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AVIFAUNAL SENSITIVITY ASSESSMENT

PROPOSED JUNO-GROMIS 400KV POWER LINE DEVIATION AT THREE LOCALES, WESTERN
AND NORTHERN CAPE PROVINCES.

OCTOBER 2016



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Declaration

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

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

Signature of the specialist:



Date: 14 October 2016

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Executive Summary

Afzelia Environmental Consultants (Pty) Ltd were appointed by Nsovo Environmental Consulting to undertake an avifaunal sensitivity assessment for the deviation of the proposed construction of the Juno-Gromis 400kV transmission power line project from the authorised corridor, traversing through portions of the Western and Northern Cape provinces. The power line will traverse in a southerly direction, exiting the Gromis Substation, near Kleinsee, and will enter the Juno Substation just outside Vredendal. It will be approximately 230km long. The deviation of the power line occurs within three localities along the authorised route namely Lutzville landing strip, Tronox Mine Namakwa Sands and at Kamiesberg Mine. The primary aim of this assessment was to determine the sensitivity of the environment surrounding the deviations of the authorised power line from an avifaunal perspective.

A total of 73 bird species are predicted to occur within the three quarter degree grid squares through which the proposed power line deviations will traverse (South African Bird Atlas Project 2), one of which are considered “Endangered”, two are considered “Vulnerable” and “Near Threatened” (Barnes 2014). Avian species likely to be impacted by the proposed power line development include locally resident or transient raptors (Martial Eagle) and large terrestrial birds (Secretarybird, Blue Crane, Ludwig’s Bustard and Kori Bustard).

Avifaunal activity within arid areas, in which the deviated power line corridor is located, is driven by rainfall events as this influences the growth of vegetation, presence of prey items and most notably the presence of water. As a result, avian populations tend to follow these rainfall events. This makes it very difficult to predict the abundance of avian species within this biome.

The impacts associated with the proposed 400kV power line project include:

- Destruction and alteration of avian habitats;
- Disturbance and displacement of birds; and
- Collision on associated overhead power lines.

Collisions with the earth wire is the main impact associated with the power line deviation. In order to mitigate this impact, it is imperative that earth wires crossing important avian habitats (agricultural lands, rivers, drainage lines and avian flyways) are fitted with anti-collision marking devices to increase the visibility of the power line and reduce likelihood of collisions. These must be Eskom approved anti-collision devices that are durable as the area is prone to strong winds.

The deviation of the route at the three localities is not deemed significant from avifaunal perspective. However, marking of the power line within sensitive avifaunal areas of the deviated power line route is imperative to mitigating the impact of this project.

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1. INTRODUCTION

1.1 BACKGROUND AND LOCALITY OF THE ASSESSMENT

Afzelia Environmental Consultants (Pty) Ltd were appointed by Nsovo Environmental Consulting to undertake an avifaunal sensitivity assessment for the deviation of the proposed construction of the Juno-Gromis 400kV transmission power line project from the authorised corridor, traversing through portions of the Western and Northern Cape provinces. The power line will traverse in a southerly direction, exiting the Gromis Substation, near Kleinsee, and will enter the Juno Substation just outside Vredendal. It will be approximately 230km long. The deviation of the power line occurs within three localities along the authorised route namely Lutzville landing strip, Tronox Mine Namakwa Sands and at Kamiesberg Mine.

This report must be read in conjunction with the avifaunal site walk down report for the proposed Juno-Gromis 400kV power line corridor project (Afzelia Environmental Consultants, 2016).

The implications of the proposed power line to avifauna includes:

- A width of approximately 55m of land along the length of the power line will be altered during the creation and use of the power line servitude.
- During the construction phase, disturbance levels will be significantly higher in the immediate vicinity than previously. This disturbance will consist of machinery and vehicle disturbance as well as other construction activities.
- During the operational phase, there will be some vehicle activity resulting in disturbance, particularly within the road access corridor.
- There will be a collision risk to avifauna, particularly heavier birds with low manoeuvrability (Ludwig's Bustard and Kori Bustard).

The primary aim of this assessment was to determine the sensitivity of the environment surrounding the deviations of the authorised power line from an avifaunal perspective.

1.2 SCOPE OF WORK

- A description of the Red Listed avifauna along the deviated power line corridor potentially affected by the proposed overhead power lines;
- Integration of the site data collected from avian atlases and counts within the area to develop a comprehensive avifaunal database likely to be present within the development footprint; and
- Identify sensitive avifaunal habitats through which the deviated power line traverses.

1.3 SOURCES OF INFORMATION

The avifaunal sensitivity study made use of the following data sources:

- The original avifaunal impact assessment conducted by EWT in November 2006;
- Avifaunal site walk-down conducted on the 29th February – 16th March 2016 and again on the 11th – 15th April.
- Bird distribution data of the Southern African Bird Atlas Project obtained from the Animal Demography Unit of the University of Cape Town, in order to ascertain species occurrence within the study area (Harrison *et al.* 1997);
- The conservation and endemic status of all bird species occurring within the quarter degree squares determined with the use of The Eskom Red Data book of birds of South Africa, Lesotho and Swaziland (Taylor 2014) and BirdLife SA checklist of endemics and near-endemics;
- The Important Bird Areas (IBA) programme according to BirdLife South Africa was consulted;
- Coordinated Waterbird Count (CWAC) data was consulted and analysed; and
- A classification of the vegetation types in the study area was obtained from Mucina and Rutherford (2006).

1.4 ASSUMPTIONS AND LIMITATIONS

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

- The greater study area as well as the deviated power line route was visited during the initial avifaunal walk down conducted in February and April 2016.
- Avifaunal activity within arid areas, in which the power line corridor is located, is driven by rainfall events as this influences the growth of vegetation, presence of prey items and presence of water. As a result, avian populations tend to follow these rainfall events. This makes it very difficult to predict the abundance of avian species within this biome.
- Avian behaviour is relatively unpredictable and cannot be reduced to formulas that will hold true under all circumstances. However, power line impacts can be predicted with a fair amount of certainty due to the vast amount of data available in this regard.
- It is important to note that, although the predicted impacts are mostly concerned with Red Data species, the non-Red Data species will also benefit from the proposed mitigation measures as they share the same habitat and face the same potential impacts.

2. STUDY APPROACH

The methodology used to predict the sensitivity of the environment surrounding the deviated power line route from an avifaunal perspective was as follows:

- The various data sets discussed above under “sources of information” were collated and examined with the aim of determining the focal species for this study.
- The data was examined to determine the location and abundance of species which may be susceptible to impacts from the proposed project including both Red Data and non-Red Data species.
- A desk top examination of the site, using Google Earth imagery was done to identify avian micro-habitats and sensitive habitats for avifaunal communities. This was confirmed during the site visit.
- The broader study area was visited during a seventeen-day (29th Feb – 16th March) site visit and power line corridor walk-down. The deviated power line corridor was thoroughly traversed to obtain a first-hand perspective of the avian abundance and species diversity, and to identify sensitive bird micro-habitats present along the corridor which will require the implementation of mitigation measures. This involved driving around in the broader study area, taking photographs, and walking the route. Due to the limited access roads within the area sections of the power line route were re-visited using a helicopter in April 2016. During the walk-over special attention was placed on sensitive avifaunal habitats including rivers, wetlands systems, drainage lines and important flight paths.
- One of the main impacts identified in the above assessment is the collisions of large avian species with low in-flight manoeuvrability such as Ludwig’s and Kori Bustard.
- The impacts of the proposed project on the avifaunal populations were predicted by analysing data on wildlife impacts with power lines throughout southern Africa.

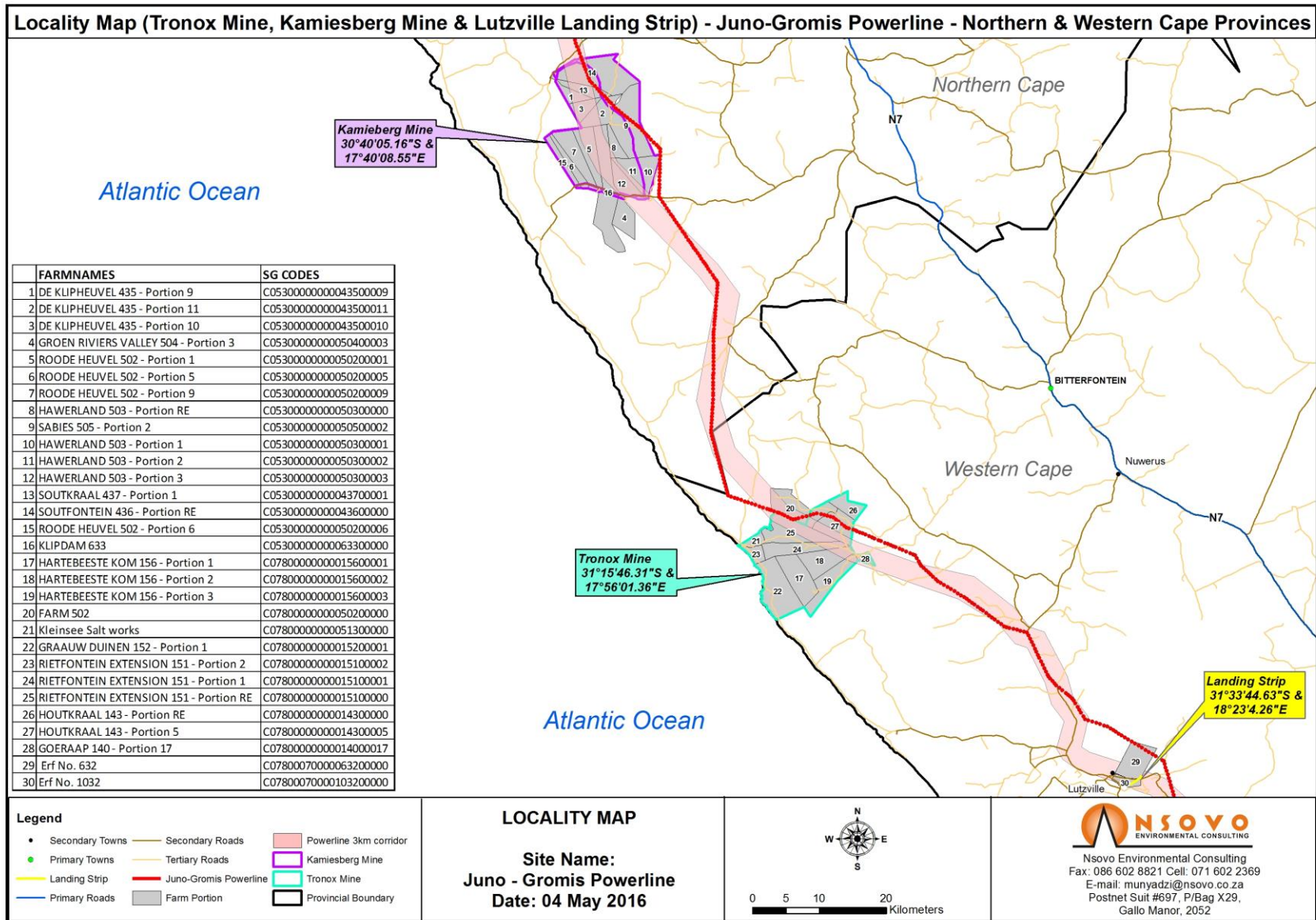


Figure 1: Locality of study area for the proposed power line infrastructure

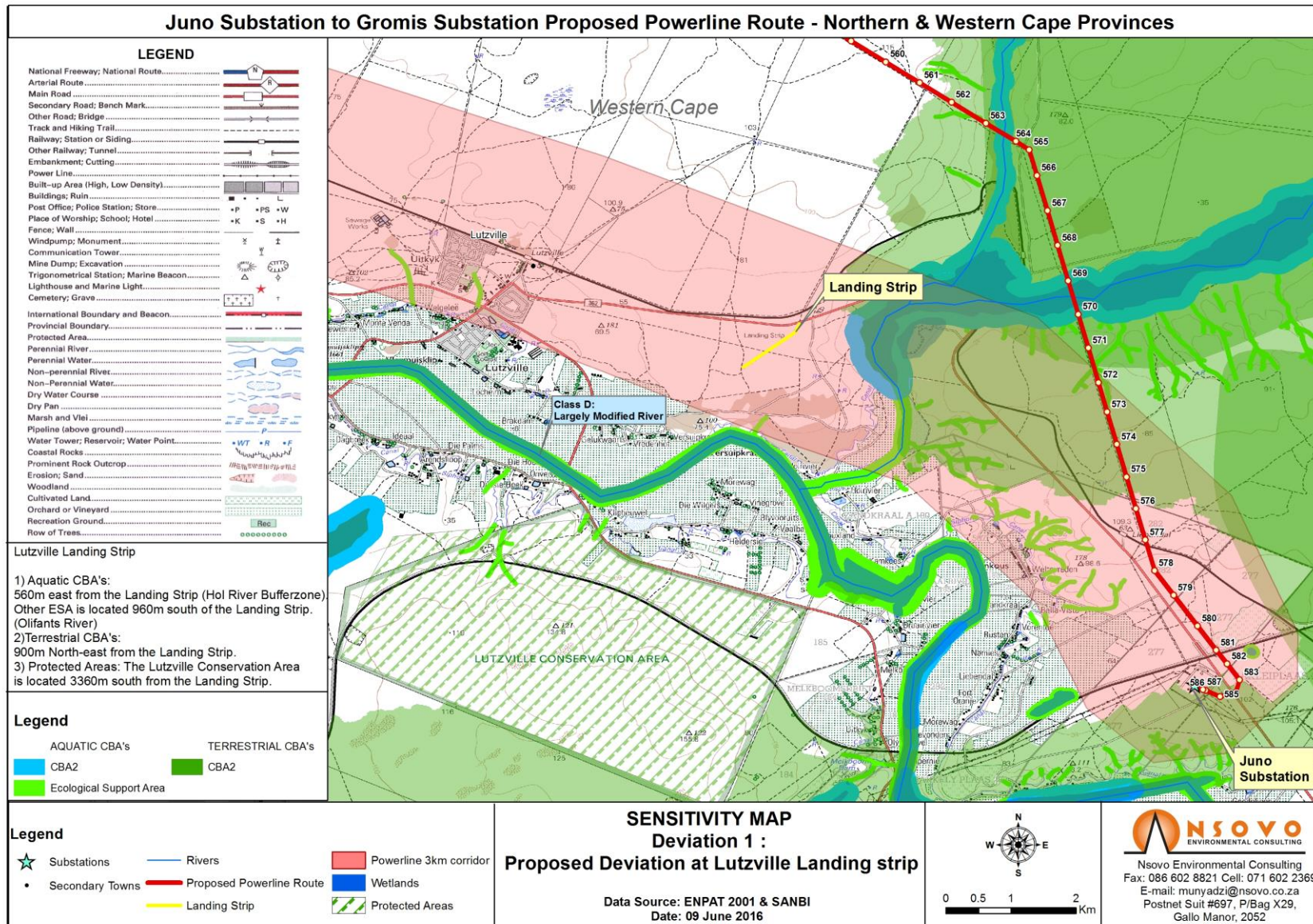


Figure 2: Power line deviation at Lutzville Landing Strip

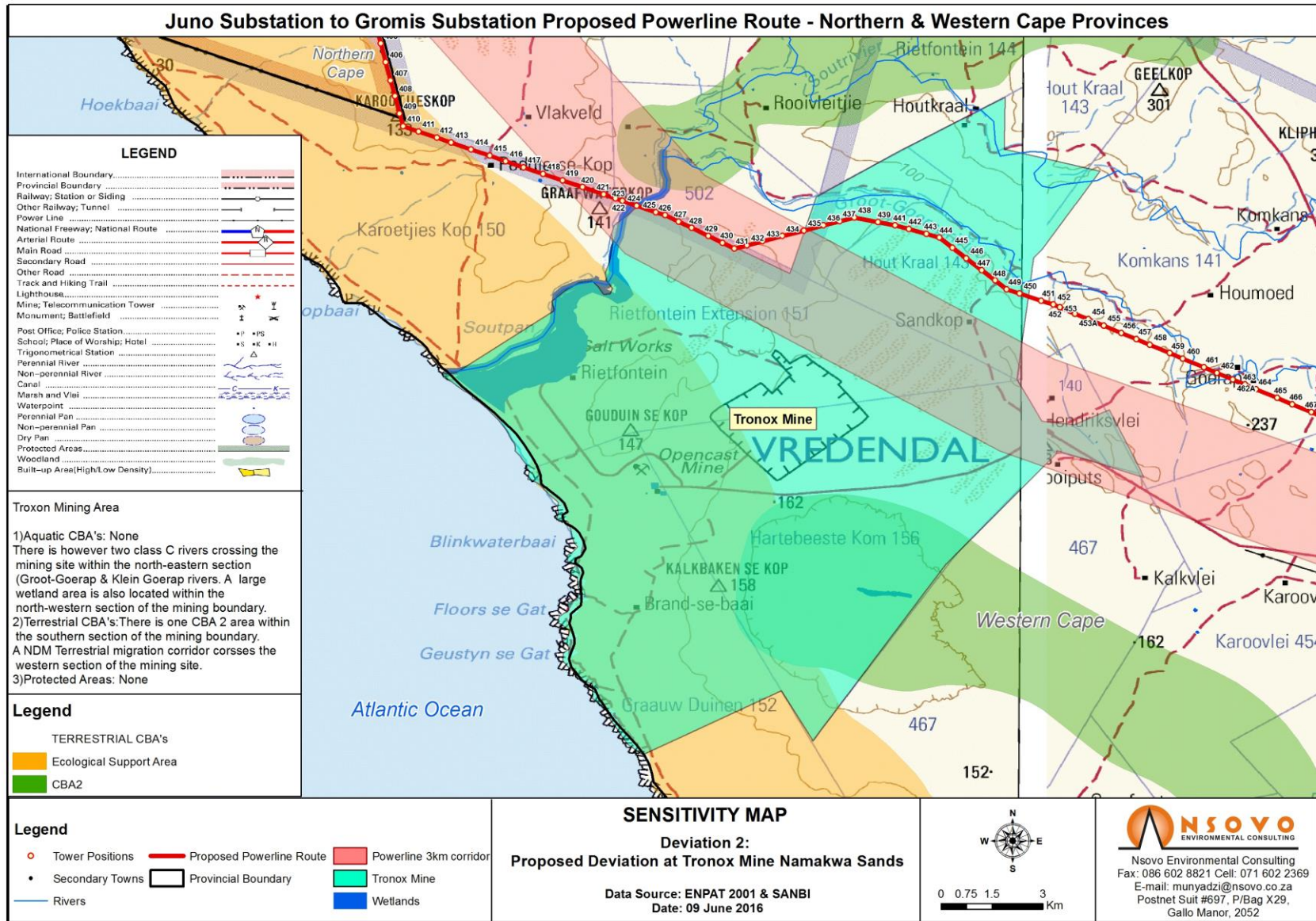


Figure 3: Power line deviation at Tronox Mine Namaqua Sands

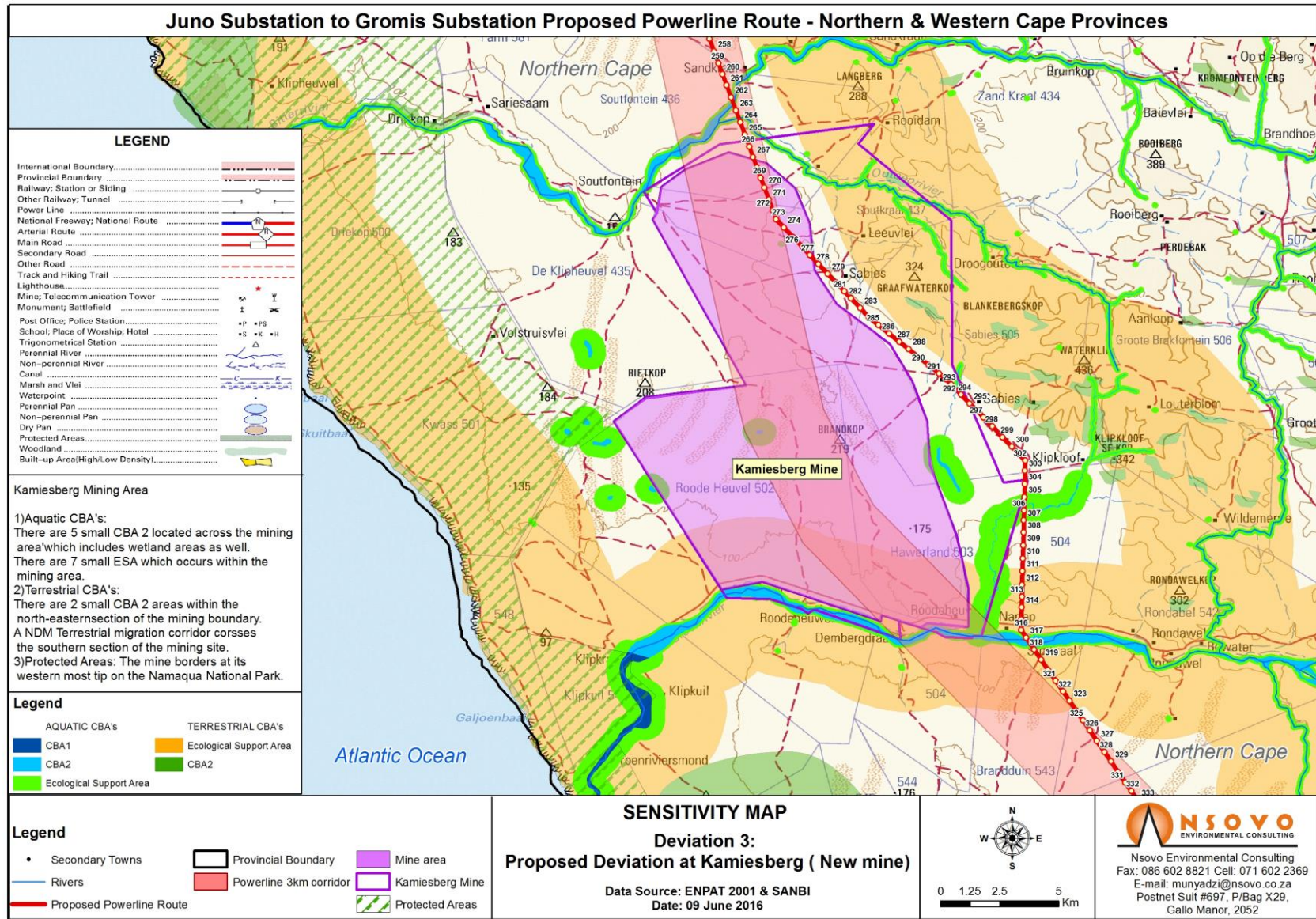


Figure 4: Power line deviation at Kamiesberg Mine

3. AVIAN SENSITIVITY ASSESSMENT

The sensitivity of the deviated power line corridor within the three locales, was predicted by making use of three factors namely:

i. *Presence and status of sensitive avifaunal micro-habitats*

The identification of suitable avifaunal micro-habitats is fundamental in order to effectively predict the potential presence of Red Listed and endemic avifauna within proximity of the deviated power line corridor. There is a correlation between the presence of Red Listed and endemic species and the availability of various habitats within the study area. These important avian habitats influence the occurrence of species within a landscape providing nesting, foraging and reproductive benefits. The integration of these micro-habitats with the ability of priority species to make use of these habitats within the study site, is pivotal in predicting the sensitivity of the study area

ii. *Existing impacts surrounding the power line deviations*

This focuses on the presence of anthropogenic disturbances within the proximity of the power line (Mining, residential and power line infrastructure) and the impact on sensitive avifaunal micro-habitats

iii. *Avifaunal species composition*

This primarily focuses on Red Listed and endemic species that could be impacted by the power line project. The identification of power line sensitive species was based on prior studies conducted within South Africa. The presence of Red Listed Species was determined by visual sightings during the initial avifaunal site walk-down coupled with the South African Bird Atlas Project (SABAP2) reporting rates. Report rates are the likelihood of a particular species occurring along deviated power line corridor represented as a percentage. It is important to note that these species were recorded within the entire quarter degree square and may not have actually been recorded along the deviated power line corridors.

Finally, mitigation measures will be recommended in order to limit the impact of the proposed power line project at the three line deviation locales.

3.1 Lutzville Landing Strip Power Line Deviation

This deviation occurs within close proximity of the existing Juno Substation, 7km East of Lutzville. Two sensitive avifaunal micro-habitats were identified along the deviated power line corridor namely Succulent Karoo shrublands and watercourses (rivers, wetland systems and drainage lines). The deviation occurs between towers 572 and 542.

3.1.1 *Presence and status of sensitive avifaunal micro-habitats*

Karoo shrublands were the dominant land cover along the deviated power line corridor and is the most common micro-habitat within the study site. This micro-habitat is characterised by sparsely vegetated rocky to sandy soils with patches of grasslands dominated by *Stipagrostis* species. The avifauna associated with this open micro-habitat are dominated by ground-dwelling species with many species displaying nomadic life histories. This allows these species to periodically utilise this micro-habitat when resources such as water and food are

available, particularly after rainfall events. Relevant bird species that will be attracted to these areas include most importantly Ludwig's and on occasions Kori Bustard. The Karoo-like vegetation supports a high diversity of endemic avian species most notable the Lark family *Alaudidae*.

Due to the aridity of the project area, very few rivers and wetland systems are present and as a result attract avian species. Furthermore, vegetation structure surrounding these systems (large stands of Acacias and other trees species) differs from the karroid shrublands that dominate the area and in turn influences avian species distribution.

These factors provide suitable breeding and foraging opportunities and attract various waterbirds. The pans in this study area could be used by White Storks (*Ciconia ciconia*), Yellow-billed Duck (*Anas undulata*), Blacksmith Lapwing (*Vanellus armatus*) and a number of resident and migratory wader species.

The power line corridor within the Lutzville deviation crosses two rivers namely the Hol and the Moedverloor River.

3.1.2 Existing impacts surrounding the power line deviations

Both avifaunal micro-habitats identified along the deviated route were in good condition and largely intact. A series of formal and informal roads were noted within this area. Most importantly existing power lines are located within the vicinity of the route and the Lutzville deviated corridor follows an existing power line route.

3.1.3 Avifaunal species composition

Table 1 provides a list of Red Listed species that were identified within the area and associated with the existing avian micro-habitats.

Table 1. Red Listed bird species recorded within fourteen quarter degree squares within which the proposed power line infrastructure are located.

NAME	CONSERVATION STATUS (2014)	HABITAT	HABITAT DESTRUCTION	DISTURBANCE	COLLISIONS WITH POWER LINE
SECRETARY BIRD <i>Sagittarius serpentarius</i>	VU	Grassland		X	X
MARTIAL EAGLE <i>Polemaetus bellicosus</i>	VU	Woodland/Savannah		X	X
LUDWIG'S BUSTARD <i>Neotis ludwigii</i>	EN	Savannah	X	X	X
KORRI BUSTARD <i>Ardeotis kori</i>	NT	Grassland/Thornveld	X	X	X
BLUE CRANE <i>Anthropoides paradiseus</i>	NT	Croplands and pastures		X	X

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

Due to the design of the proposed tower structures electrocution is considered unlikely and thus not considered a significant impact to avian species.

Based on the presence and status of the sensitive avian micro-habitats along the deviated corridor, five Red Listed species are likely to be impacted by the proposed power line. It is not envisaged that any Red Data species will be displaced by the habitat transformation that will take place as a result of the construction of the power line. The impact on smaller, non-Red Data species that are potentially breeding in the area will be local in extent, in that it will not have a significant effect on regional or national populations.



Due to the homogenous nature of the habitat, specifically within the larger area, habitat modification due to the construction of the power line is predicted to be negligible. The main impact associated with the power line is collisions with the power line. The potential collision of avian species with the power line earth wire is considered the most significant impact pertaining to avifauna within the project area. It is predicted that this impact will have a moderate negative impact prior to the implementation of mitigation measures. This is due to the presence of collision prone species including Ludwig's Bustard, Kori Bustard, Secretarybird and Blue Crane.

3.1.4 Mitigation measures

As stated above, the main impact to avifaunal species along the deviated route at Lutzville landing strip is associated with the collision with the power line. In order to mitigate this impact, it is imperative that sensitive areas are marked with anti-collision marking devices to increase the visibility of the power line and reduce likelihood of collisions. These must be Eskom approved anti-collision devices that are durable as the area is prone to strong winds. Anti-collision devices must be installed as soon as the wires are strung. A detailed methodology for the installation of anti-collision devices is provided in **Section 7**. Based on the information obtained during the power line walk-down and avifaunal impact assessment, the following tower positions and power line spans were identified for marking along the Lutzville landing strip deviated corridor. These areas must be marked with anti-collision devices.

Table 2. Areas identified along the power line corridor for marking with anti-collision devices.

TOWER POSITION	AVIAN HABITAT DESCRIPTION	AERIAL IMAGERY OF THE TOWER POSITIONS
570-569	River crossing (Hol River) <ul style="list-style-type: none"> • <i>Avian flight path and a collision prone area</i> 	 <p>The image is an aerial photograph of a river crossing. A dark, winding river flows through a dry, scrubby landscape. Two tower positions are marked with black 'X' symbols, one near the top and one near the bottom of a vertical orange rectangular area that spans across the river. The terrain is a mix of brown and greyish-green, indicating sparse vegetation. In the bottom right corner, there is a 'Google earth' logo and some small copyright text: 'Image © 2016 © NES / Astrum © 2016 Google © 2016 AfrGIS (Pty) Ltd.'</p>

<p>563-564</p>	<p>River crossing (Moedverloor River)</p> <ul style="list-style-type: none"> • <i>Avian flight path and a collision prone area</i> 	 <p>A satellite image showing a river crossing. An orange rectangular area is drawn around the river, with two black 'X' markers placed within the rectangle. The text 'Google earth' is visible in the bottom right corner.</p>
<p>542-539</p>	<p>River crossing (Droekraal se River)</p> <ul style="list-style-type: none"> • <i>Higher collision risk associated with the presence of water</i> 	 <p>A satellite image showing a river crossing in a more arid, hilly landscape. An orange rectangular area is drawn around the river, with three black 'X' markers placed within the rectangle. The text '© 2016 AfrGIS (Pty) Ltd.', '© 2016 Google', 'Image © 2016 CNES / Astrium', and 'Google earth' are visible in the bottom right corner.</p>

3.2 Tronox Mine Namaqua Sands Power Line Deviation

This power line deviation occurs between towers 474-434, in the vicinity of Tronox Mine, Namaqua Sands. There are two avifaunal microhabitats within the vicinity of the deviated power line corridor namely farmland and cultivated landscape interspersed with succulent Karoo vegetation and watercourses.

3.2.1 *Presence and status of sensitive avifaunal micro-habitats*

Agricultural lands are the dominant habitat along the deviated power line corridor. Relevant bird species that will be attracted to these areas include Western Cattle Egret (*Bubulcus ibis*), Hammerkop (*Scopus umbretta*), Black-headed Heron (*Ardea melanocephala*), African Sacred Ibis (*Threskiornis aethiopicus*), Blue Crane (*Anthropoides paradiseus*) and small granivorous species (Southern Red Bishops). In particular, the White Stork and Blue Cranes have a high affinity for arable land, with 80% of sightings in South Africa recorded within this habitat (Dean & Ryan 2005).

Farmland or cultivated land provides foraging opportunities for many bird species for the following reasons:

- Through the process of land preparation many insects, seeds, bulbs and other food sources become readily accessible to bird species;
- The agricultural plants that are cultivated are often consumed by birds, or attract insects which are in turn consumed by birds; and
- The use of agricultural lands as foraging sites is likely to fluctuate throughout the year. It is predicted that greater concentrations of birds will increase during spring when the fields are ploughed, and in late summer / autumn when the crops are harvested and the birds are attracted to feed on the residual grains.

However, these benefits do not apply to all species and active agricultural lands are not a preferred environment for certain avian species due to the lack of vegetation cover and the regular disturbance experienced during the harvesting period.

Areas where agricultural lands meet with natural shrublands have created a mosaic habitat merging the foraging advantages of the agricultural habitats and the protection of shrubland habitats. This has provided a novel habitat and Ludwig's Bustard were observed within this habitat.

A series of watercourses were also identified within proximity of the deviated power line corridor. These factors provide suitable breeding and foraging opportunities and attract various waterbirds. The power line corridor within the Tronox deviation runs adjacent to the Groet-Goerap River.

3.2.2 *Existing impacts surrounding the power line deviations*

Both avifaunal micro-habitats identified along the deviated route were in good condition and largely intact. Various sections of the route have been impacted by mining activities and rehabilitation of land. The Tronox Mine Namaqua Sands area is located within the vicinity of the power line. This area experiences regular disturbances.

3.2.3 Avifaunal species composition

Table 3. Red Listed bird species recorded within fourteen quarter degree squares within which the proposed power line infrastructure are located.

NAME	CONSERVATION STATUS (2014)	HABITAT	HABITAT DESTRUCTION	DISTURBANCE	COLLISIONS WITH POWER LINE
MARTIAL EAGLE <i>Polemaetus bellicosus</i>	VU	Woodland/Savannah		X	X
LUDWIG'S BUSTARD <i>Neotis ludwigii</i>	EN	Savannah	X	X	X
KORRI BUSTARD <i>Ardeotis kori</i>	NT	Grassland/Thornveld	X	X	X
BLUE CRANE <i>Anthropoides paradiseus</i>	NT	Croplands and pastures		X	X

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

Due to the design of the proposed tower structures electrocution is considered unlikely and thus not considered a significant impact to avian species.



Based on the presence and status of the avian micro-habitats along the deviated corridor, four Red Listed species are likely to be impacted by the proposed power line. It is not envisaged that any Red Data species will be displaced by the habitat transformation that will take place as a result of the construction of the power line. This is due to the homogenous nature of the habitats coupled with the varying degrees of existing landscape transformation. The impact on smaller, non-Red Data species that are potentially breeding in the area will be local in extent, in that it will not have a significant effect on regional or national populations.

Due to the homogenous nature of the habitat, specifically within the larger area, habitat modification due to the construction of the power line is predicted to be negligible. The main impact associated with the power line is collisions with the power line. The potential collision of avian species with the power line earth wire is considered the most significant impact pertaining to avifauna within the project area. It is predicted that this impact will have a moderate negative impact prior to the implementation of mitigation measures. This is due to the presence of collision prone species including Ludwig's Bustard, Kori Bustard and Blue Crane.

3.2.4 Mitigation measures

As stated above, the main impact to avifaunal species along the deviated corridor at Tronox Mine is associated with the collision with the power line. In order to mitigate this impact, it is imperative that sensitive areas are marked with anti-collision marking devices to increase the visibility of the power line and reduce likelihood of collisions. These must be Eskom approved anti-collision devices that are durable as the area is prone to strong winds. Anti-collision devices must be installed as soon as the wires are strung. A detailed methodology for the installation of anti-collision devices is provided in **Section 7**. Based on the information obtained during the power line walk-down and avifaunal impact assessment, the following tower positions and power line spans were identified for marking along the Lutzville landing strip deviated corridor. These areas must be marked with anti-collision devices.

Table 4. Areas identified along the power line corridor for marking with anti-collision devices.

TOWER POSITION	AVIAN HABITAT DESCRIPTION	AERIAL IMAGERY OF THE TOWER POSITIONS
471-468	Drainage line and water course <ul style="list-style-type: none"> Higher collision risk associated with the presence of water 	
464-460	River crossing (Groot Goerap) <ul style="list-style-type: none"> Avian flight path and a collision prone area 	

3.3 Kamiesberg Mine Power Line Deviation

This deviation occurs within close proximity of the Kamiesberg Mine. Two sensitive avifaunal micro-habitats were identified along the deviated power line corridor namely Succulent Karoo shrublands and watercourses (rivers, wetland systems and drainage lines). The deviation occurs between towers 323-273.

3.3.1 *Presence and status of sensitive avifaunal micro-habitats*

Karoo shrublands were the dominant land cover along the deviated power line corridor. The avifauna associated with this open micro-habitat are dominated by ground-dwelling species with many species displaying nomadic life histories. This allows these species to periodically utilise this micro-habitat when resources such as water and food are available, particularly after rainfall events. Relevant bird species that will be attracted to these areas include most importantly Ludwig's and on occasions Kori Bustard. The Karoo-like vegetation supports a high diversity of endemic avian species most notable the Lark family *Alaudidae*.

Due to the aridity of the project area, very few rivers and wetland systems are present and as a result attract avian species. Furthermore, vegetation structure surrounding these systems (large stands of Acacias and other trees species) differs from the karroid shrublands that dominate the area and in turn influences avian species distribution. These systems provide suitable foraging habitat for several Red Listed species including Kori Bustard and Ludwig's Bustard.

The power line corridor within the Kamiesberg deviation crosses the Groen River.

3.3.2 *Existing impacts surrounding the power line deviations*

Both avifaunal micro-habitats identified along the deviated route were in good condition and largely intact. A series of formal and informal roads were noted within this area.

3.3.3 *Avifaunal species composition*

Table 5 provides a list of Red Listed species that were identified within the area and associated with the existing avian micro-habitats.

Table 5. Red Listed bird species recorded within fourteen quarter degree squares within which the proposed power line infrastructure are located.

NAME	CONSERVATION STATUS (2014)	HABITAT	HABITAT DESTRUCTION	DISTURBANCE	COLLISIONS WITH POWER LINE
MARTIAL EAGLE <i>Polemaetus bellicosus</i>	VU	Woodland/Savannah		X	X
LUDWIG'S BUSTARD <i>Neotis ludwigii</i>	EN	Savannah	X	X	X
KORRI BUSTARD <i>Ardeotis kori</i>	NT	Grassland/Thornveld	X	X	X

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


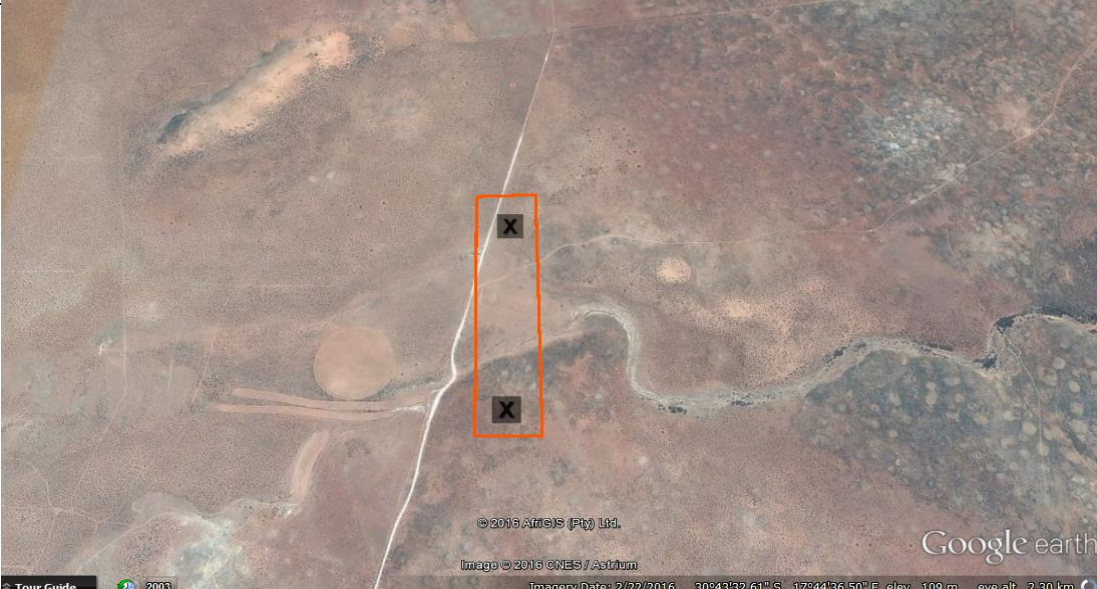

Due to the design of the proposed tower structures electrocution is considered unlikely and thus not considered a significant impact to avian species.

Based on the presence and status of the avian micro-habitats along the deviated corridor, three Red Listed species are likely to be impacted by the proposed power line. Due to the homogenous nature of the habitat, specifically within the larger area, habitat modification due to the construction of the power line is predicted to be negligible. The main impact associated with the power line is collisions with the power line. The potential collision of avian species with the power line earth wire is considered the most significant impact pertaining to avifauna within the project area. It is predicted that this impact will have a moderate negative impact prior to the implementation of mitigation measures. This is due to the presence of collision prone species including Ludwig's Bustard and Kori Bustard.

3.3.4 Mitigation measures

As stated above, the main impact to avifaunal species along the deviated corridor at Kamiesberg Mine is associated with the collision with the power line. In order to mitigate this impact, it is imperative that sensitive areas are marked with anti-collision marking devices to increase the visibility of the power line and reduce likelihood of collisions. These must be Eskom approved anti-collision devices that are durable as the area is prone to strong winds. Anti-collision devices must be installed as soon as the wires are strung. A detailed methodology for the installation of anti-collision devices is provided in **Section 7**. Based on the information obtained during the power line walk-down and avifaunal impact assessment, the following tower positions and power line spans were identified for marking along the Kamiesberg Mine deviated corridor. These areas must be marked with anti-collision devices.

Table 6. Areas identified along the power line corridor for marking with anti-collision devices.

TOWER POSITION	AVIAN HABITAT DESCRIPTION	AERIAL IMAGERY OF THE TOWER POSITIONS
319-316	River crossing (Groen River) <i>Avian flight path and a collision prone area</i>	 <p>© 2016 AfrisGIS (Pty) Ltd. Image © 2016 CNES / Astrium Imagery Date: 2/24/2016 30°46'48.77" S 17°45'04.66" E elev 54 m eye alt 3.68 km</p>
306-305	Drainage line <ul style="list-style-type: none"> <i>Higher collision risk associated with the presence of water</i> 	 <p>© 2016 AfrisGIS (Pty) Ltd. Image © 2016 CNES / Astrium Imagery Date: 2/22/2016 30°43'32.61" S 17°44'36.50" E elev 109 m eye alt 2.30 km</p>
295-293	Drainage line <ul style="list-style-type: none"> <i>Higher collision risk associated with the presence of water</i> 	 <p>© 2016 AfrisGIS (Pty) Ltd. Image © 2016 DigitalGlobe Image © 2016 CNES / Astrium Imagery Date: 2/22/2016 30°41'00.87" S 17°43'13.04" E elev 155 m eye alt 2.27 km</p>

6 IMPACTS

6.1 HABITAT DESTRUCTION

During the construction phase as well as maintenance of the power line, some habitat destruction and alteration will occur due to the clearing of servitudes along the deviated power line route. These activities have an impact on foraging, breeding and roosting ecology of avian species within the area through modification of habitat. The continual clearing of servitudes will have the effect of altering bird community structure along the length of the power line (Kind and Byers 2002).

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

Various sections of the habitat are already largely transformed and fragmented by agricultural land. Furthermore, this is not a unique habitat within the landscape. The construction of the proposed power line at the three deviation locales should therefore have a low displacement impact from an avifaunal perspective.

6.2 DISTURBANCE AND DISPLACEMENT

The disturbance of avifauna during the construction and operation of the deviated power line infrastructure will occur. This is an indirect impact that will affect the movement and distribution of avian species surrounding the power line corridor, particularly during the construction of the proposed project. The avoidance of these areas by avian species will impact the breeding and foraging characteristics of affected bird species. Species sensitive to disturbance are ground-nesting species resident within the development footprint. Disturbance can also influence the community structure of avifauna within close proximity to the development as certain species will be displaced and forced to find alternative territories. Avian species with small territories are particularly susceptible.

Disturbance could have a negative impact on the breeding activities of various species, particularly if this occurs during a sensitive period in the breeding cycle.

Species of concern include Southern Black Korhaan (*Afrotis afra*), African Marsh Harrier (*Circus ranivorus*), Black Harrier (*Circus maurus*) and Blue Cranes (*Anthropoides paradiseus*). Both Harrier species often breed in damp vegetation in close proximity to wetlands or pans and Blue Cranes often breed on open ground near a water source (Hockey *et al.* 2006). These species will be sensitive to disturbance and habitat loss due to the construction of the proposed overhead power lines. Both Harrier species and Blue Cranes prefer habitats in close proximity to water sources (Hockey *et al.* 2006).

The three corridor deviations already subject to varying degrees of disturbance due to agriculture, industrial infrastructure and mining as well as existing power line infrastructure. Therefore, species within these locales experience disturbance. As a result, disturbance of birds by the proposed deviated power line corridor is anticipated to be of low significance as birds will move away from the area temporarily. However, species are particularly sensitive to disturbance during the breeding season and this must be borne in mind during both the construction and operational (maintenance) phases.

6.3 ELECTROCUTION OF BIRDS ON OVERHEAD POWER LINE

Electrocution¹ of birds on associated overhead power lines is a primary cause of mortality for a variety of bird species particularly storks, cranes and raptors in South Africa (Van Rooyen & Ledger 1999). Electrocution risk is influenced by the voltage of the power line coupled with the pole structure. As discussed previously the risk of avian electrocution due to 400kV power lines utilised for this project are low.

6.4 COLLISIONS WITH THE POWER LINE

Collisions are the biggest single threat posed by overhead power lines to birds in southern Africa (van Rooyen 2004). Larger bird species such as bustards, storks, flamingos, cranes and raptors are highly susceptible to power line collisions (**Appendix 2**). These species often collide with the earthing wire as it is not highly visible. These species are mostly heavy-bodied species with limited manoeuvrability and are not sufficiently mobile to take the necessary evasive action to avoid colliding with power lines (Anderson 2001; Van Rooyen 2004, Jenkins and Smallie 2009). This impact is further exacerbated as they tend to fly between foraging bouts and roosting sites within the elevation ranges of both high and low voltage power lines. Many of the collision sensitive species are considered threatened in southern Africa.

The Red Data species that are vulnerable to power line collisions are generally long living, slow reproducing species. Furthermore, various species require specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. These species have not evolved to cope with high adult mortality. Therefore, consistent high adult mortality over an extensive period could have a serious effect on a population's ability to sustain itself in the medium to long term.



Photograph 1. The remains of several Ludwig's Bustard recovered below the existing JUKO 134 power line, which runs parallel to the proposed 400kV transmission power line.

¹ Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004).

The potential collision of avian species with the power line earth wire is considered the most significant impact pertaining to avifauna within the three corridor deviation localities. It is predicted that this impact will have a moderate negative impact prior to the implementation of mitigation measures. This is due to the presence of collision prone species including Ludwig's Bustard, Kori Bustard, Secretarybird, Blue Crane and to a lesser extent Southern Black Korhaan.

7. MITIGATION OF IDENTIFIED IMPACTS

Habitat destruction

- All construction and maintenance activities must be carried out according to the generally accepted environmental best practice and the temporal and spatial footprint of the development must be kept to a minimum. In particular, care must be taken in the vicinity of the drainage lines and existing roads must be used as much as possible for access during construction.
- The boundaries of the project footprint areas are to be clearly demarcated and all activities must remain within the demarcated footprint area.
- Any bird nests that are found during the construction period must be reported to the Environmental Control Officer (ECO).
- The movement of vehicles and heavy machinery around sensitive avian habitats (river crossings, pan systems and thickets) must be controlled.
- The above measures must be covered in a site specific EMPr and controlled by an ECO.

Disturbance and displacement

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

Collisions with power line

In order to mitigate for collision prone species, it is imperative that earth wires crossing important avian habitats are fitted with anti-collision marking devices to increase the visibility of the power line and reduce likelihood of collisions. These must be Eskom approved anti-collision devices that are durable as the area is prone to strong winds. Anti-collision devices must be installed as soon as the wires are strung.

EBM Flapper and the Tyco Flight Diverter are approved bird flight diverters which are currently used by Eskom (Transmission Bird Collision Guideline 2014; Distribution Technical Bulletin 2009).

The devices must be installed 5m apart and alternate between a light and dark colour in order to increase the visibility of the earth wires. Furthermore 100% of the identified spans must be marked with devices as collision probability is equally possible along the entire span (Shaw 2013). According to Shaw (2013), marking of only 60% of the line may divert collision prone species to the unmarked portions of the line.

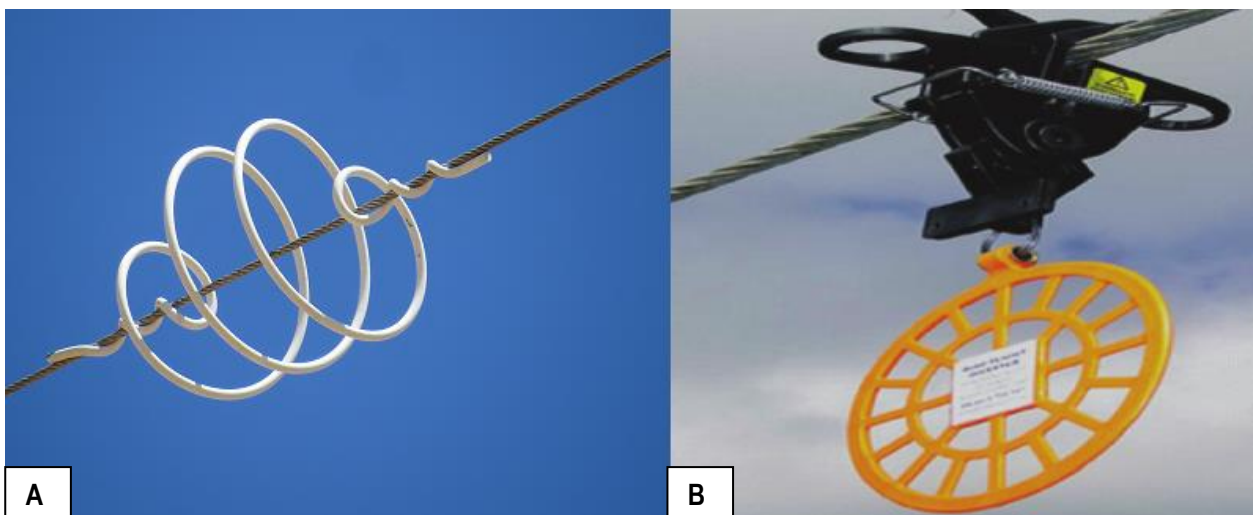


Figure 5. Static Helical bird flight diverter and a mobile bird flapper device.

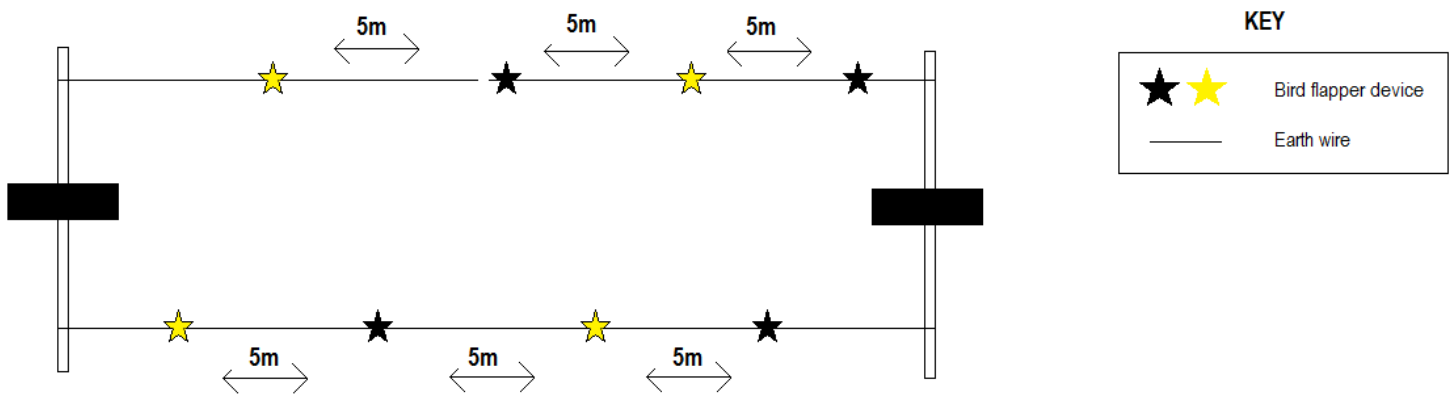


Figure 6. Technique and guideline for marking of the earth wire with bird flapper devices (*Adapted from Vosloo et al. 2014*).

8. CONCLUSION

Collisions with the power lines pose the single biggest threat to large, low manoeuvrability bird species. Species of particular concern for collisions with the power line are Secretary Bird, Martial Eagle, Ludwig's Bustard, Kori Bustard. High collisions rates were observed under existing power lines in the agricultural areas. Ludwig's Bustard and Blue crane were observed in these agricultural areas, indicating the need for mitigation in this micro-habitat.

The deviation of the route at the three localities is not deemed significant from avifaunal perspective. However, marking of the power line within sensitive avifaunal areas of the deviated power line route is imperative to mitigating the impact of this project on avifaunal populations.

9. REFERENCES

- Anderson, M.D. 2001. The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Draft report to Eskom Resources and Strategy Division. Johannesburg. South Africa.
- Allan, D.G. 1996b. Population structure and breeding habits of the Blue Crane *Anthropoides paradiseus* in the Western Cape Province and Karoo, South Africa. In Beilfuss R *et al.* (eds), *The African Crane and Wetland Training Workshop*, Maun, Botswana, 1993. International Crane Foundation pp. 355-376.
- Barnes, K.N. (ed.) 2000. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa: Johannesburg.
- De Klerk, H.M., Crowe, T.M., Fieldsa, J., Burgess, N.D. 2002. Patterns of species richness and narrow endemism of terrestrial birds species in the Afrotropical region. *Journal of Zoology* 56: 327-342.
- De Villiers, M.S. (eds). 2009. Birds and environmental change: building an early warning system in South Africa. SANBI, Pretoria.
- Goudie, R.I., 2006. Effects of power lines on birds. Harlequin Enterprises. St. John's, Newfoundland.
- Harrison, J.A., Allan. D.G., Underhill, L.G., Herremans, M., Tee, A.J., Parker, V., Brown, C.J (eds). 1997. The atlas of southern African Birds. Vol. 1 & 2. BirdLife South Africa: Johannesburg.
- Herholdt, J.J., Anderson, M.D. 2006. Observations on the population and breeding status of the African White-backed Vulture, the Black-chested Snake Eagle, and the Secretarybird in the Kgalagadi Transfontier Park. *Ostrich* 77, 127-135.
- Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (Eds) 2006. Roberts birds of southern Africa, VII. John Voelcker Bird Book Fund, Cape Town.
- Hunting, K. 2002. A roadmap for PIER research on avian power line electrocution in California. California Energy Commission, California.
- Jenkins, A.R., Smallie, J.J., Diamond, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. *Bird Conservation International* 20: 263-278.
- Jenkins, A., Smallie, J. 2009. Terminal Velocity. End of the line for Ludwig's Bustard? *Africa – Birds and Birding*. 35 – 39.
- Kagan, R.A., Viner, T.C., Trail, P.W., Espinoza, E.O. 2014. Avian Mortality at Solar Energy Facilities in Southern California: A Preliminary Analysis. National Fish and Wildlife Forensics Laboratory.
- King, D.I., Byers, B.E. 2002. An evaluation of power line rights-of-way as habitat for early-successional shrubland birds. *Wildlife Society Bulletin* 30: 868-874.
- Lehman, R.N., Kennedy, P.L., Savidge, J.A. 2007. The state of the art in raptor electrocution research: a global review. *Biological Conservation* 136: 159-174.

- Maclean, G.L. 1999. Southern African endemic birds: Their distribution and conservation. *Ostrich* 69: Iss. 1-2.
- Marnewick M, D., Retief E,F., Theron N,T., Wright D,R., Anderson T, A. 2015. Important Bird and Biodiversity Areas of South Africa. Johannesburg: BirdLife South Africa.
- Martin, G.R., Shaw, J.M. 2010. Bird collisions with power lines: Failing to see the way ahead? *Biological Conservation*. 2695-2702.
- Mucina, L., Rutherford, M.C., Powrie, L.W. (eds) 2006. *Vegetation Map of South Africa, Lesotho and Swaziland*. Strelitzia 19. South African National Biodiversity Institute, Pretoria.
- Prinsen, H.A.M., Smallie, J.J., Boere, G.C., Pires, N. 2012. Guidelines on how to avoid or mitigate impact of electricity power grids on migratory birds in the African-Eurasian region. Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) Conservation Guidelines No. 14.
- Scott-Shaw, C.R., Escott, B.J. (Eds) (2011) *KwaZulu-Natal Provincial Pre-Transformation Vegetation Type Map – 2011*. Biodiversity Conservation Planning Division, Ezemvelo KZN Wildlife, P. O. Box 13053, Cascades, Pietermaritzburg, 3202.
- Shaw, J.M., Jenkins, A.R., Smallie, J.J., Ryan, P.G. 2010. Modelling power-line collision risk for the Blue Crane *Anthropoides paradiseus* in South Africa. *Ibis* 152: 590-599.
- Shaw, J.M., Jenkins, A.R., Ryan, P.G., Smallie, J.J. 2010. A preliminary survey of avian mortality on power lines in the Overberg, South Africa. *Ostrich* 81: 109-113.
- Smallie, J., Van Rooyen, C. 2006. KUDU - JUNO 400 kV TRANSMISSION LINE BIRD IMPACT ASSESSMENT STUDY. The Endangered Wildlife Trust.
- Van Rooyen, C.S. 2004. The Management of Wildlife Interactions with overhead lines. In *The fundamentals and practice of Overhead Line Maintenance (132kV and above)*, pp217- 245. Eskom Technology, Services International, Johannesburg.
- Vosloo, H.F., Cormack, R., Majola, W. 2014. *Transmission Bird Collision Prevention Guideline*. Eskom Transmission 1-11.