CONSTRUCTION OF A NEW 400 KV LINE FROM BRAVO POWER STATION TO LULAMISA (KYALAMI) SUBSTATION (Bravo 3)
DEA Ref No - 12/12/20/1094

Specialist Avifaunal Impact Assessment

Prepared for

Limosella Consulting on behalf of Envirolution Consulting

by

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DECLARATION OF PROFESSIONAL STANDING AND INDEPENDENCE

I, Andrew Edward McKechnie (SACNASP # 400205/05) declare that I:

- hold higher degrees in the biological sciences, which allowed registration by the South African Council for Natural Scientific Professions (SACNASP) as a Professional Zoologist that sanctions me to function independently as a specialist scientific consultant;
- declare that as per prerequisites of the Natural Scientific Professions Act No. 27 of 2003 this project was my own work from inception and reflects exclusively my observations and unbiased scientific interpretations, and executed to the best of my abilities;
- abide by the Code of Ethics of SACNASP;
- am committed to biodiversity conservation but concomitantly recognize the need for economic development. Whereas I appreciate opportunities to learn through constructive criticism and debate, I reserve the right to form and hold my own opinions within the constraints of my training, experience and results and therefore will not submit willingly to the interests of other parties or change my statements to appease or unduly benefit them;
- am subcontracted as a specialist consultant for the project "Specialist Avifaunal Impact Assessment – Bravo 3 Power Line", as described in this report;
- have no financial interest in the proposed development other than remuneration for the work performed;
- do not have, and will not have in the future, any vested or conflicting interests in the proposed development;
- undertake to disclose to the consultant and its client(s) as well as to the competent authority any material information that may have the potential to influence any decisions by the competent authority, as required in terms of the Environmental Impact Assessment Regulations 2006;
- reserve the right to transfer my intellectual property contained in this report only to the client(s), (party or company that commissioned the work) on full payment of the contract fee. Upon transfer of the intellectual property, I recognise that written consent from the client will be required for me to release of any part of this report to third parties.
- In addition, remuneration for services provided by me is not subjected to or based on approval of the proposed project by the relevant authorities responsible for authorising this proposed project.

Andrew Edward McKechnie Pretoria, 13 June 2016

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Even though every care is taken to ensure the accuracy of this report, faunal and environmental assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are made, to some extent, on reasonable and informed assumptions built on *bona fide* information sources, as well as deductive reasoning. A more factual report, based on field collecting and observations, can only be derived over several years and seasons of research, to account for fluctuating environmental conditions and animal migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage. The specialist can therefore not accept responsibility for conclusions and mitigation measures, made in good faith, based on own databases, and on the information provided at the time of the directive. Although the author exercised due care and diligence in rendering services and preparing documents, he accepts no liability and the client, by accepting this document, indemnifies the author against all actions, claims, demands, losses, liabilities, costs, damages and expenses that arise from or in connection with services rendered, directly or indirectly, by the author and use of this document. This report should therefore be viewed and acted upon with these limitations in mind.

Executive Summary

The proposed Bravo 3 project consists of a new 400 kV line from Bravo power station in Mpumalanga to Lulamisa (Kyalami) substation in Gauteng, along a route approximately 120 km in length. The need for this line is related to the construction of the new Bravo power station between Bronkhorstspruit and Witbank, with the Bravo-Lulamisa line representing Phase 3 of the Bravo Integration Project. Alternative routes for these lines were evaluated previously by van Rooyen (2008).

The proposed line traverses six natural vegetation types, Egoli Granite Grassland, Carletonville Dolomite Grassland, Rand Highveld Grassland, Andesite Mountain Bushveld, Gold Reef Mountain Bushveld and Eastern Highveld Grassland. In terms of current conservation status, the line route crosses an Endangered area to the west of the line and a Critically Endangered area in the central portion. However, much of the area of area has been highly transformed by human activities such as agriculture, and the passes through several heavily urbanised areas. The line also passes through the southern section of the Rietvlei Nature Reserve south of Pretoria.

Birds and avian habitats occurring at the site were surveyed through a desktop study (based in part on data from the South African Bird Atlas Project), and field surveys in late May and early June 2016. In addition, previous assessments of the impacts of this project on birds were consulted during the preparation of this report.

Avian habitats along the proposed power line route can be broadly divided into the following categories: grasslands, wetlands, water bodies and drainage lines, woodlands, agricultural fields and urbanised areas. Many of the grasslands, particularly at the western and eastern ends of the route, ae in good condition and provide suitable habitat for threatened species such as African Grass-owl, Secretarybird and White-bellied Korhaan. At its western edge, the route passes through an area known to hold grass-owls.

In broad terms, the impacts of the proposed power lines and required mitigation measures are as follows:

- Habitat loss – avian habitats will be lost in the areas cleared for the towers involved in this project. The fact that the line runs through areas of African Grass-owl habitat (in particular, north of the N14 highway) is concerning, and particular care needs to be taken to avoid the loss of habitat for this species. Additional habitat loss may occur during the construction phase, because of areas cleared for the construction of the towers and lines, new access roads, and clearing vegetation from the servitude. Construction activities should be confined to the area directly under the new lines, and as far as possible existing access roads should be used. No towers should be positioned in habitat suitable for African Grass-owls.

- Disturbance – construction activities, and to a lesser extent maintenance activities, will cause disturbance to birds along the route of the proposed power line. This impact will be most severe if it affects breeding birds, particularly threatened species. Construction should take place in winter, in order to minimise disturbance of breeding birds.

- Collisions – the proposed power lines will pose a significant collision risk to several species, including Greater and Lesser Flamingos, Secretarybirds, and White-bellied Korhaans, and bird flight diverters must be installed in areas where species vulnerable to collisions are likely to move though. Areas of particular concern in this regard are where the proposed line crosses water bodies and/or drainage lines along which large-bodied species fly regularly. In

addition, sections of the line traversing habitat potentially suitable for Secretarybirds, African Grass-owls, White-bellied Korhaans and other threatened grassland species must be fitted with these devices. **It is strongly recommended that before construction commences, an ornithologist be engaged to examine the entire route with Eskom staff and identify spans requiring the installation of flight diverters.**

- Electrocution risk – the risk of birds being electrocuted is lower for the large 400 kV towers involved in this project compared to smaller 11 – 132 kV sub-transmission and reticulation lines. No specific mitigation requirements are needed beyond the installation of standard Eskom Bird Guards on all towers near water in order to prevent shorting caused by avian excreta.

- Electromagnetic fields – no specific mitigation measures are needed.

At its western-most limit, the proposed line traverses African Grass-owl habitat in the Northern Farms area, on account of the fact that the route loops to the northwest instead of following a direct route to the Lulamisa substation. Widening the existing servitude to accommodate the new line will result in habitat loss for the Grass-owl. If changing the line's route to avoid this area altogether is not possible, then it will be critical that a specialist be engaged to ensure that the line is routed so as to minimise habitat loss for this species.

In conclusion, the author's opinion is that the negative avifaunal impacts associated with the proposed Bravo 3 line can to a large extent be mitigated, and that the project should therefore go ahead subject to the mitigation measures outlined above. Once operational, the Bravo 3 line should be regularly monitored for avian fatalities, and any additional spans subsequently identified as posing a collision risk will need to be retrofitted with bird flight diverters.

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Eskom plans to construct a new 400 kV line from Bravo power station in Mpumalanga to Lulamisa (Kyalami) substation in Gauteng, along a route approximately 120 km in length (Figure 1). The need for this line is related to the construction of the new Bravo power station between Bronkhorstspruit and Witbank, with the Bravo-Lulamisa line representing Phase 3 of the Bravo Integration Project.

The route for these lines was selected on the basis of an evaluation of alternative routes by van Rooyen (2008). For this reason, the present report does not include impact assessments for any routes other than that shown in Figure 1.

The author was appointed by Limosella Consulting to undertake a specialist avifaunal impact assessment study of the proposed power line. This investigation is in accordance with the EIA Regulations No. R982-985, Department of Environmental Affairs and Tourism, 4 December 2014 emanating from Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998) and other relevant legislation.

1.1 SCOPE AND OBJECTIVES OF THE STUDY

- To qualitatively and quantitatively assess the significance of the habitat components and current general conservation status of the study site;
- Identify and comment on ecologically sensitive areas or ecological services;
- Comment on connectivity with natural vegetation and habitats on adjacent terrain;
- To provide a list of species that occur or might occur, and to identify species of conservation importance;
- To highlight potential impacts of the proposed development on the avifauna and habitats of the study site;
- To investigate the possibility of knock-on effects within the district as a result of the development, and
- To provide management recommendations to mitigate negative and enhance positive impacts should the proposed development be approved.
- Calculate a significance rating for the proposed development.

1.2 DESKTOP ANALYSIS OF POTENTIAL IMPACTS

The major potential avifaunal impacts associated with power lines in general include the following:

- habitat loss
- disturbance, particularly during construction phase
- collisions
- electrocution
- electromagnetic fields

Below, each category of impact is discussed.

1.2.1 DISPLACEMENT THROUGH HABITAT LOSS AND HUMAN ACTIVITY

Worldwide, habitat loss through human activities represents a major cause for declining bird populations. Many species, particularly those restricted to scarce and/or fragmented habitat types, have experienced significant population decreases through the loss of habitat for mining, agriculture etc. The central Highveld regions of South Africa are home to several such species, such as the *Vulnerable* African Grass-owl and *Vulnerable* White-bellied Korhaan. In the case of both these species, as well as many others, habitat losses and subsequent reliance on increasingly fragmented

patches of natural habitat have been identified as key causes of recent population declines (Taylor et al. 2015). Any development that involves clearing and/or construction in natural vegetation risks placing additional pressure on already threatened species, and the presence of such species must be thoroughly investigated during the EIA process.

Human activities during the construction, operational and decommissioning phases of a project can also generate significant negative impacts. Many bird species are highly sensitive to disturbance, particularly when breeding. Human activities in the vicinity of breeding birds can cause significant problems for reproductive success, even when those activities are comparatively benign (e.g., avitourism, e.g., (Müllner et al. 2004).

1.2.2 DISTURBANCE DURING CONSTRUCTION PHASE

The construction phase of a project often involves much higher levels of activity than the subsequent operational phase, and disturbance of birds and other animals is often greatest during this phase. In addition to large numbers of vehicles and personnel being present on site, the construction phase often involves clearing of additional areas surrounding the development itself for purposes of temporary housing, vehicle maintenance, fuel depots, storage of construction materials, rubble dumping, etc. Many of these activities increase the probability of impacts such as fuel spills, as well as activities such as illegal hunting of birds by construction workers. For these reasons, the impacts of the construction phase need to feature prominently in the environmental management plan, and due care must be taken to avoid excessive impacts.

1.2.3 COLLISIONS

Bird deaths from collisions with power lines have been documented in many parts of the world. Some groups of birds are more susceptible to collisions with power lines than others, with the orders Galliformes (gamebirds), Gruiformes (cranes), and Ciconiiformes (storks and allies) being most vulnerable (Bevanger 1995). Variation among groups of birds in their likelihood of colliding with power lines appears to reflect variation in flight patterns and aerodynamics. Birds with high wing loading (i.e., higher body mass per unit wing area) collide more frequently with power lines than species with lower wing loading (Bevanger 1998, Janss 2000). In several studies, the most common collision victims were “poor fliers”, species with rapid flight and high wing loading resulting in a limited ability to rapidly change direction in mid-air and avoid collisions (Bevanger 1998, Janss 2000). In addition to characteristics of the birds themselves, an important determinant of collision risk is the structure of power lines. (Bevanger and Brøseth 2001) found that power lines with fewer wire levels in the vertical plane resulted in fewer avian collisions, a finding consistent with those of earlier studies (e.g., (Renssen et al. 1975). In the former study, significantly more birds collided with a power line before the removal of the lower earth wire than after removal.

In South Africa, collisions with power lines have been implicated in population declines of several threatened birds, with two key species being Ludwigs’ Bustard and Blue Crane. A recent study documented very high mortality rates for Ludwig’s Bustard in the Nama and Succulent Karoo, with an average of 0.63 fatal collisions per km of 400 kV transmission line per year (Jenkins et al. 2011). These authors extrapolated this average collision rate across the bustard’s range, and estimated that collisions kill 4,000 – 11,900 individuals per year. Given that the total population of this southern African near-endemic is thought to number no more than 81,000 birds, the current power-line-associated mortality rate is extremely alarming (Jenkins et al. 2011). Blue Cranes, South Africa’s national bird, have also been hard-hit. In the Overberg region of the Western Cape, recent data suggest that around 12 % of the local Blue Crane population is killed by collisions each year, a mortality rate that is completely unsustainable (Shaw et al. 2010). These two studies provide a sobering insight into the potential impacts of power lines on birds, and underscore the extreme caution required when erecting power lines anywhere in southern Africa.

1.2.4 ELECTROCUTIONS

The second major threat posed to birds by power lines is electrocution. In several studies, electrocution victims ranged in size from large species (e.g., vultures, and storks) to medium and small species (e.g., falcons, starlings) (Bevanger 1998, Janss 2000, Mañosa 2001). On pylons constructed of conductive materials (e.g., steel), even small species can create a short circuit between a live wire and the pylon (Janss 2000). Even when pylons are constructed of non-conductive materials (e.g., wood), small species are electrocuted when several perching and/or flying individuals come into contact with each other, creating a short circuit between wires (Bevanger 1998). In general, groups most susceptible to electrocution are the orders Ciconiiformes (storks and allies), Falconiformes (raptors, including vultures), Strigiformes (owls) and Passeriformes (songbirds) (Bevanger 1995). Pylon structure is an important determinant of electrocution risk (Mañosa 2001). In a comparison of five pylon designs, the "crossbow" design was found to be the most dangerous in terms of avian electrocution, whereas the vertically arranged design was safest (Mañosa 2001). Electrocution can have profound impacts on populations of endangered species. A recent study of the population impacts of electrocution in Eagle Owls (*Bubo bubo*) in Europe revealed that population dynamics were severely affected by the presence of power lines (Sergio et al. 2004). Over a 10-year period, the majority of Eagle Owl territories near power lines were abandoned, leading to a significant decline in population size (Sergio et al. 2004). In southern Africa, Cape Vultures (*Gyps coprotheres*) perching on power lines have been severely affected by electrocution (Ledger and Annegarn 1981, Hobbs and Ledger 1986, van Rooyen 2000, 2003).

1.2.5 ELECTROMAGNETIC FIELDS

There is some evidence that electromagnetic fields (EMFs) generated by power lines affect aspects of avian behaviour, reproductive success, growth and development, and physiology and hormone levels (Fernie and Reynolds 2005). However, the results of studies examining the effects of EMFs vary in their findings, and it is not currently possible to draw general conclusions regarding the effects of power line EMFs on avian survival and reproduction (Fernie et al. 2000, Fernie and Reynolds 2005). More recently, experimental evidence has emerged that "electrosmog", electromagnetic noise associated with high densities of electronic devices in urban areas, interferes with the ability of migrant birds to navigate by disrupting their sense of magnetoreception (Engels et al. 2014).

1.3 DESCRIPTION OF STUDY AREA

The proposed 400KV powerline runs from the Lulamisa substation in Kyalami, Gauteng, east over flat Highveld plains to the Bravo substation at the Kusile Power station southwest of Balmoral in Mpumalanga (Figure 1).

The western section of the line runs through formal and informal residential areas at Diepsloot, Olievenhoutbosch, Blue Valley and Midstream. From there the line crosses primarily agricultural land, small holdings and some mining areas. Pockets of untransformed land are interspersed between the other land uses, particularly in the vicinity of Bronkhorstpruit towards the eastern extent of the line. The line runs along a section of the border of the Diepsloot Nature Reserve and crosses the Rietvlei Nature Reserve. The Gauteng Conservation Plan (CPlan v 3.3, GDARD 2011) and the Mpumalanga Biodiversity Conservation plan: Critical Biodiversity Areas (Terrestrial) Map show the line traversing primarily areas with intermediate to low sensitivity although areas classified as Important/Highly Significant, Ecological Support Areas and Important and Necessary are relevant (Figure 2).

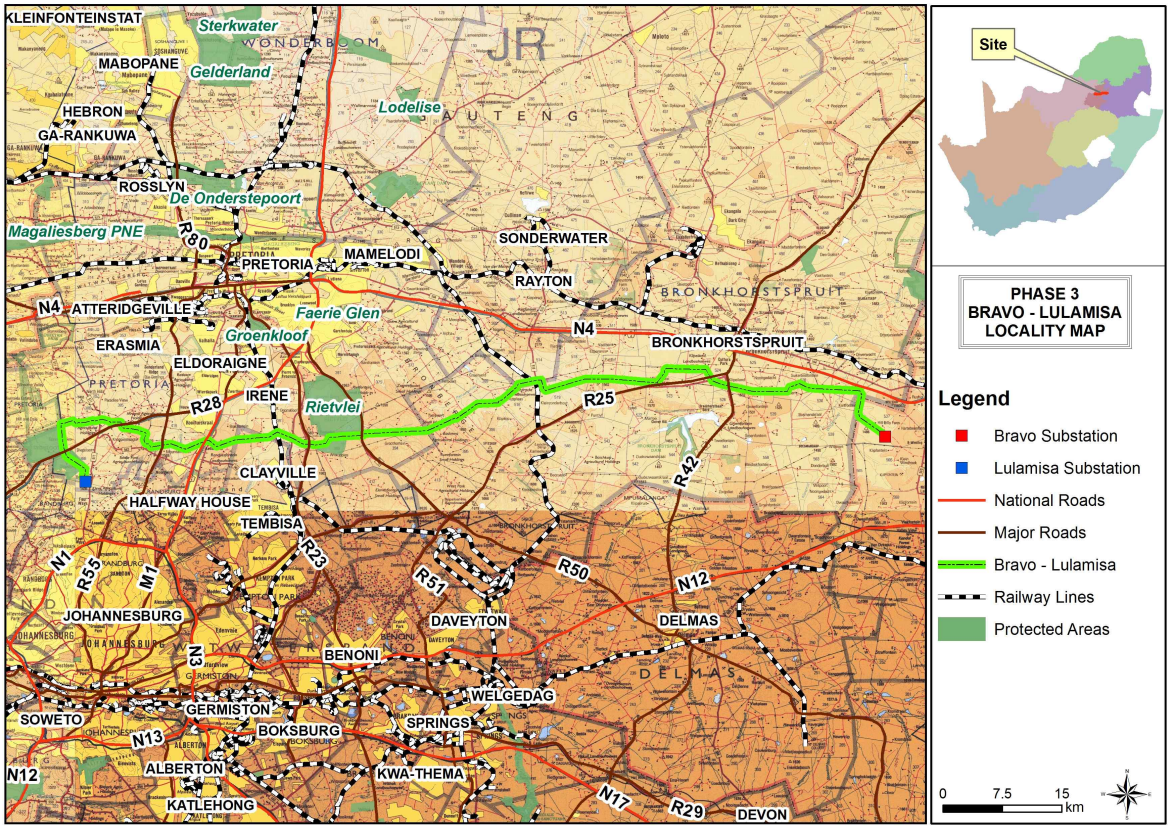

Figure 1. *Route of the proposed Bravo 3 Power Lines connecting Bravo Power Station and Lulamisa Substation.*

1.3.1 CONSERVATION STATUS

Conservation status as indicated by the National Biodiversity Assessment (SANBI, 2011) shows the line crossing an Endangered area to the west of the line and a Critically Endangered area in the central portion (Figure 3).

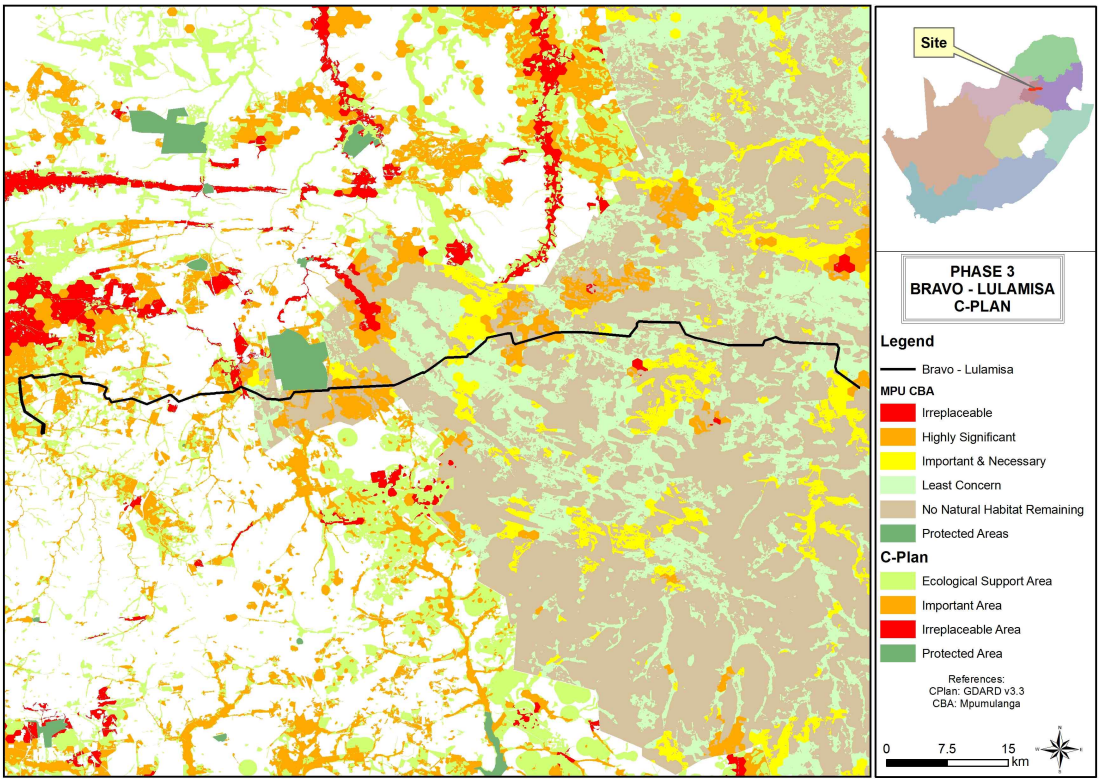

Figure 2: Conservation status of areas traversed by the proposed powerline as classified in Gauteng and Mpumalanga regional datasets.

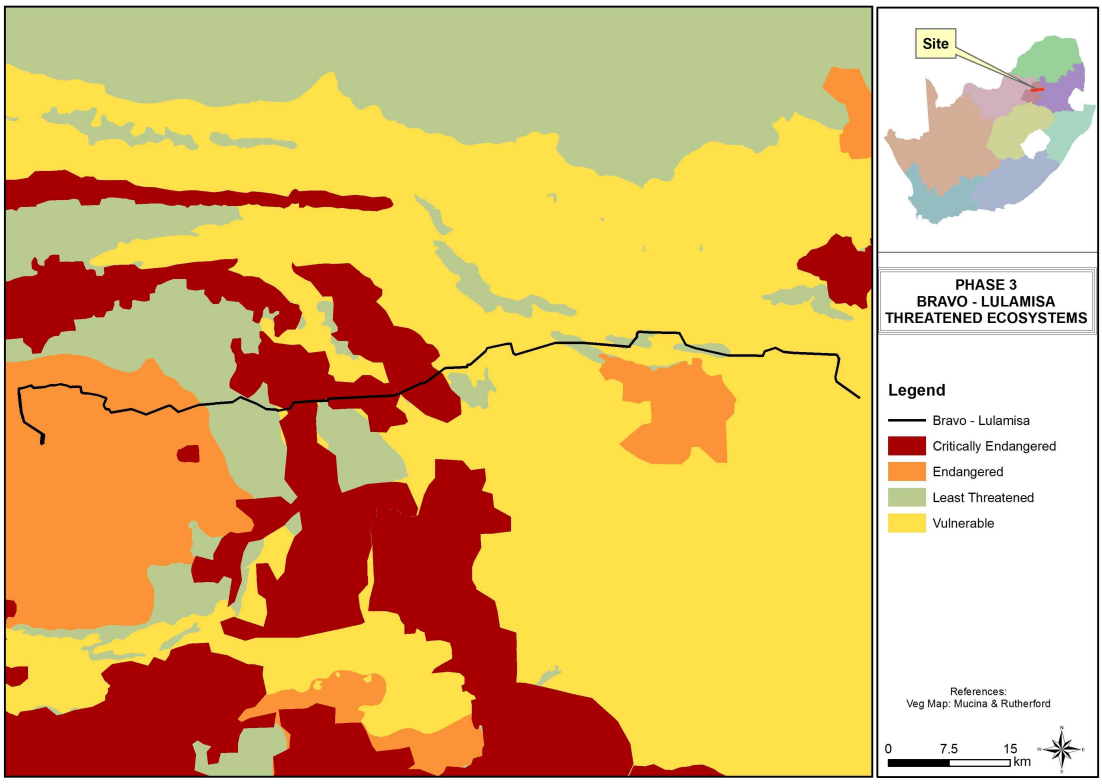

Figure 3: Threatened ecosystems as classified by the 2011 SANBI National Biodiversity Assessment.

1.3.2 VEGETATION TYPES

The vegetation classification of South Africa (Mucina & Rutherford, 2006) lists the vegetation units crossed by the proposed powerline (Figure 4). These include:

- Egoli Granite Grassland,
- Carletonville Dolomite Grassland,
- Rand Highveld Grassland,
- Andesite Mountain Bushveld,
- Gold Reef Mountain Bushveld and
- Eastern Highveld Grassland

The accompanying floral report presents a more comprehensive overview of the site, incorporating all the elements underpinning the above-mentioned vegetation units as well as their conservation status.

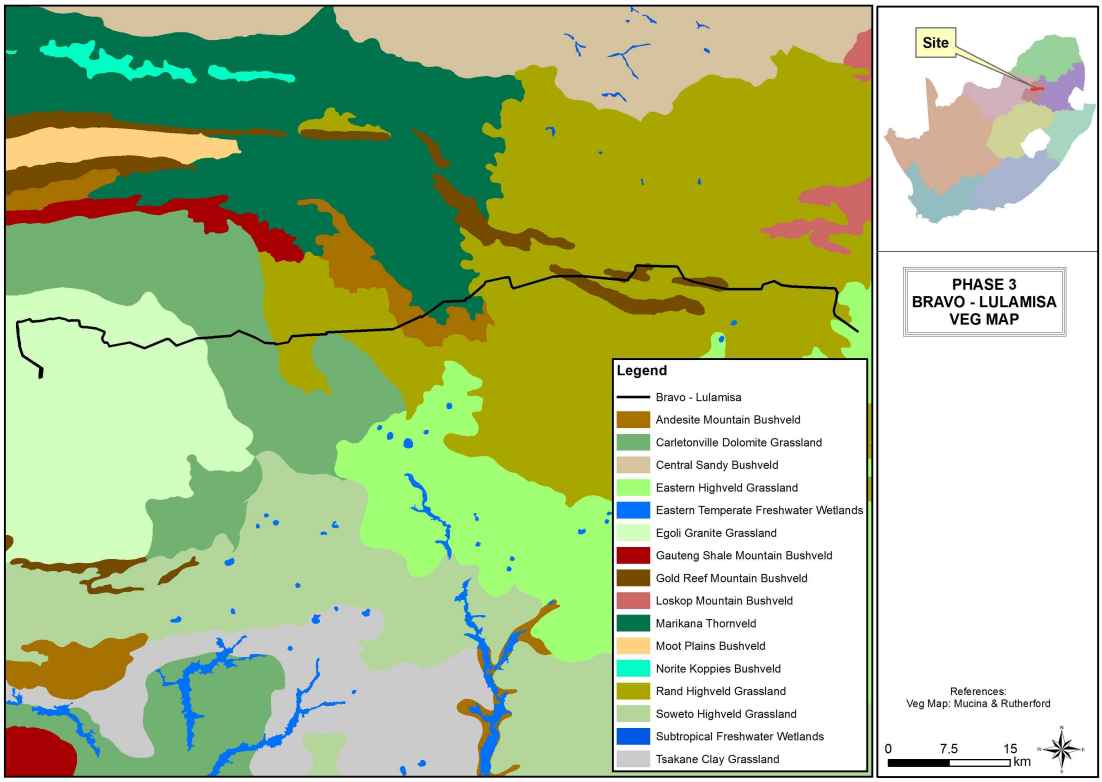

Figure 4: *The vegetation classification for the proposed powerline.*

1.3.3 REGIONAL HYDROLOGY

Wetland and river systems affected by the proposed powerline are discussed in detail in the accompanying wetland assessment report. In general, the powerline crosses 6 Quaternary Catchments (A21C, A21B, A21A, A23A, B20D and B20F). Several perennial and non-perennial watercourses are crossed by the proposed powerline (Figure 5).

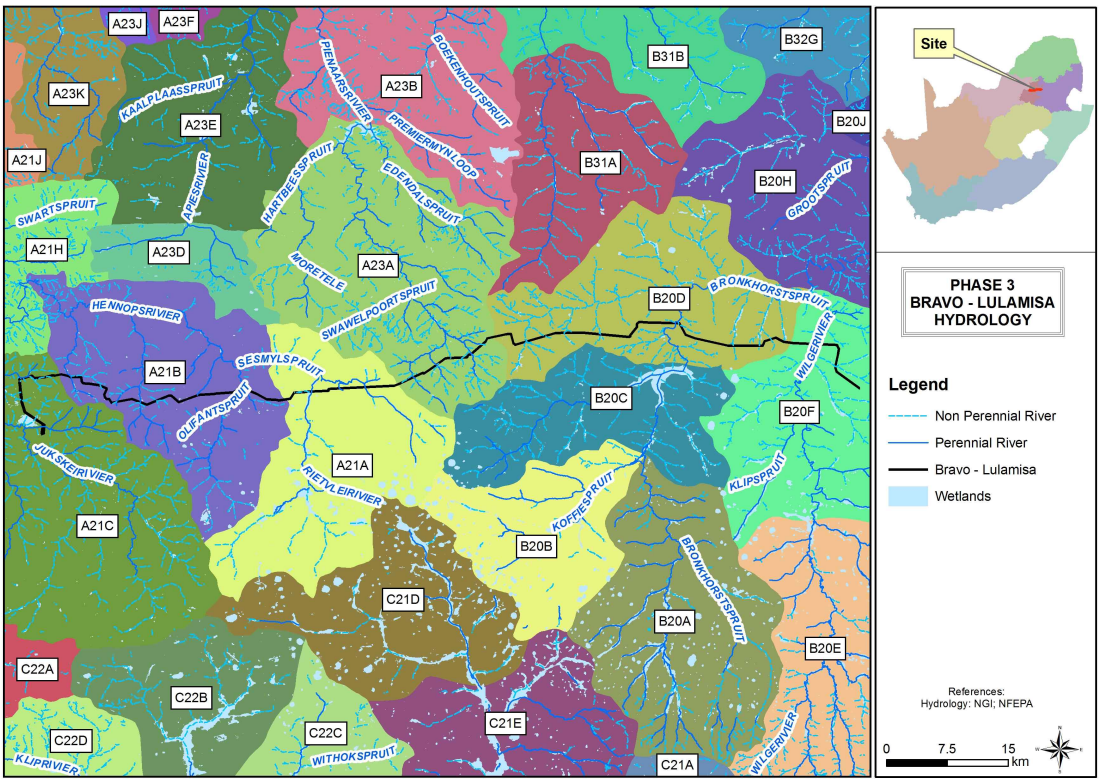

***Figure 5**: A hydrology map of the site and water features in the proximity of the powerline route*

2. METHODS

Birds occurring along the route of the proposed development were assessed in several steps, as detailed below. Red-listed species were identified using the most recent (2015) Red Data Book for South Africa, Lesotho and Swaziland (Taylor et al. 2015).

2.1 DESKTOP STUDY

Prior to the site visit, a desktop study was undertaken in which bird species that potentially occur at the site and in the surrounding areas were identified using data from the first and second South African Bird Atlas Projects (SABAP 1 and 2). SABAP 2 data are based on records for pentads (i.e., 5' X 5'), whereas SABAP 1 data were based on quarter-degree grid cells (i.e., 15' X 15'). A list of species potentially occurring along the route of the proposed power line was developed using data for all the SABAP 2 pentads within which the project is located, plus surrounding pentads (Figure 6). The pentads at the four corners of this region are: northwest: 2545_2755; northeast: 2545_2855; southeast: 2605_2855; southwest: 2605_2755. The area considered during the desktop study is thus much larger than the area likely to be affected by the project (Figure 6). This approach is adopted to ensure that all species potentially occurring at the site, whether resident, nomadic, or migratory, are identified.

2.2 FIELD SURVEYS

Surveys along the proposed power line route were conducted on 29 May 2016 and 4 June 2016, with a total of 12 hours spent along the route. On both days, the weather was warm and clear with little wind.

Figure 6. *Approximate extent of area included (red rectangle) when generating the list of birds potentially occurring along the route of the proposed Bravo 3 power lines (red line). Image courtesy of Google Earth, and inset outline map showing national context courtesy of Wikipedia.*

2.2.1 INTENSIVE SEARCHING AND HABITAT ASSESSMENT

During the field survey, birds occurring along the route were identified during transects and adjacent areas (Figure 3). During these transects, an observer with binoculars walks slowly through the site, identifying all birds encountered (seen or heard), identifying nests observed, and assessing the avian habitats present. This methodology is loosely based on the point count method of (Ralph et al. 1993). One key issue with avian censuses concerns the relationship between detectability and distance from an observer; several authors have proposed methods to correct census data for this problem. However, the open nature of the habitat along the Bravo 3 route means that detectability remains relatively constant with distance from an observer, unlike the case in dense forests, for instance.

2.2.2 ROAD SURVEYS AND HABITAT ASSESSMENT

Because of the high mobility of birds, during the field survey habitats occurring in a radius of approximately 10 km of the power line route were surveyed by means of road transects, driving at a maximum of 60 km/h and noting all available habitats and birds detected. This survey method is particularly effective for detecting birds that habitually perch on power lines, including many raptors.

2.2.3 DISCUSSION WITH LOCAL RESIDENTS

Local landowners are often a good source of information regarding the presence of birds, particularly readily identifiable groups such as raptors, gamebirds and large-bodied groups such as cranes and bustards. During the field survey, landowners were approached for information on the occurrence of such species on their properties.

2.2.4 CONSULTATION OF PREVIOUS REPORTS

The Bravo 3 Bravo - Lulamisa power line has been the subject of a previous avifaunal impact assessment. Van Rooyen (van Rooyen 2008) conducted an Bird Impact Assessment Study, in which three alternate routes were evaluated and one selected based on minimising impacts on avifauna. This study was extensively consulted during the process of compiling the present report, and relevant recommendations have been incorporated here. An additional source of information consulted during preparation of the present report is a study by Matt Pretorius of the Endangered Birds of Prey Program which involved the tracking of one female African Grass-owl between April and September 2015 in the Midrand area. To the best of my knowledge, these data have not yet been published.

2.2.5 LIMITATIONS OF BASELINE DATA

- Bird species occurring at the site of the proposed project were intensively assessed during several days, and the possibility exists that rarer species in the area were not encountered due to the short time spent on site. This constraint is partly offset by the incorporation of data in from SABAP 1 and SABAP 2.
- The field surveys took place in winter, a time of year when migrants are absent and bird activity is reduced compared to summer. This constraint is partly offset by the incorporation of data in from SABAP 1 and SABAP 2. Moreover, the area of the proposed power lines is relatively well-covered in terms of atlasing effort, meaning that bird lists compiled from SABAP data are more reliable than would be the case for remote areas in which little atlassing has takne place.
- The behaviour and ecology of birds, like that of other organisms, is not completely predictable. The overall impacts of the proposed project can reliably be predicted on the basis of impacts observed elsewhere, but it is important to appreciate that specific, and sometimes subtle, local factors can modify interactions between birds and human activities

3. RESULTS

Along most its length, the proposed Bravo 3 power line does not fall within a recognized Important Bird and Biodiversity Area (IBA) (Marnewick et al. 2015). However, at the western-most end of the route, part of the proposed line north of the N14 highway is located within the Magaliesberg IBA (Marnewick et al. 2015).

3.1 AVIAN HABITATS ALONG THE POWER LINE ROUTE

Avian habitats along the proposed power line route can be broadly divided into the following categories:

- Grasslands – some of the route, particularly in the eastern and western sections, traverses natural grassland. Some of these grasslands are in good condition and suitable for threatened species such as African Grass-owl, White-bellied Korhaan and Secretarybird.

- Woodland – several patches of woodland occur along the route. Whereas some of these comprise stands of the indigenous *Acacia karroo*, many consist of alien species, such as black wattle (*Acacia mearnsii*). Much of the woodland occurs in the central third of power line route, which crosses an area consisting of small-holdings east of Pretoria.

- Wetlands – a number of small wetlands occur along the route of the proposed power line. This includes wetlands in the Northern Farms area which represent good habitat for African Grass-owls

- Water bodies and drainage lines – the proposed route traverses a number of drainage lines, and there a few small farm dams close to the route. These provide habitat for a number of aquatic and riparian species. There is also a small dam in the southern section of Rietvlei Nature Reserve that is traversed by the line.

- Agricultural fields – some areas along the route are made up of transformed agricultural landscapes, with irrigated cultivated fields predominating.

- Urban areas – the western portion of the power line route traverses heavily urbanised areas in Gauteng.

The proposed route crosses the southern part of Rietvlei Nature Reserve, an important conservation area just south of Pretoria. The section of the reserve crossed by the line consists primarily of grassland, and has high conservation significance.

In terms of overall conservation significance from an avifaunal standpoint, the route passes through areas varying from medium-high significance to low significance. The areas of highest conservation significance are the grasslands and wetlands north of the N14 highway at the western-most section of the route, the grasslands in the eastern-most part of the route near Kusile power station, and Rietvlei Nature Reserve.

***Figure 7**. Disturbed grasslands between the Lulamisa substation and the point where the proposed line crosses the N14 highway.*

***Figure 8**. Grasslands traversed by the power line route north of the N14 highway. This section of the route falls within the Magaliesberg IBA.*

***Figure 9**. One of several small dams in proximity to the power line route north of the N14 highway.*

***Figure 10**. Grassland along the power line route where it passes through Midstream Estate*

***Figure 11**. Mosaic of disturbed grassland, patches of alien trees and human settlements. This landscape is typical of the central third of the power line route east of Pretoria.*

***Figure 12**. Rocky ridge crossed by power line route at 25° 54' S 28° 26' E.*

***Figure 13**. Small-holdings east of Pretoria traversed by power line route.*

***Figure 14**. Grassland landscape typical of the eastern third of the power line route.*

***Figure 15**. Grasslands at the start of the power line route at Kusile Power station.*

3.2 BASELINE DATA: BIRDS OCCURRING ALONG THE POWER LINE ROUTE

A total of 438 species have been recorded during SABAP 1 and SABAP 2 in the area considered for the desktop survey, a diverse avifauna representing the range of habitats in the area. Of these, the presence of 60 was confirmed during surveys, another 96 are considered highly likely to occur along the route, and there are 72 additional species whose likelihood of occurrence is considered medium (Table 1). These species include grassland specialists, water birds, species characteristic of agricultural and urban areas, as well as woodland species.

Table 1. *Bird species recorded in the area considered for the desktop survey (see Figure 6). The current (2015) regional red data status ("RD" column) of each red-listed species is provided (NT = Near Threatened; VU = Vulnerable; EN = Endangered; CR = Critically Endangered), and the likelihood of each species occurring along the power line route is rated as confirmed, high, medium or low.*

English name	Scientific name	RD	Likelihood	English name	Scientific name	RD	Likelihood
Apalis, Bar-throated	*Apalis thoracica*		High	Avocet, Pied	*Recurvirostra avosetta*		Low
Babbler, Arrow-marked	*Turdoides jardineii*		Confirmed	Babbler, Southern Pied	*Turdoides bicolor*		Low
Barbet, Acacia Pied	*Tricholaema leucomelas*		Medium	Barbet, Black-collared	*Lybius torquatus*		Confirmed
Barbet, Crested	*Trachyphonus vaillantii*		Confirmed	Batis, Chinspot	*Batis molitor*		High
Bee-eater, Blue-cheeked	*Merops persicus*		Low	Bee-eater, European	*Merops apiaster*		High
Bee-eater, Little	*Merops pusillus*		Medium	Bee-eater, Swallow-tailed	*Merops hirundineus*		Low
Bee-eater, White-fronted	*Merops bullockoides*		High	Bishop, Southern Red	*Euplectes orix*		Confirmed
Bishop, Yellow	*Euplectes capensis*		Low	Bishop, Yellow-crowned	*Euplectes afer*		Confirmed
Bittern, Dwarf	*Ixobrychus sturmii*		Low	Bittern, Little	*Ixobrychus minutus*		Medium
Bokmakierie, Bokmakierie	*Telophorus zeylonus*		Confirmed	Boubou, Southern	*Laniarius ferrugineus*		High
Brubru	*Nilaus afer*		Low	Bulbul, African Red-eyed	*Pycnonotus nigricans*		Low
Bulbul, Dark-capped	*Pycnonotus tricolor*		Confirmed	Bunting, Cape	*Emberiza capensis*		Low
Bunting, Cinnamon-breasted	*Emberiza tahapisi*		High	Bunting, Golden-breasted	*Emberiza flaviventris*		Low
Bunting, Lark-like	*Emberiza impetuani*		Low	Bush-shrike, Grey-headed	*Malaconotus blanchoti*		Low
Bush-shrike, Orange-breasted	*Telophorus sulfureopectus*		Low	Bustard, Denham's	*Neotis denhami*	VU	Medium
Buttonquail, Kurrichane	*Turnix sylvaticus*		Low	Buzzard, Jackal	*Buteo rufofuscus*		Medium
Buzzard, Lizard	*Kaupifalco monogrammicus*		Low	Buzzard, Steppe	*Buteo vulpinus*		High
Camaroptera, Green-backed	*Camaroptera brachyura*		Low	Canary, Black-throated	*Crithagra atrogularis*		High
Canary, Cape	*Serinus canicollis*		Low	Canary, Yellow	*Crithagra flaviventris*		Low
Canary, Yellow-fronted	*Crithagra mozambicus*		Confirmed	Chat, Anteating	*Myrmecocichla formicivora*		High
Chat, Familiar	*Cercomela familiaris*		Medium	Cisticola, Cloud	*Cisticola textrix*		High
Cisticola, Desert	*Cisticola aridulus*		High	Cisticola, Lazy	*Cisticola aberrans*		Medium
Cisticola, Levaillant's	*Cisticola tinniens*		Confirmed	Cisticola, Pale-crowned	*Cisticola cinnamomeus*		Low
Cisticola, Rattling	*Cisticola chiniana*		Medium	Cisticola, Wailing	*Cisticola lais*		Medium
Cisticola, Wing-snapping	*Cisticola ayresii*		High	Cisticola, Zitting	*Cisticola juncidis*		Confirmed
Cliff-chat, Mocking	*Thamnolaea cinnamomeiventris*		Medium	Cliff-swallow, South African	*Hirundo spilodera*		High
Coot, Red-knobbed	*Fulica cristata*		Medium	Cormorant, Cape	*Phalacrocorax capensis*		Low
Cormorant, Reed	*Phalacrocorax africanus*		Medium	Cormorant, White-breasted	*Phalacrocorax carbo*		Medium
Coucal, Burchell's	*Centropus burchellii*		Confirmed	Coucal, White-browed	*Centropus superciliosus*		Low
Courser, Bronze-winged	*Rhinoptilus chalcopterus*		Low	Courser, Temminck's	*Cursorius temminckii*		Low
Crake, African	*Crecopsis egregia*		Low	Crake, Baillon's	*Porzana pusilla*		Low
Crake, Black	*Amaurornis flavirostris*		Low	Crake, Corn	*Crex crex*		Low

Crake, Spotted	*Porzana porzana*		Low
Crane, Grey Crowned	*Balearica regulorum*	EN	Low
Crombec, Long-billed	*Sylvietta rufescens*		Medium
Crow, Pied	*Corvus albus*		Confirmed
Cuckoo-shrike, White-breasted	*Coracina pectoralis*		Low
Cuckoo, Black	*Cuculus clamosus*		Medium
Cuckoo, Diderick	*Chrysococcyx caprius*		High
Cuckoo, Jacobin	*Clamator jacobinus*		Low
Cuckoo, Levaillant's	*Clamator levaillantii*		Medium
Darter, African	*Anhinga rufa*		Low
Dove, Namaqua	*Oena capensis*		High
Dove, Rock	*Columba livia*		High
Duck, African Black	*Anas sparsa*		Medium
Duck, Fulvous	*Dendrocygna bicolor*		Low
Duck, White-backed	*Thalassornis leuconotus*		Low
Duck, Yellow-billed	*Anas undulata*		Low
Eagle-owl, Spotted	*Bubo africanus*		High
Eagle, Booted	*Aquila pennatus*		Low
Eagle, Martial	*Polemaetus bellicosus*	EN	Low
Eagle, Verreaux's	*Aquila verreauxii*	VU	Medium
Egret, Cattle	*Bubulcus ibis*		High
Egret, Little	*Egretta garzetta*		Low
Egret, Yellow-billed	*Egretta intermedia*		Low
Eremomela, Yellow-bellied	*Eremomela icteropygialis*		Low
Falcon, Lanner	*Falco biarmicus*	VU	Medium
Falcon, Red-footed	*Falco vespertinus*	NT	Medium
Finch, Cut-throat	*Amadina fasciata*		Medium
Finch, Scaly-feathered	*Sporopipes squamifrons*		Low
Firefinch, African	*Lagonosticta rubricata*		Low
Firefinch, Red-billed	*Lagonosticta senegala*		Low
Fish-eagle, African	*Haliaeetus vocifer*		Medium
Flamingo, Lesser	*Phoenicopterus minor*	NT	Medium
Flufftail, Red-chested	*Sarothrura rufa*		High
Flycatcher, Fiscal	*Sigelus silens*		Confirmed
Flycatcher, Pale	*Bradornis pallidus*		Low
Flycatcher, Spotted	*Muscicapa striata*		High
Francolin, Crested	*Dendroperdix sephaena*		Confirmed

Crane, Blue	*Anthropoides paradiseus*	NT	High
Crane, Wattled	*Bugeranus carunculatus*	CR	Low
Crow, Cape	*Corvus capensis*		Low
Cuckoo-shrike, Black	*Campephaga flava*		Medium
Cuckoo, African	*Cuculus gularis*		Low
Cuckoo, Common	*Cuculus canorus*		Low
Cuckoo, Great Spotted	*Clamator glandarius*		Low
Cuckoo, Klaas's	*Chrysococcyx klaas*		Low
Cuckoo, Red-chested	*Cuculus solitarius*		High
Dove, Laughing	*Streptopelia senegalensis*		Confirmed
Dove, Red-eyed	*Streptopelia semitorquata*		Confirmed
Drongo, Fork-tailed	*Dicrurus adsimilis*		High
Duck, Comb	*Sarkidiornis melanotos*		Low
Duck, Maccoa	*Oxyura maccoa*	NT	Low
Duck, White-faced	*Dendrocygna viduata*		Low
Eagle-owl, Cape	*Bubo capensis*		Low
Eagle-owl, Verreaux's	*Bubo lacteus*		Low
Eagle, Long-crested	*Lophaetus occipitalis*		Medium
Eagle, Tawny	*Aquila rapax*	EN	Low
Eagle, Wahlberg's	*Aquila wahlbergi*		Low
Egret, Great	*Egretta alba*		Low
Egret, Slaty	*Egretta vinaceigula*		Low
Eremomela, Burnt-necked	*Eremomela usticollis*		Low
Falcon, Amur	*Falco amurensis*		High
Falcon, Peregrine	*Falco peregrinus*		Medium
Finch, Cuckoo	*Anomalospiza imberbis*		Medium
Finch, Red-headed	*Amadina erythrocephala*		Confirmed
Finfoot, African	*Podica senegalensis*	VU	Low
Firefinch, Jameson's	*Lagonosticta rhodopareia*		High
Fiscal, Common (Southern)	*Lanius collaris*		Confirmed
Flamingo, Greater	*Phoenicopterus ruber*	NT	Medium
Flufftail, Buff-spotted	*Sarothrura elegans*		Low
Flycatcher, Fairy	*Stenostira scita*		High
Flycatcher, Marico	*Bradornis mariquensis*		Low
Flycatcher, Southern Black	*Melaenornis pammelaina*		Confirmed
Francolin, Coqui	*Peliperdix coqui*		High
Francolin, Orange River	*Scleroptila levaillantoides*		Low

Francolin, Red-winged	*Scleroptila levaillantii*		Low
Go-away-bird, Grey	*Corythaixoides concolor*		Confirmed
Godwit, Black-tailed	*Limosa limosa*		Low
Goose, Spur-winged	*Plectropterus gambensis*		Low
Goshawk, Gabar	*Melierax gabar*		High
Grass-owl, African	*Tyto capensis*	VU	Confirmed
Grebe, Black-necked	*Podiceps nigricollis*		Low
Grebe, Little	*Tachybaptus ruficollis*		Low
Greenbul, Yellow-bellied	*Chlorocichla flaviventris*		Low
Guineafowl, Helmeted	*Numida meleagris*		Confirmed
Gull, Grey-headed	*Larus cirrocephalus*		Confirmed
Gull, Lesser Black-backed	*Larus fuscus*		Low
Harrier-Hawk, African	*Polyboroides typus*		High
Harrier, Pallid	*Circus macrourus*		Medium
Hawk-eagle, Ayres's	*Aquila ayresii*		Medium
Helmet-shrike, White-crested	*Prionops plumatus*		Low
Heron, Black-headed	*Ardea melanocephala*		Confirmed
Heron, Green-backed	*Butorides striata*		Low
Heron, Purple	*Ardea purpurea*		Low
Heron, Squacco	*Ardeola ralloides*		Low
Honey-buzzard, European	*Pernis apivorus*		Medium
Honeyguide, Greater	*Indicator indicator*		Medium
Hoopoe, African	*Upupa africana*		Confirmed
Hornbill, Red-billed	*Tockus erythrorhynchus*		Low
Hornbill, Southern Yellow-billed	*Tockus leucomelas*		Low
Ibis, African Sacred	*Threskiornis aethiopicus*		Confirmed
Ibis, Hadeda	*Bostrychia hagedash*		Confirmed
Indigobird, Dusky	*Vidua funerea*		Low
Indigobird, Village	*Vidua chalybeata*		Low
Kestrel, Greater	*Falco rupicoloides*		Confirmed
Kestrel, Rock	*Falco rupicolus*		Medium
Kingfisher, Giant	*Megaceryle maximus*		Low
Kingfisher, Malachite	*Alcedo cristata*		Medium
Kingfisher, Striped	*Halcyon chelicuti*		Low
Kite, Black-shouldered	*Elanus caeruleus*		Confirmed
Korhaan, Blue	*Eupodotis caerulescens*		Medium
Korhaan, Red-crested	*Lophotis ruficrista*		Low

Francolin, Shelley's	*Scleroptila shelleyi*		Low
Godwit, Bar-tailed	*Limosa lapponica*		Low
Goose, Egyptian	*Alopochen aegyptiacus*		Confirmed
Goshawk, African	*Accipiter tachiro*		Low
Goshawk, Southern Pale Chanting	*Melierax canorus*		Low
Grassbird, Cape	*Sphenoeacus afer*		High
Grebe, Great Crested	*Podiceps cristatus*		Low
Green-pigeon, African	*Treron calvus*		Medium
Greenshank, Common	*Tringa nebularia*		Low
Gull, Franklin's	*Larus pipixcan*		Low
Gull, Hartlaub's	*Larus hartlaubii*		Low
Hamerkop, Hamerkop	*Scopus umbretta*		Medium
Harrier, Montagu's	*Circus pygargus*		Medium
Hawk-eagle, African	*Aquila spilogaster*		Low
Hawk, African Cuckoo	*Aviceda cuculoides*		Low
Heron, Black	*Egretta ardesiaca*		Low
Heron, Goliath	*Ardea goliath*		Low
Heron, Grey	*Ardea cinerea*		Confirmed
Heron, Rufous-bellied	*Ardeola rufiventris*		Low
Hobby, Eurasian	*Falco subbuteo*		Low
Honeybird, Brown-backed	*Prodotiscus regulus*		Medium
Honeyguide, Lesser	*Indicator minor*		Medium
Hornbill, African Grey	*Tockus nasutus*		High
Hornbill, Redbilled	*Tockus erythrorhynchus*		Low
House-martin, Common	*Delichon urbicum*		High
Ibis, Glossy	*Plegadis falcinellus*		High
Ibis, Southern Bald	*Geronticus calvus*	VU	High
Indigobird, Purple	*Vidua purpurascens*		Medium
Jacana, African	*Actophilornis africanus*		Low
Kestrel, Lesser	*Falco naumanni*		High
Kingfisher, Brown-hooded	*Halcyon albiventris*		High
Kingfisher, Half-collared	*Alcedo semitorquata*	NT	Medium
Kingfisher, Pied	*Ceryle rudis*		Medium
Kingfisher, Woodland	*Halcyon senegalensis*		Low
Kite, Yellow-billed	*Milvus aegyptius*		High
Korhaan, Northern Black	*Afrotis afraoides*		Confirmed
Korhaan, White-bellied	*Eupodotis senegalensis*	VU	HIgh

Lapwing, African Wattled	*Vanellus senegallus*		Confirmed
Lapwing, Crowned	*Vanellus coronatus*		Confirmed
Lark, Eastern Clapper	*Mirafra fasciolata*		High
Lark, Fawn-coloured	*Calendulauda africanoides*		Medium
Lark, Melodious	*Mirafra cheniana*		High
Lark, Pink-billed	*Spizocorys conirostris*		Low
Lark, Rufous-naped	*Mirafra africana*		Confirmed
Lark, Spike-heeled	*Chersomanes albofasciata*		High
Mannikin, Bronze	*Spermestes cucullatus*		High
Marsh-harrier, African	*Circus ranivorus*	EN	High
Martin, Brown-throated	*Riparia paludicola*		High
Martin, Sand	*Riparia riparia*		High
Masked-weaver, Southern	*Ploceus velatus*		High
Moorhen, Lesser	*Gallinula angulata*		Low
Mousebird, Speckled	*Colius striatus*		Confirmed
Myna, Common	*Acridotheres tristis*		Confirmed
Night-Heron, Black-crowned	*Nycticorax nycticorax*		Medium
Nightjar, Fiery-necked	*Caprimulgus pectoralis*		Medium
Nightjar, Rufous-cheeked	*Caprimulgus rufigena*		Medium
Olive-pigeon, African	*Columba arquatrix*		High
Oriole, Black-headed	*Oriolus larvatus*		High
Osprey	*Pandion haliaetus*		Low
Owl, Barn	*Tyto alba*		High
Owlet, Pearl-spotted	*Glaucidium perlatum*		Low
Painted-snipe, Greater	*Rostratula benghalensis*	NT	Low
Paradise-flycatcher, African	*Terpsiphone viridis*		High
Parrot, Brown-headed	*Poicephalus cryptoxanthus*		Low
Penduline-tit, Cape	*Anthoscopus minutus*		Low
Petronia, Yellow-throated	*Petronia superciliaris*		Low
Pigeon, Speckled	*Columba guinea*		Confirmed
Pipit, Buffy	*Anthus vaalensis*		Medium
Pipit, Long-billed	*Anthus similis*		Medium
Pipit, Striped	*Anthus lineiventris*		Medium
Plover, Kittlitz's	*Charadrius pecuarius*		Low
Pochard, Southern	*Netta erythrophthalma*		Low
Prinia, Black-chested	*Prinia flavicans*		Confirmed
Puffback, Black-backed	*Dryoscopus cubla*		High

Lapwing, Blacksmith	*Vanellus armatus*		Confirmed
Lark, Dusky	*Pinarocorys nigricans*		Low
Lark, Eastern Long-billed	*Certhilauda semitorquata*		Medium
Lark, Flappet	*Mirafra rufocinnamomea*		Low
Lark, Monotonous	*Mirafra passerina*		Low
Lark, Red-capped	*Calandrella cinerea*		Confirmed
Lark, Sabota	*Calendulauda sabota*		Low
Longclaw, Cape	*Macronyx capensis*		Confirmed
Mannikin, Red-backed	*Spermestes bicolor*		Low
Martin, Banded	*Riparia cincta*		High
Martin, Rock	*Hirundo fuligula*		High
Masked-weaver, Lesser	*Ploceus intermedius*		Low
Moorhen, Common	*Gallinula chloropus*		Low
Mousebird, Red-faced	*Urocolius indicus*		Confirmed
Mousebird, White-backed	*Colius colius*		Low
Neddicky, Neddicky	*Cisticola fulvicapilla*		High
Nightjar, European	*Caprimulgus europaeus*		Medium
Nightjar, Freckled	*Caprimulgus tristigma*		High
Nightjar, Square-tailed	*Caprimulgus fossii*		Low
Openbill, African	*Anastomus lamelligerus*		Low
Oriole, Eurasian Golden	*Oriolus oriolus*		Low
Ostrich, Common	*Struthio camelus*		Low
Owl, Marsh	*Asio capensis*		High
Oxpecker, Red-billed	*Buphagus erythrorhynchus*		Low
Palm-swift, African	*Cypsiurus parvus*		High
Paradise-whydah, Long-tailed	*Vidua paradisaea*		Low
Parrot, Meyer's	*Poicephalus meyeri*		Low
Penduline-tit, Grey	*Anthoscopus caroli*		Low
Phalarope, Red	*Phalaropus fulicaria*		Low
Pipit, African	*Anthus cinnamomeus*		Confirmed
Pipit, Bushveld	*Anthus caffer*		Low
Pipit, Plain-backed	*Anthus leucophrys*		Medium
Plover, Common Ringed	*Charadrius hiaticula*		Low
Plover, Three-banded	*Charadrius tricollaris*		Low
Pratincole, Black-winged	*Glareola nordmanni*	NT	Medium
Prinia, Tawny-flanked	*Prinia subflava*		Confirmed
Pygmy-Kingfisher, African	*Ispidina picta*		Low

Pytilia, Green-winged	*Pytilia melba*		Low
Quail, Harlequin	*Coturnix delegorguei*		Low
Quelea, Red-billed	*Quelea quelea*		Confirmed
Reed-warbler, African	*Acrocephalus baeticatus*		Low
Robin-chat, Cape	*Cossypha caffra*		High
Rock-thrush, Cape	*Monticola rupestris*		Medium
Rock-thrush, Short-toed	*Monticola brevipes*		Medium
Roller, Lilac-breasted	*Coracias caudatus*		Low
Ruff	*Philomachus pugnax*		Low
Sandpiper, Buff-breasted	*Tryngites subruficollis*		Low
Sandpiper, Curlew	*Calidris ferruginea*		Low
Sandpiper, Marsh	*Tringa stagnatilis*		Low
Sandpiper, Terek	*Xenus cinereus*		Low
Scimitarbill, Common	*Rhinopomastus cyanomelas*		Medium
Scops-owl, Southern White-faced	*Ptilopsus granti*		Low
Scrub-robin, White-browed	*Cercotrichas leucophrys*		Medium
Seedeater, Streaky-headed	*Crithagra gularis*		High
Shikra, Shikra	*Accipiter badius*		Medium
Shrike, Crimson-breasted	*Laniarius atrococcineus*		High
Shrike, Magpie	*Corvinella melanoleuca*		Low
Snake-eagle, Black-chested	*Circaetus pectoralis*		High
Snipe, African	*Gallinago nigripennis*		Low
Sparrow, Cape	*Passer melanurus*		Confirmed
Sparrow, House	*Passer domesticus*		Confirmed
Sparrowhawk, Black	*Accipiter melanoleucus*		High
Sparrowhawk, Ovambo	*Accipiter ovampensis*		High
Sparrowlark, Grey-backed	*Eremopterix verticalis*		Low
Spurfowl, Natal	*Pternistis natalensis*		Low
Starling, Burchell's	*Lamprotornis australis*		Low
Starling, Pied	*Spreo bicolor*		High
Starling, Violet-backed	*Cinnyricinclus leucogaster*		Low
Stilt, Black-winged	*Himantopus himantopus*		Low
Stonechat, African	*Saxicola torquatus*		Confirmed
Stork, Black	*Ciconia nigra*	VU	Low
Stork, Saddle-billed	*Ephippiorhynchus senegalensis*	EN	Low
Stork, Woolly-necked	*Ciconia episcopus*		Low
Sunbird, Amethyst	*Chalcomitra amethystina*		Confirmed

Quail, Common	*Coturnix coturnix*		Medium
Quailfinch, African	*Ortygospiza atricollis*		Confirmed
Rail, African	*Rallus caerulescens*		Low
Reed-warbler, Great	*Acrocephalus arundinaceus*		Low
Robin-chat, White-throated	*Cossypha humeralis*		Medium
Rock-thrush, Sentinel	*Monticola explorator*		Low
Roller, European	*Coracias garrulus*	NT	Low
Roller, Purple	*Coracias naevius*		Low
Rush-warbler, Little	*Bradypterus baboecala*		Low
Sandpiper, Common	*Actitis hypoleucos*		Low
Sandpiper, Green	*Tringa ochropus*		Low
Sandpiper, Pectoral	*Calidris melanotos*		Low
Sandpiper, Wood	*Tringa glareola*		Low
Scops-owl, African	*Otus senegalensis*		Low
Scrub-robin, Kalahari	*Cercotrichas paena*		Low
Secretarybird	*Sagittarius serpentarius*	VU	High
Shelduck, South African	*Tadorna cana*		Low
Shoveler, Cape	*Anas smithii*		Low
Shrike, Lesser Grey	*Lanius minor*		Medium
Shrike, Red-backed	*Lanius collurio*		High
Snake-eagle, Brown	*Circaetus cinereus*		Medium
Sparrow-weaver, White-browed	*Plocepasser mahali*		Medium
Sparrow, Great	*Passer motitensis*		Low
Sparrow, Southern Grey-headed	*Passer diffusus*		High
Sparrowhawk, Little	*Accipiter minullus*		High
Sparrowlark, Chestnut-backed	*Eremopterix leucotis*		Low
Spoonbill, African	*Platalea alba*		Low
Spurfowl, Swainson's	*Pternistis swainsonii*		Confirmed
Starling, Cape Glossy	*Lamprotornis nitens*		Confirmed
Starling, Red-winged	*Onychognathus morio*		High
Starling, Wattled	*Creatophora cinerea*		High
Stint, Little	*Calidris minuta*		Low
Stork, Abdim's	*Ciconia abdimii*	NT	Medium
Stork, Marabou	*Leptoptilos crumeniferus*	NT	Low
Stork, White	*Ciconia ciconia*		High
Stork, Yellow-billed	*Mycteria ibis*	EN	Medium
Sunbird, Greater Double-collared	*Cinnyris afer*		Medium

Sunbird, Malachite	*Nectarinia famosa*		Low
Sunbird, White-bellied	*Cinnyris talatala*		Confirmed
Swallow, Greater Striped	*Hirundo cucullata*		High
Swallow, Pearl-breasted	*Hirundo dimidiata*		High
Swallow, White-throated	*Hirundo albigularis*		High
Swamphen, African Purple	*Porphyrio madagascariensis*		Low
Swift, Alpine	*Tachymarptis melba*		Low
Swift, Horus	*Apus horus*		Medium
Swift, White-rumped	*Apus caffer*		High
Tchagra, Brown-crowned	*Tchagra australis*		High
Teal, Hottentot	*Anas hottentota*		Low
Tern, Caspian	*Sterna caspia*		Low
Tern, White-winged	*Chlidonias leucopterus*		Low
Thick-knee, Water	*Burhinus vermiculatus*		Low
Thrush, Karoo	*Turdus smithi*		Confirmed
Tinkerbird, Yellow-fronted	*Pogoniulus chrysoconus*		Low
Tit-flycatcher, Grey	*Myioparus plumbeus*		Low
Tit, Southern Black	*Parus niger*		Low
Vulture, Cape	*Gyps coprotheres*	EN	Low
Wagtail, African Pied	*Motacilla aguimp*		Low
Wagtail, Grey	*Motacilla cinerea*		Low
Wagtail, Yellow	*Motacilla flava*		Low
Warbler, Garden	*Sylvia borin*		Medium
Warbler, Marsh	*Acrocephalus palustris*		Low
Warbler, Sedge	*Acrocephalus schoenobaenus*		Low
Waxbill, Black-faced	*Estrilda erythronotos*		Low
Waxbill, Common	*Estrilda astrild*		High
Waxbill, Swee	*Coccopygia melanotis*		Low
Weaver, Cape	*Ploceus capensis*		High
Weaver, Thick-billed	*Amblyospiza albifrons*		High
Wheatear, Capped	*Oenanthe pileata*		High
White-eye, Cape	*Zosterops virens*		Confirmed
Whydah, Pin-tailed	*Vidua macroura*		Confirmed
Widowbird, Fan-tailed	*Euplectes axillaris*		High
Widowbird, Red-collared	*Euplectes ardens*		High
Wood-dove, Emerald-spotted	*Turtur chalcospilos*		Low
Woodpecker, Bearded	*Dendropicos namaquus*		Low

Sunbird, Marico	*Cinnyris mariquensis*		Low
Swallow, Barn	*Hirundo rustica*		High
Swallow, Lesser Striped	*Hirundo abyssinica*		High
Swallow, Red-breasted	*Hirundo semirufa*		Medium
Swamp-warbler, Lesser	*Acrocephalus gracilirostris*		Low
Swift, African Black	*Apus barbatus*		Medium
Swift, Common	*Apus apus*		Medium
Swift, Little	*Apus affinis*		High
Tchagra, Black-crowned	*Tchagra senegalus*		High
Teal, Cape	*Anas capensis*		Low
Teal, Red-billed	*Anas erythrorhyncha*		Low
Tern, Whiskered	*Chlidonias hybrida*		Low
Thick-knee, Spotted	*Burhinus capensis*		High
Thrush, Groundscraper	*Psophocichla litsipsirupa*		High
Thrush, Kurrichane	*Turdus libonyanus*		High
Tit-babbler, Chestnut-vented	*Parisoma subcaeruleum*		High
Tit, Ashy	*Parus cinerascens*		Low
Turtle-dove, Cape	*Streptopelia capicola*		High
Vulture, White-backed	*Gyps africanus*	CR	Low
Wagtail, Cape	*Motacilla capensis*		Confirmed
Wagtail, Mountain	*Motacilla clara*		Low
Warbler, Dark-capped Yellow	*Chloropeta natalensis*		Low
Warbler, Icterine	*Hippolais icterina*		Low
Warbler, River	*Locustella fluviatilis*		Low
Warbler, Willow	*Phylloscopus trochilus*		Medium
Waxbill, Blue	*Uraeginthus angolensis*		Medium
Waxbill, Orange-breasted	*Amandava subflava*		Medium
Waxbill, Violet-eared	*Granatina granatina*		Low
Weaver, Red-headed	*Anaplectes rubriceps*		Low
Weaver, Village	*Ploceus cucullatus*		Low
Wheatear, Mountain	*Oenanthe monticola*		High
Whitethroat, Common	*Sylvia communis*		Low
Whydah, Shaft-tailed	*Vidua regia*		Low
Widowbird, Long-tailed	*Euplectes progne*		High
Widowbird, White-winged	*Euplectes albonotatus*		High
Wood-hoopoe, Green	*Phoeniculus purpureus*		High
Woodpecker, Bennett's	*Campethera bennettii*		Low

Woodpecker, Cardinal	*Dendropicos fuscescens*	Confirmed	Woodpecker, Golden-tailed	*Campethera abingoni*	High
Wren-warbler, Barred	*Calamonastes fasciolatus*	Low	Wryneck, Red-throated	*Jynx ruficollis*	Confirmed

3.3 BASELINE DATA: THREATENED SPECIES OCCURRING ALONG THE POWER LINE ROUTE

A total of 28 threatened or near-threatened species have been recorded during SABAP 1 and SABAP 2 in the area considered for the desktop survey (Table 2). These include members of several groups known to be vulnerable to collisions with power lines and/or electrocution (e.g., cranes, bustards, storks, large raptors). The following species are considered significant in terms of mitigating impacts related to collisions and electrocutions along the Bravo 3 power line:

- Yellow-billed Stork
- Abdim's Stork
- Southern Bald Ibis
- Great Flamingo
- Lesser Flamingo
- Secretarybird
- Cape Vulture
- Verreaux's Eagle
- Blue Crane
- Denham's Bustard
- White-bellied Korhaan
- African Grass-owl

Many of these species have slow life-histories, with long intervals between breeding and low rates of reproduction. For this reason, power line related mortality is a much more severe impact for these birds than it would be for smaller, more rapidly-reproducing species. For this reason, a strongly precautionary approach is required in terms of mitigating the risk of collisions with power lines. Moreover, during a previous assessment of the impacts of this line, van Rooyen (2008) found evidence that Blue Cranes were being killed through collision with the existing lines in the area.

In addition, African Grass-owl is a species that deserves special consideration in terms of mitigating habitat loss. The entire route should be carefully checked before construction commences to ensure that no towers are positioned in habitat that is potentially suitable for this species. Grass-owls inhabitat areas of tall, rank grassland in marshes and vleis, but may also occur in drier grasslands.

Near the western end of the route in the Diepsloot area, the proposed power line passes through areas known to hold grass-owls. Matt Pretorius's recent tracking study of a female owl between April and September 2015 revealed how this bird moved between three core areas, one of which was in the Northern Farms area traversed by the proposed power line route (Figure 16). These data reveal that this bird spent large amounts of time in this area, and underscore the importance of preserving all remaining grass-owl habitat in this area. Several parts of the proposed power line route in this area are sensitive in terms of habitat loss for this species (Figure 17). The loop taken by the power line route north of the N14 highway here is unfortunate; a different route running in a southwesterly direction from just north of Summit Road directly across to immediatel south of Diepsloot would have been preferable from the standpoint of avoiding grass-owl habitat loss. This change to the route would also mean that the new line does not fall within the Magaliesberg IBA. Grass-owl habitat loss in the highlighted areas is largely unavoidable, as the current servitude is too narrow to accommodate an additional power line.

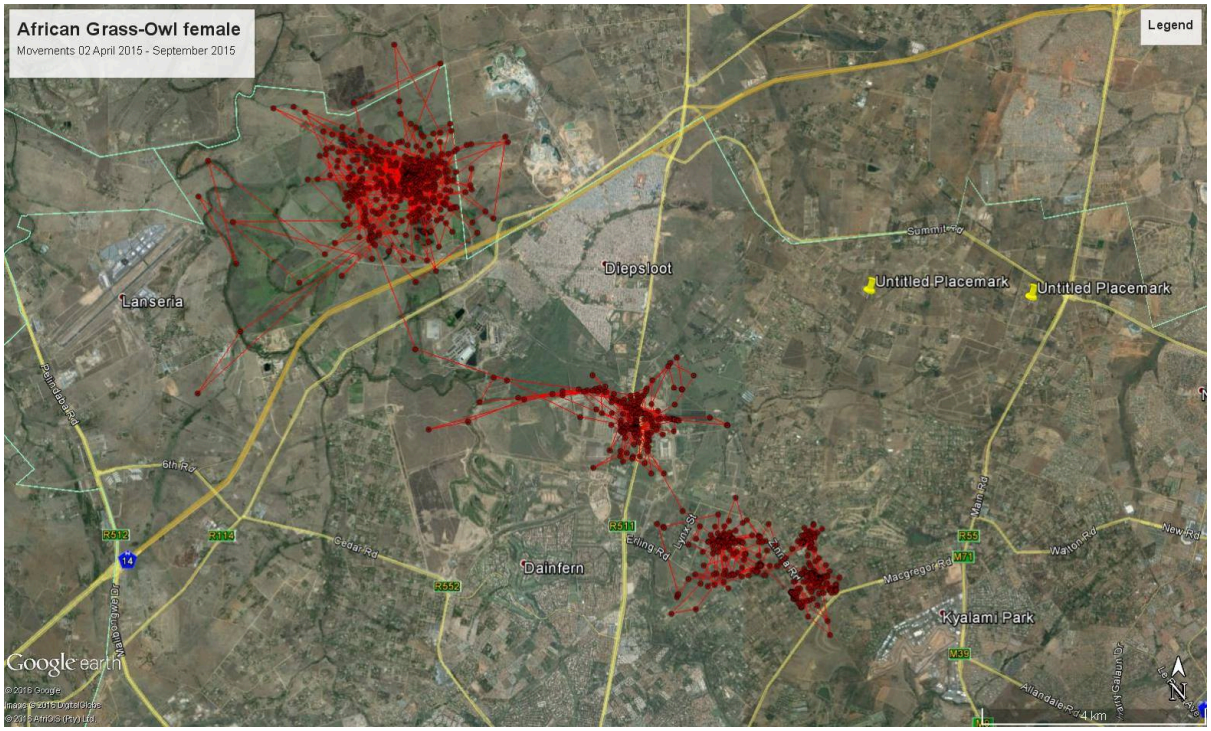

***Figure 16**: Locations of a female African Grass-owl fitted with a transmitter between April and September 2015 (Matt Pretorius, unpublished data).*

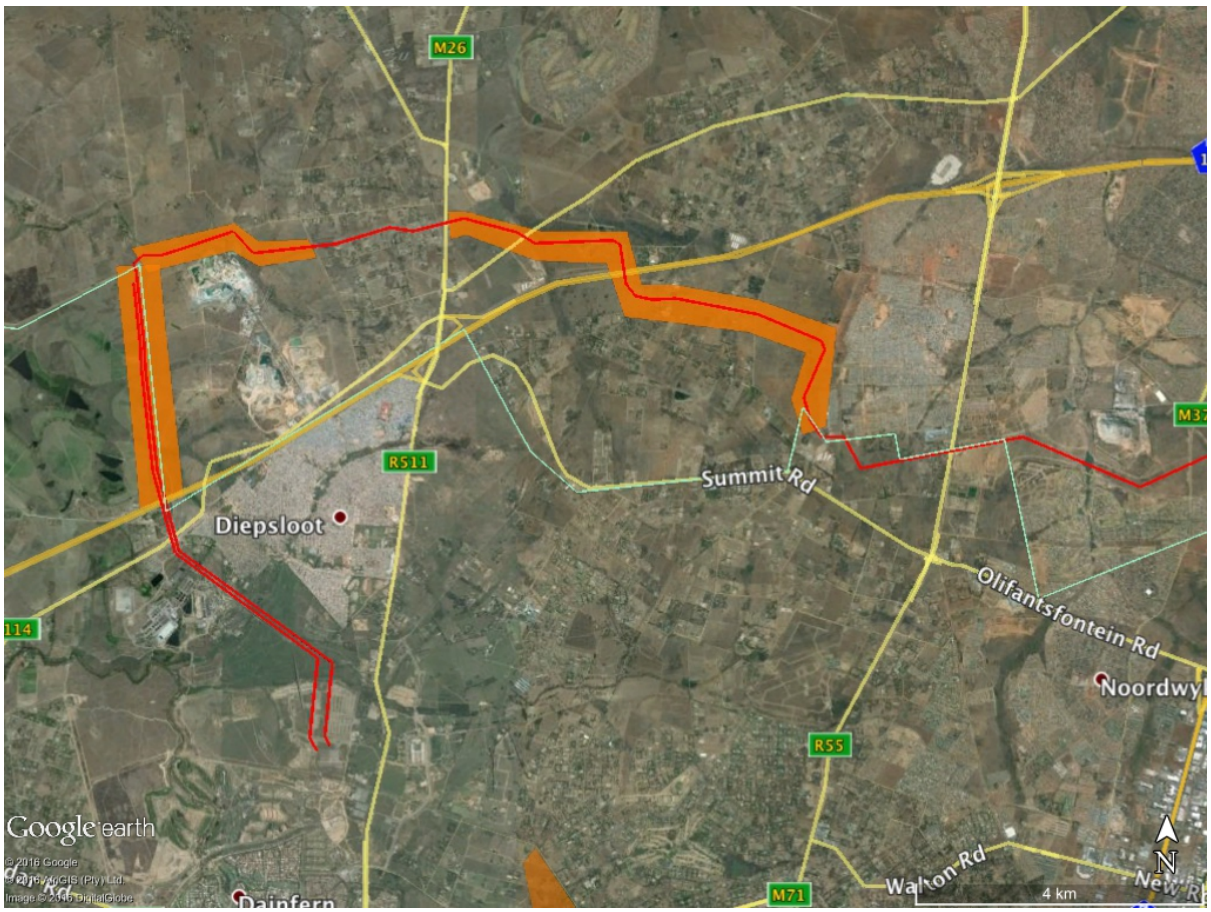

***Figure 17**: Sections of the western part of the proposed Bravo 3 power line considered sensitive in terms of possible loss of African Grass-owl habitat (indicated in orange).*

Table 2. *Red-listed species whose possible presence along the route of the proposed Bravo 3 power lines was evaluated during the assessment process.*

Species	Scientific name	Red Data Status[1]	NEMBA[2]	GDARD[3]	Assessment of likelihood of presence at site
Stork, Marabou	*Leptoptilos crumeniferus*	NT			Occurs in open, semi-arid areas, and wetlands. Rarely found outside of game reserves / ranching areas. Very few records along Bravo 3 route. Considered vulnerable to collisions.
Stork, Saddle-billed	*Ephippiorhynchus senegalensis*	EN			No SABAP 2 records from Bravo 3 route, and extremely unlikely to occur in area. Considered vulnerable to collisions.
Stork, Yellow-billed	*Mycteria ibis*	EN			Occurs in inland water bodies. Recorded along Bravo 3 route, mainly to the east of Pretoria. May be attracted to water bodies near the route, including Bronkhorstspruit and Rietvlei Dams. Considered vulnerable to collisions.
Stork, Abdim's	*Ciconia abdimii*	NT			Occurs in grasslands, woodlands and cultivated fields in rural areas. Recorded in several parts of the area considered for the desktop study, generally with low reporting rates. Considered vulnerable to collisions.
Stork, Black	*Ciconia nigra*	VU	VU	✔	Usually associated with mountainous regions, but nevertheless a few records from the area considered for the desktop study. Considered vulnerable to collisions.
Ibis, Southern Bald	*Geronticus calvus*	VU			Regularly recorded in eastern third of proposed Bravo 3 route, although area is somewhat outside of this species' core range. Considered vulnerable to collisions.
Flamingo, Greater	*Phoenicopterus ruber*	NT		✔	Occurs in lakes and pans. Recorded regularly in area considered for desktop survey. Considered highly vulnerable to collisions.
Flamingo, Lesser	*Phoenicopterus minor*	NT		✔	Occurs in lakes and pans. Recorded in area considered for desktop survey, with high reporting rate near Bronkhorstspruit. Considered vulnerable to collisions.
Duck, Maccoa	*Oxyura maccoa*	NT			Occurs in permanent standing water bodies such as dams. Recorded in area of proposed Bravo 3 route. Considered vulnerable to collisions.
Secretarybird	*Sagittarius serpentarius*	VU		✔	Likely to occur in grasslands in eastern third of power line route. Inhabits undisturbed grasslands and savannas. Considered vulnerable to collisions.
Vulture, Cape	*Gyps coprotheres*	EN	EN	✔	Occurs along the Magaliesberg, with several important breeding sites and vulture restaurants. Some records in the western section of the proposed Bravo 3 route, but very unlikely to occur regularly along route. Considered vulnerable to collisions.
Vulture, White-backed	*Gyps africanus*	CR	EN		Very few records in area, only in the western section of the proposed Bravo 3 route. Very unlikely to occur regularly along route. Considered vulnerable to collisions.

Falcon, Lanner	*Falco biarmicus*	VU			Some records from area considered for desktop survey, but reporting rates generally low. Not considered vulnerable to collisions.
Falcon, Red-footed	*Falco vespertinus*	NT			Some records from area considered for desktop survey, but reporting rates generally low. Not considered vulnerable to collisions.
Eagle, Verreaux's	*Aquila verreauxii*	VU			Occurs in area, including at least one breeding site at Bronkhorstspruit Dam. Several pairs breeding in the eastern reaches of the Magaliesberg, including Wonderboom Nature Reserve. Considered vulnerable to collisions.
Eagle, Tawny	*Aquila rapax*	EN			Recorded in area considered for desktop survey, although not common. Considered vulnerable to collisions.
Eagle, Martial	*Polemaetus bellicosus*	EN	VU	✔	Recorded in area, although not common. Considered vulnerable to collisions.
Marsh-harrier, African	*Circus ranivorus*	EN		✔	Recorded in area. Occurs in wetlands and grasslands. This species is considered moderately vulnerable to collision risk, since it generally flies at heights lower than 400 kV power lines, and its slow flight speeds mean that the likelihood of collision is reduced.
Finfoot, African	*Podica senegalensis*	VU		✔	Occurs in slow-flowing water in large river systems. A few records from area, but very unlikely to interact with lines.
Crane, Grey Crowned	*Balearica regulorum*	EN			Small number of records from area, but power line route is well outside of core range. Considered highly vulnerable to collisions.
Crane, Wattled	*Bugeranus carunculatus*	CR			No SABAP 2 records from area, although occasional vagrants cannot be ruled out. Considered highly vulnerable to collisions.
Crane, Blue	*Anthropoides paradiseus*	NT	EN	✔	Occurs in area, and considered highly vulnerable to collisions.
Bustard, Denham's	*Neotis denhami*	VU			Recorded in area near Bronkhorstspruit. Considered vulnerable to collisions.
Korhaan, White-bellied	*Eupodotis senegalensis*	VU		✔	Occurs in area, particularly grasslands in eastern third of power line route. Considered vulnerable to collisions
Painted-snipe, Greater	*Rostratula benghalensis*	NT			Some records from western section of power line route. Occurs in thick vegetation along the edges of water bodies. Not considered vulnerable to collision.
Pratincole, Black-winged	*Glareola nordmanni*	NT			Occurs in area, although not within core range. Not likely to be susceptible to collisions or electrocution.
Grass Owl, African	*Tyto capensis*	VU	VU	✔	Power line route falls within core range of this species. This species is not known to be particularly susceptible to collisions or electrocution, but caution is required. Placing towers in habitat suitable for this species should be avoided.

Kingfisher, Half-collared	*Alcedo semitorquata*	NT	✔	Occurs in area, with high reporting rates to the east of Pretoria. Not considered vulnerable to collisions.
Roller, European	Coracias garrulus	NT		Some records from area, but habitat generally not suitable. Not considered vulnerable to collisions.

[1]Current (2015) IUCN Red List Status for South Africa, Lesotho and Swaziland (Taylor et al. 2015). NT = *Near Threatened*; VU = *Vulnerable*; EN = *Endangered*; CR = *Critically Endangered*

[2]Indicates species listed as Protected ("PR), Vulnerable ("VU"), Endangered ('EN") or Critically Endangered ("CR") in the National Environmental Management: Biodiversity Act, 2004 list of Threatened or Protected Species (2007 version).

[3]Indicates priority species listed in GDARD Requirements for Biodiversity Assessments (Version 3, 2014).

4. DISCUSSION: IMPACT ASSESSMENT AND MITIGATION RECOMMENDATIONS

4.1 GENERAL IMPACTS

Much of the area through which the proposed Bravo 3 power line route passes is heavily transformed by agriculture and urbanisation. As such, the overall ecological sensitivity of this area as a whole can be considered medium. However, there are several areas of grassland along the route that provide good habitat for African Grass-owls and other threatened species, and tower placement needs to be achieved so as to avoid habitat losses for these threatened grassland specialists. Minimising habitat loss in these areas needs to be viewed as a priority when the Bravo 3 line is constructed. Moreover, the occurrence or potential occurance of several threatened species along the route belonging to groups known to be sensitive to collisions and/or electrocutions with power lines, means that these impacts need to be carefully mitigated. In broad terms, the impacts of the proposed power lines are as follow:

- Habitat loss (Table 3) – avian habitats will be lost in the areas cleared for the towers involved in this project. Whereas the individual footprint of each tower is small, the cumulative impact of the area cleared for power lines can be significant. In the case of the Bravo 3 line, this impact is made less severe by the fact that lines run immediately adjacent to existing lines, and therefore the area cleared will involve the widening of existing servitudes. However, the fact that the line runs through areas of African Grass-owl habitat (in particular, north of the N14 highway) is concerning, and particular care needs to be taken to avoid the loss of habitat for this species. Additional habitat loss may occur during the construction phase, because of areas cleared for the construction of the towers and lines, new access roads, and clearing vegetation from the servitude under the lines.

- Disturbance (Table 4) – construction activities, and to a lesser extent maintenance activities, will cause disturbance to birds along the route of the proposed power line. This impact will be most severe if it affects breeding birds, particularly threatened species.

- Collisions (Table 5) – power lines can cause signficant avian mortality through collisions, and in South Africa species such as Ludwig's Bustard and Blue Cranes provide sobering examples of the severity of this impact for populations of threatened birds. Eskom already has a partnership with the Endangered Wildlife Trust focused on mitigating these impacts, and the current lines will require the installation of bird flight diverters in sections where species vulnerable to collisions are likely to move though. Areas of particular concern in this regard are where the proposed lines cross water bodies and/or drainage lines along which large-bodied species fly regularly. In addition, sections of the lines traversing habitat potentially suitable for Secretarybirds, African Grass-owls, White-bellied Korhaans and other threatened grassland species must be fitted with these devices. **It is strongly recommended that before construction commences, an ornithologist be engaged to examine the entire route with Eskom staff and identify spans requiring the installation of flight diverters.**

- Electrocution risk (Table 6) – the risk of birds being electrocuted by coming into contact with live wires and towers simultaneously, or through excreta coming into contact with live wires below a perching bird, is lower for the large 400 kV towers involved in this project compared to smaller 11 – 132 kV sub-transmission and reticulation lines. No specific mitigation requirements are needed beyond the installation of standard Eskom Bird Guards on all towers near water in order to prevent shorting caused by avian excreta.

- Electromagnetic fields (Table 7) – no specific mitigation measures are needed.

4.2 SPECIFIC IMPACTS AND MITIGATION RECOMMENDATIONS

Table 3: Impact assessment - Habitat loss

Nature: Avian habitats will be lost in the areas cleared for the construction of the towers involved in this project. Whereas the individual footprint of each tower is small, the cumulative impact of the area cleared for power lines can be significant. In the case of the Bravo 3 line, this impact is made less severe by the fact that lines run immediately adjacent to existing lines, and therefore the area cleared will involve the widening of existing servitudes. However, the fact that the line runs through areas of African Grass-owl habitat (in particular, north of the N14 highway) is concerning, and particular care needs to be taken to avoid the loss of habitat for this species. Additional habitat loss may occur during the construction phase, because of areas cleared for the construction of the towers and lines, new access roads, and clearing vegetation from the servitude under the line				
	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Definite	5	Highly probable	4
Duration	Short term	2	Short term	2
Extent	Limited to Route	2	Limited to Route	2
Magnitude	High	8	Moderate	6
Significance	**High**	**60**	**Moderate**	**40**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Definite	5	Highly probable	4
Duration	Long term	4	Long term	4
Extent	Limited to Route	1	Limited to Route	1
Magnitude	Moderate	6	Moderate	6
Significance	**Moderate**	**55**	**Moderate**	**44**
Status (positive or negative)	Negative		Negative	
Reversibility	Low		Low	
Irreplaceable loss of resources?	Moderate		Moderate	
Can impacts be mitigated?	Yes			

Mitigation: • Minimise areas cleared for towers, construction activities and access roads, and as far as possible use existing roads • Restrict construction activities to area directly below power line • Minimise width of servitude cleared for power line • Ensure that no towers are placed in habitat suitable for African Grass-owl • Consider re-routing line to avoid loop north of N14 highway
Cumulative impacts: Will result in further loss of natural habitat in an area that is already heavily transformed.
Residual Risks: None anticipated provided that the mitigation measures are implemented correctly.

Table 4: Impact assessment - Disturbance

Nature: The presence of vehicles and personnel during construction will create disturbance for birds along the route of the proposed line. This disturbance will be most likely manifested through increased stress levels modulated by the avian stress hormone corticosterone, with consequences for breeding success, immune function and foraging. Further disturbance will occur during the operational phase as a consequence of routine maintenance, but the magnitude of this impact will be lower than during the construction phase.

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Highly probable	4	Probable	3
Duration	Short term	2	Short term	2
Extent	Limited to Route	2	Limited to Route	2
Magnitude	Moderate	8	Low	4
Significance	**Moderate**	**48**	**Low**	**27**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Highly probable	4	Probable	3
Duration	Long term	4	Long term	4
Extent	Limited to Route	1	Limited to Route	1
Magnitude	Moderate	4	Low	2
Significance	**Moderate**	**36**	**Low**	**21**
Status (positive or negative)	Negative		Negative	
Reversibility	Moderate		Moderate	

Irreplaceable loss of resources?	Low	Low
Can impacts be mitigated?	Yes	
Mitigation: • Construction of the proposed power line should take place during winter, outside the breeding season of most birds and when migrants are absent. • Construction workers must be instructed to minimise disturbance of birds at all times. • Illegal hunting of birds must be strictly prevented • During construction, any threatened species breeding along the route should be identified by the Environmental Control Officer, and the author of this report contacted for advice on how to proceed. • All construction and maintenance should take place as per Eskom Transmission's environmental best practice standards.		
Cumulative impacts: Construction activities, and to a lesser extent maintenance activities thereafter, will increase overall levels of human disturbance along the power line route.		
Residual Risks: None anticipated provided that the mitigation measures are implemented correctly.		

Table 5: Impact assessment - Collisions

Nature: Avian mortalities and injuries as a result of birds colliding with power lines while in flight.				
	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Highly probable	4	Improbable	1
Duration	Short term	2	Short term	2
Extent	Limited to Route	1	Limited to Route	2
Magnitude	High	8	High	8
Significance	**Moderate**	**44**	**Low**	**12**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Highly probable	4	Improbable	1
Duration	Long term	4	Long term	4
Extent	Limited to Route	2	Limited to Route	2
Magnitude	High	9	High	8
Significance	**High**	**60**	**Low**	**14**
Status (positive or negative)	Negative		Negative	
Reversibility	Low		Low	

Irreplaceable loss of resources?	High	Low
Can impacts be mitigated?	Yes	
Mitigation: • Wherever possible, the new power line should be placed as close to the existing lines as possible, so as to minimise the spatial extent of the collision risk • Bird flight diverters should be fitted to the line in areas where the risk of collision is considered significant. Specifically, "Bird flappers" or double-loop flight diverters developed by the Eskom / Endangered Wildlife Trust (EWT) Strategic Partnership should be fitted to the line during initial construction. These devices must be attached to the centre 60% of the line between each pair of pylons, with the flappers 5 m apart in a staggered configuration. • Spans requiring flight diverters should identified at the start of the construction phase by engaging a suitable ornithologist to accompany Eskom staff along the entire route. At this stage, spans that can be identifed as requiring flight diverters on the basis of satellite imagery and field surveys are listed in Table 5b below.		
Cumulative impacts: Collisions caused by power lines have had devastating impacts on the populations of a number of threatened bird species, and it is critical that this impact of the new Bravo 3 line be mitigated to the greatest extent possible.		
Residual Risks: The efficacy of bird flight diverters is dependent on their ongoing maintenance; the devices fitted to the Bravo 3 line must be maintained following Eskom Transmission's environmental best practice standards.		

Table 5b. Sections of the Bravo 3 line requiring bird flight diverters. Tower positions were not available at the time of writing; unless otherwise stated, diverters should be fitted to at least three spans centred on the locations provided.

Latitude	Longitude	Reason for flight diverters being required
25°53'17.34"S	28°53'14.37"E	Flight path for waterbirds along drainage line
25°51'49.11"S	28°52'11.27"E	Line crosses wetland
25°51'38.58"S	28°49'50.69"E	Proximity to small wetland
25°51'30.23"S	28°48'57.30"E	Stream crossing, likely waterbird flight path
25°51'55.36"S	28°46'26.72"E	Stream crossing, likely waterbird flight path
25°51'11.54"S	28°43'19.54"E	Proximity to wetlands – diverters should be fitted for 2 km on either side of this location (i.e., 4 km total)
25°51'8.92"S	28°37'27.68"E	Line traverses wetland. Diverters should be fitted for 3 km on either side of this location (i.e., 6 km total)
25°51'39.52"S	28°32'44.21"E	Stream crossing, likely waterbird flight path
25°52'26.09"S	28°29'4.96"E	Stream crossing, proximity to dams, likely flightpath
25°53'47.61"S	28°25'40.60"E	Line crosses ridge, likely flightpath
25°54'42.69"S	28°21'30.43"E	Line crosses farm dam
25°55'2.67"S	28°17'31.70"E	Line traverses Rietvlei Nature Reserve. Flight diverters should be fitted to entire section within the reserve, as well as to the point where the line crosses the R50 road.
25°54'45.75"S	28°13'52.82"E	Stream crossing, likely waterbird flight path
25°55'28.17"S	28°10'7.97"E	Line crosses dam
25°55'40.82"S	28° 7'2.81"E	Dam crossing, likely waterbird flight path
25°55'38.49"S	28° 5'30.60"E	Stream crossing, likely waterbird flight path
25°54'45.10"S	28° 4'46.15"E	Likely African Grass-owl habitat; diverters should be fitted to entire section in this grassland.
25°54'0.41"S	28° 2'51.01"E	Proximity to water bodies
25°53'57.66"S	27°59'39.17"E	Proximity to water bodies
25°54'11.07"S	27°58'59.14"E	Diverters should be fitted from this point to where the line crosses the N14 highway at 25°55'59.39"S 27°59'14.65"E. Adjacent grasslands hold Grass-owls.
25°56'45.85"S	27°59'57.25"E	Diverters should be fitted from this point to the Lulamisa substation. Grass-owls known to move through this area.

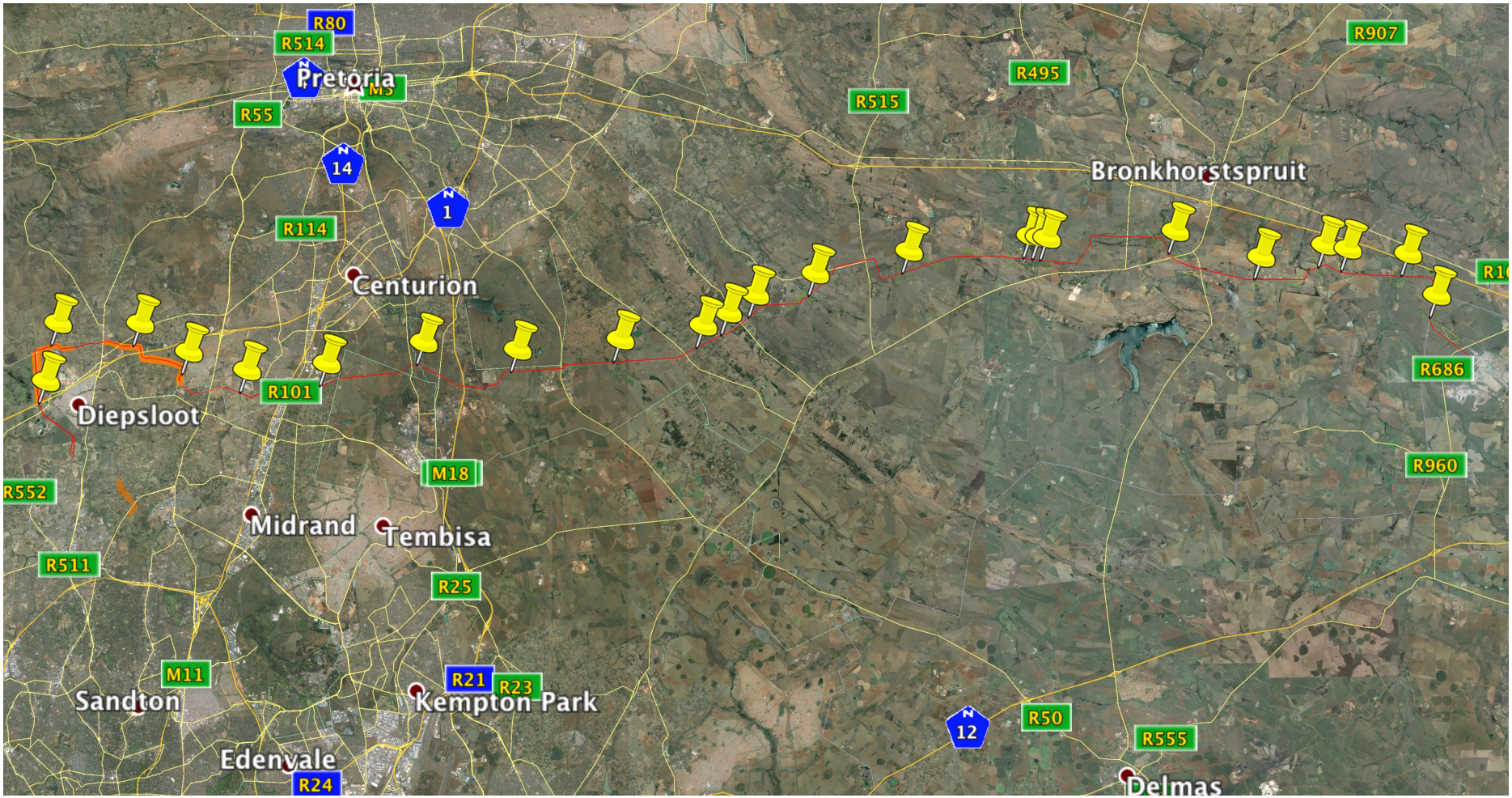

***Figure 18**. Route of proposed Bravo 3 power line, showing locations where bird flight diverters need to be fitted to the lines (see Table 5b)*

Table 6: Impact assessment - Electrocutions

Nature: Avian mortalities and injuries as a result of birds creating short circuits between live wires, or between live wire and tower. Risk generally low for 400 kV lines.				
	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Improbable	1	Improbable	1
Duration	Short term	2	Short term	2
Extent	Limited to Route	1	Limited to Route	2
Magnitude	Low	4	Low	4
Significance	**Low**	**7**	**Low**	**7**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Improbable	1	Improbable	1
Duration	Long term	4	Long term	4
Extent	Limited to Route	1	Limited to Route	1
Magnitude	Low	4	Low	4
Significance	**Low**	**9**	**Low**	**9**
Status (positive or negative)	Negative		Negative	
Reversibility	Low		Low	
Irreplaceable loss of resources?	Low		Low	
Can impacts be mitigated?	Yes			
Mitigation: • Electrocutions are extremely unlikely on 400 kV towers. However, in the interests of preventing short circuits caused by excreta, it is recommended that standard Eskom Bird Guards be fitted to all towers in the vicinity of water.				
Cumulative impacts: Electrocutions are unlikely to be a cause of avian mortality				
Residual Risks: None.				

Table 7: Impact assessment – Electromagnetic fields

Nature: There is some evidence that the electromagnetic fields generated by power lines have negative effects on avian breeding, as well as the ability of migrants to navigate

	Without mitigation		**With mitigation**	
CONSTRUCTION PHASE				
Probability	Very Improbable	1	Very Improbable	1
Duration	Short term	1	Short term	1
Extent	Limited to Route	1	Limited to Route	1
Magnitude	Low	2	Low	2
Significance	**Low**	**4**	**Low**	**4**
Status (positive or negative)	Negative		Negative	
OPERATIONAL PHASE				
Probability	Improbable	2	Improbable	2
Duration	Long term	4	Long term	4
Extent	Limited to Route	1	Limited to Route	1
Magnitude	Low	4	Low	4
Significance	**Low**	**18**	**Low**	**18**
Status (positive or negative)	Negative		Negative	
Reversibility	Low		Low	
Irreplaceable loss of resources?	Low		Low	
Can impacts be mitigated?	No			

Mitigation:

- None necessary beyond installation of insulators and shielding following Eskom's standard guidelines for best practise.

Cumulative impacts: Will contribute to widespread EMFs generated by electrical infrastructure. Evidence of negative impacts is limited.

Residual Risks: None.

4.3 CONCLUSIONS AND RECOMMENDATIONS

The 400 kV power line of the proposed Bravo 3 project will pass through an area that consists of five broad categories of avian habitats, namely grasslands, wetlands, water bodies and drainage lines, woodlands, agricultural landscapes and urban areas. The area holds a number of threatened bird species, a number of which are known to be highly vulnerable to collisions with power lines. This is a source of mortality that has already had devastating effects on a number of southern African species. The new line will run parallel to exisiting lines for most of its length, a factor that will slighty reduce collision risk along these sections. However, it remains critical that bird flight diverters be installed on the new line, particularly along sections identified in this report where natural grasslands, stream crossings and/or proximity to water bodies increase the likelihood of large-bodied species flying through the area. The fact that previous surveys produced evidence that species such as Blue Cranes are already colliding with existing lines in this area underscores the need to carefully mitigate this impact. In contrast to collisions, the risk of electrocutions is very small, on account of the size of the towers used for 400 kV lines. Standard bird guards should nevertheless be fitted to any towers in the proximity of water bodies, to prevent excreta from perching birds creating short circuits.

At its western-most limit, the proposed line traverses African Grass-owl habitat in the Northern Farms area, on account of the fact that the route loops to the northwest instead of following a direct route to the Lulamisa substation. Widening the existing servitude to accommodate the new line will result in habitat loss for the Grass-owl. If changing the line's route to avoid this area altogether is not possible, then it will be critical that a specialist be engaged to ensure that the line is routed so as to minimise habitat loss for this species.

In conclusion, the author's opinion is that the negative avifaunal impacts associated with the proposed Bravo 3 line can to a large extent be mitigated, and that the project should therefore go ahead subject to the mitigation measures outlined above. Once operational, the Bravo 3 line should be regularly monitored for avian fatalities, and any additional spans subsequently identified as posing a collision risk will need to be retrofitted with bird flight diverters.

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PROFESSIONAL QUALIFICATIONS

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TECHNICAL REPORTS [31 in total, only 10 most recent shown]

McKechnie, A.E. 2013. *Specialist avifaunal assessment: proposed Frankfort Power Station.* Prepared for Rural Maintenance.

McKechnie, A.E. 2013. *Specialist avifaunal assessment: proposed MOGS oil storage facility, Saldanha Bay.* Prepared for Enviro-Insight.

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PEER-REVIEWED SCIENTIFIC PUBLICATIONS [71 in total, only three most recent shown]

Pietersen, D.W., Symes, C.T., Woodborne, S.W., **McKechnie, A.E.** and Jansen, R. (in press)

Diet and prey selectivity of the specialist myrmecophage, Temminck's ground pangolin (*Smutsia temminckii*). *Journal of Zoology*

Smit, B. and **McKechnie, A.E.** 2015. Water and energy fluxes during summer in an arid-zone passerine bird. *Ibis* 157(4): 774-786.

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ARTICLES IN SEMI-POPULAR MAGAZINES [73 in total, only three most recent shown]

McKechnie, A.E. 2016. Mercury rising - South Africa's national parks are getting warmer. *African* in press.

McKechnie, A.E. 2016. Enormous, enigmatic, extinct – the elephant birds of Madagascar. *African Birdlife* press.

Noakes, M.J. and **McKechnie, A.E.** 2015 Hot or not? Physiological variation in white-browed sparrow-weavers. *African Birdlife* September/October 2015: 12-13.

CONFERENCE PRESENTATIONS [110 in total, only plenary lectures shown]

McKechnie. A.E., Smit, B., Hockey, P.A.R. and Wolf, B.O. Taking the heat: climate change and desert *At*: Frontiers in South African Ornithology, 15-16 March 2012, Port Elizabeth, South Africa.

McKechnie, A.E., Smit, B., Cory Toussaint, D., Boyles, J.G. and Wolf, B.O. Hot birds and bats: approaches to predicting climate change impacts in small endotherms. *At:* Joint ZSSA and PARSA Conference, 10-13 July 2011, Stellenbosch, South Africa.

SCIENTIFIC AWARDS AND RECOGNITION [only last five years shown]

2013	Finalist: 2012/2013 NSTF/BHP Billiton Awards
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STUDENT SUPERVISION

Current supervision: 4 PhD, 1 BSc(Hons); Current co-supervision: 3 PhD
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EDITORSHIP

Associate Editor: *Climate Change Responses*
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INVITED SEMINARS AND LECTURES [23 in total, only 3 most recent shown]

Mitrani Department for Desert Ecology, Ben-Gurion University of the Negev, Israel, August 2015.
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Hawkesbury Institute for the Environment, University of Western Sydney, July 2015.

OTHER CONTRIBUTIONS

Scientific Advisor, *African Birdlife* magazine
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Member, Research Ethics and Scientific Committee, National Zoological Gardens
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Council Member, Zoological Society of Southern Africa [2009-2013]

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