BORUTHO – NZHELELE 400KV POWER LINE

AVIFAUNAL SPECIALIST STUDY

NOVEMBER 2012

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Professional registration

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"Only a registered person may practice in a consulting capacity" – Natural Scientific Professions Act of 2003 (20(1)-pg 14)

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Declaration of Independence

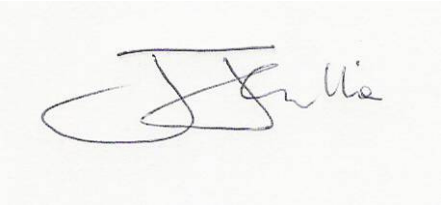
The specialist investigator declares that:

- We act as independent specialists for this project.
- We consider ourselves bound by the rules and ethics of the South African Council for Natural Scientific Professions.
- We do not have any personal or financial interest in the project except for financial compensation for specialist investigations completed in a professional capacity as specified by the Environmental Impact Assessment Regulations, 2006.
- We will not be affected by the outcome of the environmental process, of which this report forms part of.
- We do not have any influence over the decisions made by the governing authorities.
- We do not object to or endorse the proposed developments, but aim to present facts and our best scientific and professional opinion with regard to the impacts of the development.
- We undertake to disclose to the relevant authorities any information that has or may have the potential to influence its decision or the objectivity of any report, plan, or document required in terms of the Environmental Impact Assessment Regulations, 2006.
- Should we consider ourselves to be in conflict with any of the above declarations, we shall formally submit a Notice of Withdrawal to all relevant parties and formally register as an Interested and Affected Party.

Terms and Liabilities

- This report is based on a short term investigation using the available information and data related to the site to be affected. No long term investigation or monitoring was conducted.
- The Precautionary Principle has been applied throughout this investigation.
- Additional information may become known or available during a later stage of the process for which no allowance could have been made at the time of this report.
- The specialist investigator reserves the right to amend this report, recommendations and conclusions at any stage should additional information become available.
- Information, recommendations and conclusions in this report cannot be applied to any other area without proper investigation.
- This report, in its entirety or any portion thereof, may not be altered in any manner or form or for any purpose without the specific and written consent of the specialist investigator as specified above.
- Acceptance of this report, in any physical or digital form, serves to confirm acknowledgment of these terms and liabilities.

Signed on the 13th November 2012 by Jon Smallie in his capacity as specialist investigator.



EXECUTIVE SUMMARY

Eskom has identified a need for a new 400kV power line from the proposed substation called Borutho, west of Polokwane, to the proposed substation north of Makhado, called Nzhelele. Depending on which route is selected for the proposed power line, the line should be approximately 230 kilometres in length. Nzumbululo Heritage Solutions was appointed as the environmental practitioner on the project, and subsequently appointed Jon Smallie (WildSkies Ecological Services) as the avifaunal specialist.

A total of up to 494 bird species have been recorded across the 14 relevant quarter degree squares (Southern African Bird Atlas Project 1 – Harrison *et al,* 1997)(Southern African Bird Atlas Project 2 has already recorded 282 species, www.sabap2.adu.org.za) and hence could occur on the site of the proposed project. Up to 29 Red Listed species could occur on site, comprising 1 'Regionally extinct", 1 "Endangered", 15 'Vulnerable", and 12 "Near-threatened". Three additional species are considered as threatened for the purpose of this study. These are the White Stork *Ciconia ciconia*, Abdim's Stork *Ciconia abdimii* (both protected internationally under the Bonn Convention on Migratory Species), and the Hamerkop *Scopus umbretta* (the subject of recent conservation concern due to its apparently contracting range). Of the threatened species, the Cape Vulture is particularly important due to the presence nearby of two breeding colonies, at Blouberg Nature Reserve (800-868 breeding pairs, van Wyk pers. comm.), and Soutpansberg (173 breeding pairs, van Wyk pers. comm). It is well known that birds from these colonies forage in the wider area, and cross frequently between the two mountain ranges. This high abundance of the birds in the area, coupled with their preference for perching and roosting on power lines (demonstrated elsewhere in the country) could place them at risk of collision with the power line. Young vultures which become grounded on the flats between the two mountain ranges whilst learning to fly could be particularly vulnerable to collision. Numerous other large raptors occur in the area, but are not in this authors' opinion (and supported by Eskom-EWT data) very vulnerable to collision with power lines. Several other species such as the Kori Bustard, Secretarybird and storks (Saddle-billed, White, Abdim's) and are important because of their vulnerability to collision with overhead power lines. The Lanner Falcon *Falco biarmicus* is also an important species as it occurs at relatively high abundance in the area, and will likely perch and nest on the proposed power line. This may place it at risk of collision with the overhead cables. Impacts on the physically smaller species are likely to be less direct, through disturbance and habitat destruction. For this reason they are considered slightly less important than the above species which will be impacted on directly.

Avifaunal sensitive features in the study area include: the Blouberg Nature Reserve, which includes most importantly the worlds' largest Cape Vulture breeding colony (van Wyk pers. comm.)and is a declared Important Bird Area (Barnes 1998); the Soutpansberg, also classified as an Important Bird Area and containing a second Cape Vulture breeding colony; the Brakrivier & Sandrivier, fairly significant rivers that are both sources of significantly different vegetation to the surrounds, and represent flight paths in landscapes such as this one. Ideally all of the above features would be avoided by a greater distance than is the case with the proposed power line. It is also not ideal for a linear project such as this to bisect the Blouberg and Soutpansberg, as birds such as Cape Vulture move so much between these features (although likely at far greater height than the proposed power line). However, the alternative is for the power line to pass right over either of these ranges, which would be far worse for birds, not to mention general environmental impacts.

Typically a project of this nature could impact on avifauna through: collision of birds with overhead cables, electrocution of birds on pylons/towers, destruction of bird habitat, disturbance of birds (particularly those breeding), and birds could impact on the business through causing electrical faults through their faeces or nests. Of these, the most important for this project is collision of birds with the overhead cables, in particular the earth wire. This impact has been adjudged to be of medium negative significance and will require mitigation. It is recommended that the high risk sections of line be installed with approved, effective anti-bird collision marking devices on the earth wires as per Eskom standards. These high risk sections should be identified by an avifaunal walk through as part of the site specific Environmental Management Plan. At that stage the exact spans of power line requiring marking can be identified by an avifaunal specialist. It is likely that long sections of line will require this mitigation in the area between the two mountain ranges.

Perhaps the key issue for this project is the presence of the two Cape Vulture breeding colonies discussed above. The proposed power line routes are far enough from both colonies for disturbance of birds to be a non- issue. Much of the habitat on the flats between the two colonies is already degraded to a large extent, and it is unlikely therefore that the power line will impact significantly on the vultures through habitat destruction. Although there are several reasons for us to suspect that Cape Vulture could be susceptible to collision with overhead power lines such as the one proposed, the data that I have been able to obtain, and my thirteen years of experience in the field of bird power line interaction do not support the contention that this risk is sufficient to prevent this power line from being built. The data on vulture mortality collected by the Eskom-Endangered Wildlife Trust Strategic Partnership confirms that collision has so far not been the primary power line impact on the species nationally (making up 13% of reported mortalities). Although for various reasons (discussed elsewhere in this report) this data should not be taken as the final answer in this regard, to my knowledge no focused systematic line searches have been undertaken near any vulture colonies to date. In reports on the status and conservation of the Blouberg vulture colony, power line collision is not identified as a major threat to the birds (although electrocution is – but is not possible on the proposed power line), and no specific action on this matter has been taken by the conservationists and authors of these reports, even in order to obtain more data.

Three alternative alignments were proposed for the power line. The preferred route from an avifaunal perspective is the most eastern route, Alternative 3 mostly since it passes further from the larger Blouberg vulture colony than the other routes.

This author is of the opinion that if the preferred alternative is chosen, and the other recommendations of this report are accepted and implemented, this project should be allowed to proceed.

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1. INTRODUCTION & BACKGROUND

Eskom have identified a need to strengthen the network between the Polokwane and Makhado areas. The proposed project consists of approximately 230km of new 400kV overhead power line between the above two localities, with new proposed substations at either end, Borutho in the south and Nzhelele in the north. Nzumbululo Heritage Solutions was appointed as the Environmental Assessment Practitioner. A project of this nature has the potential to impact on avifauna and as such this study was commissioned, and WildSkies Ecological Services was appointed.

A site visit was conducted during April 2012. Typically a project of this nature could be expected to impact on avifauna through: bird collisions with overhead cables, bird electrocutions on towers/pylons, habitat destruction, and disturbance. Birds are also capable of impacting on the business itself through causing electrical faults with their faeces or nests.

The methods, receiving environment, as well as the impacts will be further discussed and examined below.

1.1 Terms of reference

The following terms of reference were utilized for this study:

- Present the *status quo* of avifauna in the area.
- Identify and discuss avifaunal impacts and rate them according to a specified methodology.
- Identify and provide mitigation measures for each impact.
- Conclude with a recommendation on whether the project should proceed or not and if so to what extent avifauna will be impacted upon.

The proposed project has been mapped in Figure 1 below. The project consists of a 400kV power line from the proposed Borutho Substation to the proposed Nzhelele Substation 230km away. There are three alternative routes for the proposed power line. The tower or pylon structure has not been supplied. This affects only the risk of electrical faulting due to birds, and not the conservation impacts, so it is not considered a significant limitation at this stage. A corridor 4km wide (2km either side of centre line) has been considered for the EIA purposes.

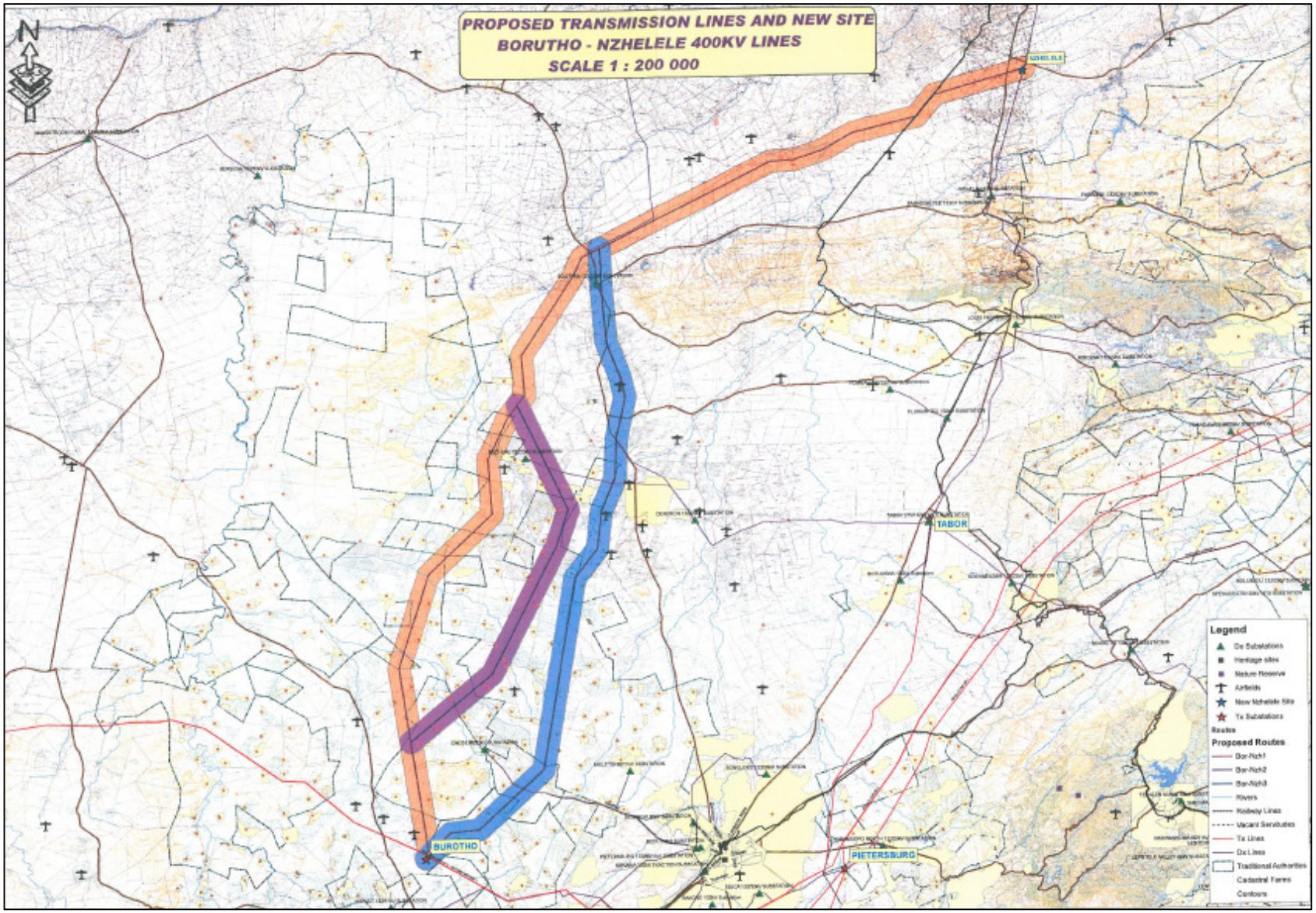

Figure 1. The layout of the Borutho Nzhelele 400kV project, showing the three alternative power line routes. The orange line is "Alternative 1", the purple is "Alternative 2", and the blue is "Alternative 3" (Map supplied by Nzumbululo Heritage Solutions).

2. BACKGROUND TO POTENTIAL IMPACTS

Bird collision with conductors and earth wires

Various bird species are vulnerable to collision with the earth wires or conductors of overhead power lines. This occurs because the birds can't see the cables, particularly against dark backgrounds, or may not be able to take evasive action quickly enough once they do see the cables. Large birds such as cranes, storks, vultures and bustards are particularly vulnerable due to their large wing span and slow flight characteristics. Various non- threatened water fowl are also vulnerable, such as ducks and geese, herons, ibises and many others. In recent times Cape Vultures *Gyps coprotheres* have increasingly been reported colliding with power lines. This typically occurs where this species has reason to congregate such as at feeding and roosting sites. Only one site in South Africa has to my knowledge been reported to kill large numbers of vultures through collision, where a vulture restaurant is placed less than 1km from a transmission line. The birds feed at the feeding site and return to roost on the power line when full and at low light conditions (since food is placed at the site in the late afternoon frequently). The Eskom-Endangered Wildlife Trust Strategic Partnership has to date recorded 983 vulture mortalities (all vulture species, 1996 to 2012) on power lines, of which 812 were caused by electrocution and 98 by collision. On the Cape Vulture specifically a total of 562 birds have been reported killed, with 491 or 87% of these being killed through electrocution. Certain biases exist in this data including: that electrocution victims fall closer to poles and therefore are more likely to be found by maintenance staff; that certain high collision risk sections of power line traverse valleys and steep terrain where detection of carcasses would be unlikely (although the same applies to electrocution to some extent); and various others. However it does seem that based on the actual data collected, electrocution is by far the greater threat to Cape Vultures in South Africa. This does not mean that the collision threat should not be addressed by conservationists and Eskom, but it does place the threat in perspective. In this study area breeding colonies of this species exist at Blouberg and at Soutpansberg. Although these colonies will clearly concentrate large numbers of these birds, their distance from the proposed power line should render the risk lower than at a site such as the above described one. Monadjem *et al* (in a report on the status of the Blouberg colony) state that electrocution of vultures on secondary power lines is the second most important threat to the birds after poisoning. No mention is made in this report of collision of birds or mortalities on larger power lines. Guegnard *et al* again in a similar report mention electrocution as the second most important threat, although also refer to 'some' birds collected for rehabilitation after colliding with power lines. It would seem then that although collision with transmission power lines must be a threat to these birds it has not yet been identified as being particularly significant (unless other publications exist that this author is unaware of). Also, if it were a significant threat to the survival of birds at this colony one could expect that conservationists would have implemented some more focused monitoring of sections of power lines, or even just kept anecdotal statistics on birds colliding with power lines (as they have done for fledglings collected as described below). Young vultures which become grounded on the flats between the two mountain ranges whilst learning to fly could be particularly vulnerable to collision. According to Monadjem *et al* (2004) 293 fledglings were recovered during the period 1993/94 to 2004. These birds had become exhausted and grounded on the lower ground below the colony. It is these birds that may be particularly at risk of collision. Collision of this and other threatened species is anticipated to be a possible significant impact of the proposed power line.

Electrocution of birds on tower/pylon structures

Electrocution refers to the scenario whereby a bird bridges the gap between two phases or a phase and an earthed component thereby causing an electrical short circuit. The larger bird species such as vultures and eagles are particularly vulnerable to this impact, as obviously the larger the wingspan and other dimensions of a bird, the greater the likelihood of

the bird being able to bridge the gap between hardware. On 400kV lines electrocution is not possible through conventional means (it is possible through bird streamer faults) and this is not discussed further here.

Habitat destruction

During the construction phase of power lines and substations, habitat destruction and alteration inevitably takes place on the site. This happens with the construction of access roads, the clearing of the site itself and any associated infrastructure. The servitude and substation yard has to be maintained free of any natural vegetation, to minimize the risk of fire amongst other reasons. These activities have an impact on birds breeding, foraging and roosting in close proximity to the power line through modification of habitat. Due to the position of the study area, and current existing disturbance and degradation in the vicinity (certainly in the southern parts of the study area) this impact is not anticipated to be of high significance for much of the power lines route. In the northern parts the habitat is in better condition, but this is still not anticipated to be a major impact.

Disturbance

Similarly, the above mentioned construction and maintenance activities impact on birds through disturbance, particularly during breeding activities. The potential exists for the impact of disturbance to influence a greater area than the site itself. This site is already relatively disturbed by various activities, particularly in the south. Against this background, the impact of disturbance of the proposed power lines is likely to be of low significance.

Electrical faulting caused by birds

Birds are able to cause faults on overhead power lines through dropping faeces or nest material on live components. This poses problems for the business in terms of quality of electrical supply to the customer. In this study area, species such as Cape Vulture, other vulture species, large eagles and storks are likely to perch on towers and could cause electrical faulting.

3. METHODOLOGY

3.1. Information sources used

The following information sources were consulted in order to conduct this study:

- Bird distribution data of the Southern African Bird Atlas Project (Harrison *et al*, 1997) was obtained for the quarter degree squares which cover the study area from the Avian Demography Unit of the University of Cape Town, as a means to ascertain which species occur within the study area.
- The data from the more recent second Southern African Bird Atlas Project (SABAP2 – http://sabap2.adu.org.za) was consulted, and used slightly less formally to determine bird species that could occur in the area that were not recorded by the first atlas project.
- The conservation status of all bird species occurring in the aforementioned quarter degree squares was determined with the use of The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Barnes, 2000).
- Google Earth was used to examine the study area.
- The location of the project in relation to the Important Bird Areas (IBA's) (Barnes 1998)

- A site visit was conducted during April 2012 to examine the micro-habitats available in the area and get an overall idea of what the site looks like.
- Comprehensive input from local bird experts including BirdLife South Africa, Birdlife Soutpansberg, Friends of Blouberg, the management of Blouberg Nature Reserve, Mr Barry Fourie, and Mr Johan van Wyk was received and has been incorporated into the report where appropriate.
- The Eskom-Endangered Wildlife Trust Strategic Partnership was consulted for data on vulture collisions with power lines.

A limitation for the study was the difficult access to parts of the study area, and no access to certain game farm areas. Since the proposed routes could still be seen from a distance this is not considered to be a serious limitation. The lack of data on specific vulture movement patterns in the area is a limitation. If the significance of collision of these birds had been adjudged to be higher than is the case, this data limitation would have been more important to this study.

A comment was made by an Interested & Affected Party that vultures fly at night in the study area. This comment remains unsubstantiated as far as I am aware, and would in my opinion surely not be a common practice. One published record refers to Eurasian Griffons flying at night at a colony and vulture restaurant in Spain and one refers to Turkey Vultures (Fernandez 1993, in Hernando 1998; and Tabor & McAllister 1998 respectively). If this is indeed a common practice in the study area then this would certainly increase the risk of collision of vultures. At this stage however I have no facts on which to alter my assessment of this issue.

This study represents my best possible effort to assess the risks of the proposed project for birds. It is based upon a short term study which by necessity relies heavily upon the existing and available data sources.

4. DESCRIPTION OF THE RECEIVING ENVIRONMENT

4.1. Vegetation, land use and micro-habitats

The site is relatively flat and uniform in topography, passing between the mountain ranges of Blouberg to the west and Soutpansberg to the east. In the southern sections of the study area it is home to numerous small settlements, interspersed with bush. Each settlement has an effect on the vegetation around it for a certain radius, through hunting, fire wood harvesting, littering and other activities. The northern sections of the study area are predominantly used for game farming, human density seems lower, and the vegetation is in good condition.

According to Mucina & Rutherford (2006) the southern parts of the site are dominated by “Makhado Sweet Bushveld”. In the very south towards Borutho, Alternative 3 passes through “Polokwane Plateau Bushveld”. The northern parts of the site are dominated by “Musina Mopane Bushveld”. This classification is shown in Figure 2 below. It is generally accepted within in ornithological circles that vegetation structure is more important than species composition, in determining the bird species which occur in an area, and their abundances. The importance of the above classification then is really that it is bushveld predominantly. Of course not all of the bushveld has been left untransformed, as described below in the micro habitat section.

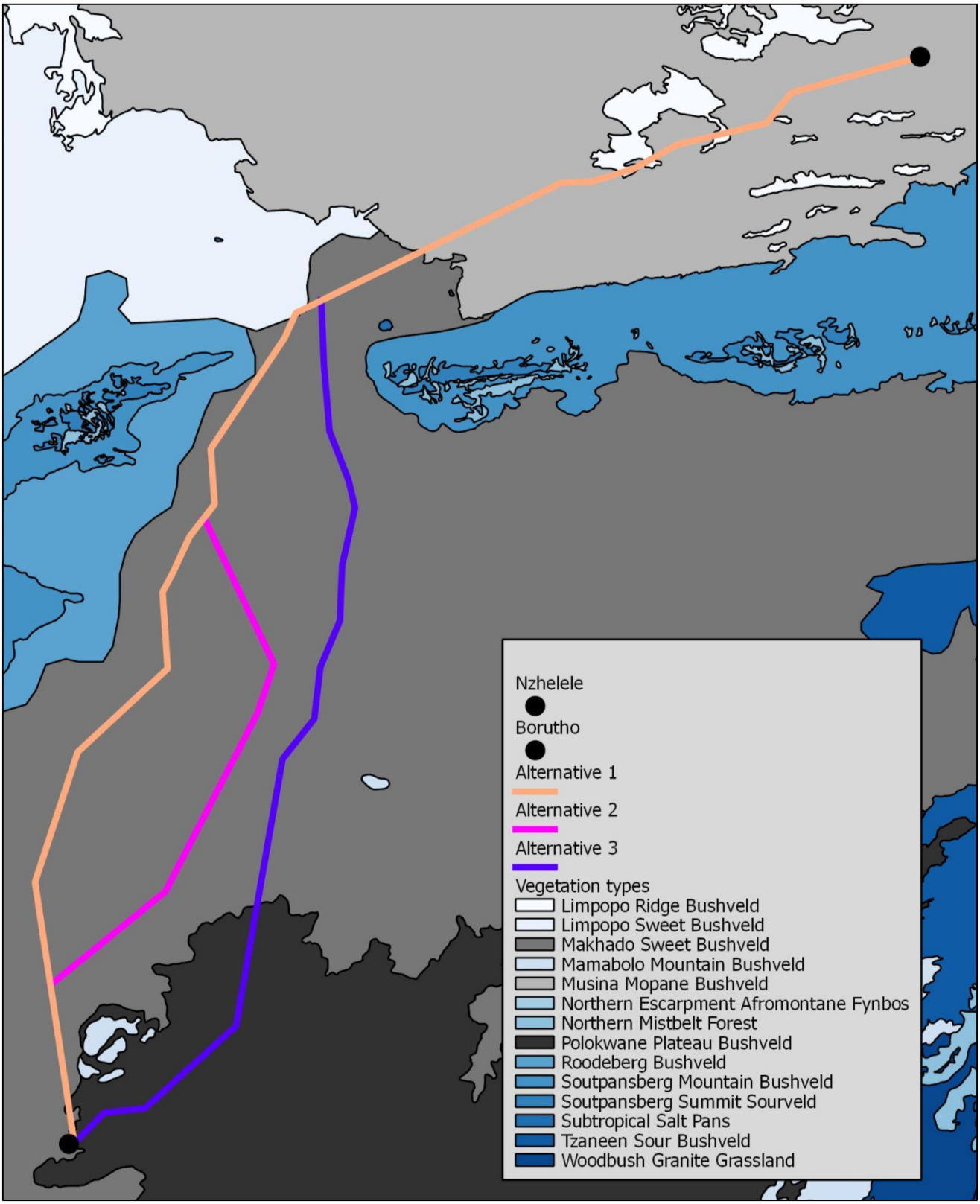

Figure 2. Vegetation classification for the Borutho Nzhelele study area (Mucina & Rutherford, 2006).

More important than vegetation type in determining bird species distribution and abundance are the micro habitats available to birds on site. A number of different micro habitats were observed on site during field work, and are described in more detail below:

Arable lands:

Arable or cultivated land represents 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 readily accessible to birds and other predators; the crop or pasture plants cultivated are often eaten themselves by birds, or attract insects which are in turn eaten by birds; during the dry season arable lands often represent the only green or attractive food sources in an otherwise dry landscape. Arable lands exist in this study area, both subsistence type lands associated with the settlements, and commercial type lands. The attractiveness of these areas to birds is generally determined by the crop that is planted. For a project of this long term nature it is considered likely that at some point in the project lifespan these lands will carry an attractive crop. Furthermore these lands often represent the most open micro habitats in this bushveld area. Those species which favour open habitats will therefore tend to frequent these areas. In addition these lands are often left fallow or disused and revert to grassland. Relevant bird species that will be attracted to these areas include most importantly the Kori Bustard, Secretarybird, Abdim's and White Storks.

Dams:

Artificially constructed dams have become important attractants to various bird species in the South African landscape. Several small dams exist in the study area. Various non-threatened waterfowl frequent these areas and are vulnerable to collision with power lines. Storks will also make use of these areas.

Rivers or drainage lines:

Most rivers in southern Africa are in the east and extreme south, in the higher rainfall areas. Various species of water bird are mostly restricted to riverine habitat in southern Africa. The map distribution of these species correlates with the river courses in southern Africa. Many of these species, particularly the larger ones, are known to interact with power lines through collision. These rivers also form significant flight paths for many of these species. Two large rivers are present in this study area, the Brak and the Sand rivers and are likely to attract amongst others the stork species.

Bushveld:

This is the dominant micro habitat in the study area. It varies from relatively open, savannah like bushveld, to fairly closed bushveld. The diversity is pictured in Figure 3. A wide diversity of birds frequent this habitat type, ranging from small passerines to large raptors. It would appear that where land is used for game farming the bushveld is generally more dense, whilst the unused and cattle farmed areas appear to be more open, with less large trees present.

A general comment is that it appears that for a certain radius around each human settlement the vegetation has been disturbed and degraded, and that this effect gradually diminishes with increased distance from the settlement. It is likely that this effect is due to human activities such as fire wood harvesting, livestock grazing, littering, and various others. This affects the suitability of the habitat for avifauna. At the other end of the continuum are the game farms, which at face value

at least, appear relatively undisturbed and pristine. One can expect greater diversity, greater abundance, and more sensitive bird species to occur the further away from these sources of disturbance one travels.

Open bushveld

Subsistence arable land

Open bushveld

Arable land - irrigated

Open bushveld

Human settlement

Degraded bushveld close to a human settlement

Bushveld

Bushveld

Bushveld

Small drainage line

Sandrivier

Figure 3. Examples of micro habitats available in the study area.

4.2. Relevant bird populations

The bird distribution and abundance data source used for this study is the Southern African Bird Atlas Project (SABAP1 - Harrison *et al,* 1997). This project collected data on birds over a ten year period, and as such represents a far greater and more representative sampling effort than could ever be conducted as part of this EIA process. Although there is a more recent atlas project (SABAP2 – http://sapap2.adu.org.za), this project has not yet covered this study area sufficiently and uniformly enough for this data to be useful formally. The coverage of this project is shown below in Figure 4.

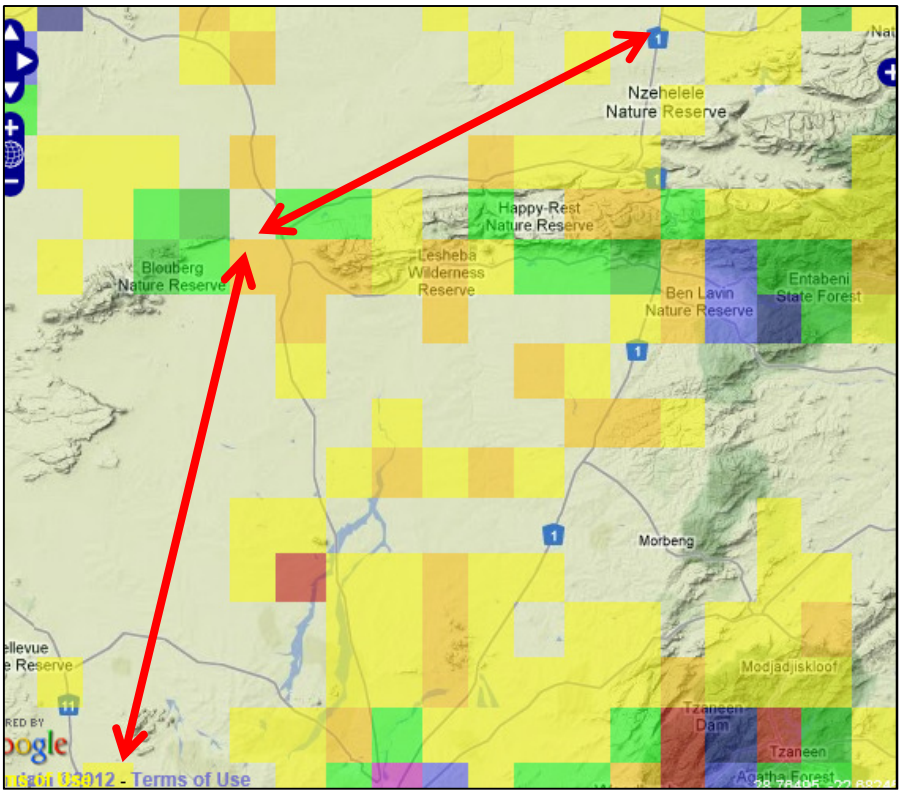

Figure 4. The coverage by the Southern African Bird Atlas Project 2 (http://sabap2.adu.org.za). Yellow pentads have been counted once, orange pentads 2-3 times, and green pentads counted 4-6 times. The approximate position of the proposed power line is shown by red arrows.

The SABAP2 data was however used by BirdLife South Africa to develop a list of relevant bird species that have been recorded in the area that are relevant to this study, and three additional threatened species were identified: Maccoa Duck; European Roller and Greater Painted Snipe. These species have therefore been added to Table 1 below for examination.

The most reliable data source therefore remains the SABAP1 data. Report rates are essentially an expression of the number of times a species was recorded in a square, as a percentage of the number of times that square was counted. It is important to note that these species could have been recorded anywhere in the relevant quarter degree square, and not necessarily in the exact study area. A total of up to 494 bird species have been recorded across the 14 quarter degree

squares. Table 1 shows only the Red Listed species recorded. These species will be the focus of this study. Up to 29 Red Listed species could occur on site, comprising 1 'Regionally extinct", 1 "Endangered", 15 'Vulnerable", and 12 "Near-threatened". Three additional species are included in Table 1 and considered as threatened for the purpose of this study. These are the White Stork *Ciconia ciconia*, Abdim's Stork *Ciconia abdimii* (both protected internationally under the Bonn Convention on Migratory Species), and the Hamerkop *Scopus umbretta* (the subject of recent conservation concern due to its apparently contracting range).

In Table 2, the characteristics of these 32 species are described in more detail, based on the authors' ornithological experience, site visit findings and various other information sources.

Table 1. Red Listed bird species abundance in the study area (pentads 2610_2840 & 2610_2845) as per Southern African Bird Atlas Project 2 data. Key species are shown in grey

Common Name	Cons status	2229CC (56 cards)	2229CD (29 cards)	2229DA (9 cards)	2229DB (14 cards)	2229DC (19 cards)	2328BD (4 cards)	2328DB (7 cards)	2328DD (11 cards)	2329AA (10 cards)	2329AB (20 cards)	2329AC (3 cards)	2329AD (12 cards)	2329CA (7 cards)	2329CC (12 cards)
Egyptian Vulture	RE	0.1607	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Saddle-billed Stork	E	0.0357	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Southern Bald Ibis	V	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0833
Hooded Vulture	V	0.0357	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cape Vulture	V	0.6250	0.3448	0.1111	0.2143	0.1579	0.5000	0.0000	0.0000	0.8000	0.3000	0.0000	0.2500	0.4286	0.0000
White-backed Vulture	V	0.1250	0.0000	0.0000	0.2143	0.0526	0.0000	0.0000	0.0000	0.0000	0.0500	0.0000	0.0833	0.0000	0.0000
Lappet-faced Vulture	V	0.1250	0.0000	0.0000	0.2143	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tawny Eagle	V	0.1071	0.0345	0.2222	0.0714	0.0000	0.0000	0.0000	0.0000	0.0000	0.0500	0.0000	0.0000	0.0000	0.0000
Martial Eagle	V	0.0714	0.2069	0.1111	0.2143	0.0000	0.0000	0.0000	0.0909	0.1000	0.0000	0.0000	0.1667	0.0000	0.1667
Bateleur	V	0.1964	0.1034	0.0000	0.2857	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
African Marsh-Harrier	V	0.0000	0.1034	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Lesser Kestrel	V	0.0179	0.0000	0.1111	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0833	0.0000	0.2500
Blue Crane	V	0.0179	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Corncrake	V	0.0000	0.0000	0.0000	0.0000	0.0000	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Kori Bustard	V	0.7143	0.4828	0.2222	0.5000	0.0000	0.0000	0.0000	0.0000	0.2000	0.0500	0.0000	0.0000	0.0000	0.0000
White-bellied Korhaan	V	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0909	0.0000	0.0000	0.0000	0.0000	0.1429	0.1667
Southern Ground-Hornbill	V	0.0000	0.0000	0.1111	0.2857	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Black Stork	NT	0.1429	0.0000	0.0000	0.0000	0.0526	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0833	0.1429	0.0000
Marabou Stork	NT	0.1964	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Yellow-billed Stork	NT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0909	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Greater Flamingo	NT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0833
Lesser Flamingo	NT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0833
Secretarybird	NT	0.4643	0.2069	0.1111	0.2857	0.0000	0.0000	0.1429	0.0909	0.1000	0.1500	0.0000	0.2500	0.1429	0.0000
Pallid Harrier	NT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.1429	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Peregrine Falcon	NT	0.0000	0.0000	0.0000	0.0714	0.0526	0.0000	0.0000	0.0000	0.1000	0.1000	0.0000	0.0000	0.0000	0.0000

Lanner Falcon	NT	0.1071	0.1379	0.1111	0.0714	0.0526	0.5000	0.1429	0.0000	0.1000	0.2000	0.3333	0.0000	0.0000	0.0833
Short-clawed Lark	NT	0.0000	0.0000	0.0000	0.0000	0.0000	0.5000	0.0000	0.1818	0.0000	0.0000	0.3333	0.0833	0.2857	0.1667
Orange Ground-Thrush	NT	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Red-billed Oxpecker	NT	0.0714	0.3103	0.0000	0.0714	0.0526	0.0000	0.2857	0.0000	0.0000	0.0500	0.0000	0.0000	0.0000	0.0000
Hamerkop	**	0.3750	0.2414	0.0000	0.3571	0.0526	0.0000	0.0000	0.1818	0.1000	0.1000	0.0000	0.0833	0.1429	0.0000
White Stork	BONN	0.1250	0.2069	0.0000	0.1429	0.0526	0.0000	0.2857	0.0000	0.1000	0.1000	0.0000	0.0833	0.0000	0.0833
Abdim's Stork	BONN	0.2321	0.1724	0.0000	0.1429	0.0526	0.2500	0.1429	0.0000	0.0000	0.1000	0.0000	0.0000	0.0000	0.0833
Maccoa Duck	IUCN near threatened														
European Roller	IUCN near threatened														
Greater Painted-Snipe															

Table 2. Red Listed species, their preferred habitats, and the importance of the site for the species. Key species are shown in grey.

Common Name	***Scientific Name***	**Cons status**	**Preferred micro habitat**	**Likelihood of occurring on site**	**Relative importance of site for national populations of species**	**Likely impacts**
Egyptian Vulture	*Neophron percnopterus*	RE	Bushveld	Unlikely	-	-
Saddle-billed Stork	*Ephippiorhynchus senegalensis*	E	Riverine, wetland, dam	Unlikely	-	-
Southern Bald Ibis	*Geronticus calvus*	V	Grassland, cliff	Unlikely	-	-
Hooded Vulture	*Necrosyrtes monachus*	V	Bushveld	Possible	Medium	C, E, HD, D, F
Cape Vulture	*Gyps coprotheres*	V	Bushveld	Definite – recorded on site	Very high	C, E, HD, D, F
White-backed Vulture	*Gyps africanus*	V	Bushveld	Probable	Medium	C, E, HD, D, F
Lappet-faced Vulture	*Aegypius tracheliotos*	V	Bushveld	Definite – recorded on site	Medium	C, E, HD, D, F
Tawny Eagle	*Aquila rapax*	V	Bushveld	Probable	Medium	C, E, HD, D, F
Martial Eagle	*Polemaetus bellicosus*	V	Bushveld	Probable	Medium	C, E, HD, D, F
Bateleur	*Terathopius ecaudatus*	V	Bushveld	Possible	Medium	C, E, HD, D, F
African Marsh-Harrier	*Circus ranivorus*	V	Grassland, wetland	Unlikely	-	-

Lesser Kestrel	*Falco naumanni*	V	Grassland, arable land	Possible	Low	C, HD, D
Blue Crane	*Anthropoides paradiseus*	V	Arable lands, grassland, wetland, dam	Unlikely	-	-
Corncrake	*Crex crex*	V	Wetland	Unlikely	-	-
Kori Bustard	*Ardeotis kori*	V	Open bushveld, grassland, arable land	Definite – recorded on site	Medium	C, HD, D
White-bellied Korhaan	*Eupodotis senegalensis*	V	Grassland	Possible	Low	C, HD, D
Southern Ground-Hornbill	*Bucorvus leadbeateri*	V	Open bushveld	Probable	Low	C, HD, D
Black Stork	*Ciconia nigra*	NT	Riverine, cliff	Possible	Low	C, HD, D
Marabou Stork	*Leptoptilos crumeniferus*	NT	Waste disposal sites, bushveld	Possible	Low	C, E, HD, D, F
Yellow-billed Stork	*Mycteria ibis*	NT	Riverine, dams, wetlands	Possible	Low	C, E, HD, D, F
Greater Flamingo	*Phoenicopterus ruber*	NT	Pan, floodplain, dam	Probable	-	-
Lesser Flamingo	*Phoeniconaias minor*	NT	Pan, floodplain, dam	Probable	-	-
Secretarybird	*Sagittarius serpentarius*	NT	Open bushveld, grassland, arable lands	Probable	Medium	C, HD, D
Pallid Harrier	*Circus macrourus*	NT	Wetland, grassland	Unlikely	-	-
Peregrine Falcon	*Falco peregrinus*	NT	Cliffs, gorges	Possible	Low	C, HD, D
Lanner Falcon	*Falco biarmicus*	NT	Grassland, arable land	Probable	Low	C, HD, D
Short-clawed Lark	*Certhilauda chuana*	NT	Bushveld	Possible	Low	HD, D
Orange Ground-Thrush	*Zoothera gurneyi*	NT	Forest	Unlikely	-	-
Red-billed Oxpecker	*Buphagus erythrorhynchus*	NT	Bushveld	Possible	Low	HD, D
Hamerkop	*Scopus umbretta*	**	Riverine	Probable	Medium	C, HD, D
White Stork	*Ciconia ciconia*	BONN	Grassland, wetland, arable land, dam	Probable	Low	C, HD, D, E, F
Abdim's Stork	*Ciconia abdimii*	BONN	Grassland, wetland, arable land, dam	Probable	Low	C, HD, D, E, F
Maccoa Duck	*Oxyura maccoa*	IUCN near threatened	Dams, river, open water	Probable	Low	C, HD, D
European Roller	*Coracias garrulous*	IUCN near threatened	Bushveld	Probable	Low	HD, D

Greater Painted-Snipe	*Rostratula benghalensis*		Wetland, dams, rivers	Probable		HD, D, C

C = collision, E = electrocution, HD = habitat destruction, D = disturbance, F = faulting

As can be seen in the two tables above there are a number of the recorded Red Listed bird species which are actually unlikely to occur on site, due to the micro habitats available being unsuitable. The most important species for the purpose of this study are as follows: Cape Vulture; Kori Bustard *Ardeotis kori*, Secretarybird *Sagittarius serpentarius*, White Stork and Abdim's Stork (all shown in grey in Tables 1 and 2). The Cape Vulture is particularly important due to the presence nearby of two breeding colonies, at Blouberg Nature Reserve and Soutpansberg (described in more detail below). It is well known that birds from these colonies forage in the wider area, and cross frequently between the Blouberg and the Soutpansberg. This high abundance of the birds in the area, coupled with their preference for perching and roosting on power lines (demonstrated elsewhere in the country) will place them at risk of collision with the power line. Numerous other large raptors occur in the area, but are not in this authors' opinion (and supported by Eskom-EWT data) very vulnerable to collision with power lines. The remaining species such as the Kori Bustard, Secretarybird and storks are important because of their vulnerability to collision with overhead power lines. The Lanner Falcon *Falco biarmicus* is also an important species as it occurs at relatively high abundance in the area, and will likely perch and nest on the proposed power line. This may place it at risk of collision with the overhead cables. Impacts on the physically smaller species are likely to be less direct, through disturbance and habitat destruction. For this reason they are considered slightly less important than the above species which will be impacted on directly. An additional species not contained in the above tables since it is not Red Listed is the Verreaux's Eagle. This species does occur in the area and could interact with the power line through collision with cables and nesting on the towers.

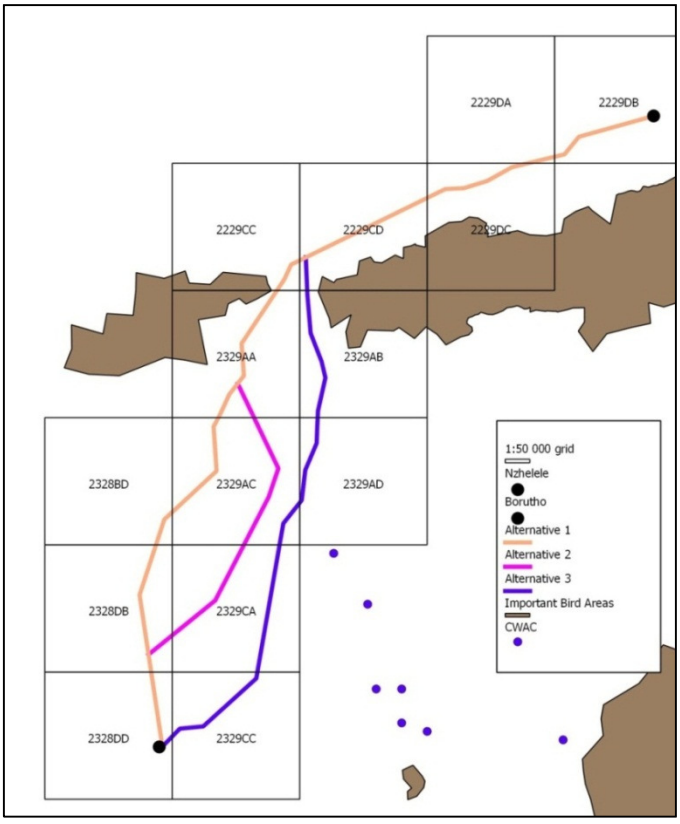

Figure 5. Avifaunal information pertaining to the proposed power line. The quarter degree squares for which bird data was obtained from Harrison *et al* (1997) are labeled. The nearest Important Bird Areas (IBA) are also shown, as well as the CWAC (Co-ordinated Waterbird Count) sites.

4.3. Sensitive bird areas or features in the study area

The following section describes key avifaunal features that are relevant to this study:

Blouberg Nature Reserve:
This nature reserve includes the worlds' largest Cape Vulture breeding colony (S29 08 50.9; E 22 59 02.9; 800 – 868 breeding pairs recorded in June 2012, van Wyk pers comm; 572 breeding pairs in 2011, Guegnard *et al*, 2011; 736 breeding pairs in 2003, Monadjem *et al*, 2004).

The site is classified as an Important Bird Area (SA004) by Barnes (1998). Most birds breed at the main colony, but several smaller satellite colonies exist throughout the mountain range. The cliffs also hold Booted Eagle *Hieraatus pennatus,* Peregrine Falcon *Falco peregrinus* and Black Stork *Ciconia nigra.* Various other sensitive species also utilize the area, and in addition to birds, the area is home to a broad diversity of fauna and flora. The large vulture colonies in southern Africa are extremely vulnerable to human induced threats such as development, poisoning, illegal trade, and power lines. Care needs to be taken to protect these areas from these threats as far as possible.

Alternative 1 of the proposed power line passes approximately 4km east of the cliffs of the Blouberg range at the closest point, and approximately 10km from the main cliffs.

Soutpansberg:
This range is classified as an Important Bird Area (SA003) by Barnes (1998). A Cape Vulture breeding colony is situated on the cliffs in this range (173 breeding pairs in June 2012, van Wyk pers comm). African Crowned Eagle *Stephanoaetus coronatus,* Peregrine Falcon, Black Stork and Cape Parrot *Poicephalus robustus* are also present in the area. As with Blouberg, this area is a biodiversity hotspot and should be protected as far as possible.

Alternative 3 of the proposed power line passes approximately 6km to the west of the Soutpansberg range.

Although the proposed power line does not pass through either of the above IBA's, IBA boundaries must be considered as 'soft' boundaries they are a broad indication of where the birds reside and since birds are mobile developments outside of the IBA's can impact on bird populations within the IBA.

Soutpan:
There are two small salt pans just to the north-west of the Soutpansberg, and approximately 5.5km from the proposed alignment. At a desktop level it appeared that these may be a significant attractant for certain bird species. It is possible that flamingos may occur here after heavy rains.

Brakrivier & Sandrivier:
The Brakrivier is a fairly significant river that runs to the west of Alternative 1, between it and the Blouberg. Alternative 1 crosses it just west of the main tar road. The Sandrivier is crossed by the proposed alignment approximately 30km west of Nzhelele Substation. These rivers are both sources of significantly different vegetation to the surrounds, and therefore attract a different set of bird species. Rivers such as these also invariably form flight paths in landscapes such as this one.

Ideally all of the above features would be avoided by a greater distance than is the case with the proposed power line. It is also not ideal for a linear project such as this to bisect the Blouberg and Soutpansberg, as birds such as Cape Vulture move so much between these features. However, the alternative is for the power line to pass right over either of these ranges, which would be far worse for birds, not to mention general environmental impacts.

5. EVALUATION OF IMPACTS AND CHOICE OF ALTERNATIVE

5.1. Evaluation of impacts

The impacts of the proposed development have been assessed and rated using the tables below and the criteria found in Appendix 1.

Table 3. Assessment of the impact of the proposed power line on birds through collision.

Nature: **Collision of birds with the power lines**		
	Without mitigation	With mitigation
Extent	4	4
Duration	4	4
Magnitude	2	2
Probability	3	2
Significance	**30 (medium)**	**20 (low)**
Status	Negative	Negative
Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources	Yes birds killed	Yes birds killed
Can impacts be mitigated	Yes – at least partially	Yes
Mitigation: High risk sections of this power line will need to be installed with Eskom approved anti bird collision marking devices as per Eskom standards. The best available device at the time of construction should be used. These high risk sections of power line will need to be identified during a site specific avifaunal walk through, which should be conducted as part of the site specific EMP. At least annual monitoring of the full length of this power line will be essential in order to detect collision hotspots, which will then need to be mitigated as soon as possible. The difficulty involved in predicting where vulture collisions in particular will occur makes this monitoring, and reactive mitigation all the more important. The need for annual line monitoring, reporting and mitigation within short time frames should be written into the operational EMP for this power line, and into the conditions of the environmental authorisation.		
Cumulative impacts: Significant – Cape Vulture in particular suffers from high mortality from power lines in SA (although not necessarily through collision with transmission lines) and can ill afford further mortality from anthropogenic sources.		
Residual impacts: Low – if lines were removed, impact would cease		

Table 4. Assessment of the impact of the proposed power line on birds through habitat destruction.

Nature: **Habitat destruction - construction and maintenance of power lines**		
	Without mitigation	With mitigation
Extent	1	1
Duration	5	5
Magnitude	2	2
Probability	3	3
Significance	**24 (Low)**	**24 (Low)**
Status	Negative	Negative

Reversibility	Irreversible	Irreversible
Irreplaceable loss of resources	Yes- bird habitat	Yes-Bird habitat
Can impacts be mitigated	Yes	Yes
Mitigation: Standard construction best practices must be followed. A construction EMP must be developed and implemented by an on-site environmental control officer during construction. In this way the impact can be mitigated to an acceptable level		
Cumulative impacts: Quite high in the southern parts where area is already fairly impacted on by other human activities		
Residual impacts: High – if lines were removed, impact would persist		

Table 5. Assessment of the impact of the proposed power line on birds through disturbance.

Nature: **Disturbance of birds during construction and maintenance of power lines**		
	Without mitigation	With mitigation
Extent	1	1
Duration	2	2
Magnitude	3	2
Probability	3	2
Significance	**18 (Low)**	**10 (Low)**
Status	Negative	Negative
Reversibility	Reversible	Reversible
Irreplaceable loss of resources	Possible loss of breeding success	Possible loss of breeding success
Can impacts be mitigated	Yes	Yes
Mitigation: A standard construction EMP must be compiled and implemented by an on-site environmental control officer. Care must be taken if any breeding sensitive species are encountered. Case specific advice can be sought from the avifaunal consultant in dealing with this should it occur. It is recommended that the eastern alternative be selected, so that the route is far enough from the Blouberg Cape Vulture colony so as not to disturb the birds whilst breeding.		
Cumulative impacts: Negligible		
Residual impacts: Low – temporary impact		

Table 6. Assessment of the impact of the birds on the proposed power line through faulting.

Nature: **Electrical** f**aulting on the power lines, caused by birds**		
	Without mitigation	With mitigation
Extent	1	1
Duration	4	4
Magnitude	4	3
Probability	3	2
Significance	**27 (low)**	**16 (Low)**
Status	Negative-for business	Negative-for business
Reversibility	Reversible	Reversible
Irreplaceable loss of resources	No	No

Can impacts be mitigated	Yes	Yes
Mitigation: Once construction has been finished, if faulting of the power lines is found to be a problem, mitigation in the form of bird guards can be fitted reactively. While it is not expected that the impact will be high it is certainly possible with some non red data species such as Black-headed Herons.		
Cumulative impacts: Negligible		
Residual impacts: Low		

5.2. Evaluation of alternatives

Table 3 below summarises key facts pertaining to each alternative route. For each alternative, a score was assigned for each factor based on the Alternatives' rank out of the three. For example, Alternative 3 is the closest to Soutpansberg (which is a negative for avifaunal impacts) and so receives a score of 3. The proximity to Blouberg has been weighted with triple the importance of the other factors, since Cape Vulture is probably *the* key species for this study, and the further away from this large breeding colony the power line is built the better. This will minimize the likelihood of birds perching on the towers of the power line, and will reduce the risk of disturbance of breeding birds at the colony during construction of the power line. The length of each alternative that is adjacent to existing large power lines, the tar road, and the railway, are all also relevant factors. Placing the new power line adjacent to these existing infrastructures is an advantage in terms of avifaunal impacts, since these are already disturbed areas. Also in the case of bird collision, it is believed that placing more power lines next to each other makes them more visible to birds, and easier to avoid. When these scores are summed for each alternative, a total score for the route is obtained. The alternative with the lowest total score is the most preferred alternative from an avifaunal perspective.

Table 3. Key avifaunal factor scoring for each alternative route for the proposed power line.

Feature	**Alternative 1**	**Alternative 2**	**Alternative 3**
Length	196km (1)	201km (3)	199km (2)
Proximity to Blouberg at closest point	Approx. 4km (6)	Approx. 4km (6)	Approx. 11km (3)
Proximity to Soutpansberg at closest point	Approx. 11km (1)	Approx. 11km (1)	Approx. 6km (3)
Length adjacent to existing 132kv or larger power line	12km (2)	12km (2)	46km (1)
Length adjacent (within 4km) to tar road	0 (2)	0 (2)	41km (1)
Major river courses crossed	2 - Brakrivier & Sandrivier (2)	2 – Brakrivier & Sandrivier (2)	1 – Sandrivier (1)
Length adjacent to railway line	4.8km (1)	4.8km (1)	4.8km (1)
Number natural & artificial surface water sources in 4km buffer (dams, wetlands, pans etc)	99 (3)	50 (1)	85 (2)
Total score	**18**	**18**	**14**

Alternative 3, i.e. the most eastern alternative scores the lowest, and is therefore the most preferred alternative in terms of avifaunal impacts. Alternatives 1 and 2 have scored equally, and so there is no clear preference between them.

6. CONCLUSION

The most significant issue for this project is the proximity of the proposed power line to the Blouberg Nature Reserve (which contains the worlds' largest Cape Vulture breeding colony). Secondary to this is the proximity to the Soutpansberg (which also house a Cape Vulture breeding colony). This proximity means that these birds are likely to utilize the power line for perching and roosting extensively, which will place them at risk of collision with the earth wires. In addition, in their general movements around the area they will frequently need to cross the proposed power line, placing them at risk of collision. However, given that this species has not been widely reported to collide with transmission lines in large numbers (by either Eskom-EWT reports or assorted vulture conservation reports cited elsewhere in this report) it is hoped that this impact will not be significant. Extensive line marking will be implemented on various sections of the power line in order to attempt to reduce this risk further. Various other large species will also be at risk of collision, including storks, Secretarybird, Martial Eagle, Lappet-faced Vulture, and White-backed Vulture. Provided that the preferred alternative, Alternative 3 (the eastern alternative), is selected, and the other mitigation measures recommended in this report are implemented, this risk should be contained.

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Appendix 1- Criteria for assessment of the impacts

The following criteria were used to evaluate the significance of the anticipated impacts:

Extent of the impact:
The extent of the impact was assessed accordingly:

- (**1**) Limited to the site and its immediate surroundings
- (**2**) Local/Municipal extending only as far as the local community or urban area
- (**3**) Provincial/Regional
- (**4**) National i.e. South Africa
- (**5**) Across International borders

Duration of the impact:
The lifespan of the impact was assessed to be:

- (**1**) Immediate (less than 1 year)
- (**2**) Short term (1-5 years)
- (**3**) Medium term (6-15 years)
- (**4**) Long term (the impact will cease after the operational life span of the project)
- (**5**) Permanent (no mitigation measures of natural process will reduce the impact after construction)

Magnitude of the impact:
The magnitude or severity of the impacts is indicated as either:

- (**0**) None (where the aspect will have no impact on the environment)
- (**1**) Minor (where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected),
- (**2**) Low (where the impact affects the environment in such a way that natural, cultural and social functions and processes are slightly affected),
- (**3**) Moderate (where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way),
- (**4**) High (where natural, cultural or social functions or processes are altered to the extent that it will temporarily cease), or
- (**5**) Very high / don't know (where natural, cultural or social functions or processes are altered to the extent that it will permanently cease).

Probability of occurrence:
The likelihood of the impact actually occurring was indicated as either:

- (**0**) None (impact will not occur)
- (**1**) Improbable (the possibility of the impact materializing is very low as a result of design, historic experience or implementation of adequate mitigation measures)
- (**2**) Low probability (there is a possibility that the impact will occur)
- (**3**) Medium probability (the impact may occur)
- (**4**) High probability (it is most likely that the impact will occur)
- (**5**) Definite / do not know (the impact will occur regardless of the implementation of any prevention or corrective actions or it the specialist does not know what the probability will be based on too little published information)

Status of the Impact:

The impacts are assessed as either having a:

- Negative effect (i.e. at a cost to the environment)
- Positive effect (i.e. at a benefit to the environment)
- Neutral effect on the environment.

Accumulative Impact:
The impact of the development is considered together with additional developments of the same or similar nature and magnitude. The combined impacts may be:

- Negligible (i.e. the net effect is the same as a single development)
- Marginal (i.e. the impact of the two developments of a similar nature is less than twice the impact of a single development. This implies it is better to place the two developments in the same environment rather than in separate environments.
- Compounding (i.e. the impact of the two developments is more than twice the impact of two single developments. This implies that it is better to split the two developments into separate environments.

Significance of the Impact:
Based on a synthesis of the information contained in the points above, the potential impacts were assigned a significance weighting (S). The weighting is formulated by adding the sum of the numbers assigned to extent (E), duration (D) and magnitude (M) and multiplying this sum by the probability (P) of the impact hence S=(E+D+M)P.

- *Low (less than 30 points)*: the impact does not have a direct influence on the decision to develop the area

- *Medium (30-60 points)*: the impact could influence the decision to develop in the area unless it is effectively mitigated

- *High (above 60 points)*: where the impact must have an influence on the decision to proceed to develop in the area