Endangered Wildlife Trust
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BIRD IMPACT ASSESSMENT STUDY

Etna – Glockner
400kV Transmission Line

February 2007

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Prepared for:
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EXECUTIVE SUMMARY

The Endangered Wildlife Trust (EWT) was appointed by Naledzi Environmental Consultants to conduct a specialist avifaunal impact assessment for a 400kv power line extending in a southerly direction from the Etna substation to the Glockner substation. Various sources of information were consulted during this study, to ascertain bird distribution patterns and densities as well as the conservation status for each bird species prevalent in the study area. Because vegetation structure influences bird species distribution, a detailed description of the existing environment and micro habitats within the study area has been provided.

An assessment of the possible impacts has also been included in this report, together with a list of suggested recommendations to be used as means of mitigation for each of the perceived impacts.

1. INTRODUCTION & BACKGROUND

In order to provide a high quality supply of electricity to meet the ever increasing needs of its end users and to support annual load growth, Eskom plans to construct a new double circuit, 400kV transmission power line extending from the Etna substation north of Ennerdale to the Glockner substation near Rothdene in the Gauteng Province. The proposed line covers a distance of approximately 30km in a north – south direction primarily within the following quarter degree squares: 2627BD and 2627DB. The Endangered Wildlife Trust (EWT) was appointed by Naledzi Environmental Consultants to conduct a specialist avifaunal impact assessment for both suggested alternative alignments (indicated as the red and blue lines in FIGURE 1).

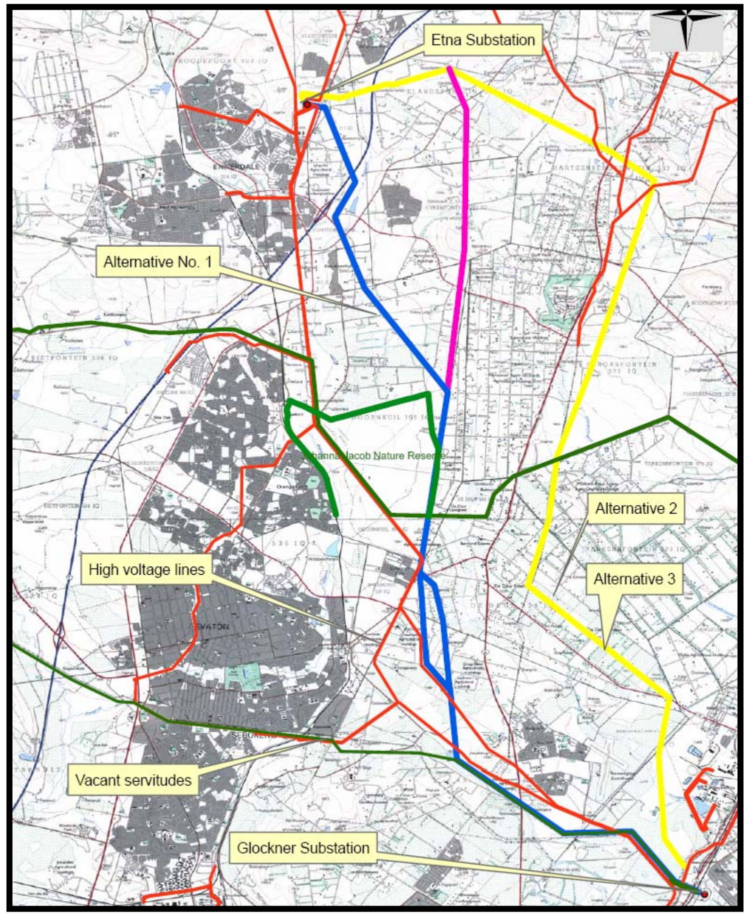

FIGURE 1: The proposed 400kV alignments.

A field investigation for this study was conducted during February 2007.

Terms of reference

The following terms of reference for the EWT avifaunal study was supplied by Naledzi Environmental Consultants and is listed as follows:

- Mapping of sensitive areas.
- Description of the affected environment and determine status quo.
- Indicate how a resource or community will be affected
- Discussion of gaps in baseline data.
- Listing and describing the expected impacts.
- Assessment and evaluation of impacts.
- Recommendations for relevant mitigation measures.
- Summary of residual impacts after mitigation.
- A monitoring program if necessary.

1.1 Sources of information

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

- Bird distribution data of the Southern African Bird Atlas Project (SABAP – Harrison *et al,* 1997) obtained from the Avian Demography Unit of the University of Cape Town, as a means to ascertain which species occur within the study area. A data set was obtained for these quarter degree squares (see TABLE 1).

- The conservation status of all bird species occurring in the aforementioned quarter degree square was determined with the use of The Eskom Red Data book of birds of South Africa, Lesotho and Swaziland (Barnes, 2000).
- The power line bird mortality incident database of the Eskom - Endangered Wildlife Trust Strategic Partnership (1996 to present) was consulted to determine which of the species occurring in the study area are typically impacted upon by power lines and the extent to which they are impacted on.
- A classification of the vegetation types in the quarter degree square was obtained from Harrison *et al* (1997).
- Information on the micro habitat level was obtained through a site visit to the area to obtain a first hand perspective. Micro habitats are identified using a combination of ornithological and ecological experience.

1.2 Assumptions & Limitations

This study made the assumption that the above sources of information are reliable. The following factors may potentially detract from the accuracy of the predicted results:

- The SABAP data covers the period 1986-1997. Bird distribution patterns fluctuate continuously according to availability of food and nesting substrate.
- Sources of error in the SABAP database, particularly inadequate coverage of some quarter degree squares. This means that the reporting rates of species, may not be an accurate reflection of the true densities in quarter degree squares that were sparsely covered during the data collecting period, as was the case with several of the squares (for a full discussion of potential inaccuracies in SABAP data, see Harrison *et al*, 1997). It must be noted that in this instance the both 2627BD and 2627DB quarter degree squares have been adequately covered with data being recorded on a combined total of 983 SABAP checklists.

General comment: Predictions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will hold true under all circumstances. However, power line impacts can be predicted with a fair amount of certainty, based on experience gained through the investigation of hundreds of localities in southern Africa, since 1996, where birds have interacted with power lines.

2 DESCRIPTION OF AFFECTED ENVIRONMENT

2.1 Vegetation

TABLE 1 below shows the vegetation composition of the quarter degree squares within the study area (Harrison *et al,* 1997). It is widely accepted within the ornithological community that vegetation structure, rather than the actual plant species, influences bird species distribution and abundance (in Harrison *et al,* 1997). Therefore, the vegetation description below does not focus on lists of plant species, but rather on factors which are relevant to bird distribution. The description makes extensive use of the work of Harrison *et al* (1997).

TABLE 1: Vegetation composition of the study area (Harrison *et al,* 1997).

Biome	Vegetation type	2627BD	2627DB

Grassland	Sour Grassland	72%	0%
Grassland	Mixed Grassland	28%	100%

It is evident from the table above that the dominant vegetation type found within the study area is grassland of one type or another, i.e. sour and/or mixed grassland. It must be noted that the majority of this study area is urbanized, with a number of settlements (see FIGURE 2) and small holdings dotted throughout the immediate surrounds intermingled with industrial areas and small business developments. As a result, a great deal of the vegetation within the study area has and is being transformed. The habitat in the area has been subjected to severe pressure from the neighboring communities.

FIGURE 2: An example of one of the many settlements surrounding the study area

Grassland Biome:

This biome encompasses the open grassland regions of the eastern interior plateau of South Africa. Grasslands are maintained largely by a combination of relatively high summer rainfall, frequent fires, frost and grazing, which preclude the presence of shrubs and trees.

- Sour grasslands occur in the higher rainfall regions on acidic soils. They are characterized by being shorter and denser in structure when compared to Sweet grasslands.
- Mixed grasslands represent the transition or combination of Sour and Sweet Grassland types.

Relevant to this study area, much of the grassland biome has been transformed by crop farming, afforestation and dense human settlement. One of the frequent impacts of human activities is to obscure the association between bird distribution patterns and natural vegetation types. While some species may expand their distribution beyond those areas in which they naturally occur, most species become so reduced in distribution and density owing to this activity that former associations between their distribution and the prevailing vegetation type are no longer apparent (Harrison *et al,* 1997) – this study area is characteristic of this phenomenon.

2.2 Bird micro habitats

Whilst much of the distribution and abundance of the bird species in the study area can be explained by the description of vegetation types above, it is even more important to examine the micro habitats available to birds. These are generally evident at a much smaller spatial scale than the vegetation types, and are determined by a host of factors such as vegetation type, topography, land use and man made infrastructure.

The micro habitats observed in this study area during the field visit are described below.

Grassland Patches: These open areas may be indicative of old agricultural lands that have long since been abandoned and are in a process of reverting back to a natural grassland state (see FIGURE 3). They represent a significant feeding area for many bird species in densely populated areas. Specifically, these open grassland patches typically attract the Secretarybird, Blue and White-bellied Korhaans and Abdim's Stork, all being power line sensitive species. However, it is unlikely that they will occur in these areas as a result of the disturbance caused by pedestrian and road traffic passing through the area on a daily basis. The low reporting rate (see TABLE 2) for these species is evidence of the impact that the surrounding communities are having on the birds that would, under optimum conditions, inhabit these open areas. The grassland patches are also a favourite foraging area for game birds such as Swainson's Spurfowl and Helmeted Guineafowl. This in turn attracts large raptors such as the Blackbreasted Snake Eagle because of both the presence and accessibility of prey.

Cultivated/irrigated lands and old fallow fields: There is fairly large concentration of irrigated land lying within close proximity to both alternative alignments just to the east of the Glockner substation (See FIGURE 4). Irrigation crops, especially lucerne, are important draw cards for species such as cranes, Abdim's stork and White stork, especially in an arid landscape and therefore the construction of power lines in these areas will increase the risk of collisions.

FIGURE 4: Irrigated lands

Dams: Alternatives 1 and 2 (indicated as red and blue lines in FIGURE 1) will cross within close proximity to a number of dams (see FIGURE 5). Ordinarily, of the bird species highlighted in TABLE 2, the most likely of those to be associated with these wetlands are the Flamingos, Yellow-billed, Black and White Storks and a variety of non Red Data species such as ducks and geese. In this area, wetlands are extremely important sources of water for most bird species and will be regularly utilised not only as a source of drinking water and food, but also for bathing. Again, it must be emphasized that the dams are being used by the neighbouring communities, thus making these areas less desirable to these birds. It must also be noted that there are a number of dams associated with quarries to the north-east of the Glockner substation (See FIGURE 6). These too are important, in view of the fact that although the quarry may no longer be active, the water source will remain and become an attraction for most bird species. The cliff sides of these quarries could also provide habitat for a number of Rock Kestrels and Lanner Falcons

FIGURE 5: Indication of the number of dams in the area

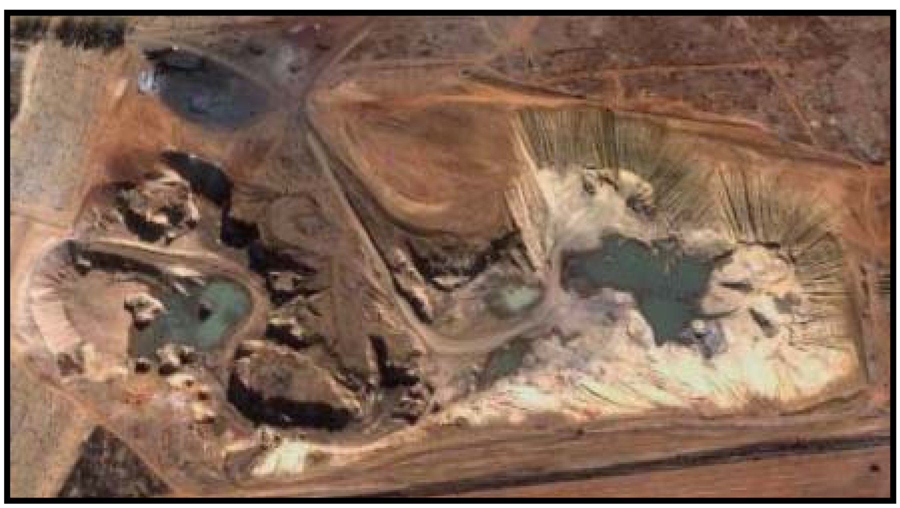

FIGURE 6: Dams associated with quarries

2.3 Relevant bird populations

Table 2 below shows the **power line sensitive** Red Data bird species recorded in 2627BD and 2627DB (Harrison *et al,* 1997) **which could potentially occur in the proximity of the proposed alignment.** In addition to the Red Data species, the White Stork and Abdim's Stork have been included, as they are afforded international protection under the Bonn Convention on Migratory Species (shaded in grey). Reporting rates are a measure of the number of times a species was reported relative to the total number of cards that were completed for the square.
The large difference in reporting rates are more a function of the number of cards that had been completed per square rather than an accurate reflection of actual densities. The table provides an important a guideline of what could potentially be encountered anywhere in the study area (which is very uniform) in suitable habitat, and should not be used as a guideline for actual densities on the ground.

TABLE 2: Red Data bird species occurring in the quarter degree squares bisected by the alignment (Harrison *et al,* 1997)

Abbreviations: NT=Near threatened V=Vulnerable

Most of the species in TABLE 2 are large birds (i.e. the cranes, flamingos, korhaans and storks) and could potentially be impacted on directly by power lines, through electrocution and/or collision. The micro habitat that is preferred by each species – in the context of this study area – is also listed in TABLE 2, with photographs of the micro habitats in APPENDIX A.

3 EVALUATION OF CORRIDORS

3.1 Relevant factors in selecting a preferred corridor

A sensitivity index was drawn up for each of the proposed alignments in order to ascertain

Species	**Micro habitat**	**Cons. status**	**2627BD Reporting Rate (%)**	**2627DB Reporting Rate (%)**
Number of SABAP checklists			**247**	**736**
Pink-backed Pelican	Large dams	V		<1
White-backed Night Heron	Dams (especially those with overhanging vegetation)	V		4
Cape Vulture	Woodland and cliffs	V		<1
African Marsh Harrier	Wetlands	V	1	1
Lesser Kestrel	Fallow fields	V	5	19
Blue Crane	Open grassland patches	V	<1	<1
White-bellied Korhaan	Open grassland patches	V	1	
Grass Owl	Thick grassland near water	V	<1	2
Secretarybird	Open grassland patches	NT	3	<1
Lesser Flamingo	Dams	NT	10	2
Greater Flamingo	Dams	NT	3	4
Black Harrier	Grassland and cultivated fields	NT	<1	
Black Stork	Dams	NT		1
Yellow-billed Stork	Dams	NT		1
Lanner Falcon	Cliff sides at quarries, grassland and cultivated fields	NT		1
Blue Korhaan	Open grassland patches and fallow fields	NT		<1
Half-collared Kingfisher	Rivers	NT		<1
Painted Snipe	Dams	NT		1
Chestnut-banded Plover	Coastal estuaries - vagrant	NT		<1
Caspian Tern	Dams	NT		2
White Stork	Grassland patches and cultivated/fallow fields	Bonn	3	4
Abdim’s Stork	Grassland patches and cultivated/fallow fields	Bonn	0	4

which of the alignments are the most sensitive in terms of potential bird interactions. The following factors were incorporated into the formula, using the CSIR Land Cover Database as the main source of data:

- Wetlands and dams: Wetlands and dams are of particular importance for birds in the study area, as the area is largely urbanized. The study area does not contain many important wetlands, but it does contain a number of small dams, that fall directly within the both alternative corridors. The presence of dams is therefore and indicator of a higher collision risk.
- Grassland: The entire study area falls within the grassland biome. The grasslands in the study area have been greatly transformed by agriculture with only fragmented pieces remaining. These patches of grassland are important to the small number of Secretarybird, Blue Cranes, the Blue and White-bellied Korhaans, Abdim's and White Storks that may occur in the area. Grassland is an indication of a higher collision risk.
- Irrigation: Irrigation crops, especially lucerne, are important draw cards for species such as cranes and storks, especially in this urbanised landscape and therefore increase the risk of collisions.

3.2 Designing an index to calculate the collision risk in each corridor. Collisions are the biggest single threat posed by transmission lines to birds in southern Africa (van Rooyen 2004) and refer to the scenario where a bird collides with the conductors or earth wires of overhead power lines. Most heavily impacted upon are bustards, storks, cranes and various species of water birds.

The factors mentioned in 3.1 were incorporated into a formula to determine a risk rating for each corridor. The formula was designed as follows:

- Wetlands and dams: The total number of wetlands and dams present in each corridor was calculated.
- Grassland: The total length of the proposed alignment falling within sensitive grassland areas was measured in kilometres.
- The length of the proposed alignment running parallel with or across irrigated crops in each corridor was measured in kilometres.

The results of measurements and counts for both alternatives are as follows:

Risk Factor	**Alternative 1**	**Alternative 2**	**Alternative 3**
Dams/wetlands	8	12	9
Grassland	9.30	15.67	10.82
Irrigation	6.78	6.78	2.72
Total	**24.08**	**34.45**	**22.54**

Obviously all these factors do not have an equal impact on the size of the risk, therefore a weighting was assigned to each factor, based on the author's judgment with regards to the importance of each factor within the total equation.

The following weights were assigned:

Risk weighting	
Dams/wetlands	5
Grassland	4
Irrigation	2

The final risk score for a **factor** was calculated as follows: measurements/counts x weighting. The final risk rating for a **corridor** was calculated as the sum of the risk scores of the individual factors:

Factor	**Risk score Alternative 1**	**Risk score Alternative 2**	**Risk score Alternative 3**
Dams/wetlands	40	60	45
Grassland	37.20	62.68	43.28
Irrigation	13.56	13.56	5.44
Total (Risk rating)	**90.76**	**136.24**	**93.72**

From the analysis it is clear that **alternative 1 is the preferred alignment** from a bird collision point of view.

4 ASSESSMENT OF IMPACTS

4.1 General description of power line impacts on birds

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are the electrocution of birds (and other animals) and birds colliding with power lines. Other problems are: electrical faults caused by bird excreta when roosting or breeding on electricity infrastructure; and disturbance and habitat destruction during the construction and maintenance activities associated with electrical infrastructure.

A) **Electrocution** of birds on overhead lines is an emotional issue as well as an important cause of unnatural mortality of raptors and storks. It has attracted plenty of attention in Europe, USA and South Africa (APLIC 1994; van Rooyen and Ledger 1999). However, in the context of overhead lines above 132kV, electrocutions are not of major concern. 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). Due to the large size of the clearances on most overhead lines above 132kV, electrocutions are generally ruled out as even the largest birds cannot physically bridge the gap between dangerous components. In fact, transmission lines have proven to be beneficial to many birds, including species such as Bald Ibis, Martial Eagles, Tawny Eagles, African White-backed Vultures, and even occasionally Verreaux's Eagles by providing safe nesting and roosting sites in areas where suitable natural alternatives are scarce (van Rooyen 2004).

Electrocutions are not envisaged as an impact by the proposed lines primarily because of the obvious size of the clearances between the live and earthed components and secondly, the unlikely occurrences of any of these species within the study area.

B) As mentioned previously, **Collisions** are the biggest single threat posed by transmission lines to birds in southern Africa (van Rooyen 2004) and refers to the scenario where a bird collides with the conductors or earth wires of overhead power lines. Most heavily impacted upon are bustards, storks, cranes and various species of water birds. These species are mostly heavy-bodied birds with limited maneuverability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines. Unfortunately, many of the collision sensitive species are considered threatened (Red Data status) in southern Africa. The Red Data species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. A good example of this is the two flamingo species that occur in southern Africa, which have experienced hardly any successful breeding attempts at Etosha Pan in Namibia for several decades. These species have not evolved to cope with high adult mortality, with the result that consistently high adult mortalities over an extensive period could have a serious effect on a population's ability to sustain itself in the long or even medium term. Many of the anthropogenic threats to these species are non-discriminatory as far as age is concerned (e.g. habitat destruction, disturbance and power lines) and therefore contribute to adult mortality, and it is not known what the cumulative effect of these impacts could be over the long term. Using computer modelling, the South African Crane Working Group estimated that an annual mortality rate of 150 adult Blue Cranes could reduce the eastern population of Blue Cranes (approx. 2000 individuals in Mpumalanga and Kwa-Zulu-Natal) by 90% by the end of the 21st century (McCann *et al,* 2002). At that stage the population would be functionally extinct.

FIGURE 7: Existing 132kV power line

From the figures quoted above, it is clear that power lines are a major cause of avian mortality among power line sensitive species, especially Red Data species. Furthermore, the cumulative effects of power lines and other sources of unnatural mortality might only manifest itself decades later, when it might be too late to reverse the trend. It is therefore imperative to reduce any form of unnatural mortality in these species, regardless of how insignificant it might seem at the present moment in time.

Collisions are envisaged as an impact in the study area. The most sensitive area will be where the lines run adjacent to and cross the numerous dams (See FIGURE 5). The dams may be frequented by vagrant individuals of Flamingos and Black, White and Yellow-billed Storks, using the area as a 'stop-over' when flying between localities.

Agricultural lands are also sensitive from a collision point of view as these areas are much sought after by storks. The areas where the alignment will cross or run parallel to the large concentration of irrigated lands to the south will obviously pose a higher risk in terms of collisions.

C) During the construction phase and maintenance of power lines and substations, some **habitat destruction** and alteration inevitably takes place. This happens with the construction of access roads, the clearing of servitudes and the leveling of substation yards. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude, through the modification of habitat. Similarly, the above mentioned construction and maintenance activities impact on birds through disturbance, particularly during the bird's breeding activities.

D) **Impact of the birds on the proposed power line**: Although this does not form part of the brief, it is important to mention that birds could have an impact on the line, primarily through streamers produced by large raptors and herons roosting at night above the phases on strain towers. They will not be able to roost on the suspension towers (assuming that the cross-rope suspension structure will be used), but it could be a problem on the strain towers.

4.2 Description of the anticipated impacts of this power line on birds

APPENDICES B and C assess, in detail, the anticipated impacts of this line on both the Red Data and non Red Data species, according to the criteria shown in APPENDIX D. Those impacts that were rated as MEDIUM or higher magnitude and significance are listed here, with the recommended mitigation measures highlighted in point 4:

Collision with earth wire/conductor:
- Black, White and Yellow-billed Storks and Flamingos at or near the dams.
- White and Abdim's Storks at or near grassland patches and cultivated land (indicated in FIGURES 3 and 4).
- Secretarybird in open grassland patches.
- Various non Red Data species in the vicinity of water sources.

Electrocution:
- The threat of electrocution is unlikely, owing to the obvious size of the clearances between the live and earthed components.

Disturbance & habitat destruction:
- Although these impacts were not rated as MEDIUM for any of the species, they should always be considered, as resident bird species and will almost invariably be affected to some extent by a project such as this one.

Streamer related faults on the strain towers:
- Streamers produced by large raptors and herons could potentially induce electrical faulting along the power line. The reporting rate for herons within this study area is relatively large, therefore increasing the likelihood of streamer faulting along the proposed 400kV.

5 CONCLUSIONS & RECOMMENDATIONS

The following are recommended in order to mitigate as far as possible for the above mentioned impacts:

Collision with earth wire:
- The earth wire of those sections of line that are in close proximity to the dams, the grassland patches and the irrigated land to the south (near Glockner substation) should be marked with a suitable marking device.

Disturbance and habitat destruction:

- All construction and maintenance activities should be carried out according to generally accepted environmental best practices. In particular, care should be taken in the vicinity of the river crossings, and existing roads must be used as far as possible for access during construction.

Streamer related faults on the strain towers:

- It is suggested that bird guards are fitted to strain towers above the phases as a precautionary measure

Please note that site specific recommendations will be provided prior to construction during the EMP phase of this project.

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APPENDIX A: Micro habitat located along the proposed alignment

Figure 1: An example of the many settlements in the area

Figure 2: A typical example of a small holding

APPENDIX A: Micro habitat located along the proposed alignment

Figure 3: A dam, south of the Etna substation

Figure 4: One of the last extensive grassland patches alongside the alignments

APPENDIX A: Micro habitat located along the proposed alignment

FIGURE 5: Industrial area near Glockner substation

1.1.1.1 Impacts on the landscape

Activity	Nature of impact	Extent of impact	Duration of impact	Severity of impact	Probability of impact	Significance without mitigation	Significance with mitigation	Level of confidence
Construction Phase								
Alternative 1	**Habitat Destruction** (negative impact) Resident bird species will almost invariably be affected to some extent by a project such as this one	Local	Short term	Medium	Possible – particularly for Grass Owls, Greater and Lesser flamingos, White and Abdim's storks	Low	Low	High
Alternative 2		Local	Short term	Medium	Possible – particularly for Grass Owls, Greater and Lesser flamingos, White and Abdim's storks	Low	Low	High
Alternative 3		Local	Short term	Medium	Possible – particularly for Grass Owls, Greater and Lesser flamingos, White and Abdim's storks	Low	Low	High
Alternative 1	**Disturbance** (negative impact) Resident bird species will almost	Local	Medium term	Medium	Possible – particularly for Grass Owls, Greater and Lesser	Low	Low	High

					flamingos, White and Abdim's storks			
Alternative 2	invariably be affected to some extent by a project such as this one	Local	Medium term	Medium	Possible – particularly for Grass Owls, Greater and Lesser flamingos, White and Abdim's storks	Low	Low	High
Alternative 3		Local	Medium term	Medium	Possible – particularly for Grass Owls, Greater and Lesser flamingos, White and Abdim's storks	Low	Low	High
Operational Phase								
Alternative 1	**Electrocutions** (negative impact) Electrocutions are not envisaged as an impact by the proposed lines due to the large size of the clearances between the live and earthed components.	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Alternative 2		N/A	N/A	N/A	N/A	N/A	N/A	N/A
Alternative 3		N/A	N/A	N/A	N/A	N/A	N/A	N/A

Alternative 1	**Collisions** (negative impact) Collisions are envisaged as an impact by the proposed lines especially where the power lines cross dams, grassland areas and irrigated/cultivated lands	Local	Permanent	Medium	Improbable	Medium	Low	High
Alternative 2		Local	Permanent	Medium	Improbable	Medium	Low	High
Alternative 3		Local	Permanent	Medium	Improbable	Medium	Low	High
Alternative 1	**Disturbance** (negative impact) Resident bird species will almost invariably be affected through disturbance as a result of maintenance activities taking place along the power line	Local	Medium term	Medium	Possible – particularly for Grass Owls, Greater and Lesser flamingos, White and Abdim's storks	Low	Low	High
Alternative 2		Local	Medium term	Medium	Possible – particularly for Grass Owls, Greater and Lesser flamingos, White and Abdim's storks	Low	Low	High
Alternative 3		Local	Medium term	Medium	Possible – particularly for Grass Owls, Greater and Lesser flamingos, White and Abdim's storks	Low	Low	High

APPENDIX C – Non Red Data species impacts assessment

Species	Nature of impacts & general susceptibility	Location	Magnitude & significance
Water birds Reed Cormorant White-beasted Cormorant Grey Heron Black-headed Heron Purple Heron Great White Egret Little Egret Cattle Egret Black Egret Hamerkop White-faced Duck White-backed Duck Egyptian Goose Spurwinged Goose Yellow-billed Duck Knobbilled Duck	All these species are vulnerable to collision. No electrocution issues are envisaged These species are relatively tolerant and can adapt to limited habitat transformation.	Close to any water sources	Collision close wetlands and dams is MEDIUM
Medium to large raptors African Fish Eagle Black-breasted Snake Eagle	All of these species are generally vulnerable to electrocution, but there is no electrocution risk associated with this structure These species are all fairly sensitive to disturbance and habitat transformation, however this is not considered to be a significant impact in this instance.	Mostly in the woodland areas.	Low

Black Sparrowhawk Ovambo Sparrowhawk	These species are fairly sensitive to disturbance and habitat transformation, however this is not considered to be a significant impact in this instance as neither of the alignments cross the bluegum “forests”.	Large bluegum plantations	Low
Storks, ibises & African Spoonbill African Sacred Ibis Glossy Ibis Hadeda Ibis African Spoonbill	These species are vulnerable to collision, but are relatively tolerant of disturbance and habitat transformation.	Mostly close to water sources	Low
Other large terrestrial species Black Korhaan Helmeted Guineafowl	These species, in particular the korhaan will be vulnerable to collision, however this is not expected to be significant.	These species could be found almost anywhere, the guineafowl will most likely be in old lands and grasslands.	Low
Corvids Pied Crow Black Crow	These species will not be impacted on by the line in any form. Although they are known to impact on quality of electrical supply on other lines	Anywhere in the study area	Low

	through nesting on pole structures, this has not yet been reported on this proposed pole structure.		

TERMS OF REFERENCE FOR SPECIALIST STUDIES

IMPACT ASSESSMENT METHODOLOGY

All the specialist studies would be carried out and reported based on the following methodology. The identified impacts would be assessed by considering seven rating scales as listed below. All specialist studies proposed or listed for the proposed power line would consider these ratings when assessing potential impacts. These ratings include:

- Extent;
- Duration;
- Intensity;
- Significance;
- Status of impact;
- Probability; and
- Degree of confidence.

In assigning significance ratings to potential impacts before and after mitigation specialists would be instructed to follow the approach presented below:

The core criteria for determining significance ratings are “extent”,, “duration” and “intensity”. The preliminary significance ratings for combinations of these three criteria are given below.

The status of an impact is used to describe whether the impact will have a negative, positive or zero effect on the affected / receiving environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.

Describe the impact in terms of the probability of the impact occurring and the degree of confidence in the impact predictions, based on the availability of information and specialist knowledge.

Additional criteria to be considered, which could “increase” the significance rating if deemed justified by the specialist, with motivation, are the following:

- Permanent / irreversible impacts (as distinct from long-term, reversible impacts);
- Potentially substantial cumulative effects; and

- ❖ High level of risk or uncertainty, with potentially substantial negative consequences.

Additional criteria to be considered, which could "decrease" the significance rating if deemed justified by the specialist, with motivation, are the following:

- ❖ Improbable impact, where confidence level in prediction is high.

When assigning significance ratings to impacts *after mitigation*, the specialist needs to:

- ❖ First, consider probable changes in intensity, extent and duration of the impact after mitigation, assuming effective implementation of mitigation measures, leading to a revised significance rating; and
- ❖ Then moderate the significance rating after taking into account the likelihood of proposed mitigation measures being effectively implemented. Consider:
    - o Any potentially significant risks or uncertainties associated with the effectiveness of mitigation measures;
    - o The technical and financial ability of the proponent to implement the measure; and
    - o The commitment of the proponent to implementing the measure, or guarantee over time that the measures would be implemented.

The significance ratings are based on largely objective criteria and inform decision-making at a project level as opposed to a local community level. In some instances, therefore, whilst the significance rating of potential impacts might be "low" or "very low", the importance of these impacts to local communities or individuals might be extremely high. The importance which I&APs attach to impacts will be taken into consideration, and recommendations will be made as to ways of avoiding or minimising these negative impacts through project design, selection of appropriate alternatives and / or management.

The relationship between the significance ratings after mitigation and decision-making can be broadly defined as follows:

Significance rating	**Effect on decision-making**
Very Low; Low	Will not have an influence on the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented.
Medium	Should influence the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented.

High; Very High	Would strongly influence the decision to proceed with the proposed project.

EXTENT

"Extent" defines the physical extent or spatial scale of the impact.

Rating	**Description**
Local	Extending only as far as the activity, limited to the site and its immediate surroundings. Specialist studies will specify extent.
Regional	Gauteng Province
National	South Africa
International	

DURATION

Rating	Description
Short term	0-5 years
Medium term	5-15 years
Long term	Where the impact will cease after the operational life of the activity, either because of natural processes or by human intervention.
Permanent	Where mitigation either by natural processes or by human intervention will not occur in such a way or in such time span that the impact can be considered transient.

INTENSITY

"Intensity" establishes whether the impact would be destructive or benign.

Rating	**Description**
Low	Where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected.
Medium	Where the affected environment is altered, but natural, cultural and social functions

	and processes continue, albeit in a modified way.
High	Where natural, cultural and social functions or processes are altered to the extent that it will temporarily or permanently cease.

SIGNIFICANCE

"Significance" attempts to evaluate the importance of a particular impact, and in doing so incorporates the above three scales (i.e. extent, duration and intensity).

Rating	**Description**
Very High	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***long term***; OR of ***high intensity*** at a ***national level*** in the ***medium term***; OR of ***medium intensity*** at a ***national level*** in the ***long term.***
High	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***medium term***; OR of ***high intensity*** at a ***national level*** in the ***short term***; OR of ***medium intensity*** at a ***national level*** in the ***medium term;*** OR of ***low intensity*** at a ***national level*** in the ***long term***; OR of ***high intensity*** at a ***local level*** in the ***long term***; OR of ***medium intensity*** at a ***regional level*** in the ***long term.***
Medium	Impacts could be EITHER: of ***high intensity*** at a ***local level*** and endure in the ***medium term***; OR of ***medium intensity*** at a ***regional level*** in the ***medium term***; OR of ***high intensity*** at a ***regional level*** in the ***short term***; OR of ***medium intensity*** at a ***national level***

	in the ***short term***; OR of ***medium intensity*** at a ***local level*** in the ***long term***; OR of ***low intensity*** at a ***national level*** in the ***medium term;*** OR of ***low intensity*** at a ***regional level*** in the ***long term.***
Low	Impacts could be EITHER of ***low intensity*** at a ***regional level*** and endure in the ***medium term***; OR of ***low intensity*** at a ***national level*** in the ***short term***; OR of ***high intensity*** at a ***local level*** and endure in the ***short term***; OR of ***medium intensity*** at a ***regional level*** in the ***short term***; OR of ***low intensity*** at a ***local level*** in the ***long term***; OR of medium intensity at a local level and endure in the medium term.
Very low	Impacts could be EITHER of ***low intensity*** at a ***local level*** and endure in the ***medium term***; OR of ***low intensity*** at a ***regional level*** and endure in the ***short term***; OR of low to medium intensity at a local level and endure in the short term.
Not applicable	Impacts with: Zero intensity with any combination of extent and duration.
Unknown	In certain cases it may not be possible to determine the significance of an impact.

STATUS OF IMPACT

The status of an impact is used to describe whether the impact would have a negative, positive or zero effect on the affected environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.

PROBABILITY

"Probability" describes the likelihood of the impact occurring.

Rating	**Description**
Improbable	Where the possibility of the impact to materialise is very low either because of design or historic experience.
Probable	Where there is a distinct possibility that the impact will occur.
Highly probable	Where it is most likely that the impact will occur.
Definite	Where the impact will occur regardless of any prevention measures.

DEGREE OF CONFIDENCE

This indicates the degree of confidence in the impact predictions, based on the availability of information and specialist knowledge.

Rating	**Description**
High	Greater than 70% sure of impact prediction.
Medium	Between 35% and 70% sure of impact prediction.
Low	Less than 35% sure of impact prediction.

All the specialist activities should, as a minimum,

- Describe the baseline conditions that exists in the study area
- Indicate the reliability of information utilized in the assessment of impacts as well as constraints to which the assessment is subject (e.g. any areas of insufficient information or uncertainty)
- Identify feasible ways in which the impacts could be mitigated and benefits enhanced giving an indication of the likely effectiveness of such mitigation and how these could be implemented in the construction and management of the proposed power lines.