BIRD IMPACT ASSESSMENT REPORT

FOSKOR-SPENCER 400KV POWER LINE

July 2017

AFRIMAGE Photography (Pty) Ltd t/a:

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PROFESSIONAL EXPERIENCE

Chris van Rooyen

Chris has 20 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in numerous power line and wind generation projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is currently (2016) accepted as the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

DECLARATION OF INDEPENDENCE

I, Chris van Rooyen as duly authorised representative of Chris van Rooyen Consulting, and working under the supervision of and in association with Albert Froneman (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003, hereby confirm my independence (as well as that of Chris van Rooyen Consulting) as a specialist and declare that neither I nor Chris van Rooyen Consulting have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which DIGES was appointed as environmental assessment practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for worked performed, specifically in connection with the Environmental Impact Assessment for the proposed Foskor - Spencer 400kV power line and associated infrastructure.

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Full Name: Chris van Rooyen
Title / Position: Director

EXECUTIVE SUMMARY

In general, the habitat through which the proposed Foskor – Spencer 400kV corridors run is low to moderately sensitive from a potential bird powerline impact perspective, with a few areas of high sensitivity, namely rivers, dams and a vulture restaurant. The natural woodland habitat in the game farming and eco-tourism areas between Foskor substation and the R529 is likely to attract a number of Red Data power line sensitive species, mostly eagles and vultures, while the rivers are attractive to several Red Data powerline sensitive stork species, as well as vultures and eagles. Between the R529 and the Spencer substation the main economic activity is subsistence farming, with evidence of anthropogenic impacts, which is visible in the disturbed state of the majority of the woodland. This has had a negative impact on avifaunal diversity and abundance, with fewer Red Data species expected to be attracted to this section of the study area.

The construction of the proposed power line will result in various potential impacts on the birds occurring in the vicinity of the new infrastructure, with impacts ranging from low to moderate. The proposed power line poses a **moderate** collision risk which can be reduced to **low** through the application of mitigation measures. The habitat transformation and disturbance associated with the construction and decommissioning of the power line should have a **moderate** displacement impact, which could be reduced to **low** with appropriate mitigation. No electrocution risk is foreseen.

The project can proceed subject to the implementation of the following recommendations:

<u>Mitigation for displacement:</u>

- The primary means of mitigating this impact is through the selection of the optimal route for the line, explained in Section 7. This will ensure that high sensitivity habitats (e.g. rivers, dams and vulture restaurants) are avoided as far as possible.
- Construction activity should be restricted to the immediate footprint of the infrastructure.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of Red Data species.
- Measures to control noise should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned.
- The final powerline alignment must be inspected on foot by the avifaunal specialist prior to construction to ascertain if any Red Data species nests are present. All relevant detail must be recorded i.e. species, coordinates and nest status. Should any nests be recorded, it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the Environmental Control Officer. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain when and where such breeding Red Data species could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle, once it has been established that a particular nest is active.

<u>Mitigation for collisions:</u>

- The primary means of mitigating this impact is through the selection of the optimal route for the line, explained in Section 7. This will ensure that high sensitivity habitats (e.g. rivers, dams and vulture restaurants) are avoided as far as possible.

- High risk sections of power line must be identified by a qualified avifaunal specialist during the walk-through phase of the project, once the alignment has been finalized.
- Where power line marking is required (i.e. in areas that contain rivers, dams or is situated near a vulture restaurant) bird flight diverters must be installed on the full span length on each earthwire (according to Eskom guidelines - five metres apart). Light and dark colour devices must be alternated so as to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung.

Corridor 2 + deviation 1a emerged as the preferred corridor from a bird impact assessment perspective. However, none of the corridor options is fatally flawed from a bird impact perspective, provided the proposed mitigation is implemented.

Table of Contents

1 INTRODUCTION

DIGES Environmental Consultants (DIGES) has been appointed by Eskom to undertake an Environmental Impact Assessment for the proposed Foskor - Spencer 400kV power line development.

The project entails the following:

- The construction of ±110km, 400kV power line from Foskor MTS to Spencer MTS. The power line will span across 4 Local Municipalities, i.e., Ba-Phalaborwa, Maruleng, Greater Letaba and Greater Tzaneen; and
- Establishment of 400/132kV transformation yard with the installation of 1 x 500MVA, 400/132kV transformer at Spencer MTS.

DIGES has appointed Chris van Rooyen Consulting to compile a specialist avifaunal assessment report detailing the sensitive bird habitats within the study area and the potential bird related impacts associated with the proposed new transmission line.

See Figures 1 and 2 below for maps showing the location of the project and the various corridor alternatives.

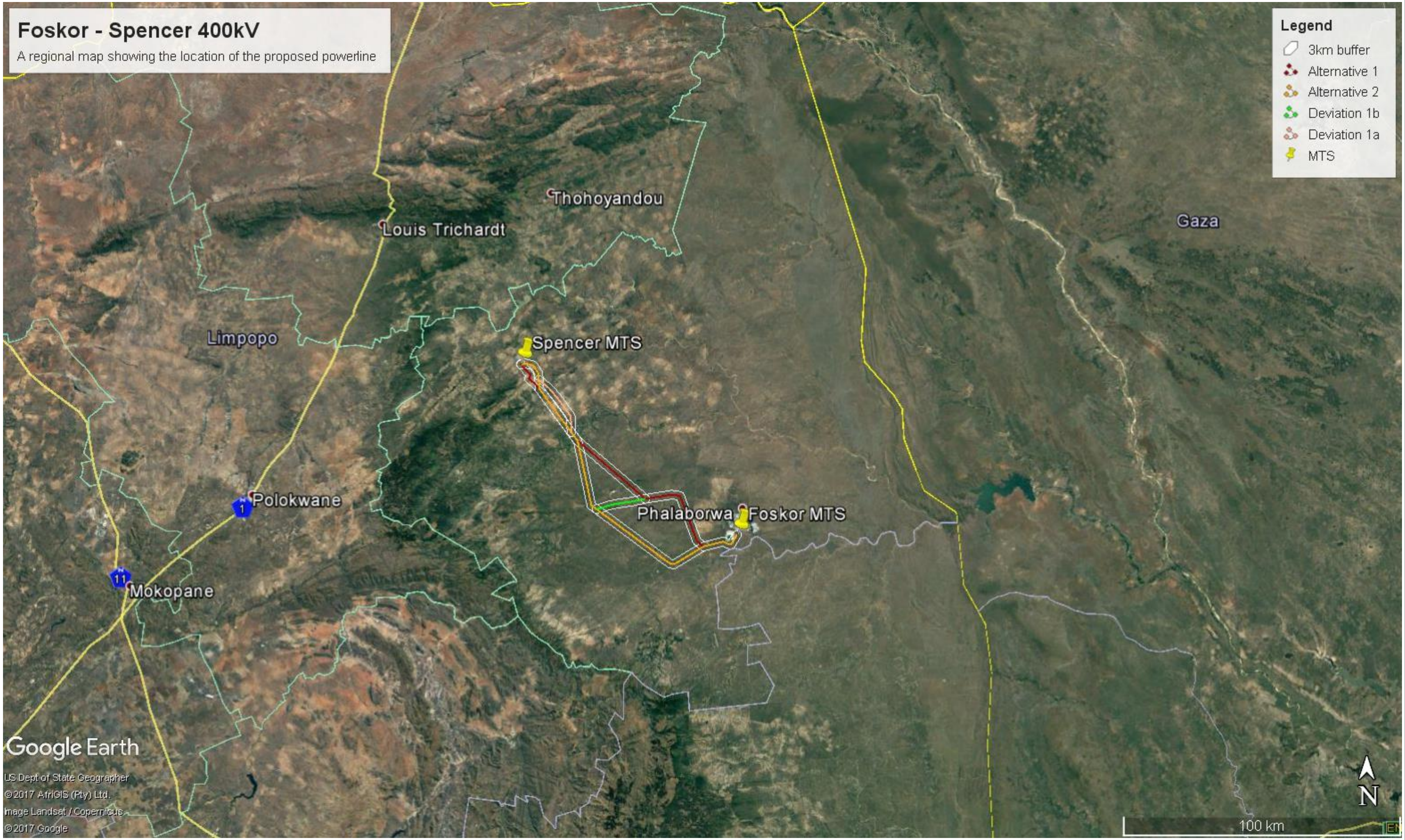

Figure 1: Regional map showing the approximate location of the study area

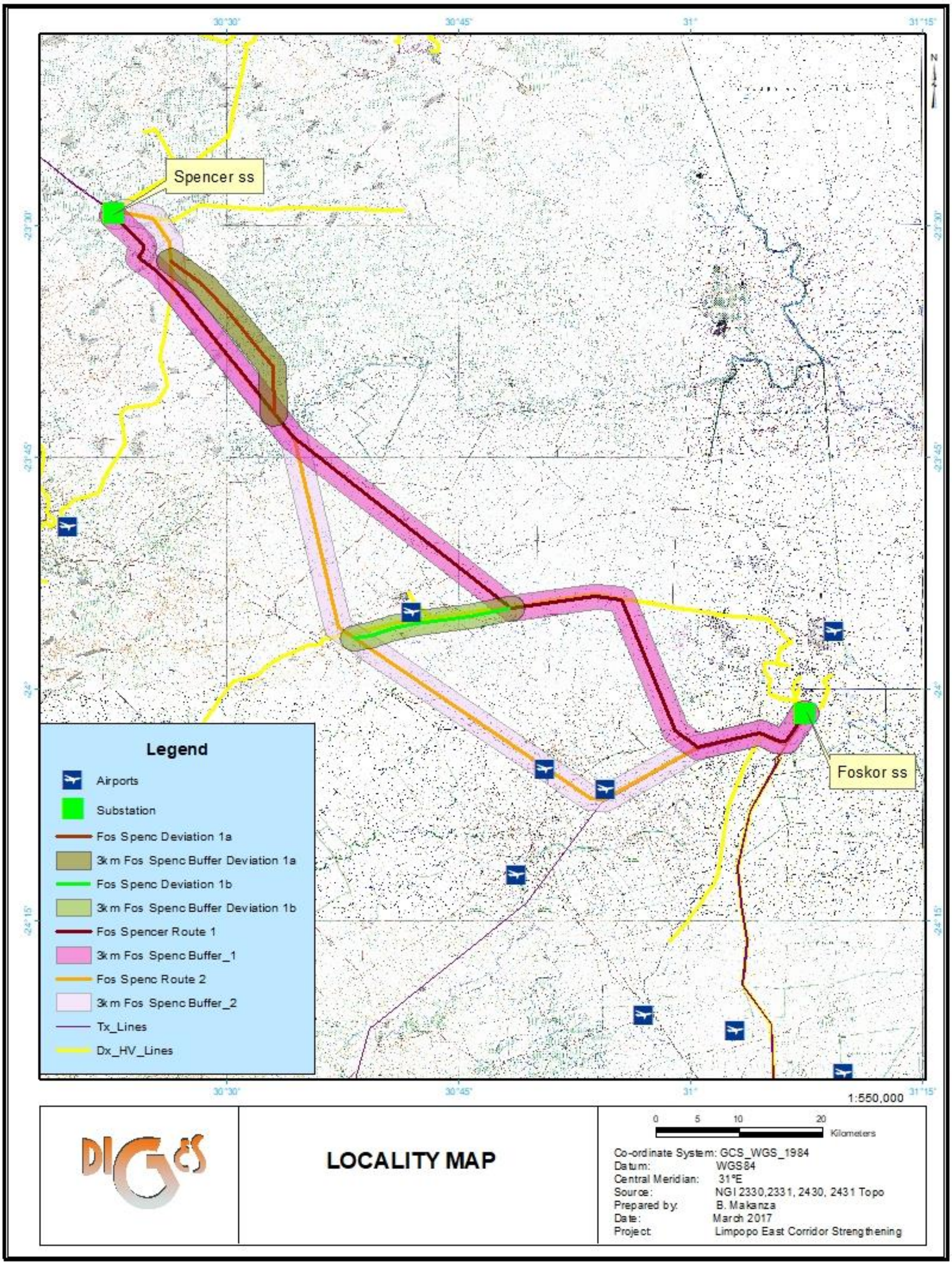

Figure 2: Close-up view of the study area and proposed alignments.

2 BACKGROUND AND BRIEF

The terms of reference for this bird impact assessment study are as follows:

- Describe the affected environment;
- Indicate how birdlife will be affected;
- Discuss gaps in baseline data;
- Describe and assess the expected impacts;
- Indicate sensitive and possible no-go areas; and
- Provide recommendations for mitigating measures.

3 STUDY APPROACH

3.1 Sources of information

The study made use of the following data sources:

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the Animal Demography Unit of the University of Cape Town, as a means to ascertain which species occur within the broader area i.e. within a block consisting of 39 pentad grid cells within which the study area is situated. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. Between August 2008 and June 2017, a total of 322 full protocol cards (i.e. 332 bird surveys lasting a minimum of two hours each, or longer) have been completed for the study area and its immediate surrounds (see Figure 3 below).
- The Important Bird Areas project data was consulted to get an overview of important bird areas (IBAs) and species diversity in the study area (Marnewick *et al*. 2015).
- The power line bird mortality incident database of the Endangered Wildlife Trust (1996 to 2007) was consulted to determine which of the species occurring in the study area are typically impacted upon by power lines (Jenkins *et al.* 2010).
- Data on vegetation types in the study area was obtained from the Vegetation Map of South Africa, (Mucina & Rutherford 2006).
- The conservation status of all species considered likely to occur in the area was determined as per the most recent iteration of the South African Red Data for birds (Taylor *et al*. 2015), the latest IUCN Red List (2017.1[1]) and the most recent and comprehensive summary of southern African bird biology (Hockey *et al.* 2005).
- Personal observations, especially experience from other projects which the author worked on in the Limpopo Province since 1996, have also been used to supplement the data that is available from SABAP2, and has been used extensively in forming a professional opinion of likely bird/habitat associations.
- The location of Cape Vulture colonies and vulture restaurants in Limpopo was obtained from Kerri Wolter at Vulpro (Wolter email com. 2017).
- Information on the Selati Game Reserve vulture restaurant was obtained from Lourette Joubert, administrative manager at the Selati Game Reserve.
- A field visit to the study area was conducted on 1-2 February 2017 to form a first-hand impression of the micro-habitat on site. This information, together with the SABAP2 data was used to compile a comprehensive list of species that could occur in the study area.
- The location of protected areas was determined from various data sources, but mostly from the South Africa Protected and Conservation Areas Data from the Department of Environmental Affairs (DEA)[2], and Google Maps satellite imagery.

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[1] http://www.iucnredlist.org/
[2] https://egis.environment.gov.za/data_egis

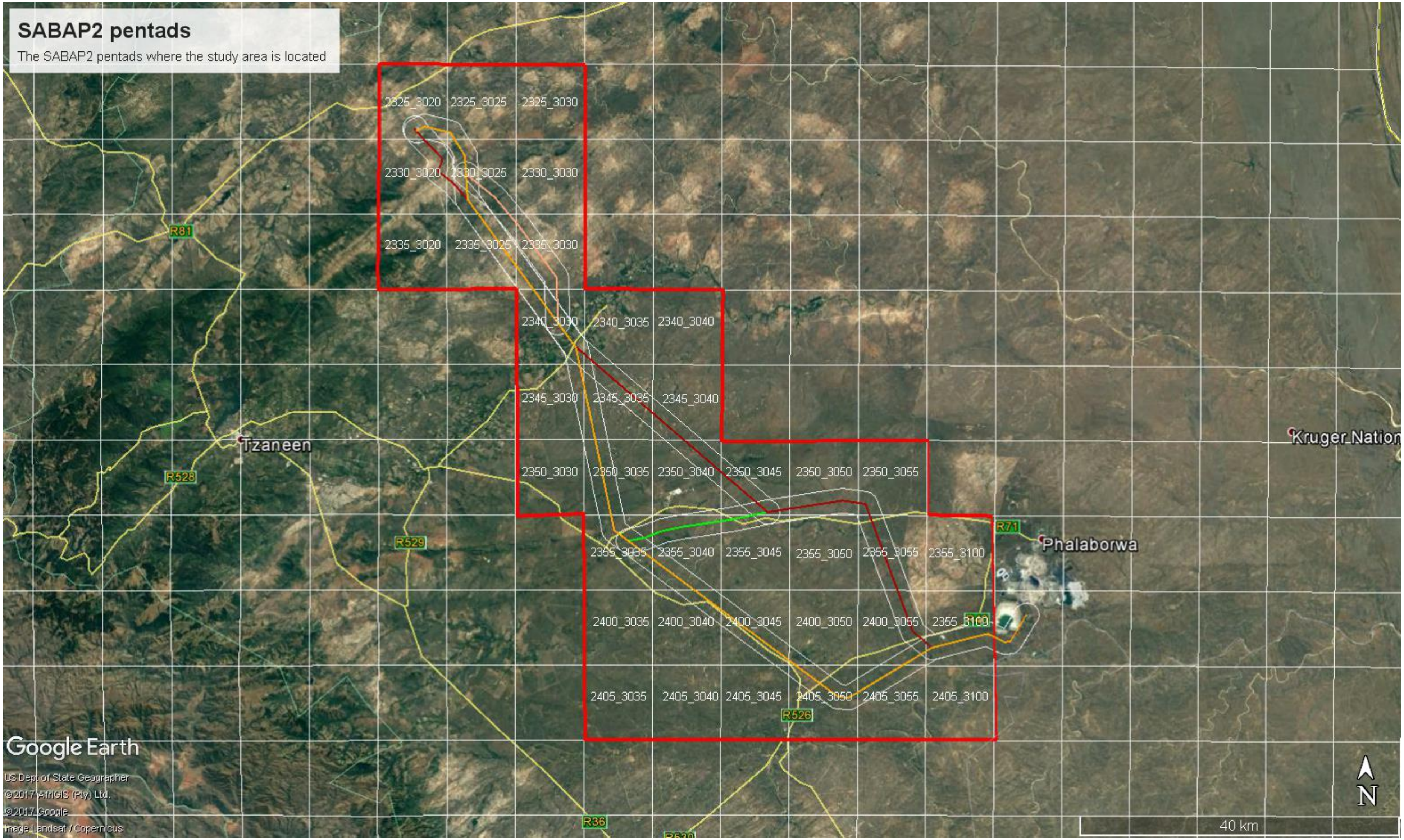

Figure 3: The SABAP2 pentads within which the study area is located.

3.2 Limitations & assumptions

This study made the following assumptions:

- The SABAP2 data is regarded as a fairly comprehensive record of the avifauna due to the substantial number of full protocol data cards (n = 332) which have been completed to date for the area.
- Predictions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will hold true under all circumstances; therefore, professional judgment played an important role in this assessment. It should also be noted that the impact of power lines on birds has been well researched with a robust body of published research stretching over thirty years.
- The study area was defined as a 3km buffer around the proposed alignments (see Figure 2).

4. STUDY AREA

4.1 Important Bird Areas

The study area does not overlap directly with any Important Bird Areas (IBAs), but it lies within relative close proximity of three IBAs. The closest IBA is the Kruger National Park IBA (SA002) which is located about 10km to the east of the Foskor substation (Marnewick *et al.* 2015). The Wolkberg Forest Belt IBA (SA005) is situated about 20km west from the closest alignment, and the Blyde River Canyon IBA (SA127) is located approximately 33km south of the closest alignment (see Figure 4).

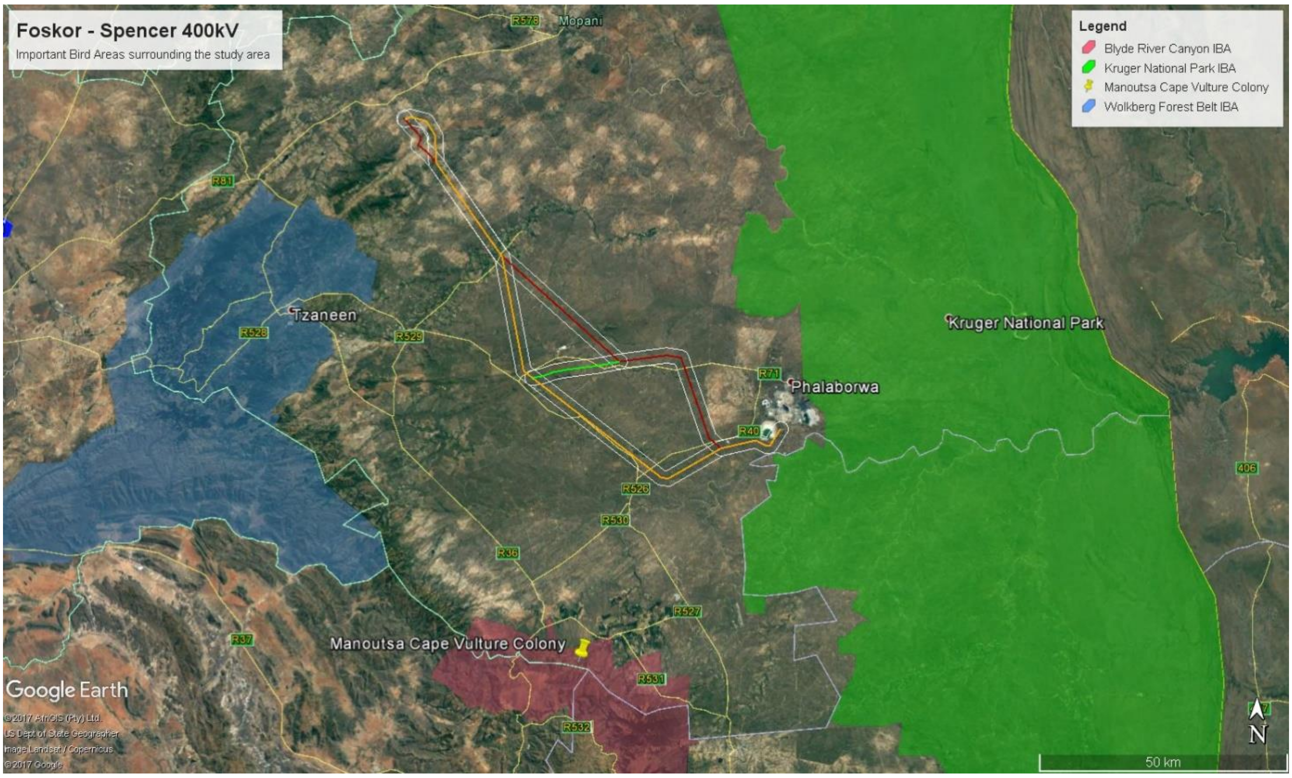

Figure 4: The location of Important Bird Areas (IBAs) relative to the study area

Although these IBAs are located within close proximity (in bird terms – particularly for wide ranging species) to the study area, the proposed development should not have any direct impact on avifauna in any of the IBAs. A possible exception to this are vultures resident in the Kruger National Park and at the Manoutsa Cape Vulture colony in the Blyde River Canyon IBA. Vultures are known to be vulnerable to collisions with powerlines, and their vast powers of flight and extensive foraging ranges will result in them regularly flying over the study area, or even roosting and feeding in or around the study area. Two Cape Vultures tagged with satellite tracking devices for 18 months between January 2012 and July 2013 regularly flew over the study area (Wolter unpublished data) (see Figure 5). Regular presence over the study area was also observed for White-backed Vultures fitted with tracking devices over a period of 9 months from September 2016 onwards (Wolter email comm. 2017), indicating that vulture traffic over the area is constant (see also 4.3 below).

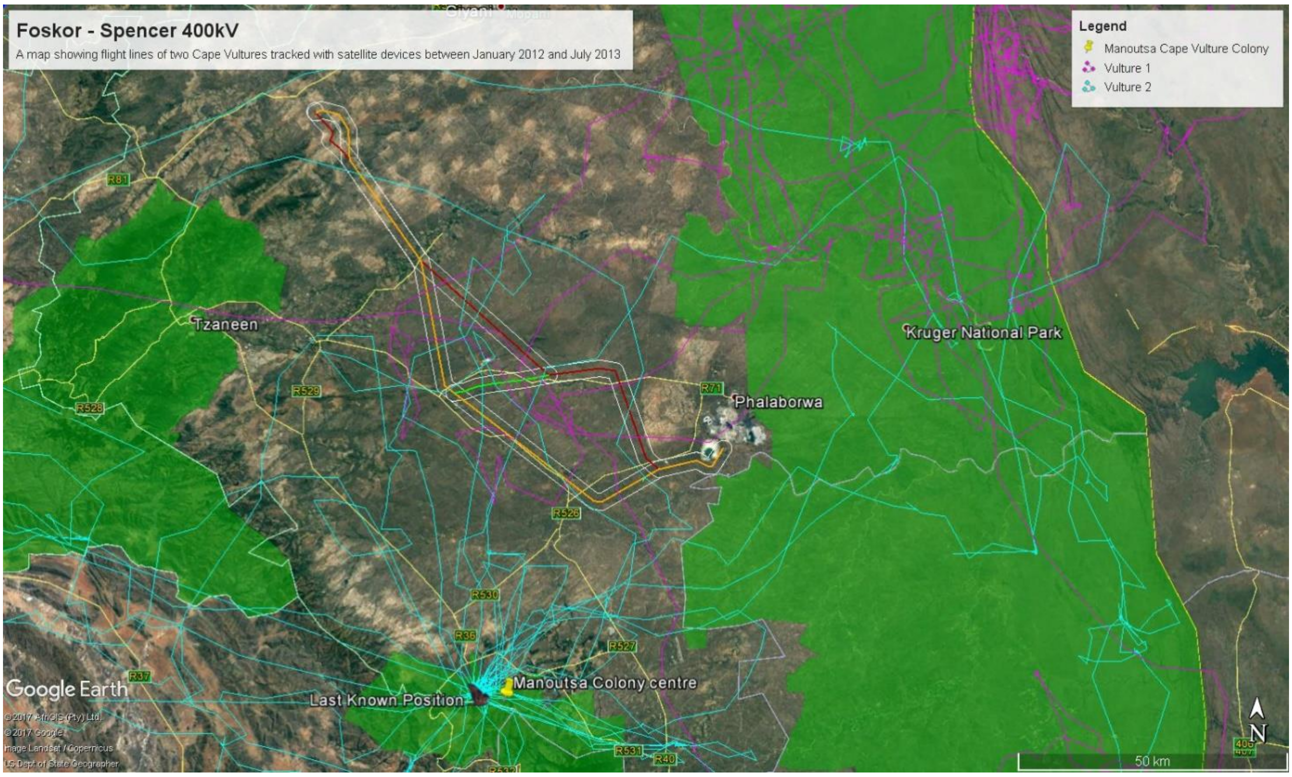

Figure 5: Recorded flight lines of two satellite tagged Cape Vultures (Source: Kerri Wolter, Vulpro)

4.2 Protected Areas

The study area is located in the Kruger to Canyons Biosphere Reserve[3], and the portion of the proposed alignments between the Groot Letaba River and Foskor MTS runs through an area consisting mostly of formal and informal private nature reserves, where land use is primarily a mixture of game breeding and eco-tourism (game lodges). These areas include inter alia prominent conservation areas such as Selati Game Reserve, Grietjie Nature Reserve, Olifants North Game Reserve, Ndzalama Game Reserve, Hans Merensky Nature Reserve, Letaba Ranch and many smaller game ranches and reserves (see Figure 6). These reserves are generally managed in an ecologically sensitive manner, resulting in a contiguous area of hundreds of thousands of hectares of practically pristine avifaunal habitat stretching all the way to the Kruger National Park, making it effectively an extension of the latter as far as birds are concerned. This is especially important for large, wide ranging species such as vultures and large eagles.

[3] http://www.kruger2canyons.org

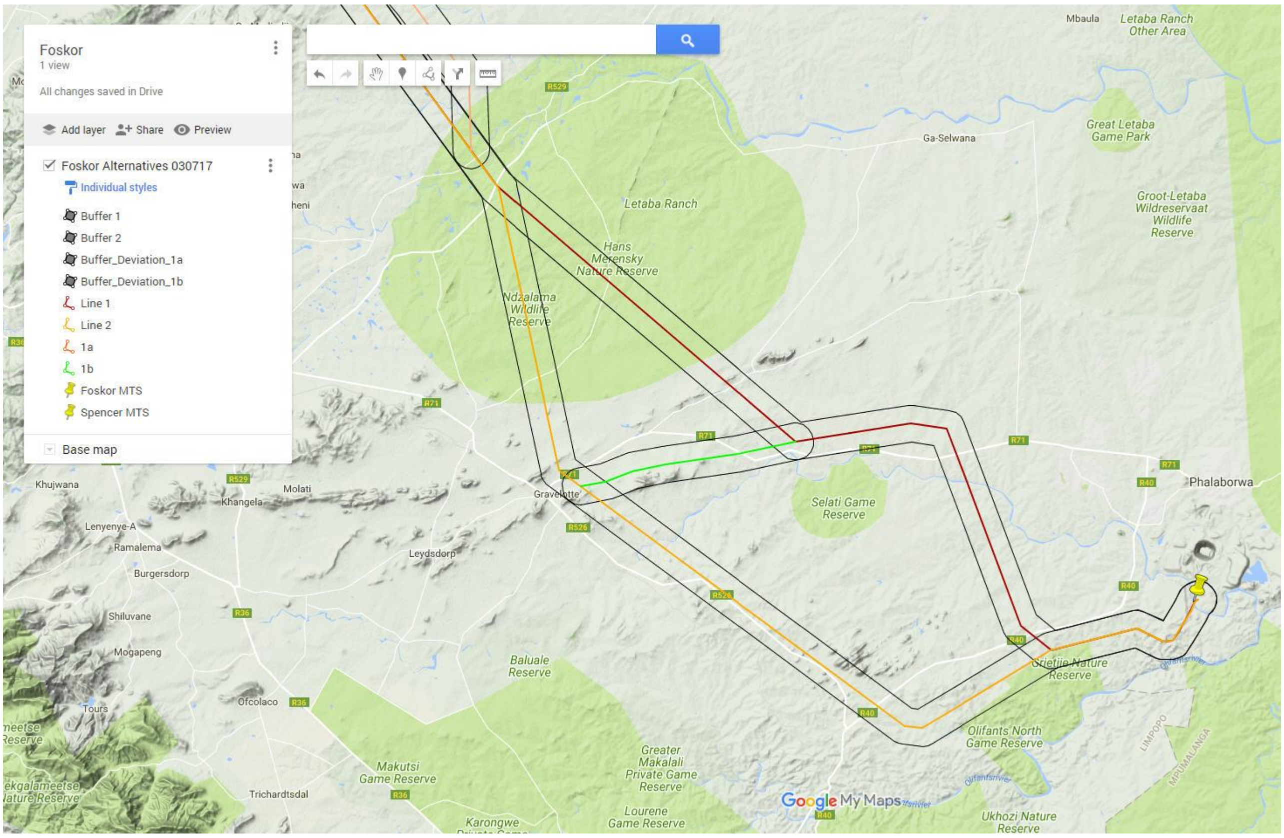

Figure 6: Prominent nature reserves in and around the study area (Source: Google Maps)

4.3 Vulture restaurants

The study area contains one active vulture restaurant, in the Selati Game Reserve (L.Joubert pers.comm 2017)(see Figure 7). According to the management of the Selati Game Reserve, various species of vultures, Marabou Storks, Tawny Eagles and Bateleurs feed there on a weekly basis, with vulture numbers ranging from 200 – 400 birds. Many of these birds are presumably resident in the nearby Kruger National Park.

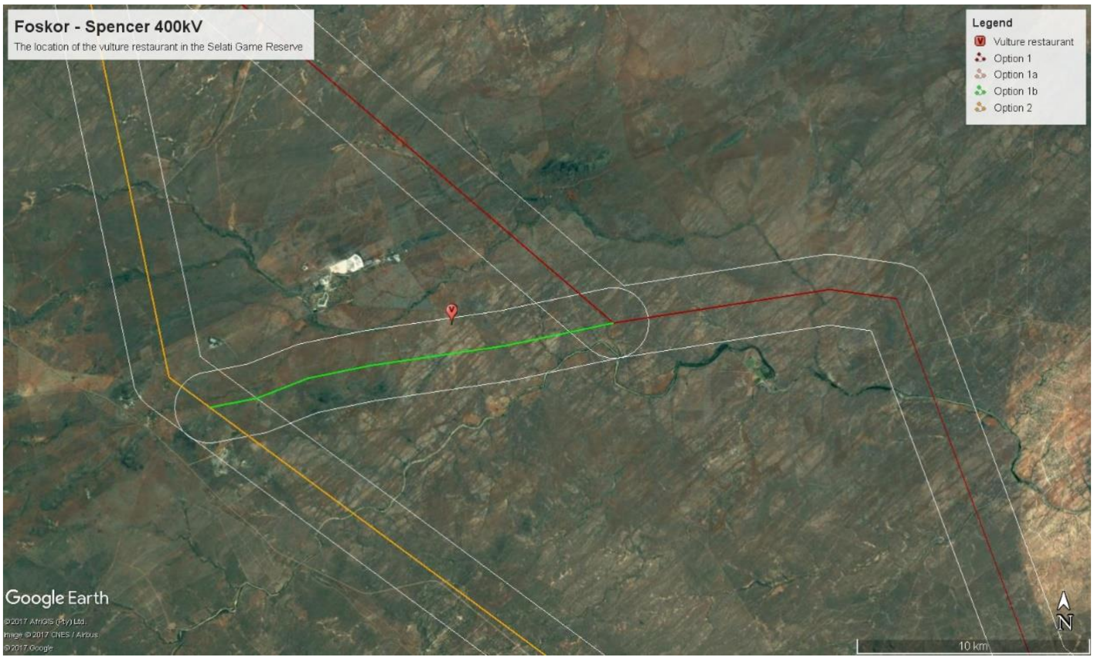

Figure 7: The location of the Selati Game Reserve vulture restaurant (Source: K. Wolter)

4.4 Primary vegetation divisions (biomes)

The study area extends over a single primary vegetation division, namely savanna (woodland) (Mucina & Rutherford 2006). It is generally accepted that vegetation structure, rather than the actual plant species, influences bird species distribution and abundance (Harrison *et al.* 1997). From an avifaunal perspective, the Atlas of southern African Birds (SABAP1) recognises six primary vegetation divisions or biomes within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison *et al.* 1997). These vegetation descriptions do not focus on lists of plant species, but rather on factors which are relevant to bird distribution. The criteria used by the SABAP 1 authors to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations.

4.5 Description of bird habitat classes

The following bird habitat classes were recorded in the study area (vegetation descriptions based largely on Harrison *et al.* 1997 and Mucina & Rutherford 2006):

4.5.1 Savanna

The study area is situated in the savanna biome and the natural woodland consists mainly of Phalaborwa-Timbavati Mopaneveld, Granite Lowveld and Tsende Mopaneveld, with small areas of Gravelotte Rocky Bushveld and Tzaneen Sour Bushveld (Muchina & Rutherford 2006). Phalaborwa-Timbavati Mopaneveld consists of open tree savanna on undulating plains with the sandy uplands dominated by *Combretum apicalatum* (Red Bushwillow), *Terminalea sericea* (Silver cluster-leaf) and *Colophospermum mopane* (Mopane). Granite Lowveld consists of tall shrubland with few trees to moderately dense low woodand on the deep sandy uplands with *Terminalea sericea*, *Combretum zeyheri* (Bushwillow) and *Combretum apicalatum*, while the bottomlands consist of dense thickets to open savanna with *Acacia nigrens* (Knobthorn), *Dichrostachys cinerea* (Sicklebush) and *Grewia bicolor* (White raisin) in the woody layer. Tsende Mopaneveld occurs on undulating terrain with medium-high shrubby savanna with some trees and a dense ground layer dominated by *Colosphospermum mopane*.

The natural woodland in the study area between Spencer MTS and the R529 provincial road has been heavily disturbed and eradicated in places. Bush clearing and removal of trees is clearly visible in some areas, and evidence of grazing pressure is evident in the depleted state of the grass layer and dense bush encroachment in places, especially in the immediate vicinity of towns and settlements. Large sections of the study area have been completely transformed by human settlement and subsistence farming. Very little undisturbed woodland remains, but a few relic patches of good quality woodland exist in some areas, particularly on koppies. The woodland areas are utilised mainly for live-stock grazing. The state of the woodland in the study area between the R529 and the Foskor MTS in Phalaborwa is markedly different and consists of mostly undisturbed, pristine savanna, utilised for game farming and eco-tourism. Large trees are plentiful and the grass layer is dense.

SABAP 2 reporting rates for large power line sensitive Red Data vultures and eagles occurring in the study area are generally high (see Table 4-1), which is a strong indicator of a healthy ecosystem, which is certainly the case with the areas utilised for game farming and eco-toursim. Red Data species that could potentially occur in undisturbed woodland in the study area are Lanner Falcon, Verreaux's Eagle (around koppies), European Roller, Marabou Stork, Bateleur, Tawny Eagle, Cape Vulture, Martial Eagle, Lappet-faced Vulture, Southern Ground-Hornbill, Bat Hawk, White-backed Vulture, Hooded Vulture and White-headed Vulture. The disturbed woodland in the subsistence farming areas is unlikely to regularly support the same rich complement of raptors, but vultures also forage in those areas.

4.5.2 Rivers

The study area is bisected by the Groot Letaba River as well as many smaller rivers, including prominent rivers like the Merekome, Lerwatlou and Ga-Selati. Rivers are important habitat for birds in the study area in that they act as corridors of microhabitat for waterbirds. These ephemeral rivers generally only flow in the rainy season, but pools of water can persist for many months into the dry season and aquatic organisms that occur in those pools provide potential sources of food for various species, including the Red Data Black Stork, Yellow-billed Stork, Saddle-billed Stork, Marabou Stork and Greater Painted-snipe. Thick riverine vegetation provides cover for the skulking Red Data White-backed Night-heron. Rivers are also important for large raptors and vultures for bathing and drinking purposes, and vultures often congregate in numbers on sandbanks to sun-bathe. The pools in the ephemeral rivers also attract many other non-threatened waterbirds apart from the Red Data species mentioned above.

4.5.3 Dams

Many thousands of earthen and other dams exist in the southern African landscape. Whilst dams have altered flow patterns of streams and rivers, and affected many bird species detrimentally, a number of species have benefited from their construction. The construction of these dams has probably resulted in a range expansion for many water bird species that were formerly restricted to areas of higher rainfall. Man-made impoundments, although artificial in nature, can be very important for a variety of birds, particularly water birds. Apart from the water quality, the structure of the dam, and specifically the margins and the associated shoreline and vegetation, plays a big role in determining the species that will be attracted to the dam. Non-Red Data species in the study area that could use dams and dam edges include Red-knobbed Coot *Fulica cristata*, Black-headed Heron *Ardea melanocephala*, Red-billed Teal *Anas erythrorhyncha* White-faced Duck *Dendrocygna viduata*, Yellow-billed Duck *Anas undulata*, Blacksmith Lapwing *Vanellus armatus,* African Sacred Ibis *Threskiornis aethiopicus* and Egyptian Goose *Alopochen aegyptiaca,* and many others. The study area does not contain any prominent dams, but a few dams are present along the Groot Letaba River mainly for irrigation purposes. Red Data species recorded in the study area by SABAP 2 that could potentially be attracted to these dams include Black Stork, Yellow-billed Stork, Marabou Stork and Saddle-billed Stork.

4.5.4 Agricultural clearings and old lands

The tilling of soil is one of the most drastic and irrevocable transformations brought on the environment. It completely destroys the structure and species composition of the natural vegetation, either temporarily or permanently. However, arable or cultivated land may represent a significant feeding area for many bird species in any landscape for the following reasons: through opening up the soil surface, land preparation makes many insects, seeds, bulbs and other food sources suddenly accessible to birds and other predators; the crop or pasture plants cultivated are often themselves fed on by birds, or attract insects which are in turn fed on by birds; during the dry season arable lands often represent the only green or attractive food sources in an otherwise dry landscape. The study area between Spencer MTS and R529 contains many subsistence agricultural lands and old agricultural clearings, while the areas on both sides of the Groot Letaba River contains extensive irrigated crops where citrus is cultivated commercially.

In general, agricultural areas are of lesser importance for the Red Data species recorded in the study area, compared to the other avifaunal habitats (i.e. woodland, rivers and dams). None of the Red Data species likely to utilise agricultural lands and old clearings in the study area on a regular basis. The one possible exception is Lanner Falcon which sometimes hunt small birds in agricultural clearings in rural areas.

4.5.5 Koppies and ridges

There are a few ridges and koppies in the study area. The koppies are potentially suitable roosting and breeding habitat for the Red Data Lanner Falcon. The Red Data Verreaux's Eagle could on occasion forage on ridges and koppies in search of rock hyrax.

See APPENDIX 1 for a photographic record of the bird habitats in the study area.

4.6 Power line sensitive species occurring in the study area

A total of 22 Red Data species could potentially occur in the study area (Table 4-1). For each species, the potential for occurring in a specific habitat class is indicated, as well as the type of impact that could potentially affect the species **in the study area**.

Table 4-1: Red Data species that could potentially occur in the study area.

CR = Critically endangered EN = Endangered VU = Vulnerable NT = Near-threatened LC = Least concern

Name	Global conservation status (IUCN 2017)	National conservation status (Taylor *et al.* 2015)	Consolidated reporting rate in the SABAP 2 pentads %	Rivers	Koppies	Dams	Savanna	Agricultural clearings	Collisions	Electrocutions	Displacement through disturbance	Displacement through habitat destruction
Martial Eagle *Polemaetus bellicosus*	VU	EN	6.54	x	-	-	x	-	x	-	x	x
Lanner Falcon *Falco biarmicus*	LC	VU	4.67	-	x	-	x	x	x	-	-	-
European Roller *Coracias garrulus*	LC	NT	12.15	-	-	-	x	-	-	-	-	-
Yellow-billed Stork *Mycteria ibis*	LC	EN	0.31	x	-	x	-	-	x	-	-	-
Greater Painted-snipe *Rostratula benghalensis*	LC	NT	0.62	x	-	x	-	-	-	-	-	-
Marabou Stork *Leptoptilos crumeniferus*	LC	NT	2.8	x	-	-	x	-	x	-	-	-

Name	Global conservation status (IUCN 2017)	Conservation status (Taylor *et al.* 2015)	Consolidated reporting rate in the SABAP 2 pentads %	Rivers	Koppies	Dams	Savanna	Agricultural clearings	Collisions	Electrocutions	Displacement through disturbance	Displacement through habitat destruction
Cape Vulture *Gyps coprotheres*	EN	EN	7.48	x	-	-	x	-	x	-	-	-
White-backed Vulture *Gyps africanus*	CR	CR	36.14	x	-		x	-	x	-	x	x
Black Stork *Ciconia ciconia*	LC	VU	4.67	x	-	-	-	-	x	-	-	-
Tawny Eagle *Aquila rapax*	LC	EN	10.59	x	-	-	x	-	x	-	x	x
Bateleur *Terathopius ecaudatus*	NT	EN	27.41	x	-	-	x	-	x	-	x	x
Lappet-faced Vulture *Torgos tracheliotis*	EN	EN	4.98	x	-	-	x	-	x	-	x	x

Name	Global conservation status (IUCN 2017)	Conservation status (Taylor *et al.* 2015)	Consolidated reporting rate in the SABAP 2 pentads %	Rivers	Koppies	Dams	Savanna	Agricultural clearings	Collisions	Electrocutions	Displacement through disturbance	Displacement through habitat destruction
White-headed Vulture *Trigonoceps occipitalis*	CR	CR	0.93	x	-	-	x	-	x	-	x	x
Pel's Fishing-Owl *Scotopelia peli*	LC	EN	0.62	x	-	-	-	-	-	-	x	
Hooded Vulture *Necrosyrtes monachus*	CR	CR	14.95	x	-	-	x	-	x	-	x	x
Half-collared Kingfisher *Alcedo semitorquata*	LC	NT	0.62	x	-	-	-	-	-	-	-	x
Bat Hawk *Macheiramphus alcinus*	LC	EN	0.62	-	-	-	x	-	x	-	x	x
Southern Ground-Hornbill *Bucorvus leadbeateri*	VU	EN	0.93	-	-	-	x	x	x	-	x	x

Name	Global conservation status (IUCN 2017)	Conservation status (Taylor *et al.* 2015)	Consolidated reporting rate in the SABAP 2 pentads %	Rivers	Koppies	Dams	Savanna	Agricultural clearings	Collisions	Electrocutions	Displacement through disturbance	Displacement through habitat destruction
Saddle-billed Stork *Ephippiorhynchus senegalensis*	LC	EN	2.8	x	-	-	-	-	x	-	x	x
Curlew Sandpiper *Calidris ferruginea*	NT	-	0.31	x	-	x	-	-	-	-	-	-
Verreaux's Eagle *Aquila verreauxii*	LC	VU	1.25	-	x	-	-	-	x	-	-	-
White-backed Night-Heron *Gorsachius leuconotus*	LC	VU	0.31	x	-	-	-	-	x	-	x	x

5. DESCRIPTION OF EXPECTED IMPACTS

Because of their size and prominence, electrical infrastructure constitutes an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds (and other animals) and birds colliding with power lines (Ledger and Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs and Ledger 1986a; Hobbs and Ledger 1986b; Ledger, Hobbs and Smith, 1992; Verdoorn 1996; Kruger and Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000; Anderson 2001; Shaw 2013).

5.1 Electrocutions

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). The electrocution risk is largely determined by the pole/tower design. In the case of a 400kV line, such as is the case with the proposed Foskor - Spencer line, the clearances between the live components, and the earthed and live components, are too large for any bird to bridge. Electrocution can therefore be ruled out as a potential impact on Red Data species in this instance.

5.2 Collisions

Collisions are probably the biggest single threat posed by transmission lines to birds in southern Africa (van Rooyen 2004; Shaw 2013). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds. These species are mostly heavy-bodied birds with limited manoeuvrability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004; Anderson 2001; Shaw 2013).

In her PhD study, Shaw (2013) provides a concise summary of the phenomenon of avian collisions with power lines:

“The collision risk posed by power lines is complex and problems are often localised. While any bird flying near a power line is at risk of collision, this risk varies greatly between different groups of birds, and depends on the interplay of a wide range of factors (APLIC 1994). Bevanger (1994) described these factors in four main groups – biological, topographical, meteorological and technical. Birds at highest risk are those that are both susceptible to collisions and frequently exposed to power lines, with waterbirds, gamebirds, rails, cranes and bustards usually the most numerous reported victims (Bevanger 1998, Rubolini *et al*. 2005, Jenkins *et al*. 2010).

The proliferation of man-made structures in the landscape is relatively recent, and birds are not evolved to avoid them. Body size and morphology are key predictive factors of collision risk, with large-bodied birds with high wing loadings (the ratio of body weight to wing area) most at risk (Bevanger 1998, Janss 2000). These birds must fly fast to remain airborne, and do not have sufficient manoeuvrability to avoid unexpected obstacles. Vision is another key biological factor, with many collision-prone birds principally using lateral vision to navigate in flight, when it is the low-resolution and often restricted, forward vision that is useful to detect obstacles (Martin & Shaw 2010, Martin 2011, Martin *et al*. 2012). Behaviour is important, with birds flying in flocks, at low levels and in crepuscular or nocturnal conditions at higher risk of collision (Bevanger 1994). Experience affects risk, with migratory and nomadic species that spend much of their time in unfamiliar locations also expected to collide more often (Anderson 1978, Anderson 2002). Juvenile birds have often been reported as being more collision-prone than adults (e.g. Brown *et al.* 1987, Henderson *et al.* 1996).

Topography and weather conditions affect how birds use the landscape. Power lines in sensitive bird areas (e.g. those that separate feeding and roosting areas, or cross flyways) can be very dangerous (APLIC 1994, Bevanger 1994). Lines crossing the prevailing wind conditions can pose a problem for large birds that use the wind to aid take-off and landing (Bevanger 1994). Inclement weather can disorient birds and reduce their flight altitude, and strong winds can result in birds colliding with power lines that they can see but do not have enough flight control to avoid (Brown *et al*. 1987, APLIC 1994).

The technical aspects of power line design and siting also play a big part in collision risk. Grouping similar power lines on a common servitude, or locating them along other features such as tree lines, are both approaches thought to reduce risk (Bevanger 1994). In general, low lines with short span lengths (i.e. the distance between two adjacent pylons) and flat conductor configurations are thought to be the least dangerous (Bevanger 1994, Jenkins *et al.* 2010). On many higher voltage lines, there is a thin earth (or ground) wire above the conductors, protecting the system from lightning strikes. Earth wires are widely accepted to cause the majority of collisions on power lines with this configuration because they are difficult to see, and birds flaring to avoid hitting the conductors often put themselves directly in the path of these wires (Brown *et al.* 1987, Faanes 1987, Bevanger 1994)."

As mentioned by Shaw (2013) in the extract above, several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions and power line configuration. An important additional factor that previously has received little attention is the visual capacity of birds; i.e. whether they are able to see obstacles such as power lines, and whether they are looking ahead to see obstacles with enough time to avoid a collision. In addition to helping explain the susceptibility of some species to collision, this factor is essential to planning effective mitigation measures. Recent research provides the first evidence that birds can render themselves blind in the direction of travel during flight through voluntary head movements (Martin & Shaw 2010). Visual fields were determined in three bird species representative of families known to be subject to high levels of mortality associated with power lines i.e. Kori Bustards, Blue Cranes and White Storks. In all species the frontal visual fields showed narrow and vertically long binocular fields typical of birds that take food items directly in the bill under visual guidance. However, these species differed markedly in the vertical extent of their binocular fields and in the extent of the blind areas which project above and below the binocular fields in the forward facing hemisphere. The importance of these blind areas is that when in flight, head movements in the vertical plane (pitching the head to look downwards) will render the bird blind in the direction of travel. Such movements may frequently occur when birds are scanning below them (for foraging or roost sites, or for conspecifics). In bustards and cranes pitch movements of only 25° and 35° respectively are sufficient to render the birds blind in the direction of travel; in storks head movements of 55° are necessary. That flying birds can render themselves blind in the direction of travel has not been previously recognised and has important implications for the effective mitigation of collisions with human artefacts including wind turbines and power lines. These findings have applicability to species outside of these families especially raptors (*Accipitridae*) which are known to have small binocular fields and large blind areas similar to those of bustards and cranes, and are also known to be vulnerable to power line collisions.

Thus visual field topographies which have evolved primarily to meet visual challenges associated with foraging may render certain bird species particularly vulnerable to collisions with human artefacts, such as power lines and wind turbines that extend into the otherwise open airspace above their preferred habitats. For these species placing devices upon power lines to render them more visible may have limited success since no matter what the device the birds may not see them. It may be that in certain situations it may be necessary to distract birds away from the obstacles, or encourage them to land nearby (for example by the use of decoy models of conspecifics, or the provision of sites attractive for roosting) since increased marking of the obstacle cannot be guaranteed to render it visible if the visual field configuration prevents it being detected. Perhaps most importantly, the results indicate that collision mitigation may need to vary substantially for different collision prone species, taking account of species specific behaviours, habitat and foraging preferences, since an effective all-purpose marking device is probably not reaDataic if some birds do not see the obstacle at all (Martin & Shaw 2010).

Despite speculation that line marking might be ineffective for some species due to differences in visual fields and behaviour, or have only a small reduction in mortality in certain situations for certain species, particularly bustards (Martin & Shaw 2010; Barrientos *et al.* 2012; Shaw 2013), it is generally accepted that marking a line with PVC spiral type Bird Flight Diverters (BFDs) can reduce the collision mortality rates (Sporer *et al.* 2013; Barrientos *et al.* 2012, Alonso & Alonso 1999; Koops & De Jong 1982). Regardless of statistical significance, a slight mortality reduction may be very biologically relevant in areas, species or populations of high conservation concern (e.g. Ludwig's Bustard) (Barrientos *et al.* 2012). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. A recent study reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease in bird collisions. At unmarked lines, there were 0.21 deaths/1000 birds (n = 339,830) that flew among lines or over lines. At marked lines, the mortality rate was 78% lower (n = 1,060,746) (Barrientos *et al.* 2011). Koops and De Jong (1982) found that the spacing of the BFDs were critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5 metres, whereas using the same devices at 10 metre intervals only reduces the mortality by 57%. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important, as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin *et al.* 2010).

A potential impact of the proposed 400kV sub-transmission line is collisions with the earth wire of the proposed lines. Quantifying this impact in terms of the likely number of birds that will be impacted, is very difficult because such a huge number of variables play a role in determining the risk, for example weather, rainfall, wind, age, flocking behaviour, power line height, light conditions, topography, population density and so forth. However, from incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are likely to be impacted upon (see Figure 8 below - Jenkins *et al.* 2010). This only gives a measure of the general susceptibility of the species to power line collisions, and not an absolute measurement for any specific line.

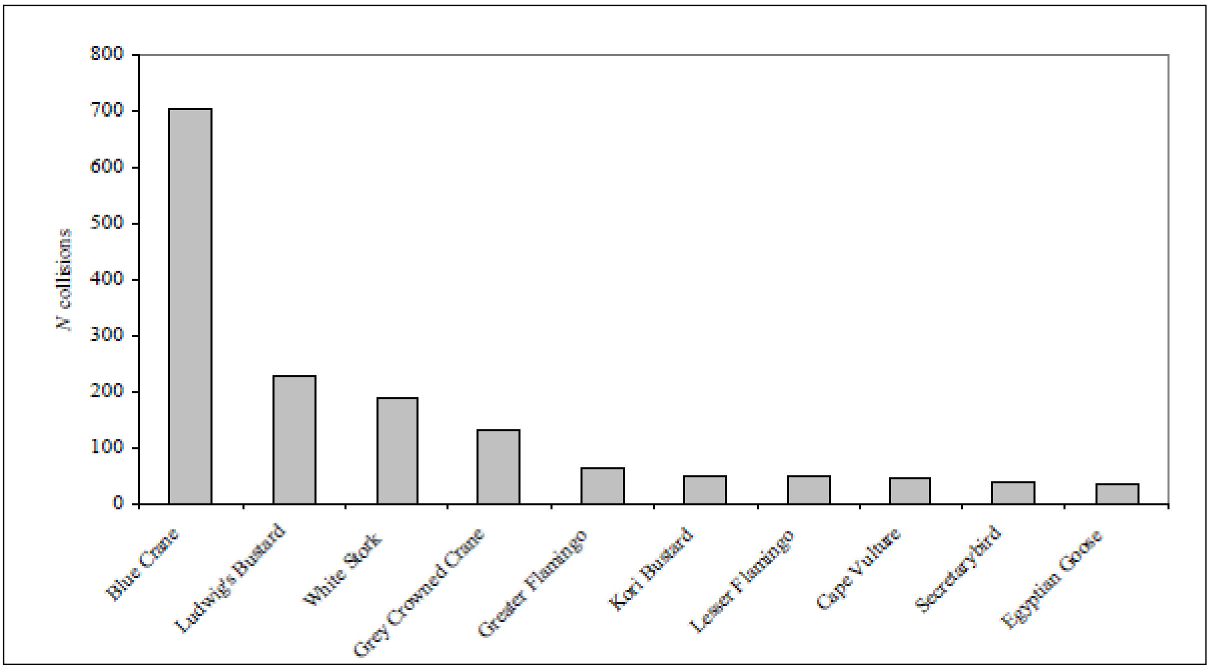

Figure 8: The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/EWT Strategic Partnership central incident register 1996 - 2008 (Jenkins *et al.* 2010)

In the present instance, potential Red Data candidates for collision mortality in the woodland habitat on the proposed power line are Cape Vulture, White-backed Vulture, Lappet-faced Vulture, Hooded Vulture, Marabou Stork, Martial Eagle, White-headed Vulture, Tawny Eagle, Bateleur and Southern Ground-hornbill. Collisions are likely to be few and far between, as there are no specific areas where one would expect a concentration of birds in the **woodland habitat**, except at the active vulture restaurant in the Selati Game Reserve. Several species of vultures and eagles, as well as Marabou Storks would be most at risk of collision if they descend to a carcass at the restaurant, if the proposed line (Option 1b) is located within 500m or less of the active restaurant. It is also possible that the vultures could start roosting in numbers on the 400kV line in the vicinity of the vulture restaurant, depending on which tower structure will be used. While this would not necessarily be a negative development as far as the birds are concerned, it could mean that intermittent collisions could be possible with the earthwire of the line when birds fly between roosting towers. This has been observed at other vulture restaurants where birds are using the high voltage lines to roost on.

There may be a limited risk of collisions for Lanner Falcons in **agricultural clearings**.

There is a potential collision risk associated with **rivers** as it is expected that waterbirds will commute up and down the river when it is flowing or when it contains large pools of standing water. Red Data waterbird species that could be impacted in this manner are Yellow-billed Stork, Saddle-billed Stork, Black Stork, and Marabou Stork as well as many other non-threatened waterbirds. Large pools of standing water and sandbanks attracts vultures and eagles, there could therefore be a collision risk for these species should the line skirt or cross any of these features, especially in the Ga-Selati River which is situated in pristine woodland with ample sandbanks where Option 1and 2 cross it.

A few **dams** are present along the Groot Letaba River mainly for irrigation purposes. These dams could attract several non-Red Data waterbird species, and Red Data species such as Yellow-billed Stork, Marabou Stork, White-backed Night-Heron and Black Stork.

The collision risk associated with koppies is likely to be insignificant as the line would most likely not be built across koppies, due to the technical challenges. However, in the unlikely event of that happening, there will be a limited risk of collisions to Lanner Falcon and Verreaux's Eagle.

5.3 Displacement due to habitat destruction and disturbance

During the construction phase and maintenance of power lines and associated infrastructure, some habitat destruction and transformation inevitably takes place. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line, which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through transformation of habitat, which could result in temporary or permanent displacement.

In the present instance, the risk of displacement of Red Data species due to habitat transformation is likely to be fairly limited for the area between Spencer MTS and the R529 provincial road, due to the extensive impacts already evident on the natural woodland. Most of the study area have been impacted significantly by human settlement and subsistence farming. The biggest potential impact would be the removal of large trees that could potentially serve as nesting substrate for large Red Data raptors such as Martial Eagle (and many other non-threatened avifauna), although few suitable large trees remain. Furthermore, the high levels of disturbance and significant habitat transformation make it unlikely that large raptors will breed in the study area. The biggest potential impact is likely to be on koppies, ridges, and some of the ephemeral rivers where the natural habitat is more intact. The largest trees are likely to be found where the proposed alignment crosses the Groot Letaba River.

The situation is different as far as the section of the study area between the R529 provincial road and the Foskor Substation is concerned. This section of the study area runs through relatively pristine woodland, with many large trees which are suitable for breeding large raptors. The bush clearing associated with the construction of the line will have a more significant impact on the natural vegetation, due to the relatively pristine state of the bush. However, due to the availability of many large trees in the study area and its immediate environment, the impact of tree removal in the servitude will be limited, due to the availability of alternative nesting substrate. Furthermore, the powerline will provide a safe roosting space for raptors and vultures, which may off-set the loss of a number of large trees to some extent.

Apart from direct habitat destruction, the above mentioned construction and maintenance activities also impact on birds through **disturbance**; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities in close proximity could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests. The relatively high reporting rates for Red Data species in the study area are an indication that they may regularly utilise the area for breeding. Once the alignment is authorised, a detailed inspection would be required to establish if there are any breeding Red Data species that could be disturbed. In such an event, appropriate mitigation measures would need to be implemented (such as postponing the construction of the line to avoid peak breeding season).

6 ASSESSMENT OF EXPECTED IMPACTS

6.1 Assessment criteria

Impacts are described and then evaluated in terms of the criteria given below.

Criteria	Rating Scales	Notes
Nature	**Positive**	This is an evaluation of the type of effect the construction, operation and management of the proposed development would have on the affected environment. Would it be positive, negative or neutral?
	Negative	
	Neutral	
Extent	**Footprint**	Site-specific, affects only the development footprint
	Site	The impact could affect the whole or a significant portion of the site.
	Regional	The impact could affect the area including the neighbouring farms, the transport routes and adjoining towns or cities.
Duration	**Short**	The impact will be relevant through to the end of the construction phase.
	Medium	The impact will last up to the end of the development phases, where after it will be entirely negated.
	Long term	The impact will continue or last for the entire operational lifetime of the development
Severity	**Low**	Where the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected
	Medium	Where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive or vulnerable systems or communities are negatively affected
	High	Where natural, cultural or social functions and processes are altered to the extent that the impact will temporarily or permanently cease; and valued, important, sensitive or vulnerable systems or communities are substantially affected.

Potential for impact on irreplaceable resources	**No**	No irreplaceable resources will be impacted.
	Yes	Irreplaceable resources will be impacted.
Consequence	**Extremely detrimental**	A combination of extent, duration, intensity and the potential for impact on irreplaceable resources.
	Highly detrimental	
	Moderately detrimental	
	Slightly detrimental	
	Negligible	
	Slightly beneficial	
	Moderately beneficial	
Probability	**Improbable**	Improbable. It is highly unlikely or less than 50 % likely that an impact will occur.
	Probable	Distinct possibility. It is between 50 and 70 % certain that the impact will occur.
	Definite	Most likely. It is more than 75 % certain that the impact will occur or it is definite that the impact will occur.
Significance	**Very high - negative**	A function of Consequence and Probability
	High - negative	
	Moderate - negative	
	Low - negative	
	Very low	
	Low - positive	
	Moderate - positive	
	High - positive	
	Very high - positive	

- ***Nature:*** This is an evaluation of the type of effect the construction, operation and management of the proposed development would have on the affected environment. Will the impact change in the environment be positive, negative or neutral?

- ***Extent or scale:*** This refers to the spatial scale at which the impact will occur. Extent of the impact is described as: footprint (affecting only the footprint of the development), site (limited to the site) and regional (limited to the immediate surroundings and closest towns to the site).

- ***Duration:*** The lifespan of the impact is indicated as short, medium and long term.

- ***Severity:*** This is a relative evaluation within the context of all the activities and the other impacts within the framework of the project. Does the activity destroy the impacted environment, alter its functioning, or render it slightly altered?

- ***Impact on irreplaceable resources:*** This refers to the potential for an environmental resource to be replaced, should it be impacted. A resource could possibly be replaced by natural processes (e.g. by natural colonisation from surrounding areas), through artificial means (e.g. by reseeding disturbed areas or replanting rescued species) or by providing a substitute resource, in certain cases. In natural systems, providing substitute resources is usually not possible, but in social systems substitutes are often possible (e.g. by constructing new social facilities for those that are lost). Should it not be possible to replace a resource, the resource is essentially irreplaceable e.g. Red Data species that are restricted to a particular site or habitat of very limited extent.

- ***Consequence:*** The consequence of the potential impacts is a summation of above criteria, namely the extent, duration, intensity and impact on irreplaceable resources.

- ***Probability of occurrence:*** The probability of the impact actually occurring based on professional experience of the specialist with environments of a similar nature to the site and/or with similar projects. It is important to distinguish between probability of the impact occurring and probability that the activity causing a potential impact will occur. Probability is defined as the probability of the impact occurring, not as the probability of the activities that may result in the impact. The fact that an activity will occur does not necessarily imply that an impact will occur. For instance, the fact that a road will be built does not necessarily imply that it will impact on a wetland. If the road is properly routed to avoid the wetland, the impact may not occur at all, or the probability of the impact will be low, even though it is certain that the activity will occur.
- ***Significance:*** Impact significance is defined to be a combination of the consequence (as described below) and probability of the impact occurring. The relationship between consequence and probability highlights that the risk (or impact significance) must be evaluated in terms of the seriousness (consequence) of the impact, weighted by the probability of the impact actually occurring. The following analogy provides an illustration of the relationship between consequence and probability. The use of a vehicle may result in an accident (an impact) with multiple fatalities, not only for the driver of the vehicle, but also for passengers and other road users. There are certain mitigation measures (e.g. the use of seatbelts, adhering to speed limits, airbags, anti-lock braking, etc.) that may reduce the consequence or probability or both. The probability of the impact is low enough that millions of vehicle users are prepared to accept the risk of driving a vehicle on a daily basis. Similarly, the consequence of an aircraft crashing is very high, but the risk is low enough that thousands of passengers happily accept this risk to travel by air on a daily basis. In simple terms, if the consequence and probability of an impact is high, then the impact will have a high significance. The significance defines the level to which the impact will influence the proposed development and/or environment. It determines whether mitigation measures need to be identified and implemented and whether the impact is important for decision-making.

- ***Degree of confidence in predictions:*** The specialist must provide an indication of the degree of confidence (low, medium or high) that there is in the predictions made for each impact, based on the available information and their level of knowledge and expertise. Degree of confidence is not taken into account in the determination of consequence or probability.

- ***Mitigation measures:*** Mitigation measures are designed to reduce the consequence or probability of an impact, or to reduce both consequence and probability. The significance of impacts has been assessed both with mitigation and without mitigation.

6.2 Assessment tables

The assessment of each impact is discussed and presented in tabular format as shown below for both "pre" and "post" mitigation. The different phases (Construction, Operation, and Decommissioning) are treated separately:

6.2.1 Construction phase

Impact	*Nature*	*Extent*	*Duration*	*Severity*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact: Displacement of Red Data species due to habitat destruction and disturbance associated with the construction of the power line									
Impact Description: Temporary displacement of Red Data species may occur during the construction phase of the power line, and may be caused by the noise and movement associated with the construction activities.									
Without Mitigation	Negative	Site	Short	Medium	No	Moderately detrimental	Probable	Moderate - negative	Medium
Mitigation Description: • The primary means of mitigating this impact is through the selection of the optimal route for the line through this area, explained in Section 7 below. This will ensure that high sensitivity habitats (e.g. rivers, dams and vulture restaurants) are avoided as far as possible. • Construction activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of Red Data species. • Measures to control noise should be applied according to current best practice in the industry. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned. • The final powerline alignment must be inspected on foot by the avifaunal specialist prior to construction to ascertain if any Red Data species nests are present. All relevant detail must be recorded i.e. species, coordinates and nest status. Should any nests be recorded, it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the Environmental Control Officer. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain when and where such breeding Red Data species could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle, once it has been established that a particular nest is active.									

Impact	*Nature*	*Extent*	*Duration*	*Severity*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
With Mitigation	Negative	Site	Short	Low	No	Slightly detrimental	Improbable	Low - Negative	High
Cumulative Impact: Although each power line probably affects a relatively small proportion of the landscape, there are already several existing activities and infrastructure in some parts of the study area that has resulted in significant habitat transformation, and additional infrastructure in the form of an additional powerline will add further cumulative impact. It is important therefore to try to limit the effects of this new power line as much as possible, by applying the mitigations described above.									

6.2.2 Operational phase

Impact	*Nature*	*Extent*	*Duration*	*Severity*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact: Collision of Red Data species with the earthwire of the 400kV line									
Impact Description: Red Data species mortality due to collisions with the earthwire of the power line.									
Without Mitigation	Negative	Regional	Long term	Medium	Yes	Moderately detrimental	Probable	Moderate-negative	Medium
Mitigation Description: • The primary means of mitigating this impact is through the selection of the optimal route for the line through this area, explained in Section 7 below. This will ensure that high sensitivity habitats (e.g. rivers, dams and vulture restaurants) are avoided as far as possible. • High risk sections of power line must be identified by a qualified avifaunal specialist during the walk-through phase of the project, once the alignment has been finalized. • Where power line marking is required (i.e. in areas that contain rivers, dams or is situated near a vulture restaurant) bird flight diverters must be installed on the full span length on each earthwire (according to Eskom guidelines - five metres apart). Light and dark colour devices must be alternated so as to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung.									
Impact	*Nature*	*Extent*	*Duration*	*Severity*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
With Mitigation	Negative	Regional	Long term	Low	Yes	Slightly detrimental	Probable	Low-Negative	Medium
Cumulative Impact:									

The cumulative impacts of power lines on several Red Data species, through collision are significant nationally. Specific concern exists for vultures because, while they are more vulnerable to electrocutions than collisions, they are also vulnerable to collisions, especially in high risk areas such as in close proximity to vulture restaurants. With mitigation, this could be reduced to low. The cumulative impact, if properly mitigated, is therefore regarded to be low, provided the proposed mitigation is implemented. The broader study area already has several existing power lines. No effort should be spared to ensure that the new power lines are built bird friendly and results in no additional impact on birds in the area.

7.2.3 De-commissioning phase

Impact	*Nature*	*Extent*	*Duration*	*Severity*	*Impact on Irreplaceable Resources*	*Consequence*	*Probability*	*Significance*	*Confidence*
Impact: Displacement of Red Data species due to disturbance associated with the decommissioning of the power line									
Impact Description: Displacement of Red Data species may occur during the decommissioning phase of the power line and may be caused by the noise and movement associated with the dismantling activities.									
Without Mitigation	Negative	Site	Short	Moderate	No	Moderately detrimental	Improbable	Moderate - negative	Medium
• Decommissioning activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of Red Data species. • Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. • The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as rehabilitation of disturbed areas is concerned.									
With Mitigation	Negative	Site	Short	Low	No	Slightly detrimental	Improbable	Low-Negative	Medium
Cumulative Impact: Very low									

7 SELECTION OF PREFERRED ALTERNATIVE

In order to arrive at a preferred corridor from an avifaunal impact perspective, the following methodology was employed:

- The study area was delineated into high, medium and low sensitivity habitat, based on the potential for negative impacts on Red Data species from the proposed 400kV line;
- The total surface area for each category of habitat was calculated in hectares, for each proposed corridor and corridor variation (see Figure 8).
- The corridor with the least amount of highly sensitive habitat was selected as the preferred corridor.

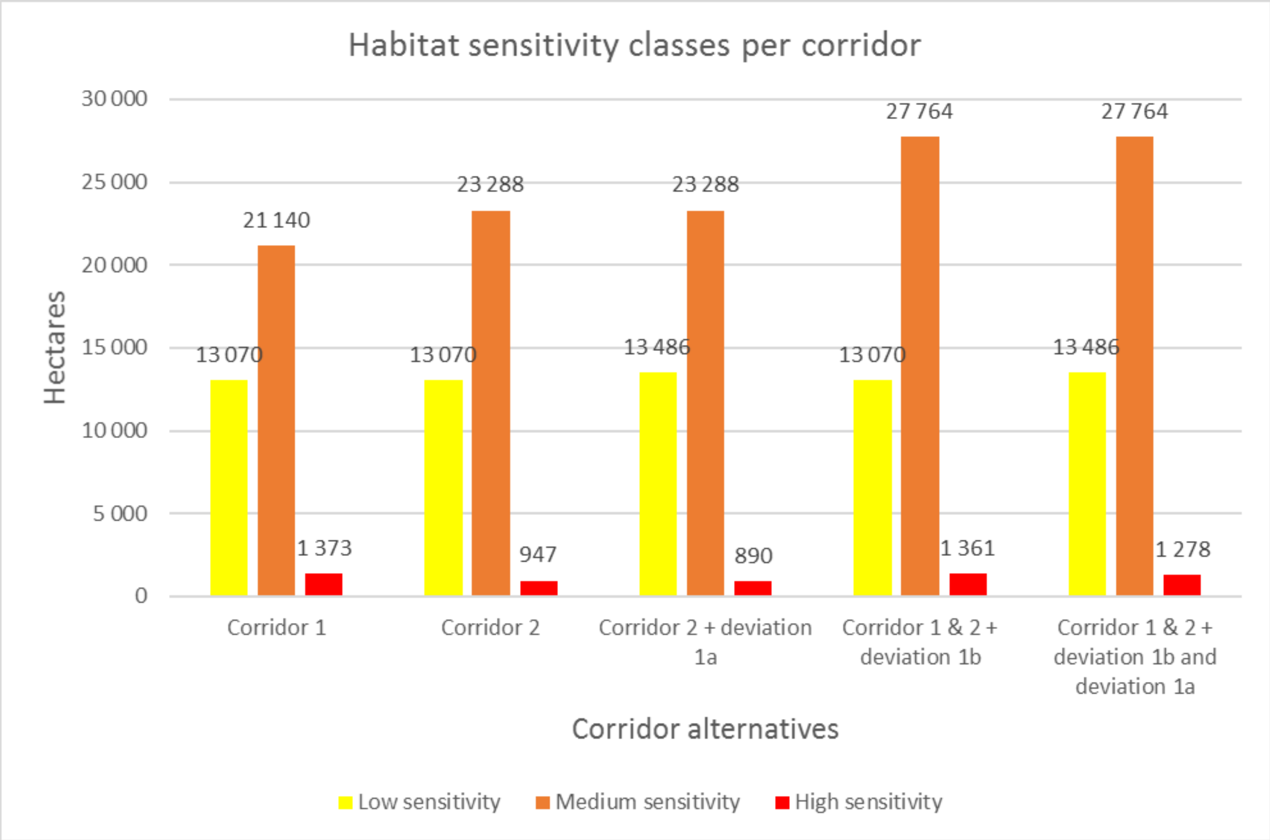

Figure 8: The various corridor options broken down per habitat sensitivity class, showing the total surface area in hectares for each habitat class.

Based on the methodology as set out above, Corridor 2 + deviation 1a emerged as the preferred corridor from a bird impact assessment perspective. However, none of the corridor options is fatally flawed from a bird impact perspective, provided the proposed mitigation is implemented.

See Figure 9 below for a sensitivity map of the study area.

Figure 9: Avifaunal sensitivity map of the study area.

8 CONCLUSIONS

In general, the habitat through which the proposed Foskor – Spencer 400kV corridors run is low to moderately sensitive from a potential bird powerline impact perspective, with a few areas of high sensitivity, namely rivers, dams and a vulture restaurant. The natural woodland habitat in the game farming and eco-tourism areas between Foskor substation and the R529 is likely to attract a number of Red Data power line sensitive species, mostly eagles and vultures, while the rivers are attractive to several Red Data powerline sensitive stork species, as well as vultures and eagles. Between the R529 and the Spencer substation the main economic activity is substance farming, with evidence of anthropogenic impacts, which is visible in the disturbed state of the majority of the woodland. This has had a negative impact on avifaunal diversity and abundance, with fewer Red Data species expected to be attracted to this section of the study area.

The construction of the proposed power line will result in various potential impacts on the birds occurring in the vicinity of the new infrastructure, with impacts ranging from low to moderate. The proposed power line poses a **moderate** collision risk which can be reduced to **low** through the application of mitigation measures. The habitat transformation and disturbance associated with the construction and decommissioning of the power line should have a **moderate** displacement impact, which could be reduced to **low** with appropriate mitigation. No electrocution risk is foreseen.

The project can proceed subject to the implementation of the following recommendations:

Mitigation for displacement:

- The primary means of mitigating this impact is through the selection of the optimal route for the line, explained in Section 7. This will ensure that high sensitivity habitats (e.g. rivers, dams and vulture restaurants) are avoided as far as possible.
- Construction activity should be restricted to the immediate footprint of the infrastructure.

- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of Red Data species.
- Measures to control noise should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned.
- The final powerline alignment must be inspected on foot by the avifaunal specialist prior to construction to ascertain if any Red Data species nests are present. All relevant detail must be recorded i.e. species, coordinates and nest status. Should any nests be recorded, it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the Environmental Control Officer. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain when and where such breeding Red Data species could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle, once it has been established that a particular nest is active.

Mitigation for collisions:

- The primary means of mitigating this impact is through the selection of the optimal route for the line, explained in Section 7. This will ensure that high sensitivity habitats (e.g. rivers, dams and vulture restaurants) are avoided as far as possible.
- High risk sections of power line must be identified by a qualified avifaunal specialist during the walk-through phase of the project, once the alignment has been finalized.
- Where power line marking is required (i.e. in areas that contain rivers, dams or is situated near a vulture restaurant) bird flight diverters must be installed on the full span length on each earthwire (according to Eskom guidelines - five metres apart). Light and dark colour devices must be alternated so as to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung.

Corridor 2 + deviation 1a emerged as the preferred corridor from a bird impact assessment perspective. However, none of the corridor options is fatally flawed from a bird impact perspective, provided the proposed mitigation is implemented.

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APPENDIX 1: BIRD HABITATS

Figure 1: An example of the woodland between the Spencer substation and the R529 provincial road, indicating high levels of disturbance.

Figure 2: A typical ephemeral river in the study area.

Figure 3: Agricultural lands in the subsistence farming areas.

Figure 4: Relic areas of intact woodland (savanna) are found mostly on ridges in the area between the Spencer substation and the R529 provincial road.

Figure 6: Pristine woodland in the commercial game farming area between the R529 and the Foskor substation.

Figure 7: The Groot Letaba River is the largest river in the study area.