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AVIFAUNAL IMPACT ASSESSMENT

PROPOSED DEVELOPMENT OF THE ESKOM AGULHAS 400/132KV 2X500 MVA TRANSMISSION SUBSTATION AND LOOP-IN LOOP-OUT LINES, SWELLENDAM LOCAL MUNICIPALITY, WESTERN CAPE PROVINCE

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Declaration

I, **Craig Widdows,** declare that -

- I act as the independent specialist in this application;
- I do not have and will not have any vested interest (either business, financial, personal or other) in the undertaking of the proposed activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2014;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Date:

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Executive Summary

Afzelia Environmental Consultants (Pty) Ltd were appointed by Nsovo Environmental Consulting to undertake an avifaunal impact assessment for the proposed construction of the Agulhas 400/132kV 2X500 MVA Transmission Substation and Loop-in Loop-out lines, Swellendam Local Municipality, Western Cape. The study site is located 20km south west of Swellendam.

A total of 216 bird species, five of which are considered "vulnerable" and one is considered "near threatened" (Barnes 2000) are recorded within the 3420 AB quarter degree grid square (South African Bird Atlas Project 2). Avian species likely to be impacted by the proposed substation and loop-in loop-out lines include local populations of endemic passerine species (Agulhas Long-billed Lark), locally resident or transient raptors (Martial Eagle and Black Harrier) and large terrestrial birds (Denham's Bustard, Blue Crane and Secretarybird). During a site visit 71 bird species were recorded within the proposed study area including the Blue Crane (vulnerable), Denham's Bustard (vulnerable), Black Harrier (Endangered) and Karoo Korhaan (Near Threatened). The avian composition was dominated by smaller passerine species including African Stone Chat, Common Waxbill and Cape Sparrows and Southern Red Bishop's.

The impacts associated with the proposed solar development include:

i. Destruction and alteration of avian habitats
ii. Disturbance of birds;
iii. Collision of birds with the solar panels;
iv. Collision and electrocution on associated overhead powerlines;
v. Nesting on the solar infrastructure.
vi.

The construction of the proposed new Eskom Agulhas MVA transmission substation and associated power line at site alternative A is the most favourable site from an avifaunal perspective. This site will pose a limited threat to the birds occurring in the vicinity of the new infrastructure. This is largely due to the extensive impacts already evident at the site (existing 400kV power line, transformed landscape and few suitable avian micro-habitats) coupled with the short length (273m) of the proposed power line. The power line poses a low collision risk and a low electrocution risk. Due to the already transformed nature of the site, displacement of avifaunal communities will be negligible.

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1. INTRODUCTION

1.1 BACKGROUND AND LOCALITY OF THE ASSESSMENT

Afzelia Environmental Consultants **(**Pty) Ltd was appointed by Nsovo Environmental Consulting to undertake an avifaunal impact assessment for the proposed Eskom Agulhas 400/132kv 2x500 MVA Transmission Substation and loop-in loop-out lines.

Eskom Holdings SOC Ltd is proposing the construction of the Agulhas 400/132kV Main Transmission Substation (MTS): the construction footprint of the development will be 600m x 600m. The project will include the construction of a 400kV loop-in loop-out overhead power lines which will feed into the existing 400kV Bacchus-Proteus power line and into the new substation.

The proposed development will form part of the Vryheid Network Strengthening project in order to increase the power output within the area. The establishment of the Agulhas Transmission substation will assist in resolving the transmission capacity constraints at Bacchus substation and will play an important role in addressing the energy transmission problems within the Western Cape Municipality.

The proposed development is located on the Leeuw Rivier 251 Portion 3 and Kluitjeskraal 256 Portions 2, 5 & RE within the Swellendam local municipality, Western Cape Province (**Figure 1**). The site is located approximately 20 km from Swellendam along the N2 and R319. There are seven proposed site alternatives all of which are situated within the quarter-degree square 3420AB (**Figure 2**).

Overhead power line infrastructure is known to negatively impact various avian species through direct mortality of birds and indirectly through the removal of natural habitats. Interactions between birds and substations is predicted to be less significant and is likely to be indirect due to habitat loss and disturbance.

1.2 SCOPE OF WORK

In summary, the most important objectives of this avifaunal impact assessment report were to evaluate the study area (Kluitjeskraal, leeuw Rivier and Farm 257) from an avifaunal sensitivity perspective:

- Field visit to identify important avian habitats associated with the proposed project as well as avian micro-habitats and species that will potentially use these niches;
- A description of the current avifauna within the study area and the identification of Red Data species potentially affected by the proposed substation.
- Recommendations on which sites are preferable for the construction of the substation and associated loop-in loop-out lines in order to have the least impact on avifauna;
- Identify potential negative impacts on the avifaunal diversity and species composition at the site of the proposed development and assess the significance of these impacts and;
- To provide recommended mitigation measures for the potential impacts in order to avert or lower the significance of the negative impacts on avifauna.

1.3 SOURCES OF INFORMATION

The study made use of the following data sources:

- Bird distribution data of the Southern African Bird Atlas Project obtained from the Avian Demography Unit of the University of Cape Town, in order to ascertain species occurrence within the study area (Harrison et al. 1997);
- The conservation status of all bird species occurring in the aforementioned degree squares was then determined with the use of The Eskom Red Data book of birds of South Africa, Lesotho and Swaziland (Taylor 2014);
- The Important Bird Areas (IBA) programme according to BirdLife South Africa was consulted;
- A classification of the vegetation types in the study area was obtained from Mucina & Rutherford (2006); and
- Information on the avian micro-habitat level was obtained during the site visit conducted on the 6-9 July 2015 by a combination of avian and ecological experience.

1.4 ASSUMPTIONS AND LIMITATIONS

It is difficult to apply pure scientific methods within a natural environment without limitations, and consequential assumptions need to be made. The following constraints may have affected this assessment:

- In this instance the 3420AB pentad were reasonably well covered by South African Bird Atlas Project (SABAP2), with data recorded on 22-72 data cards. This means that the species diversity and densities recorded by SABAP2 provides an accurate interpretation of the avifauna potentially occurring in the study area;
- The site visit was conducted in winter, over which time various species may not have been present in the broader study area;
- Conclusions of this report were based on experience of these and similar species in different parts of South Africa. Bird behaviour cannot be entirely reduced to formulas that will hold true under all circumstances. By virtue of their mobility they can rapidly adapt and relocated. However, power line and substation impacts can be predicted with a fair amount of certainty (see References Section 8); and
- It is important to note that, although the predicted impacts are mostly concerned with Red Data species, the non-Red Data species will also benefit from the proposed mitigation measures as they share the same habitat and face the same potential impacts.

2. METHODOLOGY

Generally when predicting the impacts of a proposed power line and substation on birds, a combination of science, field experience and specialist knowledge is required. More specifically the methodology used to predict impacts of the proposed project was as follows:

- The various data sets discussed above under “sources of information” were collected and examined with the aim of determining the focal species for this study.
- The data was examined to determine the location and abundance of species which may be susceptible to impacts from the proposed project including both Red Data and non Red Data.
- The broader study area was visited during a four day site visit of the proposed sites. All five sites were thoroughly traversed to obtain a first-hand perspective of the proposed project and birdlife, and to determine which bird micro habitats are present within the study site. This involved driving around in the

broader study area, taking photographs, and walking certain accessible areas, to see as much as possible of the proposed substation sites and route options for the power line.

- A desk top examination of the site, using Google Earth imagery was done to compare the power line route options and substation site alternatives. This was confirmed during the site visit.
- Avian micro-habitats and sensitive habitats for avifaunal communities were identified and mapped.
- The impacts of the proposed project on the avifaunal populations were predicted by analysing data on wildlife impacts with power lines and associated substation infrastructure throughout southern Africa.

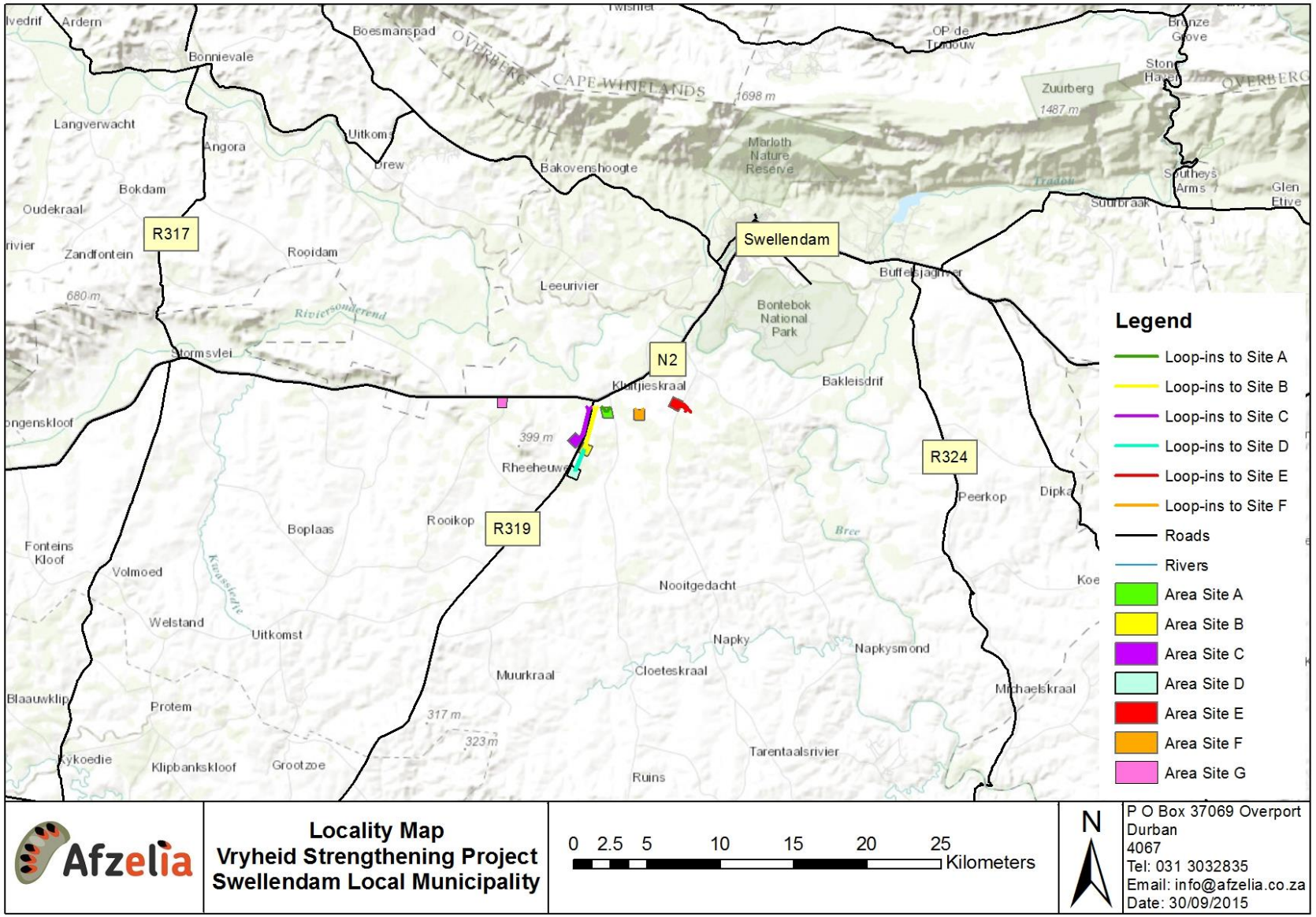

Figure 1: Locality of proposed substation and associated infrastructure.

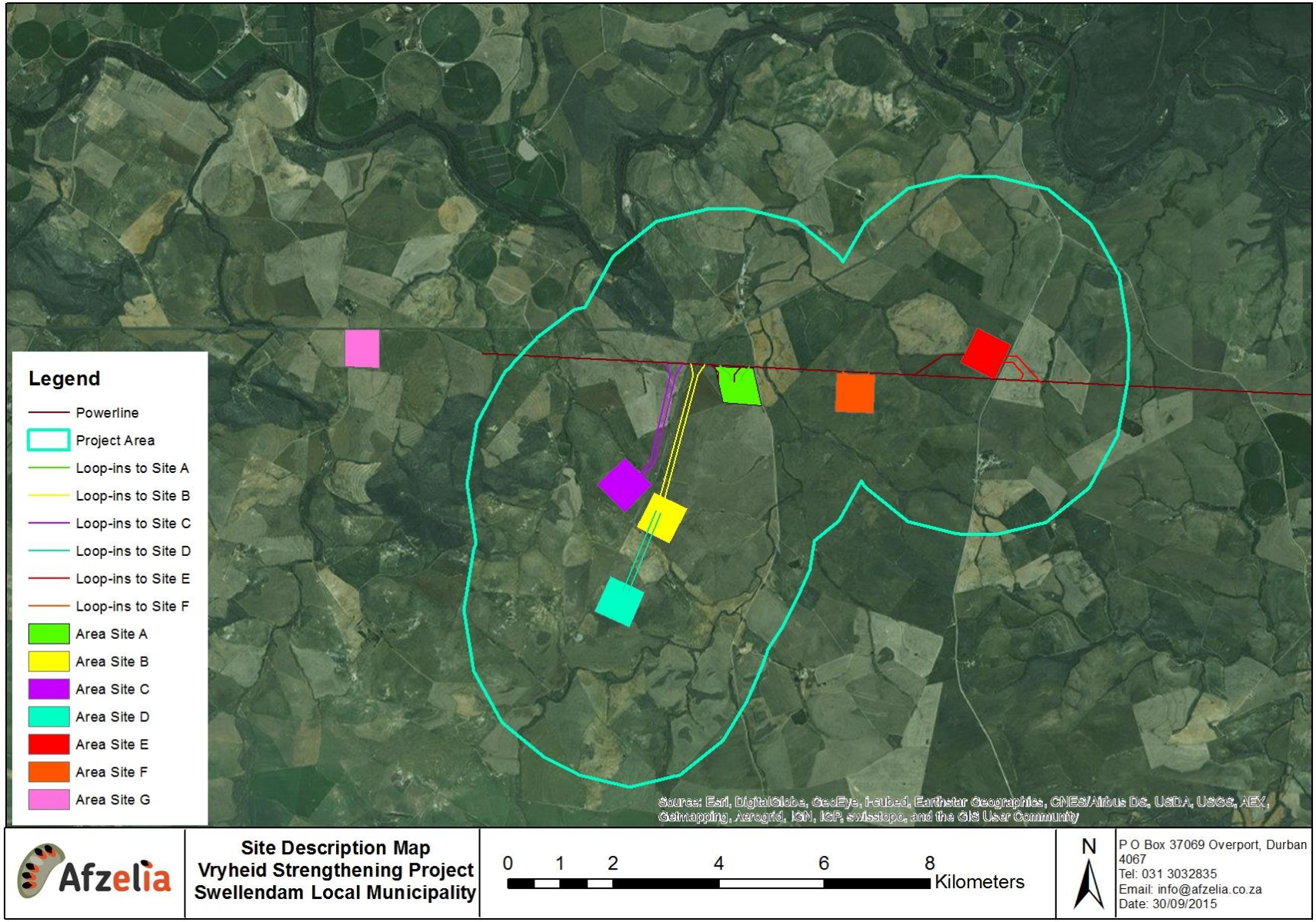

Figure 2. Site description map of the proposed site alternatives and existing 400kV overhead power line located within the study site.

3. DESCRIPTION OF AFFECTED ENVIRONMENT

3.1 CLIMATE AND VEGETATION

The Swellendam area is characterised by a winter rainfall pattern with some rain occurring in summer. The mean annual precipitation is approximately 462mm per year. It receives the lowest rainfall in June (23mm) and the highest in August (48mm). The average daily maximum temperatures range from 17.1 °C in July to 27.5 °C in January. The region is the coldest in July with minimum temperatures of 5.0 °C (Mucina and Rutherford 2006). First frosts are normally experienced after June and continue through to the beginning of September.

According to the national vegetation map (Mucina & Rutherford 2006) four vegetation types occur within the study area (Figure 2). North Sonderend Sandstone Fynbos occupies the north-west corner of the site while the Eastern Ruens Shale Renosterveld forms the majority of the site. This vegetation type is characterised by moderately tall grassy shrubland dominated by Renosterbos. This vegetation type is considered critically endangered with at least 80% transformed mostly by cultivation and croplands. (Scott-Shaw and Escott 2011; Mucina and Rutherford, 2006).

A small outcrop of Ruens Silcrete Renosterveld is located along the southern section of the site and Cape Lowland Alluvial Vegetation traverses the eastern boundary. Within the site, these different vegetation types are structurally very similar and all consist of low shrub land with varying amounts of grass, succulents, forbs and geophytes depending on the aspect and landscape position.

The vast majority of the site has been transformed by intensive agriculture with all five site alternatives falling within agricultural cropland (**Figure 3**). There is remnant vegetation along the drainage systems providing suitable habitat for nesting, foraging and roosting.

The main topographical unit within the proposed study area consists of moderately undulating hills and plains which are characteristic of the area. Major water courses in the study area include the Breede River located to the north of the proposed site alternatives (2km), and the smaller Kluitjieskraalrivier (0.8km) which drains southwards to the east of the proposed site alternatives.

In examining the region as a whole in terms of avifauna, it is important to relate the avifauna to the biomes and vegetation types present in the area. Harrison et al (1997) in "The Atlas of Southern African Birds" provide a description of the various vegetation types represented in the region and the associated bird species. It is generally accepted in the ornithological field that vegetation structure is more important in determining avian species abundance distribution than vegetation species composition (Harrison et al. 1997). Therefore, the vegetation description below does not focus on lists of plant species, but rather on vegetation structural units such as woodlands, riverine habitats or pans and wetlands. The classification used in this report makes extensive use of the work of Harrison et al. (1997).

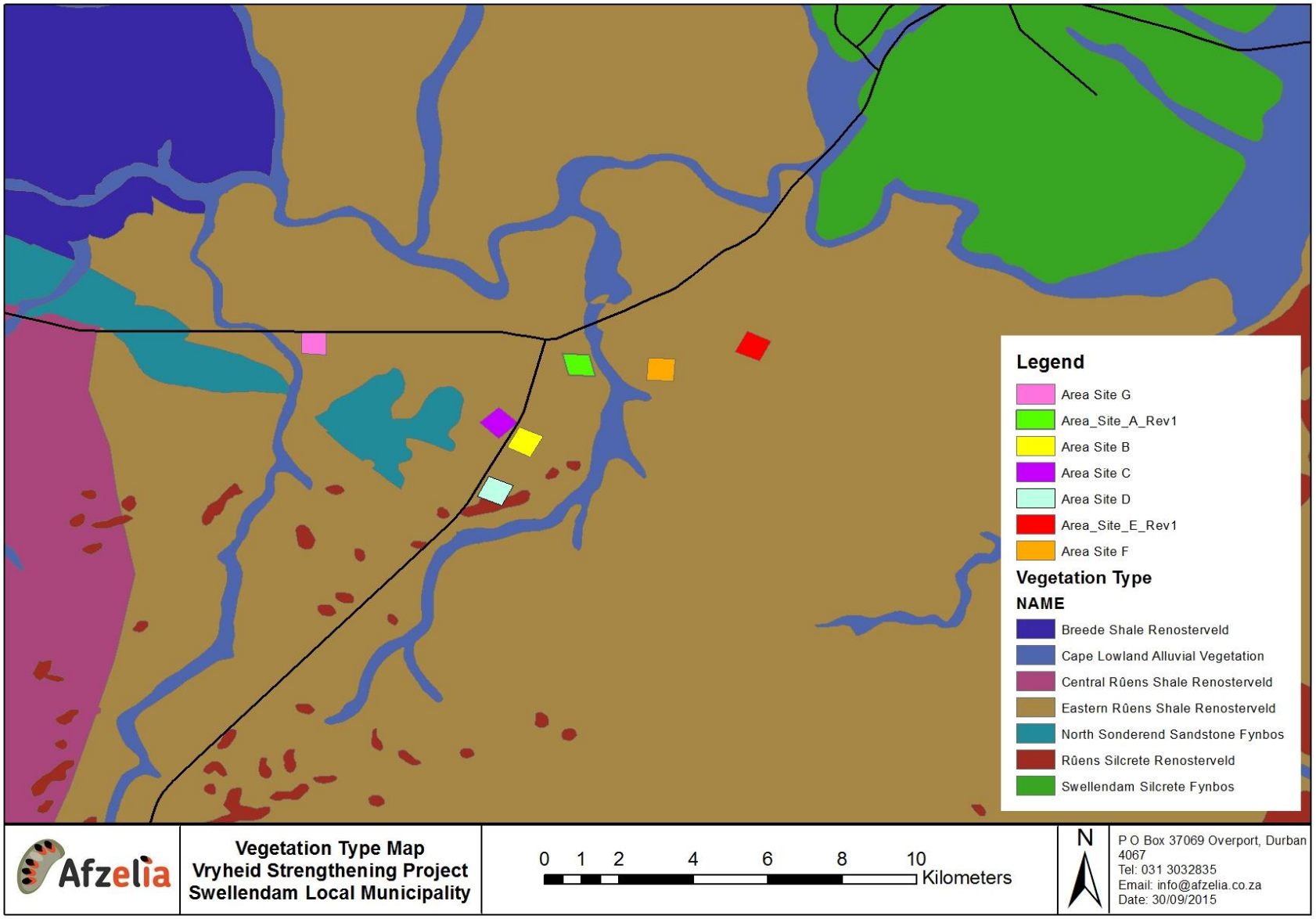

Figure 3. Vegetation type for the proposed study area.

3.2 AVIAN MICRO-HABITATS

In determining how suitable the study area is for avian species, it is necessary to look at the habitats available to determine where the relevant species will most likely occur within the study area. These "micro habitats" do not always correspond to vegetation types and are determined by a combination of vegetation type, topography, land use, food sources and other various intrinsic factors.

Investigation of the study area revealed the following important avian micro habitats. In each case, some of the species likely to make use of the various micro habitats have been described. It must be emphasised that birds will, by virtue of their mobility, utilise almost any area in a landscape from time to time.

Arable or cultivated landscape

Agricultural lands are the dominant land cover the study area and is the most common micro-habitat within the study area (**Figure 4**). Wheat and other cereals are the dominant crops within the area as well as Canola (*Brassica napus L.*) cultivated within the study site. Relevant bird species that will be attracted to these areas include most importantly Denham's Bustard, Blue Cranes and various Heron species. In particular the White Stork has a high affinity for arable land, with 80% of sightings in South Africa recorded within this habitat (Dean & Ryan 2005).

Arable or cultivated land represents a significant foraging area for a variety of avian species for the following reasons:

i. Through opening up the soil surface, land preparation makes many insects, seeds, bulbs and other food sources readily accessible to birds and other predators
ii. The agricultural or pasture plants cultivated are often eaten by birds, or attract insects which are in turn eaten by birds;
iii. During the dry season arable lands often represent the only green or attractive food sources in an otherwise dry landscape.

However, not all avian species are able to benefit from this landscape. Active agricultural lands are not favoured by certain avian species due to the lack of vegetation cover and the regular disturbance experienced during the harvesting period. During the site visit it was noted that most of the arable land did not appear to be very productive from an agricultural perspective.

Figure 4. Agricultural land consisting of grazing land (A) and Canola plantations (B) that dominated the study area.

The impacts associated with the development within this micro-habitat is displacement due to habitat loss, disturbance as well as collisions with the power line (Ludwig's Bustard and Blue Crane).

Pans

The eastern section of the study area contains seasonal pans (**Figure 5**). Pans are defined as shallow depressions or basins, usually containing an intermittent supply of water. Following good rains, they are characterised by slow flowing water and tall emergent vegetation. These factors provide habitats for various water birds and the pans in this study area will be particularly important for the Black and White Storks, Spur-Winged Goose and various Heron species. Furthermore, these water sources are often used by large flocks of granivorous bird species such as Cape Sparrow, Canary Species and Southern Red Bishop's.

Figure 5. One of several pans located within the study area. A pair of roosting Black Headed Herons as well as various other water birds were identified utilising this habitat.

Riparian

Drainage lines traverse the eastern and western boundaries of the study area (**Figure 6**). Various species of water bird are mostly restricted to riverine habitat in Southern Africa. After good rains the standing water will attract species such as Black and White Stork and Cape Teals. These drainage lines are important for Denham's Bustard as they provide foraging opportunities in the form of invertebrates and small vertebrates. Furthermore, the riparian habitat also provides habitat for various species such as Kingfishers, Robin-Chats, Thrushes and Hammerkop. Although the drainage lines within the area are negatively impacted due to the disturbance and encroachment from the croplands, they provide important corridors of natural vegetation, cover and nesting opportunities for many avian species within the largely agricultural landscape. They also represent an important flight path for many species.

The main impact associated with this habitat include habitat destruction, disturbance and collisions with the power line (larger species with low maneuverability).

Figure 6. A riparian habitat which traverses the eastern section of the proposed study area. This area is regarded as a sensitive avifaunal habitat as it provides suitable habitat for an abundance of species

Artificial habitats are provided by the existing overhead power line that traverses through the study area. The pylons are used by various species including raptors from which to hunt and to nest.

3.3 IMPORTANT BIRD AREAS (IBA)

All substation alternatives and loop-in loop-out lines fall within the Overberg Wheat-belt (SA115) Important Bird Area. The extent of the IBA is 603 540 ha and forms part of the Fynbos Biome. The landscape of the area consists of low lying hills and the natural Renoster vegetation in most areas has been replaced by cereal croplands and artificial pastures.

This IBA supports 304 bird species and hosts 30% of South Africa's Blue Crane (*Anthropoides paradiseus*) population as well as a large portion of the global range of the Agulhas Long-Billed Lark (*Certhilauda brevirostris*).The IBA also hosts large numbers of Denham's Bustard (*Neotis denhami*), White Stork (*Ciconia ciconia*) and Black Storks (*Ciconia nigra*).

IBA trigger species for this area include Cape Vulture (*Gyps coprotheres*), Blue Crane, Martial Eagle (*Polemateus bellicosus*), Black Harrier (*Circus maurus*), Denham's Bustard, Secretary Bird (*Sagittarius serpentarius*) and Southern Black Korhaan (*Afrotis afra*).

According to BirdLife South Africa, one-third of the 112 IBA's located within South Africa are under threat by alien invasive vegetation, habitat modification and agricultural expansion (Marnewick et al. 2015). It is important to include mitigation measures to ensure the development does not have a significant negative affect on protected avian species and source populations occurring within the IBA.

As the proposed study falls within this IBA it is important to include mitigation measures to ensure the development does not have a profound negative affect on protected bird species.

4. AVIFAUNA SPECIES COMPOSITION

A total of 216 species were recorded in 3240AB by SABAP2, with six species (3%) classified as Red Data species (Barnes 2000). Furthermore, 5 species are southern African endemics and 11 are near-endemics. Reporting rates are an indication of the relative density of a species on the ground in that it reflects the number of times that a species was recorded relative to the total amount of cards that were completed for the pentad.

During the site visit a total of 71 bird species were recorded within the study area. This figure was much lower than the species rich area to the east of the site within the Bontobok National Park (219 species recorded).

The most commonly recorded species within the study sites were granivorous (seed eater) species such as Waxbills, Sparrows and Canaries as well as species often associated with anthropogenically[1] modified landscapes (Pied Crow, Common Starling and Cape Crow). The drainage lines were observed to have the highest species richness and abundance of species as opposed to the open agricultural land. The agricultural land within the proposed site alternatives were fairly unproductive with a low avian species diversity and abundance. This habitat type was dominated by Common Fiscal (*Lanius collaris*), African Stone Chat (*Saxicola torquatus*), Common Waxbill (*Estrilda astrild*), Cape Sparrows (*Passer melanurus*) and Southern Red Bishop (*Euplectes orix*).

Endemic species recorded during the site visit included Cape Bulbul (*Pycnonotus capensis*) and Agulhas Long-billed Lark (*Certhilauda brevirostris*) and near-endemis included Jackal Buzzard (*Buteo rufofuscus*), Fiscal Flycatcher (*Sigelus silens*) and Black Harrier (*Circus maurus*).

4.1 AVIFAUNAL SPECIES OF CONCERN

Table 1 provides a guideline of the Red Data species that could potentially be encountered anywhere within the pentad where suitable habitat is available, and should therefore not be used as a measure of actual densities within the study area. Report rates are the likelihood of a particular species occurring along any of the alignments/ substation sites represented as a percentage. Furthermore, it is also important to note that these species were recorded within the entire quarter degree square and may not have actually been recorded on the proposed site for the study. Species that are in bold were recorded during the site visit.

[1] A disturbance due to human activities.

Table 1. Red Listed bird species recorded in the 3420AB quarter degree square within which the proposed substation and loop in loop out lines are located

Name	Conservation Status (2014)	Habitat	Likelihood of Occurrence	Habitat destruction	Disturbance	Collision with the power line	Electrocution
SECRETARY BIRD *Sagittarius serpentarius*	VU	Grassland	Low		X	X	
CAPE VULTURE *Gyps coprotheres*	EN	Grassland/Arid Savannah	Low			X	X
KAROO KORHAAN *Eupodotis vigorsii*	NT	Open Plains/Karoo Shrubland	Likely	X	X	X	
MARTIAL EAGLE *Polemaetus bellicosus*	EN	Woodland/Savannah	Low	X	X	X	X
BLACK HARRIER *Circus maurus*	EN	Wetlands/Farmlands	likely	X	X		
BLUE CRANE *Anthropoides paradiseus*	VU	Arable lands/pans	Highly likely		X	X	
DENHAM'S BUSTARD *Neotis denhami*	VU	Arable land/wetland	Highly likely	X	X	X	

*NT= Near Threatened; VU=Vulnerable; EN= Endangered

Secretary Birds roost and nest in trees (optimal heights range from 4-15 metres) and areas with these breeding requirements are important for local populations (Herholdt and Anderson 2006). As the majority of the site has an absence of trees, apart from a series of drainage lines, this may account for the limited sightings of this species. Secretary Birds are also very sensitive to habitat degradation due to overgrazing, disturbance and habitat degradation and they generally avoid these areas. As the study area falls within a highly disturbed agricultural landscape this may account for the low reporting rate of this species within this landscape.

Figure 7. Secretary Bird (*Sagittarius serpentarius*)

There were no sightings of the Cape Vulture and Martial Eagle during the site visit. The SABAP2 reporting rate for both species within the pentad was very low and this was further supported by the lack of suitable habitats. Furthermore, the availability of nest sites and suitable habitat is often a limiting factor for both species. *P. bellicosus* build their nests in large trees (ranging from 6-20 metres high) and the lack of large trees within the study area may account for the limited sightings of Martial Eagles. Both species also suffer from the direct (trapping and shooting) and indirect (poisoning) persecution by farmers (BirdLife International Factsheet 2010). As the study area falls within agricultural land these factors may account for the limited sightings within this landscape.

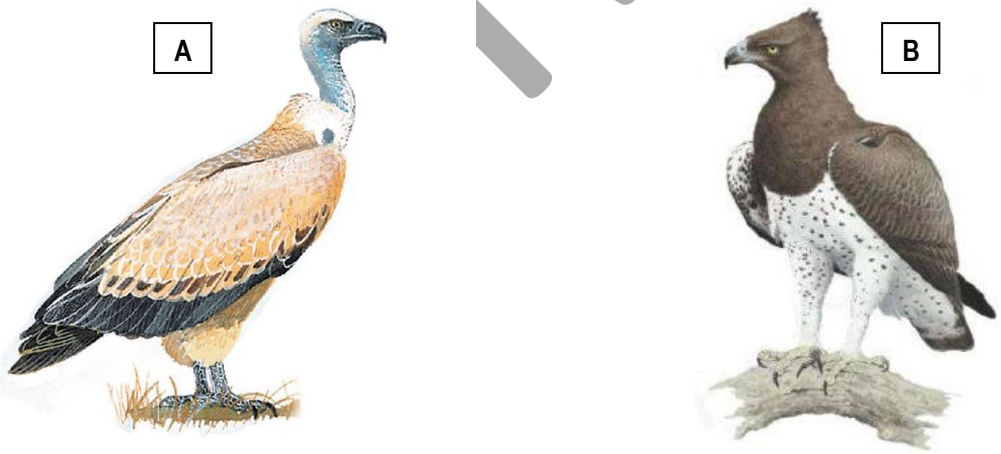

Figure 8. Cape Vulture (*Gyps coprotheres*) A, and Martial Eagle (*Polemaetus bellicosus*) B.

The Black Harrier was only recorded on the eastern boundary of the study area and the flight path was in the direction of the National Park. This area has large sections of natural Renosterveld vegetation. Although this

species forages within agricultural landscapes they require untransformed Renosterveld habitat for breeding (BirdLife SA). This may account for the confined sightings within the area.

Figure 9. Black Harrier (*Circus maurus*)

Blue Cranes and Denham's Bustard were recorded within the southern and eastern sections of the proposed study area. Both species are vulnerable to collisions with power lines (Allan 1996b). The existing 400kV power line is located within the northern section of the study area and may account for the limited sightings within its proximity. The study area falls within the Overberg Wheat Belt and this Important Bird Area (IBA) contains 30% of South Africa's Blue Crane population. This was confirmed during the site visit with groups of 20-30 individuals observed with the agricultural landscape.

Both species are susceptible to collisions with power lines. A study conducted by Shaw et al. (2010) surveyed 199km of transmission and distribution power lines within the Overberg area. 54% of all avian carcasses found were Blue Crane and the study estimated 12% of the total Blue Crane population within the Overberg area could be killed annually by collisions with power lines (Shaw et al. 2010).

Figure 10. Denham's Bustard (*Neotis denhami*) A, and Blue Crane (*Anthropoides paradiseus*) B.

5. SENSITIVITY ASSESSMENT

It is important to delineate sensitive avian habitats within the study area in order to ensure the development does not have a long term negative impact on these habitats. Important avian habitats play an integral role in their persistence within a landscape providing nesting, foraging and reproductive benefits.

A sensitivity map was compiled for the study area by making use of the results of the avifaunal micro-habitat assessment.

A large portion of the study area has been assessed as being of Low and Medium Sensitivity from an avifaunal perspective. The majority of the development foot print falls within the agricultural landscape unit and is considered to be of low ecological sensitivity as a result of the homogenous nature, which has severely transformed the ecological integrity of the area. Development within this area could proceed with little risk of significant post-mitigation residual impact of protected avifaunal species, provided that stated mitigation measures are enforced.

There are also some moderate sensitivity areas located within the study area associated with the relatively intact natural Renosterveld vegetation. This natural habitat includes rocky outcrops that provide important foraging and roosting requirements for avian species. It is important that these areas are protected for degradation.

High sensitivity avifaunal habitats are associated with the riparian habitat which traverse the study area. Although this contributes a small portion of the area, they are ecologically significant and represent an important habitat for avifaunal activity and attract many species. It will be important to maintain the connectivity of the drainage lines with the main system. Agricultural practices have encroached on this habitat but it is largely unaffected. It is important that this riparian habitat is protected from degradation. The protection of this habitat will provide an important ecological corridor and refugee for avifaunal species.

Due to the size of the development the sensitive areas located within the study area should not be affected provided that mitigation measures are implemented and the substation sites occur within the low sensitive areas as originally indicated.

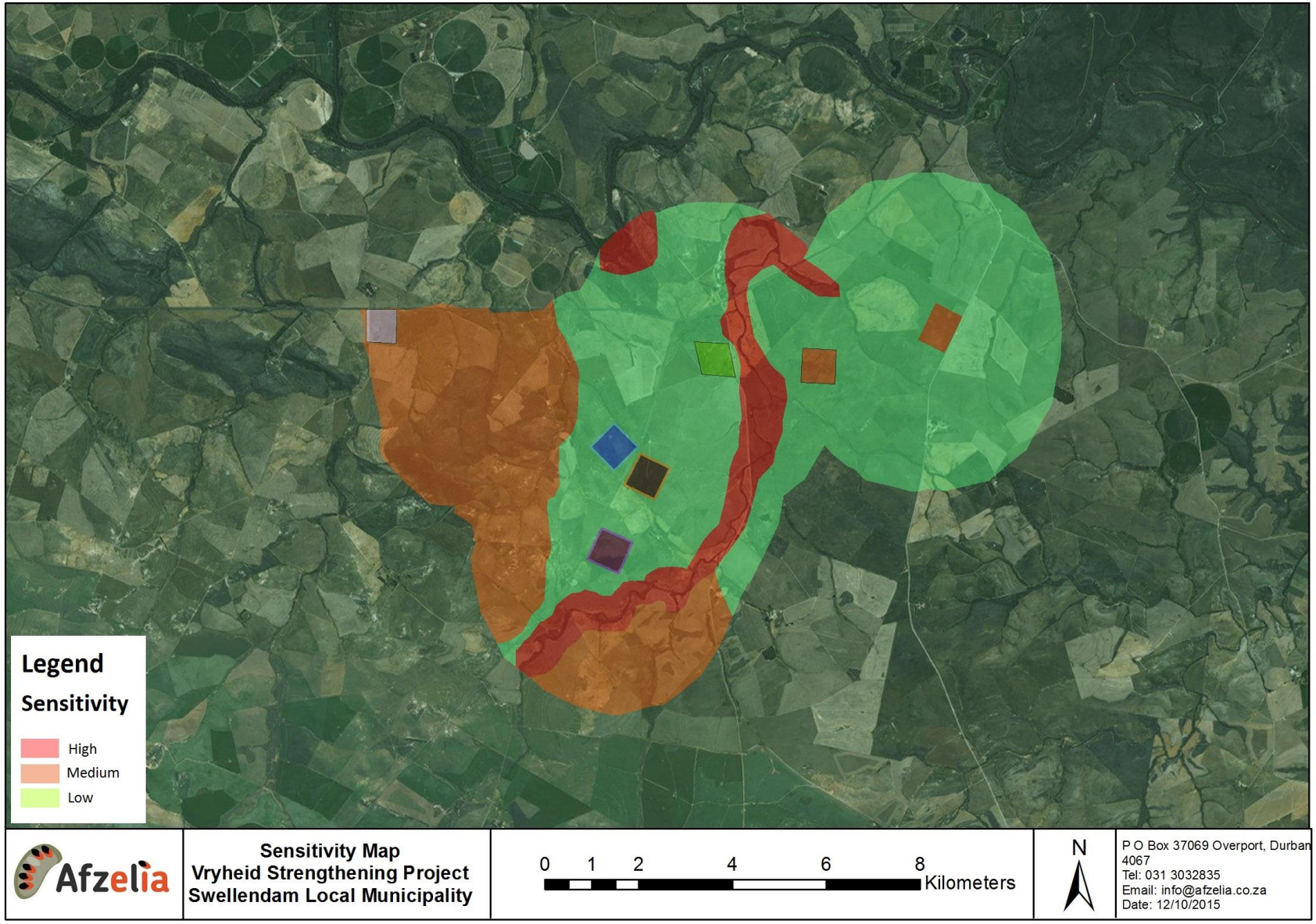

Figure 11. Sensitivity map of the study area.

6. COMPARISON OF SITE ALTERNATIVES

Substation Site A:

This is the northern substation site and is largely transformed and located next to the existing 400kV overhead power line and within close proximity to the National road (N2). The sum of impacts on avian species from the two power lines, within close proximity of one another, may be significantly lower than if these structures were separate in the landscape. The site is situated in old pasture land used for grazing and is in close proximity to human development. There are no sensitive micro-habitats within close proximity of the proposed site and the site is likely to have low sensitivity for avifauna. Furthermore, the Loop-in loop-out line from the substation will be 273m. This is the shortest line alternative. This short line alternative will pose a limit threat to the Blue Crane and Denham's Bustard population within the area, which have a high susceptibility to collision with overhead power lines.

Substation Site B:

This is located to the south of substation site A within a Canola field. A drainage line and pan micro-habitats are located within close proximity of the proposed site. Both Denham's Bustard and Blue Cranes were recorded within the site. The loop-in loop-out line from the substation will be 2363m. Due to the presence of a variety of micro-habitats and the increased length of the associated loop-in loop-out line (increased mortality potential due to collision by Blue Cranes and Denham's Bustard) this is considered to be a sensitive site in terms of avifauna.

Substation Site C:

This is located to the west of substation B and is situated in old pasture land used for grazing. A pan micro-habitat is located within the vicinity of the site. The loop-in loop-out line from the substation will be 2039m.

Substation Site D:

This is the southernmost substation site alternative and is situated with an agricultural landscape used for the production of grain. The Vryheid substation is located in close proximity (500m) to the site in a southerly direction. All three avifaunal micro-habitats are found in close proximity to this proposed site including a large riparian habitat to the east. The loop-in loop-out line from the substation will be 3730m and is the longest line alternative.

Substation Site E:

This site alterative is located on the eastern edge of the study area within a Canola field. There is a large drainage line micro-habitat located close to the site. This is the closest substation site alternative to the Bontobok National Park (which hosts a high diversity of avian species). Eight Denham's Bustards and fifteen Blue Cranes were recorded roosting and foraging within the site boundaries. This coupled with the long loop-in loop-out line from the substation 907m will result in increased mortalities of these lager species due to electrocution and collisions.

Substation Site F:

This site alternative is located on elevated landform to the east of site A. This is located within an agricultural area and the existing 400kV power line and National road (N2) are located within close proximity of this site. A drainage line micro-habitat is located to the south west of the site.

Substation Site G:

This is the western most substation alternative and was added to the scope of work after the site investigation had been completed. Analysis of areal imagery indicated that the site also falls within agricultural land (cereal cultivation) and is located adjacent to the N2. Blue Cranes were observed within close proximity with the site

alternative. The longer power line associated with this site alternative poses an increased risk of collision to Blue Cranes and Denham's Bustard.

7. IMPACT ASSESSMENT

The implications of the proposed substation development and associated power lines to avifauna are as follows:

- An area of approximately 600 x 600m of agricultural land will be altered and considered artificial, and largely unsuitable to avian species.
- During the construction phase, disturbance levels will be significantly higher in the immediate vicinity than previously. This disturbance will consist of machinery and vehicle disturbance as well as other construction activities.
- During the operational phase, there will be some vehicle activity resulting in disturbance, particularly within the road access corridor.
- Since the substation will include the loop-in loop-out overhead power lines, this will potentially pose a collision risk to avifauna, particularly heavier birds with low manoeuvrability (Bustard species).
- The substation infrastructure provides perching and nesting substrate for various avifauna, particularly crows and smaller species such as sparrows and starlings.
- There is a possibility that species such as crows/owls could be electrocuted on substation infrastructure.

7.1 SIGNIFICANCE OF IDENTIFIED IMPACTS

Significance scoring assesses and predicts the significance of environmental impacts through evaluation of the following factors; probability of the impact; duration of the impact; extent of the impact; and magnitude of the impact. The significance of environmental impacts is then assessed taking into account any proposed mitigations. The significance of the impact "without mitigation" is the prime determinant of the nature and degree of mitigation required. Each of the above impact factors have been used to assess each potential impact using ranking scales (**Table 3**).

Unknown parameters are given the highest score (5) as significance scoring follows the Precautionary Principle. The Precautionary Principle is based on the following statement: *When the information available to an evaluator is uncertain as to whether or not the impact of a proposed development on the environment will be adverse, the evaluator must accept as a matter of precaution, that the impact will be detrimental. It is a test to determine the acceptability of a proposed development. It enables the evaluator to determine whether enough information is available to ensure that a reliable decision can be made.*

Table 2: Significance scoring used for each potential impact

Probability	***Duration***
1 - very improbable	1 - very short duration (0-1years)
2 - improbable	2- short duration (2-5 years)
3 - probable	3 - medium term (5-15 years)
4 - highly probable	4 - long term (>15 years)
5 - definite	5 - permanent/unknown
Extent	***Magnitude***

1 - limited to the site 2 - limited to the local area 3 - limited to the region 4 - national 5 - international	2 – minor 4 – low 6 – moderate 8 – high 10 – very high

Significance Points = (Magnitude + Duration + Extent) x Probability.
The maximum value is 100 Significance Points.

Potential Environmental Impacts are rated as high, moderate or low significance as per the following:
<30 significance points = Low environmental significance
31-59 significance points = Moderate environmental significance
>60 significance points = High environmental significance

Table 3: Impact assessment for the proposed substation and loop-in loop-out lines.

Impacts associated with the construction phase of the activities										
Impact	Probability		Duration		Extent		Magnitude		Significance scoring without mitigation	Significance scoring with mitigation
	Without	With	Without	With	Without	With	Without	With		
Construction Phase										
Habitat Destruction	5	4	5	5	2	1	8	6	75 (high)	48 (moderate)
Disturbance to birds	5	4	2	2	2	1	6	4	50 (moderate)	28 (low)
Operational Phase										
Electrocution on substation infrastructure	2	1	5	5	1	1	4	2	20 (low)	8 (low)
Electrocution loop-in loop-out power line	3	2	4	4	2	2	6	4	36 (moderate)	20 (low)
Collisions with power line (Site A)	2	1	4	4	1	1	4	2	39 (moderate)	18 (low)
Collisions with power line (Site B)	3	2	4	4	3	2	6	4	39 (moderate)	20 (low)
Collisions with power line (Site C)	4	3	4	4	3	2	6	4	52 (moderate)	30 (moderate)
Collisions with power line (Site D)	4	3	4	4	3	2	6	4	52 (moderate)	30 (moderate)

Collisions with power line (Site E)	4	3	4	4	3	2	6	4	52 (moderate)	30 (moderate)
Collisions with power line (Site F)	2	1	4	4	1	1	4	2	39 (moderate)	18 (low)
Collisions with power line (Site G)	3	2	4	4	3	2	6	4	39 (moderate)	20 (low)

7.2 CONSTRUCTION PHASE IMPACTS

Habitat Destruction

During the construction phase and maintenance of substations and power lines, some habitat destruction and alteration will occur due to the clearing of servitudes and vegetation at the substation site. Servitudes have to be cleared of excess vegetation at regular intervals to ensure access to the line for maintenance and to prevent vegetation from intruding into the legally prescribed clearance gap, minimising the risk of fire These activities will have an impact on birds breeding, foraging and roosting in or in close proximity to the servitude, and retention of cleared servitudes can have the effect of altering bird community structure along the length of the power line (King and Byers 2002).

It is not envisaged that any Red Data species will be displaced by the habitat transformation that will take place as a result of the construction of the proposed substation. The impact on smaller, non-Red Data species that are potentially breeding in the area will be local in extent, in that it will not have a significant effect on regional or national populations.

The habitat is already largely transformed and fragmented by agricultural land. Furthermore, this is not a unique habitat within the landscape. The construction of the proposed loop-in loop-out line should therefore have a low displacement impact from an avifaunal perspective.

Recommended Mitigation

- All construction and maintenance activities must be carried out according to the generally accepted environmental best practice and the temporal and spatial footprint of the development should be kept to a minimum. In particular, care must be taken in the vicinity of the drainage lines and existing roads must be used as much as possible for access during construction.
- The boundaries of the development footprint areas are to be clearly demarcated and it must be ensured that all activities remain within the demarcated footprint area. Special care must be taken in sensitive avifaunal micro-habitats such as drainage lines, pans and natural Renosterveld.
- Provide adequate briefing for site personnel.
- Any bird nests that are found during the construction period must be reported to the Environmental Control Officer (ECO).

  The above measures must be covered in a site specific EMPr and controlled by an ECO

Disturbance

The disturbance of avifauna during the construction and operation of the substation will occur. Ground-nesting species and will be particularly susceptible. Disturbance can also influence the community structure of avifauna

within close proximity to the development as certain species will be displaced and forced to find alternative territories. Disturbance could have a negative impact on the breeding activities of various species, particularly if this occurs during a sensitive period in the breeding cycle.

The proposed site alternatives are located within an agricultural habitat close to National and Domestic roads as well as the Vryheid substation. Therefore, species within this landscape often experience disturbance. As a result, disturbance of birds by the proposed substation is anticipated to be of low significance as birds will move away from the area temporarily. The relatively small scale of the development (in relation to the large agricultural landscape) is unlikely to have a significant impact on avifauna. However, species are particularly sensitive to disturbance during the breeding season and this must be borne in mind during both the construction and operational (maintenance) phases.

Recommended Mitigation

- Strict control must be maintained over all activities during construction, in line with an approved Construction EMPr.
- During Construction, if any of the Red Data species identified in this report are observed to be roosting and/or breeding in the vicinity, the ECO must be notified.
- The construction camps must be as close to the site as possible
- Contractors and working staff should stay within the development footprint and movement outside these areas including avian micro-habitats must be restricted.
- Driving must take place on existing roads and a speed limit of 30km/h must be implemented on all roads running through the study area during all phases.

7.3 OPERATIONAL PHASE IMPACTS

Electrocution of birds on substation infrastructure

Since there is live hardware in the substation yard, the potential exists for birds to bridge the gap between two phases or a phase and earth resulting in electrocution. However, very few electrocutions have been recorded on transmission substations. Species likely to be affected are crows and other species that are tolerant of disturbance. Small raptors such as Lanner Falcons are sometimes attracted into substation yards in pursuit of species nesting there such as sparrows and canaries**.**

The impact assessment found the impact of electrocution on substation infrastructure to be of low significance once mitigation in the form of bird friendly structures and bird deterrent measures have been put in place. Species likely to be affected are crows and other non-threatened species with the majority of threatened species (Denham's Bustard and Blue Cranes) avoiding the substation yard as they are sensitive to disturbances.

Recommended Mitigation

- A "Bird Friendly" monopole structure, with a bird perch (as per standard Eskom guidelines) should be used for the tower structures.
- All relevant perching surfaces should be fitted with bird guards as deterrents

Electrocution of birds caused by the loop-in loop-out power line

Electrocution of birds on associated overhead power lines is an important cause of mortality for a variety of bird species particularly storks, cranes and raptors in South Africa (Van Rooyen & Ledger 1999). Electrocution occurs

when a bird 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).

The impact of electrocution will be of high significance, and medium significance after the mitigation in the form of bird friendly structures.

Recommended Mitigation

- A "Bird Friendly" monopole structure, with a bird perch (as per standard Eskom guidelines) should be used for the tower structures.
- All relevant perching surfaces should be fitted with bird guards and perch guards as deterrents (Hunting 2002).
- Installation of artificial bird space perches and nesting platforms, at a safe distance from energised components (Goudie 2006; Prinsen et al. 2012).

Collisions with the power line

Collisions are the biggest single threat posed by transmission power lines to birds in Southern Africa (van Rooyen 2004). Susceptible species include bustards, storks and cranes. These species are heavy-bodied birds with limited manoeuvrability and are unable to take the necessary evasive action to avoid colliding with power lines (Van Rooyen 2004, Anderson 2001). Many collision sensitive species are considered threatened in Southern Africa.

The Red Data species that are vulnerable to power line collisions are generally long living, slow reproducing species. Various species require specific conditions for breeding, resulting in limited successful breeding attempts. Due to these breeding requirements these species have not evolved to cope with high adult mortality. Therefore, regularly high adult mortality over prolonged periods could have a will have an effect on species population dynamics.

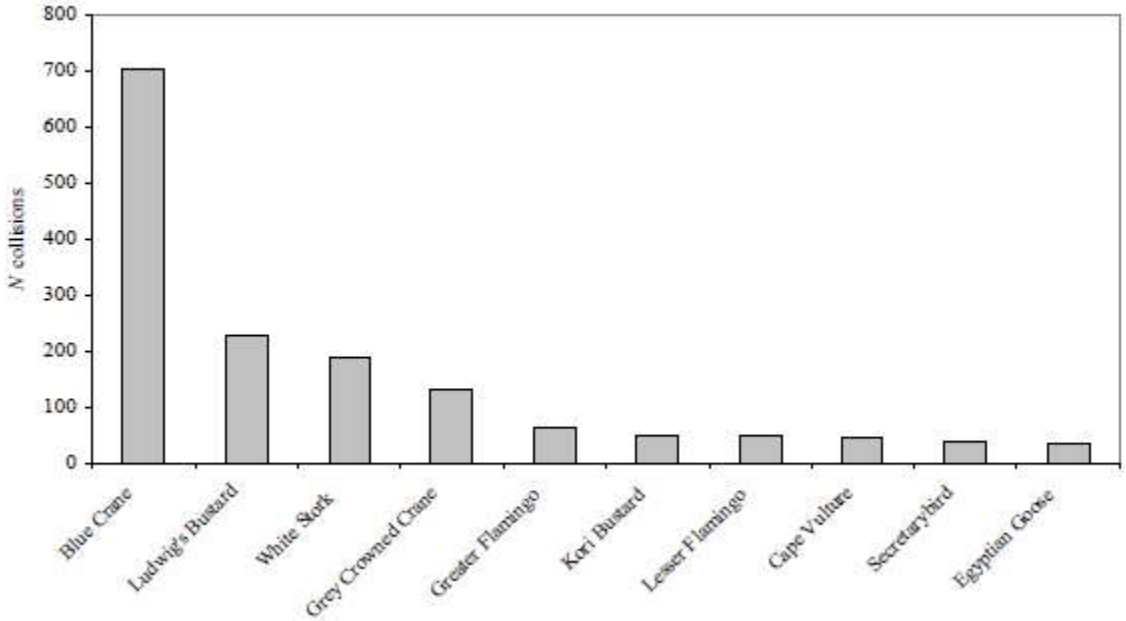

Figure 12. Collision prone species in South Africa (Jenkins et al. 2010).

Potential collision risks associated with the proposed power line by certain species such as Denham's Bustard, Blue Crane and Black Harrier, are possible at certain sites. This is particularly true for the Denhams Bustard and Blue Crane which have low manoeuvrability once in flight. Both species mentioned have been recorded within the top ten avian species in South Africa prone to collisions with overhead powerlines (**Figure 16**).

The impact assessment found this risk to be of medium significance. However, this is directly related to the length of the power line.

As would be expected the longer the power line, the higher the probability of larger birds colliding with the power line. This is compounded when the power line traverses important avifaunal micro-habitats and flight paths.

The impact assessment found the risk of collision with the power line at site alternative A to be of low significance after mitigation as site A requires the shortest power line thus reducing the risk of collision. Site alternatives C, D and E require an overhead power line length of ± 2km. The increased length coupled with the presence of three Red Data species increases the impact of the proposed development. Furthermore, these site alternatives are in close proximity with important avifaunal micro-habitats (particularly the large drainage line near site E and F), the disturbance and degradation of which will compound the negative impact on avifauna within the area.

Recommended Mitigation

- Mark sections of line in high sensitivity areas with anti-collision marking devices (diurnal and nocturnal diverters) to increase the visibility of the power line and reduce likelihood of collisions. Marking devices should be spaced 10 m apart.
- These line marking devices include spiral vibration dampers, strips, Firefly Bird Flight Diverters, bird flappers, aerial marker spheres, ribbons, tapes, flags and aviation balls (Prinsen et al. 2012).
- Construction of the power line in close proximity to the existing line will reduce the cumulative impacts and collision risk.

8. CONCLUSION

As long as alternative A is chosen for the construction of the new Eskom Agulhas 400/132kv 2x500 MVA Transmission Substation and Loop-in loop-out lines, only a limited threat to the birds occurring in the vicinity of the new infrastructure is likely to occur. This is largely due to the extensive impacts already evident at the site, the homogenous nature of the site and the relatively short length of the proposed power line. The impact of displacement due to habitat transformation will also only be low, and should only affect a few non-Red Data species at a local level. Furthermore, this site would require the shortest loop-in loop-out line from the substation reducing the risk of electrocution to avifaunal species and collisions with the power line.

Substation site A is the preferred site for the proposed development from an avifaunal perspective. This site is close to the existing power line and other human development and as a result is already highly transformed. The site has few micro-habitats within the area and will not have a negative impact on avian species richness and abundance due to habitat loss.

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Appendix 1. List of bird species identified within the study area during the site visit.

Common Name	Scientific Name	Common Name	Scientific Name
Little Grebe	*Tachybaptus ruficollis*	Cape Bulbul	*Pycnonotus capensis*
African Darter	*Anhinga rufa*	Familiar Chat	*Cercomela familiaris*
Grey Heron	*Ardea cinerea*	African Stonechat	*Saxicola torquatus*
Black-headed Heron	*Ardea melanocephala*	Cape Grassbird	*Sphenoeacus afer*
Cattle Egret	*Bubulcus ibis*	Zitting Cisticola	*Cisticola juncidis*
Hamerkop	*Scopus umbretta*	Neddicky	*Cisticola fulvicapilla*
African Sacred Ibis	*Threskiornis aethiopicus*	Grey-backed Cisticola	*Cisticola subruficapilla*
Hadeda Ibis	*Bostrychia hagedash*	Cape Batis	*Batis capensis*
Spur-winged Goose	*Plectropterus gambensis*	Fairy Flycatcher	*Stenostira scita*
Egyptian Goose	*Alopochen aegyptiacus*	Cape Wagtail	*Motacilla capensis*
Cape Teal	*Anas capensis*	African Piptit	*Anthus cinnamomeus*
Peregrine Falcon	*Falco peregrinus*	Cape Longclaw	*Macronyx capensis*
Rock Kestrel	*Falco rupicolus*	Common Fiscal	*Lanius collaris*
Black-shouldered Kite	*Elanus caeruleus*	Southern Boubou	*Laniarius ferrugineus*
Jackal Buzzard	*Buteo rufofuscus*	Bokmakierie	*Telophorus zeylonus*
African Goshawk	*Accipiter tachiro*	Common Starling	*Sturnus vulgaris*
Black Harrier	*Circus maurus*	Red-winged Starling	*Onychognathus morio*
Cape Spurfowl	*Pternistis capensis*	Pied Starling	*Spreo bicolor*
Helmeted Guineafowl	*Numida meleagris*	Malachite Sunbird	*Nectarinia famosa*
Red-knobbed Coot	*Fulica cristata*	Cape Sparrow	*Passer melanurus*
Blue Crane	*Anthropoides paradiseus*	Cape Weaver	*Ploceus capensis*
Denham's Bustard	*Neotis denhami*	Southern Red Bishop	*Euplectes orix*
Karoo Korhaan	*Eupodotis vigorsii*	Yellow Bishop	*Euplectes capensis*
Three-banded Plover	*Charadrius tricollaris*	Swee Waxbill	*Coccopygia melanotis*
Blacksmith Lapwing	*Vanellus armatus*	Common Waxbill	*Estrilda astrild*
Speckled Pigeon	*Columba guinea*	Cape Canary	*Serinus canicollis*
Cape Turtle-dove	*Streptopelia capicola*	Brimstone Canary	*Crithagra sulphuratus*
Laughing Dove	*Streptopelia senegalensis*	Streaky-headed Seedeater	*Crithagra gularis*
White-rumped Swift	*Apus caffer*	Cape Bunting	*Emberiza capensis*
Little Swift	*Apus affinis*	Cape White-eye	*Zosterops virens*
Speckled Mousebird	*Colius striatus*	Karoo Long-billed Lark	*Certhilauda subcoronata*
African Hoopoe	*Upupa africana*	Karoo Prinia	*Prinia maculosa*
Red-capped Lark	*Calandrella cinerea*	Southern Grey-headed Sparrow	*Passer diffusus*
Brown-throated Martin	*Riparia paludicola*		
Fork-tailed Drongo	*Dicrurus adsimilis*		
Pied Crow	*Corvus albus*		
Cape Crow	*Corvus capensis*		
White-necked Raven	*Corvus albicollis*		