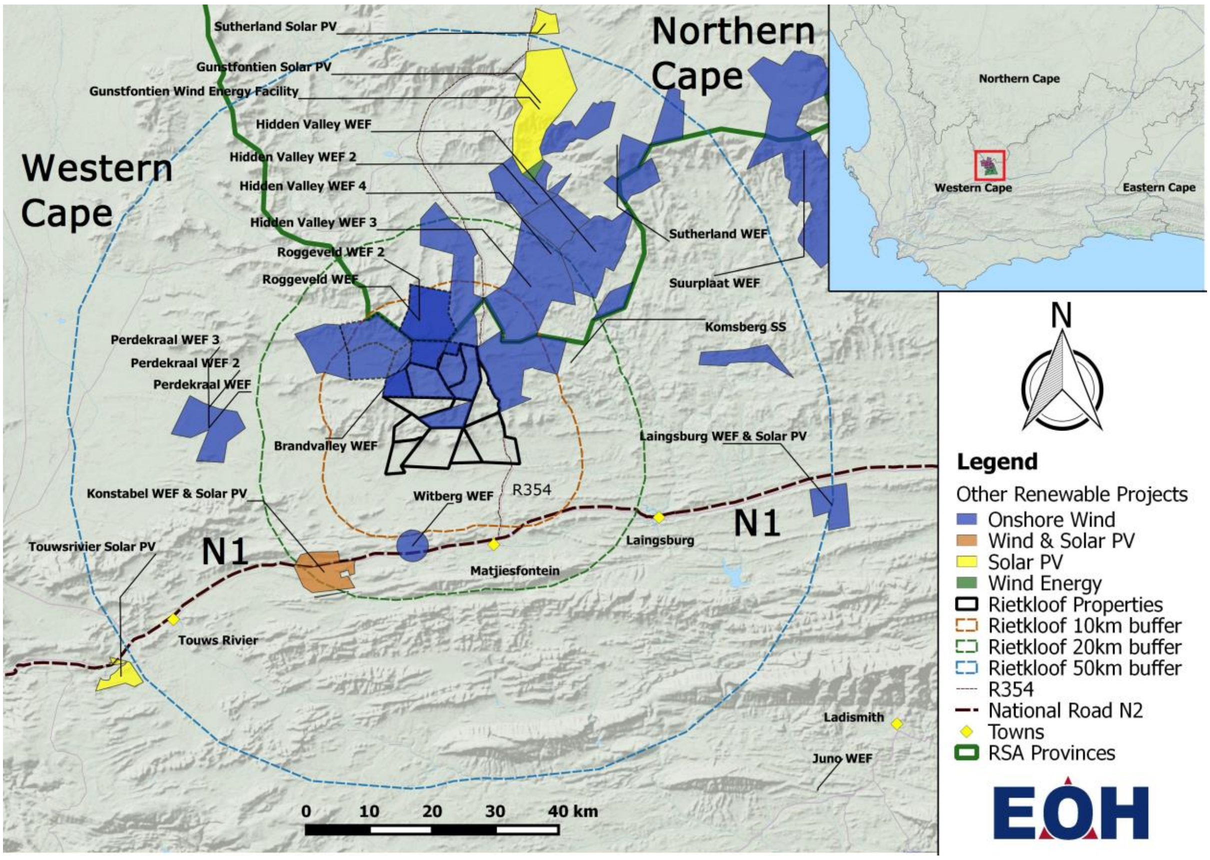
CUMULATIVE IMPACTS

Appraisal of the likely cumulative impacts of regional wind and solar projects

A number of wind (>15) and solar (5) power projects have been authorised or proposed for the area within a radius of 40 km from the proposed development which is the focal subject of this report (see figure below). This area is for convenience hereafter referred to as "the region". This conglomeration of wind development proposals is a result of the known high and persistent winds in the region and has resulted in the government designating the region as the Komsberg REDZ (Renewable Energy Development Zone). The development of so many (and more may still be proposed) developments raises the issue of cumulative impacts on the regional avifauna.



Regional ecology

The region as defined is not a natural unit. As a result of significant differences in geology and rainfall there are two sub-regions with substantially different ecology. Approximately 90% of the region, including the great majority of wind and solar projects, is underlain by rocks of the karoo supergroup, is drier, and is dominated by karoo scrub vegetation. The other 10% of the region is underlain by older rocks of the Cape supergroup, receives higher and less seasonal rainfall, and supports fynbos vegetation. These two areas are hereafter referred to as the karoo and fynbos sub-regions.

As this region is not aa natural ecological unit the populations of birds are not discrete but are part of population units that encompass far wider areas beyond the region. The populations within the region are thus small sub-sets of the wider population units. The regional population subsets are not of critical importance to any of the species' wider populations.

Cumulative impacts

The fundamental question addressed is: "***What will be the likely cumulative effect of these wind and solar projects, if developed, on birdlife in the region over the next 20 years***" - the assumed minimal operational life-span of the projects.

Here, based on extensive knowledge of the area, I assess the likely cumulative impacts of the proposed developments on the avifauna based on: brief reviews of the avifaunal ecology in terms of different groups of birds; particular bird requirements; and the impacts identified in my own, and other, specialist reports.

Knowledge of the region

I have conducted bird observations over extended periods for six proposed windfarms in this region – Roggeveld, Karreebosch, Brandvalley, and Rietkloof (for each of which I have written bird specialist reports based on four seasons of observations in which I was continually in the field with my team of monitors) and Hidden Valley 1 and 2 (for which I was a bird monitor). I have also had the opportunity to read the avifaunal appraisals for an additional four of the proposed regional wind developments. I have not had access to any of the avifauna reports for solar developments in this region. However, I have worked on avifaunal appraisals for eight solar projects outside the region, as well as one near Touws Rivier just inside the region, and so am fully aware of the impacts solar developments can have on birds.

My local experience, across a five-year period, has encompassed years which were both wetter and drier than average, as well as average, conditions. This enables me to appraise the region in terms of those near extreme climatic conditions which emphasize the impacts that proposed developments may have on the regional avifauna.

I have not conducted field work in the fynbos sub-region and this assessment of cumulative impacts relates primarily to the karoo sub-region where most of the wind and solar projects will be located.

Broad avian ecology

The karoo sub-region is dominated by karoo scrub vegetation which covers more than 90% of the ground. Dry conditions predominate and constrain resources for plants and animals.

Sub-regional ecology is dominated by rainfall. This sub-region lies on the border between the eastern edge of the winter rainfall zone of southern Africa and the western edge of the summer rainfall zone. Hence the region experiences weak, though more general, winter rains from the passage of cold fronts and inter-annually more variable and patchy summer rains that mainly result from thunderstorms. The result is that the region is semi-arid with extended periods of hot dry and wind desiccated conditions. The dominant vegetation is variably sparse woody scrub with, after rain, some seed-producing plants on open ground between the shrubs. The region is a sub-area of the far larger karoo biome which covers very extensive areas of the Northern and Western Cape provinces.

In the fynbos sub-region rainfall is more persistent winter rainfall as well as some summer rainfall. Further, as a result of more reliable rain the fynbos sub-region supports a greater density of small animals, including hyrax, than the karoo sub-region. As a result of the different geology, the fynbos sub-region also has a greater exposure of cliffs. As a consequence of the higher prey base and the greater availability of cliff ledges for breeding, this sub-region has a higher breeding population of birds of prey.

Because it is more influenced by cold fronts passing along the south coast, the fynbos sub-region is often covered in low cloud at times when most of the karoo sub-region is cloud-free. This situation may cause short-term changes in the distribution of those birds of prey or scavengers, which rely on scanning prey whilst in high flights. Low cloud will reduce the ability of such birds to forage in the fynbos sub-region. The recorded increase in occurrence of at least Verreaux's Eagles in the cloud-free southern karoo sub-region on days when the Witteberg Mountains of the fynbos sub-region are cloud-topped suggests that at least some individuals from the fynbos sub-region make temporary movements into the karoo sub-region. A reverse situation may apply when the karoo-sub-region experiences prolonged drought with accompanying heat. Few eagle sightings are made in the southern Karoo sub-region in such conditions and it is plausible that non-breeding Verreaux's Eagles from at least the southern karoo sub-region may then move 20 km south to forage in the fynbos sub-region where drought is less intense and the prey base larger. Such reciprocal movements if, as seems likely, they occur have important implications for the cumulative impacts of regional wind energy developments.

Impacts

There are six basic types of impacts on regional birds that can result from the proposed wind and solar energy developments. These are:

1) Electrocution
2) Habitat destruction
3) Disturbance to, and disruption, of bird breeding
4) Collisions with solar panels
5) Collisions with turbine infrastructure
6) Collisions with powerlines

Different broad groupings of birds are varyingly affected by these impacts.

Bird groups and special habitats

There are three groups of birds of particular conservation concern, and or impact risk, in this region. These are:

- Large terrestrial foragers – mainly bustards but also francolins and sandgrouse
- Birds of prey – eagles, buzzards, harriers, falcons etc and owls
- Waterbirds – waterfowl (ducks, grebes and gallinules), waders (herons, egrets and ibises) and shorebirds (plovers, lapwings and sandpipers)

Other birds in the region – mainly passerines – are of lesser conservation concern since they have extensive distribution across karoo or fynbos areas outside the region of concern.

There are three habitats in the region that are of particular importance for birds. All three are of limited occurrence in the region. These are:

- Riparian bushes
- Waterbodies – predominantly dams
- Topographic features – cliffs and rocky outcrops

Together these three habitats form >2% of the regional area. Croplands and farmsteads occupy <5% of the area. The rest, ca. 93%, of the region is covered by native, karoo or fynbos, low scrub vegetation.

The EIA reports for the region show that, whenever feasible, solar and wind developments plans will avoid the three key avian habitats. Consequently, the cumulative impact on these three habitats is to be considered minimal.

Consideration of the impacts

Electrocution: Electrocution affects only those birds – mainly raptors - which readily perch on the pylons of transmission lines. Means to minimize bird risk of electrocution are well known, and largely followed by Eskom and other powerline constructors. In addition, the number of birds at risk in this overall region is very small – probably fewer than 50 individuals from all species in any one year.

Only one red listed species is potentially at risk – the Martial Eagle. These eagles preferentially breed in trees. These have to be able to support the substantial nest; keep the nest well out of reach of four-legged predators; and of a height that provides good all-round vision. Martial Eagles have only been able to colonize this region through use of existing transmission pylons. That they do so confirms that the electrocution risk to this, and other, species must be extremely low.

Habitat destruction: The areas of habitat destruction differ greatly between solar and wind energy facilities.

Solar farms have intense, but area concentrated, habitat destruction. Wind facilities have widespread habitat destruction but for scattered and far smaller areas – sub-stations, construction camps, access roads, the bases of transmission pylons, and wind turbines with their associated crane pads etc.

The area of habitat destruction from the assorted projects – both solar and wind – across the region in which the powerline –is located is difficult to accurately assess because of the currently unknown extent of particularly wind farm developments (size of substations, number of new roads required etc). The total area of habitat destruction is likely to be less than 2% of the region. This is considerably less than the destruction that has occurred earlier with clearance for agriculture, roads and more recently the establishment of two major Eskom transmission lines with their associated tracks and substation.

Previous habitat destruction through clearance for agriculture has increased avian biodiversity in the region through provision of new foraging habitats and provision of water access. Neither solar nor wind facility habitat destruction will be positive for birds.

The main impact of habitat destruction for solar and wind facilities is total displacement of small birds – larger bird species require greater areas in which to live and, as known from experience elsewhere, are often able to cope with scattered and small patches of habitat destruction as will result from the solar and wind projects proposed for this region.

None of the species of small birds that regularly occur in this region, and that will be negatively impacted by habitat destruction, are of particular regional conservation concern (including national endemic and near-endemic species) as all occur widely, and in substantial numbers, across either the karoo or fynbos biomes.

Provided habitat destruction is kept removed from priority bird habitats, as is recommended in the EIA reports, the cumulative habitat destruction cannot, from an avifaunal perspective, be considered other than a minor impact of low significance.

Ideally, clearing of habitat should not be allowed during the breeding season which for the majority of passerines in this region is September-October (after the winter rainy season and as temperatures rise in spring). This should especially apply in valley bottom areas where a higher diversity, and number, of birds are likely to be affected than on slopes and particularly hill- or ridge-tops.

Displacement: Infrastructure constructions can lead to some species of birds (usually those that are larger-bodied, and so often more shy of humans and their structures) avoiding an area around the infrastructure. On a global scale such displacement has been difficult to assess, largely because earlier developments have often already displaced species sensitive to novel structures. Also partially because studies of avoidance displacement have not extended over sufficiently long periods to assess whether, with time, initially sensitive species become adjusted to structures (as has happened with many species in urban environments e.g. Hadeda Ibises and Black Sparrowhawks in urban Cape Town).

Available information is inadequate to evaluate this impact. It is here considered to be low in view of the existing extensive areas of similar habitat outside the region.

Collisions

Natural collision risk for birds in the open, effectively tree-less, karoo and fynbos biomes is negligible. There are three types of collision risk that potentially impact birds as a result of wind or solar energy developments. These will be novel risks for bird species used to the open, naturally obstruction-free karoo or fynbos areas.

Structures associated with solar and wind developments pose three types of novel collision risk for regional birds. These structures are:

- Arrays of solar panels
- Wind turbines
- Powerlines

Solar panel collision risk:

Experience in California has shown that a variety of bird species may collide with the photovoltaic panels of solar arrays. Some collide when, after foraging on the ground under the panels, they are scared into quickly taking flight. However, waterfowl are seemingly the bird group at greatest risk of collision with solar panels. Waterfowl (grebes, ducks, and gallinules) make night reconnaissance flights to assess the availability of waterbodies within a considerable range of their currently used waterbody. They make reconnaissance flights so that they are aware of alternative waterbodies if their current waterbody dries down, is subject to diminishing food resources, or there is excessive local disturbance. They perform these flights at night for two reasons. Largely because reflection of moon or star light from water surfaces can reveal waterbodies at a considerable distance, and secondarily because there is little risk of attack by any avian predators. Unfortunately, moon or starlight reflected off PV panels can give the impression that there is a waterbody and the waterfowl may fly down and collide with the panels. Since waterfowl often fly in groups the risk of collision is increased. Collision may not kill birds outright but either injure or stun them. Waterbirds have difficult in taking off from land surfaces, especially where there are obstructions. Predators apparently soon become aware that solar facilities provide a resource of stunned, injured, or unable to escape prey.

It is difficult to guestimate the degree of risk to birds in the karoo sub-region (where the larger solar developments will occur) posed by collision with solar panels. Based on counts of waterfowl at regional dams the number of birds at risk might seem small. However, there are known movements of waterfowl between external summer rainfall area breeding localities and reciprocal winter rainfall area non-breeding refuges. When these birds traverse the karoo sub-region, where waterbodies are few, they might be attracted by reflection off solar panels. Thus, the overall numbers of waterfowl potentially at risk may be considerably greater than indicated by local counts. It is likely that the larger the solar array the greater the risk that birds misinterpret this as a waterbody. The risk of bird mortality as a result of collision with solar panels is unlikely to be high but, over the indicted 20-year operational lifespan of a solar array, could result in the death of an appreciable number of waterfowl, as well as other birds. This risk is here considered unlikely to be high but the precautionary principle should apply and this risk must be considered moderate.

The only feasible mitigation would seem to be to angle panels at night so that there is minimal reflection of moon or star light. If feasible this mitigation should be built into the EIA appraisals for the regional solar developments.

Turbine risk

In this region turbines will in most, if not all, cases be located on the top of hills or ridges in order to maximize wind power generation. Over prolonged periods of time these hilltops have been subject to locally higher precipitation which, coupled with gravity movement over adjoining slopes, has led to sediments being thinned on hilltops and attendant sediment fill in valley bottoms. The result has been increased exposure of bare rock and reduced vegetation cover on hilltops and greater and thicker vegetation cover on the slopes and especially in valleys. Available open water, with associated insects, is rare on the hilltops and most available in valley bottoms. The result is that the number and diversity of birds, and other animals, is considerably less on hilltops where turbines will be located than in valleys. As a consequence, there is less food for birds in the three key bird groups.

Most bird species that occur on regional hill tops and ridges rarely fly at heights that would bring them into risk of collision with turbine blades and, at the low heights at which they often fly, the massive support structures will be readily avoided.

A range of other bird species sometimes cross ridges to get from one valley to another. The frequency with which this occurs is difficult to determine from standard monitoring protocols. Most will usually try to cross at the lowest point along ridges. The risk in this case can be mitigated by not locating turbines within 50 m of the lowest point. This mitigation has been advocated in wind development EIAs that I have written but, if included in other studies, was not detected in those studies available to me.

Several groups of birds that regularly occur along ridges, and that fly at heights that coincide with those of turbine blades, are considered at greater risk of collision with turbine blades. These are: among birds of prey: Verreaux's Eagles, Rock Kestrels, and (seasonally?) some buzzards. Martial Eagles prefer broad valleys and Black Harriers generally forage and fly below turbine blade heights; corvids often fly over ridges but are highly intelligent and so considered at low risk to collision; Aerially foraging swifts and swallows may fly at collision heights but are not known to be of particular collision risk and generally forage off the upper slopes rather than on the ridge summits. The species that may be most at risk of collision mortality is the Namaqua Sandgrouse. During wetter periods small flocks of this species fly, at speed, along ridges. This species is known to collide with powerlines and since it will generally approach turbine blades from the side of the blades may be less able to detect the risk. Again, the risk to this species seems not to have been captured in other reports, possibly because monitoring was conducted in drier periods.

The generally perception in scoping reports is that the species most at risk of turbine collision in this region is the Verreaux's Eagle. This is the only large bird of prey that breeds close to ridge tops. A 1.5 km buffer, in which no turbines are allowed, is used as a mitigation to reduce disturbance at, and potential displacement from, breeding sites. The risk is probably greatest to juvenile eagles in the period after fledging when their flight skills may be less than those of adults and they may be naïve towards risks. Due to the very low prey base, and low availability of suitable breeding sites, the population in the karoo sub-region is very small – (only one active breeding pair in the six regional windfarms with which I am familiar) and almost certainly less than 5 pairs. In contrast 5 pairs are known from the proposed Witteberg wind development in the far smaller fynbos sub-region. Also to be considered are movements within the area by dispersing immature birds, and by adults potentially making short-term foraging movements between cloudy fynbos and cloud-free karoo sub-regions and, during intense drought periods, movements of birds from the resource-poor karoo sub-region to the better resourced fynbos sub-region. These latter movements have not been considered in reports other than mine.

The risk of birds colliding with turbines varies between species or groups of birds and is difficult to mitigate under civil aviation regulations that prevent making blades more conspicuous through differential colouration of blades. Depending upon the species, the risk is considered moderate to low and so must be treated as moderate. The risk of Verreaux's Eagles to turbine collision must be greater in the fynbos than in the karoo sub-region.

Powerline risk:

Powerlines are likely to have the greatest negative impact on birds in the region. This is because they:

- are the most widespread structures that result from the solar and wind developments;
- will often stretch across, rather than along valleys, and so create obstacles across natural long-valley flight paths; and
- the relatively thin wires are less readily visible than the solid pylons and turbines, especially at night;

Mitigation, in the form of day AND night visible bird diverters at 2m intervals, should be required on lines wherever powerlines are located near open waterbodies or cross watercourses.

Cross-valley powerlines should be kept to an absolute minimum since topographical funnelling tends to focus flight paths along valleys.

Powerline pylons, and to a lesser extent wires, provide elevated vantage points for predatory birds. This will result in an un-naturally high rate of predation on smaller birds, and other animals, in the immediate vicinity of the powerlines. This impact

Movements

Most "resident" karoo bird species are nomadic and movements are related to changes in rainfall across a very wide region. In the sub-region that is the focus of this cumulative assessment bird numbers can be likened to a tidal system. Wetter than average conditions represent high tide. The number of birds rises and more birds move up-slope. Drier than average conditions represent low tide when the number of birds falls and birds move down into the valley bottoms. Super-imposed on this are wider nomadic movements of larger birds which move across far larger regions to exploit flushes of food resources. For instance an outbreak of locusts in the region would lead to an influx of bustards and a substantially increased risk of collision mortalities for these red-listed species.

The bird group most at risk during movements is that of waterbirds as these have focused movements between waterbodies which in this region are a limited and scattered resource. Most regional waterbodies lie in valley bottoms. Consequently, waterbird movement is largely funnelled along valleys. The situation is worst for waterfowl. Waterfowl (ducks and grebes and gallinules) mainly move at night and in small flocks. This is the group most likely to experience collision mortality from powerlines that run across their valley flight paths and whose lines are least visible at night. This can be mitigated by a) reducing valley crossing powerlines to a minimum and b) placing day and night bird diverters on those lines that do cross valleys.

Migrants

The largely resource poor karoo attracts few north-south migrants and their movements in and out of the region are across broad fronts i.e. dispersed with little funnelling.

Waterfowl undertake east-west migratory flights potentially across this region as several species breed in summer rainfall areas and move to dry season refuges in the winter rainfall area. As indicated earlier these might be attracted to solar arrays which they mistake for waterbodies.

Nocturnal bird movements

Though no Cape Eagle Owl has been reported during bird monitoring (easily missed as roosting in dark cavities by day and only active and/or calling at night) it is possible that a small population may occur in the region. This would be at potential risk from collision with turbines and valley powerlines.

The greatest nocturnal risk is to waterfowl moving at night between regional waterbodies or migratory waterfowl mistaking solar arrays as waterbodies.

Additional comments

There is a danger that studies conducted in drier than average years will under-state the risks whilst in wetter than average years' risks may be over-indicated relative to the long-term average situation.

Most impacts have low significance. Those impacts of moderate significance can be reduced to a low rating by mitigation.

Long-lived, slow reproducing, species may not be able to sustain additional mortality caused by the cumulative effects over and above the existing or single project situation. The primary risk to such species, effectively in this region the two large eagle species, is increased mortality of naïve juveniles. This can potentially extirpate the local population through lack of recruitment. Alternatively, local recruitment failure will lead to immigration of replacement individuals from adjacent source areas. The result could be this region forming a population sink. However, given the very low numbers supported by the region this is not considered of other than low significance.

Table 1. Developmental impacts on birds- Mitigations- and cumulative significance

IMPACTS	MITIGATIONS/ COMMENTS	CUMULATIVE SIGNIFICANCE
Electrocution	Well established methods	Low if mitigated
Habitat destruction	Avoid key habitats	Low if mitigated
	Avoid breeding season destruction	

	Ample alternatives for most species	
Displacement	Difficult to appreciate	
Collisions: Solar	Change panel angles to minimize reflection at night	Moderate. Low if mitigated
Collisions: Turbines	Avoid ridge low points	Low if mitigated
	1.5 km buffer around active raptor nests	
Collisions: Powerlines	Minimize cross-valley lines	Moderate. Low if mitigated
	Day & night diverters on lines near water	

Table 2 Cumulative effects on differing bird groups

BIRDS AFFECTED	MAIN IMPACTS	SIGNIFICANCE
Bustards & korhaans	Collisions with powerlines	Low – very few individuals at risk
Namaqua Sandgrouse	Collisions with turbines	Moderate Though not a red-listed species
Birds of prey	Collisions with turbines	Low – very few individuals at risk
	Displacement from nest sites	Low after mitigation
	Electrocution	Low after mitigation
Waterfowl	Collision with powerlines	Low after mitigation
	Collision with solar panels	
Other birds	Habitat destruction	Low, ample alternative areas
Migrants		Low – no funnelling of movements
Nocturnal bird movements	Collision with solar panels	Low if mitigated
	Collision with powerlines	
Wet years	Increased diversity & numbers	Risks increase but still low
Drought years	Reduced diversity and numbers	Very low risk
Dispersal of young of larger bodied birds	Naïve strangers	Higher risk but still low, as few individuals
Regional bird populations	Unimportant at national level	Very low significance

CUMULATIVE IMPACTS TABLE

ELECTROCUTION	**Effect**			**Risk or likelihood**	**Overall significance**
	Time scale	Spatial scale	Severity of impact		
Without mitigation	Long-term	Regional	Slight	May occur	Low
With mitigation	Long-term	Regional	Slight	May occur	Low

HABITAT DESTRUCTION	Effect			Risk or likelihood	Overall significance
	Time scale	Spatial scale	Severity of impact		
Without mitigation	Long-term	Regional	Slight	Will occur	Low
With mitigation	Long-term	Regional	Slight	Will occur	Low

DISPLACEMENT	Effect			Risk or likelihood	Overall significance
	Time scale	Spatial scale	Severity of impact		
Without mitigation	Long-term	Local	Slight	May occur	Low
With mitigation	Medium-long term	Local	Slight	May occur	Low

SOLAR ARRAY COLLISION	**Effect**			**Risk or likelihood**	**Overall significance**
	Time scale	Spatial scale	Severity of impact		
Without mitigation	Long-term	Regional	Medium	May occur	Medium
With mitigation	Long-term	Regional	Low	May occur	Low

WIND TURBINE COLLISION	**Effect**			**Risk or likelihood**	**Overall significance**
	Time scale	Spatial scale	Severity of impact		
Without mitigation	Long-term	Regional	Low	May occur	Low
With mitigation	Long-term	Regional	Low	May occur	Low

POWERLINE COLLISION	**Effect**			**Risk or likelihood**	**Overall significance**
	Time scale	Spatial scale	Severity of impact		
Without mitigation	Long-term	Regional	Medium	Will occur	Medium
With mitigation	Long-term	Regional	Low	May occur	Low

CUMULATIVE IMPACTS FOR THE PROPOSED POWER LINE: AVIFAUNAL SPECIALIST

DEA Comment	Action	Yes/No	Proof in Report
Due to the number of similar proposed and existing activities in the area, all the specialist assessments must include a cumulative environmental impact statement. Identified cumulative impacts must be clearly defined, and where possible the size of the identified impact must be indicated, i.e. hectares of cumulatively transformed land. The cumulative impacts significance rating must inform the need and desirability of the proposed development.	Is a cumulative impact statement included in the report?	Yes	addendum
	Are cumulative impacts clearly defined?	Yes	Addendum
	Has the size of the identified cumulative impact been indicated in the report?	Yes	Addendum
	Is there a clear link between the cumulative impacts and the need and desirability statement? If not please provide one.		
Identified cumulative impacts significance rating must be rated with significance rating methodology	Do the cumulative impacts include a significance rating as per the assessment methodology?	Yes	Addendum
The specialists in their studies conducted, must indicate their preferred substation location and preferred power line route.	Have you nominated one substation location above all the other as preferred?	No	In conclusion
	Have you nominated one power line route above all the other as preferred?	No	In conclusion

Dr A. J. Williams

Signature of the specialist:

AFRICAN INSIGHTS

Name of company / specialist:

29 July 2016

Date: