Eskom Holdings Limited

ENVIRONMENTAL IMPACT ASSESSMENT FOR THE PROPOSED WESTGATE TARLTON KROMDRAAI 132kV POWER LINE & NEW KROMDRAAI SUBSTATION

Avifaunal Impact Assessment Study

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EXECUTIVE SUMMARY

The Endangered Wildlife Trust was appointed to conduct a specialist avifaunal impact assessment for the proposed 132kV Westgate – Tarlton – Kromdraai power line and new Kromdraai Substation.

The study area falls into the quarter degree square 2627BA. This square is classified as being composed of 100% "sour grassland". However, much of the study area, particularly in the south, has been impacted on and transformed to the point where little original vegetation remains. Data on bird species distribution and abundance in the square was obtained from the Southern African Bird Atlas Project (Harrison *et al*, 1997). This project recorded a total of 292 bird species in 2627BA. The square was counted 212 times, which is an exceptionally good coverage and gives us confidence in the data. Of the birds recorded, fourteen are classified as Red Data species, seven of which are "vulnerable" and seven are "near-threatened. In addition, the White Stork and Abdim's Stork are considered threatened species as they are protected internationally under the Bonn Convention on Migratory Species. Of particular concern in terms of the proposed developments is the presence of African White-backed & Cape Vultures, Secretarybird and various stork species – as these are all species known to be vulnerable to the impacts of power lines.

Collision of certain bird species with the earth wires of the proposed power lines is anticipated to be of MEDIUM significance at certain sites along the corridors, particularly drainage lines and wetlands. The recommended mitigation for this impact is to mark these sections of high risk power line with a suitable anti collision marking device on the earth wire. **It is recommended that a pre construction avifaunal walk through be conducted as part of the site specific EMP for the project. This walk through will identify sections of line requiring marking or any other form of mitigation**. The recommended mitigation measures will reduce this impact to LOW significance.

It has been advised by Eskom that the power lines will be constructed on the double circuit twin tern steel lattice tower structure. If a different structure is used, EWT should be given opportunity to comment on how this affects our assessment of the electrocution risk. Electrocution of vultures is unlikely on the proposed tower for reasons explained in the main report. This impact has therefore been rated as being of LOW significance. No mitigation is required for this impact.

Electrocution of certain bird species such as owls, crows and Hadeda Ibis in the substation yard is possible - however the significance of this impact is rated as LOW, due to the common status of most bird species which would enter the substation, and the low likelihood of electrocutions. Due to the intricate infrastructure within the yard and the numerous positions on which birds could potentially be electrocuted, it is recommended that mitigation only be implemented if electrocution problems are detected by Eskom once the substation is operational. Site specific mitigation measure can then be recommended.

Destruction of habitat during construction and to a lesser extent maintenance of the power lines is rated as MEDIUM significance, particularly in the north of the study area, where grassland and wetland still exists. The Kromdraai Substation site is not anticipated to destroy any useful bird habitat. To mitigate for habitat destruction along the power lines, care must be taken not to disturb the vegetation any more than is absolutely necessary during construction. Particular care must be taken in the vicinity of drainage lines, wetland and grassland areas. These measures should reduce the significance to LOW.

Disturbance of birds during construction is rated as being of LOW significance as most of the study area already experiences high disturbance levels due to various developments and infrastructure. No specific mitigation is required in this regard.

The possibility of birds such as vultures, herons, and ibises causing electrical faults on the proposed power lines through their faeces does exist, although such faulting on 132kV power lines has not previously been reported to the EWT. No mitigation is proposed for this impact, if Eskoms' line performance monitoring detects any bird related faulting once the lines are operational, the EWT can be contacted for recommendations.

The preferred corridor for the Tarlton Kromdraai power line remains Corridor 5, and the preferred corridor for Westgate Tarlton remains Corridor 1. The main reason for the selection of these two corridors is their position adjacent to existing power lines for most of their route. This is anticipated to partially mitigate for the impacts discussed above. The overall preferred corridors, taking into account the newly proposed corridors, has been shown in Figure 5 below. In particular it is strongly recommended that the new corridor through Krugersdorp Game Reserve (Corridor 7) is not considered further.

It is the EWT's opinion that the identified impacts of the proposed developments can be mitigated to acceptable levels if the recommendations contained in this report are adhered to.

1 INTRODUCTION

1.1 Background

Eskom Distribution plan to build new 132kV power lines between the existing Westgate and Tarlton Substations, and onwards to a new proposed substation at Kromdraai.

Arcus GIBB were appointed as main consultants to conduct the Environmental Impact Assessment for the proposed developments, and subsequently appointed the Endangered Wildlife Trust (EWT) to conduct the specialist Avifaunal Impact Assessment Study.

An initial study was conducted in January 2008. Subsequent to this, several new alternative corridors were identified due to public input, and this report represents an assessment of all available alternatives. Figure 1 shows the various corridors. Corridors 1 to 6 were assessed originally and Corridors 7 and 8 are new additions to be assessed in this study.

Overhead power lines and associated infrastructure such as substations are known to impact significantly on various bird species, both directly through causing mortality of birds, and indirectly through disturbance of birds and destruction of habitats. This study will identify these impacts, their location and significance, and recommend suitable mitigation measures that can be implemented to minimise these impacts. The study will also identify the preferred corridor from a bird impact perspective.

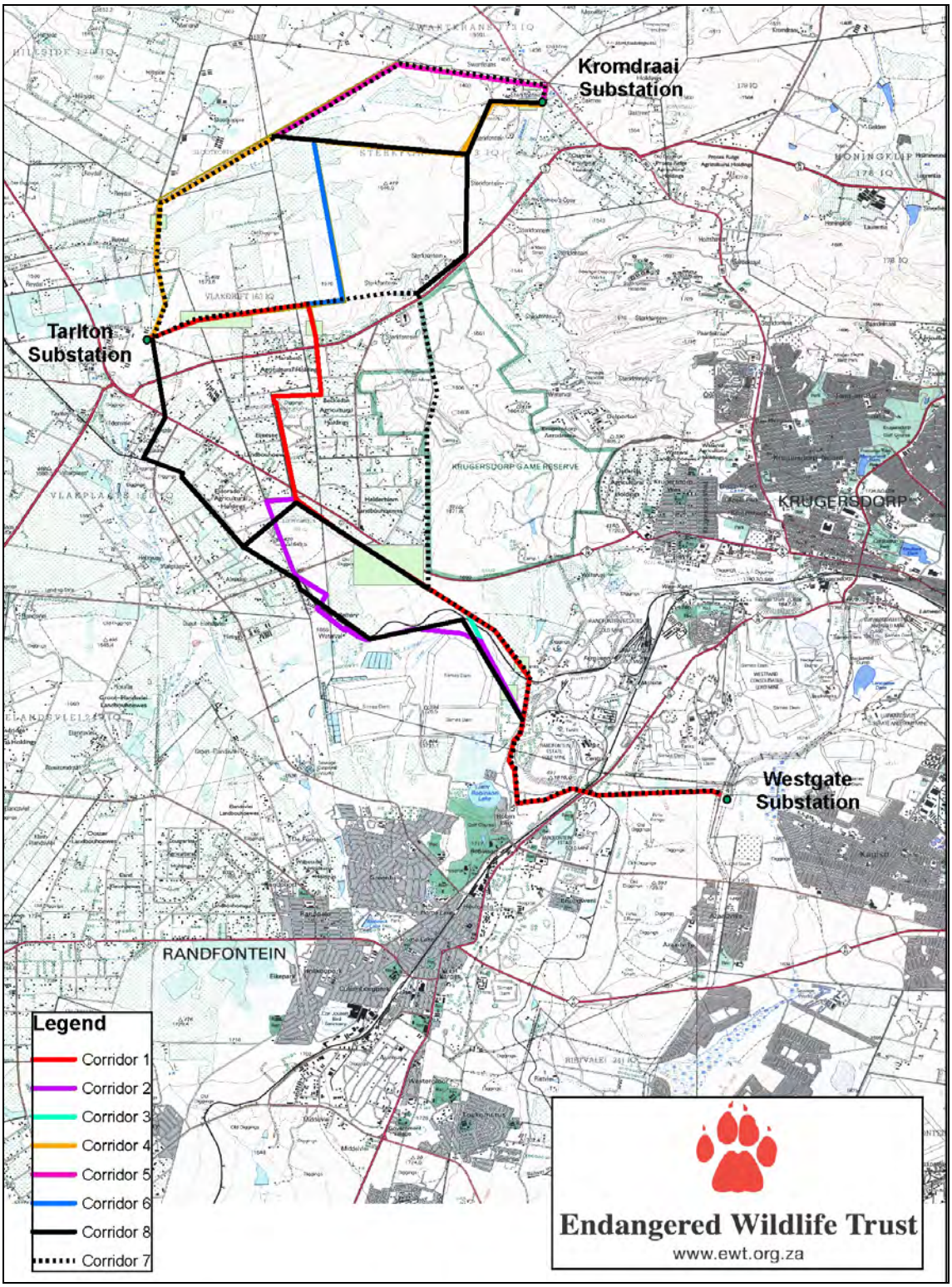


Figure 1. The Westgate Tarlton Kromdraai study area, with eight corridors shown.

1.2 Study Approach

1.2.1 Methodology

In predicting impacts of a proposed power line on birds, a combination of science, field experience and common sense is required. More specifically the methodology used to predict impacts in the current study was as follows:

- The various data sets discussed below under "sources of information" were collected and examined.
- This data was examined to determine the location and abundance of power line sensitive Red Data species as well as non-Red Data power line sensitive species in the study area.
- The area was visited to obtain a first-hand perspective of the proposed routes and birdlife and to determine which bird micro-habitats are present and relevant to the study. This involved half a day of driving the study area. A second field trip was conducted to assess the new alignments.
- The impacts of the proposed power line and substation on birds were predicted on the basis of experience in gathering and analysing data on wildlife impacts with power lines throughout southern Africa since 1996 (see van Rooyen & Ledger 1999 for an overview of methodology), supplemented with first hand data.

1.2.2 Sources of information

The study made use of the following data sources:

- Bird distribution data of the Southern African Bird Atlas Project (SABAP – Harrison, Allan, Underhill, Herremans, Tree, Parker & Brown, 1997) obtained from the Avian Demography Unit of the University of Cape Town, in order to ascertain which species occur in the study area. A separate data set was obtained for each quarter degree square covering the study area, in this case only the square 2627BA (marginal overlaps were discounted).
- The conservation status of all bird species occurring in the aforementioned degree squares was then 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.
- A classification of the vegetation types in 2627BA was obtained from Harrison, Allan, Underhill, Herremans, Tree, Parker & Brown (1997).
- Information on the micro-habitat level was obtained through visiting the area and obtaining a first hand perspective.
- Electronic 1:50 000 maps obtained from the Surveyor General

1.2.3 Limitations & assumptions

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. (For a full discussion of potential inaccuracies in ASAB data, see Harrison, Allan, Underhill, Herremans, Tree, Parker & Brown, 1997).
- Difficult road access in some sections of the study area made examination of the study area from the ground difficult.

General comment: Predictions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can not be 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 by the authors through the investigation of more than 400 localities in southern Africa where birds have interacted with power lines since 1996.

2 DESCRIPTION OF AFFECTED ENVIRONMENT

2.1 Topography & vegetation

The topography of the study area is generally very flat, with some rolling hills in the north east.

The vegetation in 2627BA is described by Harrison, Allan, Underhill, Herremans, Tree, Parker & Brown (1997) as comprising a total dominance of sour grassland. It is generally accepted within ornithological circles that vegetation structure is more important in determining bird distribution, than the actual species themselves (in Harrison *et al*, 1997). The vegetation description below will therefore probably differ from botanical descriptions in that it concentrates on factors relevant to birds, rather than exhaustively listing plant species.

2.1.1 Sour grassland

The dominant plants in the grassland biome are grass species, with geophytes and herbs also well represented (Low & Robelo 1996). Grasslands are maintained mainly by: relatively high summer rainfall; frequent fires; frost and grazing. These factors preclude the growth of trees and shrubs. This biome has been largely transformed in SA already through various land uses such as afforestation and crop cultivation.

Several of the bird species recorded in this study area, prefer grassland habitat as shown in Table 1 below.

2.2 Bird micro habitats

In this study area, where much of the natural vegetation has been transformed for various purposes, and little of the natural vegetation remains, a description of the micro habitats available to birds is more useful than a description of the vegetation that used to exist. These micro habitats do not always correspond to vegetation types and are determined by a combination of vegetation type, topography, land use, food sources and other factors.

Investigation of this study area revealed the following bird micro habitats, examples of which are shown in the accompanying pictures. Species that are likely to make use of the various micro habitats can be seen in Table 1 below. The position of some of these micro habitats in the study area can be seen in Figures 5 - 8.

- Arable lands:

  Arable or cultivated land represents a significant feeding area for many bird species in any landscape for the following reasons: through opening up the soil surface, land preparation makes many insects, seeds, bulbs and other food sources suddenly accessible to birds and other predators; the crop or pasture plants cultivated are often eaten themselves by birds, or attract insects which are in turn eaten by birds; during the dry season arable lands

often represent the only green or attractive food sources in an otherwise dry landscape.

In this study area some arable lands exist quite close to certain corridors, particularly in the north. Whilst some crops are more suitable than others for birds, most of these lands are under a rotational system whereby at some point a crop will be planted that is suitable to certain bird species. Very often the most attractive phase of crop production for birds is when the land is first ploughed – before planting even takes place.

- Grassland:

  This has been adequately described above.

Figure 2. An area of sour grassland in the study area.

- Wetland:

  Wetlands are characterized by slow flowing water and tall emergent vegetation, and provide habitat for many water birds. The conservation status of many of the bird species that are dependant on wetlands reflects the critical status of wetland nationally, with many having already been destroyed.

  In this study area, several areas of wetland were observed, in particular just to the east and north of the proposed Kromdraai Substation site.

Figure 3. A river and wetland system close to Kromdraai Substation

- Rivers or drainage lines:

  Most rivers in southern Africa are in the east and extreme south, in the higher rainfall areas. Thirteen species of water bird are mostly restricted to riverine habitat in southern Africa. The map distribution of these species correlates with the river courses in southern Africa. This study area contains several small streams or drainage lines. These areas could be important refuges for shy riverine bird species, and are also often important flight paths for other species, placing them at risk of collision with any power line in the vicinity.

- Stands of exotic trees:

  Several stands of Eucalyptus and Wattle trees exist in the study area. Since these trees are exotic, they would not normally be considered important in a study of this nature. However certain bird species may choose to roost in these trees, making them an important micro habitat for birds. In particular where these trees exist close to a water source, species such as herons, egrets and ibises will use them as roosts. A good example of this is the Eucalyptus trees close to Kromdraai Substation site.

Figure 4. Stand of exotic Eucalyptus and Wattle trees

Table 1 below shows the microhabitats that each Red Data bird species typically frequents in the study area. It must be stressed that birds can and will, by virtue of their mobility, utilise almost any areas in a landscape from time to time. However, the analysis below represents each species most preferred or normal habitats. These locations are where most of the birds of that species will spend most of their time – so logically that is where impacts on those species will be most significant.

Table 1 makes use of the authors' extensive experience gained through personal observations.

2.3 Relevant bird populations

The data source used to determine the distribution and abundance of bird species in the study area was the Southern African Bird Atlas Project data (Harrison *et al*, 1997). This data was collected over an 11 year period between 1986 and 1997. Although it is now quite old, it remains the best long term data set on bird distribution and abundance available to us at present. This data was collected on the basis of quarter degree squares, which is also a relatively large spatial scale. The species recorded in the square 2627BA could have been recorded anywhere within this square and not necessarily in the exact study area for the proposed developments. It does however provide a good indication of what could be found in the study area. Using this data in combination with the assessment of the micro habitats available to birds in the area – an effective assessment of potential impacts of the proposed developments can be made.

Report rates (as per Table 1) are an expression (%) of the number of times a species was seen in a square divided by the number of times that square was counted. A total of 292 bird species were recorded in the square which was thoroughly counted – with 212 cards submitted. A total of 14 Red Data species were recorded, consisting of seven "vulnerable" species and seven "near-threatened" species. In addition, the White Stork and Abdim's Stork are included here as they are protected internationally by the "Bonn Convention on Migratory Species". Most of the larger species listed here are known to interact directly with electrical infrastructure through collision and electrocution. The smaller species will interact indirectly through effects of construction and maintenance on their habitat and daily activities.

TABLE 1 – Abundances of Red Data bird species in 2627BA (Harrison *et al*, 1997) & their preferred microhabitat.

Species	Cons. status	2627BA Report rate %	Preferred micro habitat
Total # species		292	
Total # cards submitted		212	
White-backed Vulture	V	<1	Woodland, grassland
Cape Vulture	V	6	Grassland
Lanner Falcon	V	<1	Grassland, arable lands
Lesser Kestrel	V	2	Grassland, arable lands
White-bellied Korhaan	V	2	Grassland
African Grass Owl	V	2	Grassland, wetland

Half-collared Kingfisher	V	2	Riverine vegetation
Black Stork	NT	<1	Riverine
Yellow-billed Stork	NT	3	Riverine, wetland
Greater Flamingo	NT	25	Dams
Lesser Flamingo	NT	<1	Dams
Secretarybird	NT	1	Grassland
Melodious Lark	NT	<1	Grassland
Greater Painted Snipe	NT	<1	Wetland
White Stork	Bonn	5	Wetland, grassland, arable land
Abdim's Stork	Bonn	2	Wetland, grassland, arable land

V = Vulnerable; NT = Near-threatened; Bonn = Protected Internationally under the Bonn Convention on Migratory Species.

Examination of the data reveals that the report rates for most Red Data species are relatively low. Exceptions to this include the Cape Vulture, Greater Flamingo and White Stork. These are critical species to this study and can be considered "flag ship" species for the impacts of electrocution and collision respectively.

It must be noted that many "non Red Data" bird species also occur in the study area and will also be impacted on by the power line. Although this impact assessment focuses on Red Data species, the impact on non Red Data species is also assessed.

The above data sources, combined with the author's personal observations of habitat preferences, will be used to determine the exact locations of impacts of the proposed line on the various bird species, and to select the preferred corridor from a bird impact perspective.

3 IDENTIFICATION OF RISK SOURCES

3.1 General description of impacts of power lines on birds

Because of its' size and prominence, electrical infrastructure constitutes an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds (and other animals) and birds colliding with power lines. (Ledger & Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs & Ledger 1986a; Hobbs & Ledger 1986b; Ledger, Hobbs & Smith, 1992; Verdoorn 1996; Kruger & Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000). Other problems are electrical faults caused by bird excreta when roosting or breeding on electricity infrastructure, (Van Rooyen & Taylor 1999) and disturbance and habitat destruction during construction and maintenance activities.

3.1.1 Electrocutions

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 & Ledger 1999). However, in the context of overhead lines above 132 kV, electrocutions are not a major issue. 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 of 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 Martial Eagles *Polemaetus bellicosus*, Tawny Eagles *Aquila rapax*, African White-backed Vultures *Gyps africanus*, and even occasionally Verreaux's Eagles *Aquila verreauxii* by providing safe nesting and roosting sites in areas where suitable natural alternatives are scarce (van Rooyen 2004). Cape Vultures have also taken to roosting on power lines in certain areas in large numbers (van Rooyen 2004a), while Lappet-faced Vultures are known to use power lines as roosts, especially in areas where large trees are scarce (pers.obs.).

Electrocution on the proposed power line is improbable given the adequate clearances.

Electrocution of birds is also possible in the substation yard on the various electrical infrastructure that exists, through the same mechanisms as described above. This is a potential impact of the proposed Kromdraai Substation, likely to affect the more common species that are tolerant of high disturbance levels and human activity.

3.1.2 Collisions

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

Unfortunately, many of the collision sensitive species are considered threatened 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. These species have not evolved to cope with high adult mortality, with the results that consistent high adult mortality 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.

Collision of certain bird species, particularly at wetland and river crossings is anticipated to be an impact of the proposed power lines.

3.1.3 Habitat destruction

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 levelling 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 modification of habitat.

Habitat destruction could be an impact in the grassland and wetland areas, where natural vegetation is still relatively intact.

3.1.4 Disturbance

Similarly, the above mentioned construction and maintenance activities impact on bird through disturbance, particularly during breeding activities.

This impact could potentially occur in the north of the study area, but is unlikely in the south where existing disturbance levels are high due to mining and other activities,

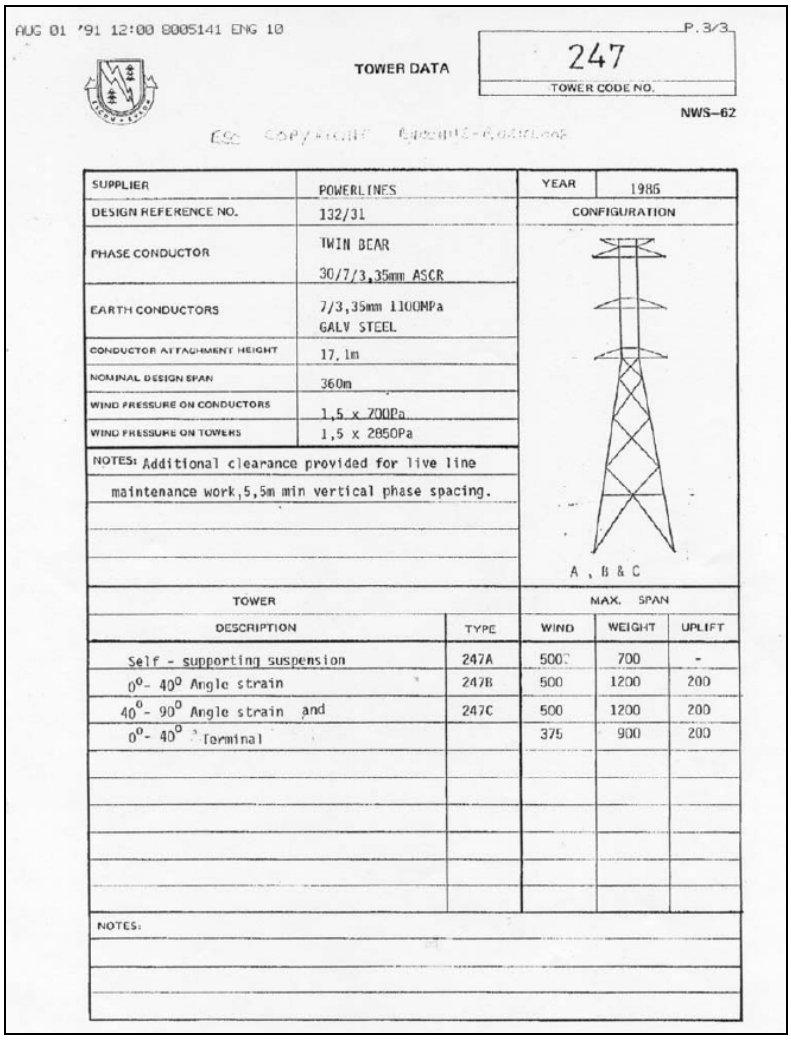
3.2 Description of impacts of this proposed development

The proposed developments comprise the following:

- A 132kV power line from Westgate to Tarlton Substation.
- A 132kV power line from Tarlton to Westgate Substation.
- A 132kV power line from Westgate to Kromdraai Substation.
- A 132kV power line from Kromdraai to Westgate Substation.
- A 132kV power line from Kromdraai to Tarlton Substation.
- A 132kV power line from Tarlton to Kromdraai Substation.
- **Eskom have advised that the power lines will be constructed on a double circuit twin tern steel lattice structure (pictured below). If a different**

structure is used, EWT should be given opportunity to comment on how this affects our assessment of the electrocution risk. The implication of this structure for electrocution is that the 5.5m vertical phase-phase clearance stated in the diagram below, means it is likely that the phase-earth clearance will be greater than the 1.8m required for safety for vultures.

- In each case, the two power lines will be built immediately adjacent to each other.
- A new substation will be built at the Kromdraai site.



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TOWER DATA

247

TOWER CODE NO.

NWS–62

SUPPLIER	POWERLINES	YEAR	1985
DESIGN REFERENCE NO.	132/31	CONFIGURATION	
PHASE CONDUCTOR	TWIN BEAR 30/7/3,35mm ASCR		
EARTH CONDUCTORS	7/3,35mm 1100MPa GALV STEEL		
CONDUCTOR ATTACHMENT HEIGHT	17,1m		
NOMINAL DESIGN SPAN	360m		
WIND PRESSURE ON CONDUCTORS	1,5 x 700Pa		
WIND PRESSURE ON TOWERS	1,5 x 2850Pa		

NOTES: Additional clearance provided for live line maintenance work,5,5m min vertical phase spacing.

A , B & C

TOWER DESCRIPTION	TYPE	MAX. SPAN WIND	WEIGHT	UPLIFT
Self - supporting suspension	247A	500	700	-
0^0- 40^0 Angle strain	247B	500	1200	200
40^0- 90^0 Angle strain and	247C	500	1200	200
0^0- 40^0 Terminal		375	900	200

NOTES:

Tables 2 to 7 below summarise the assessment of the impacts of the proposed power line and substation on the birds of the area.

Table 2. Assessment of the potential impacts of the proposed developments on birds (**before mitigation**).

Impact	**Nature**	**Species**	**Cumulative impacts**	**Intensity**	**Extent & Location**	**Duration**	**Probability**	**Confidence**	**Mitigation**
Collision of birds with conductor & earth wire	Negative	*Red Data:* White Stork, White-bellied Korhaan *Non Red Data:* egrets, ibises, herons, assorted water birds	Low	Medium	Local - Grassland areas Wetlands, dams and river crossings	Long term, as long as the line exists	Probable	High	The high risk sections of line should be marked with a suitable anti collision marking device on the earth wire as per the Eskom guidelines. It is recommended that an avifaunal walk through be conducted as part of the site specific EMP for the construction of the power lines.
Electrocution of birds on towers	Negative	*Red Data:* Cape & African White-backed Vultures *Non Red Data:* eagles, herons, ibises	Low	Low	Local - Entire line – for non Red Data species particularly close to water	Long term – as long as the line exists	Improbable due to explanation under 'mitigation'	High	The vertical phase-earth clearance is likely to be greater than 1.8m, based on the fact that the phase-phase clearance is 5.5m as per diagram supplied by Eskom. This means that electrocution of even vultures should be unlikely. No mitigation is required
Electrocution of birds in Kromdraai Substation	Negative	*Non Red Data:* Crows, owls, Hadeda Ibis	Low	Low	Local - Substation yard	Long term – as long as the substation exists	Improbable	Medium	Once operational, the substation yard will be monitored by Eskom staff as part of their operations anyway. If any electrocution problems are detected, site specific recommendations can be obtained from EWT.
Habitat Destruction	Negative	*Red Data:* All species, in particular grassland & wetland dependant species *Non Red Data:* all species	Low	Medium	Local - Wetland and grassland areas along the power line will be most important. The substation site is already highly degraded and disturbed and no impact is anticipated	Long term – habitat will be altered permanently	Probable	Medium	Vegetation clearing should be kept to an absolute minimum. The line should be sited alongside existing infrastructure as far as possible to prevent impacts on new areas of habitat.
Disturbance	Negative	*Red Data:* All species, particularly any breeding species	Low	Low	Local - Will be most noticeable in the more remote undisturbed areas of the power line route – particularly in the north-east	Short term at construction, and intermittent through the operational	Probable – although the broader area is already highly disturbed through	Medium	Care should always be taken to disturb the receiving environment as little as possible. Careful control of construction workers movements must be maintained at all times.

		Non Red Data: all species				phase	various developments and human activities		
Electrical faulting as result of birds	Negative for lines	*Red Data*: Cape & African White-backed Vultures *Non Red Data:* herons, egrets, ibises	Low	Low	Local - Anywhere along the line – most particularly close to water	Long term	Improbable – although no bird related faulting on 132kV lines has been reported to EWT previously. The congregations of egrets, ibises and herons observed in certain parts of the study area could cause significant bird pollution on pole structures if they choose to perch/roost on them.	Medium	Eskom's standard monitoring of the lines performance once operational will detect any bird related faulting. This should be reported to the EWT for site specific recommendations.

Table 3. Assessment of the potential impacts of the proposed developments on birds (**after mitigation**).

Impact	**Nature**	**Species**	**Cumulative impacts**	**Intensity**	**Extent & Location**	**Duration**	**Probability**	**Confidence**
Collision of birds with conductor & earth wire	Negative	*Red Data:* White Stork, White-bellied Korhaan *Non Red Data:*	Low	Low	Local - Grassland areas Wetlands, dams and river crossings	Long term - as long as the line exists	Improbable	High

		egrets, ibises, herons, assorted water birds						
Electrocution of birds on towers	Negative	*Red Data:* Cape & African White-backed Vultures *Non Red Data:* eagles, herons, ibises	Low	Low	Local - Entire line – for non Red Data species particularly close to water	Long term – as long as the line exists	Improbable	High
Electrocution of birds in Kromdraai Substation	Negative	*Non Red Data:* Crows, owls, Hadeda Ibis	Low	Low	Local - Substation yard	Long term – as long as the substation exists	Improbable	Medium
Habitat Destruction	Negative	*Red Data:* All species, in particular grassland & wetland dependant species *Non Red Data:* all species	Low	Low	Local - Wetland and grassland areas along the power line will be most important. The substation site is already highly degraded and disturbed and no impact is anticipated	Long term – habitat will be altered permanently	Improbable	Medium
Disturbance	Negative	*Red Data:* All species, particularly any breeding species *Non Red Data:* all species	Low	Low	Local - Will be most noticeable in the more remote undisturbed areas of the power line route – particularly in the north-east	Short term at construction, and intermittent through the operational phase	Improbable	Medium
Electrical faulting as result of birds	Negative for lines	*Red Data*: Cape & African White-backed Vultures *Non Red Data:* herons, egrets, ibises	Low	Low	Local - Anywhere along the line – most particularly close to water	Long term	Improbable – although no bird related faulting on 132kV lines has been reported to EWT previously. The congregations of egrets, ibises and herons observed in certain parts of the study area could cause significant bird pollution on pole structures if	Medium

							they choose to perch/roost on them.	

TABLE 4. Consequence rating for identified impacts **before** mitigation

Impact	Nature	Consequence	Probability	Confidence
Collision of birds with conductor & earth wire	-	Medium	Probable	High
Electrocution of birds on towers	-	Medium	Improbable	High
Electrocution of birds in Kromdraai Substation	-	Low	Improbable	Medium
Habitat Destruction	-	Medium	Probable	Medium
Disturbance	-	Low	Probable	Medium
Electrical faulting as result of birds	- for line	Low	Improbable	Medium

TABLE 5. Consequence rating for identified impacts **after** mitigation

Impact	Nature	Consequence	Probability	Confidence
Collision of birds with conductor & earth wire	-	Low	Improbable	High
Electrocution of birds on towers	-	Low	Improbable	High
Electrocution of birds in Kromdraai Substation	-	Low	Improbable	Medium
Habitat Destruction	-	Low	Improbable	Medium
Disturbance	-	Low	Improbable	Medium
Electrical faulting as result of birds	- for line	Low	Improbable	Medium

TABLE 6. Significance rating for identified impacts **before** mitigation

Impact	Consequence	Probability	Significance	Confidence
Collision of birds with conductor & earth wire	Low	Improbable	Medium	High
Electrocution of birds on towers	Low	Improbable	Low	High
Electrocution of birds in Kromdraai Substation	Low	Improbable	Low	Medium
Habitat Destruction	Low	Improbable	Low	Medium
Disturbance	Low	Improbable	Low	Medium
Electrical faulting as result of birds	Low	Improbable	Low	Medium

TABLE 7. Significance rating for identified impacts **after** mitigation

Impact	Consequence	Probability	Significance	Confidence
Collision of birds with conductor & earth wire	Low	Improbable	Low	High
Electrocution of birds on towers	Low	Improbable	Low	High
Electrocution of birds in Kromdraai Substation	Low	Improbable	Low	Medium

Habitat Destruction	Low	Improbable	Low	Medium
Disturbance	Low	Improbable	Low	Medium
Electrical faulting as result of birds	Low	Improbable	Low	Medium

4 COMPARISON OF ALTERNATIVES

Figure 1 shows the various alternative corridors.

For the Tarlton Kromdraai power lines, the preferred corridor from an avifaunal perspective remains Corridor 5 in spite of the addition of new corridors, for the following reasons:

- It is adjacent to existing power lines for most of its route. This means that habitat destruction, and disturbance of birds will be less significant as the area is already disturbed to some extent.
- It will also mean that electrocution of birds is less likely as for the two large transmission lines which it follows for most of its route are significantly taller and it is likely that birds such as vultures would choose to perch on the taller lines.
- Building the new line adjacent to an existing line should to a certain extent eliminate the need for new access roads and gates etc. This would reduce the level of disturbance and habitat destruction. In addition, birds in the immediate vicinity of the existing line would already be relatively tolerant of disturbance as a result of maintenance activities on this line.
- The impact of collision of birds is partially mitigated for by placing new lines adjacent to existing lines for the following reasons:
    - The more overhead power lines there are together, the more visible they would be to the birds in the area (Avian Power Line Interaction Committee - 1994).
    - Resident birds in an area become accustomed to a power line that crosses their flight paths, and learn to avoid it during their everyday activities. Hence adding a new power line adjacent to an existing line would probably have less impact than putting it in a totally new area, where the resident birds are not yet accustomed to overhead power lines.
    - Spatially, it makes more sense to have all the threats to birds (in particular through collision) in one relatively confined area, rather than spread out across the landscape. As many bird species are territorial to some extent, keeping the power line impacts confined to a smaller area could potentially impact on fewer birds.

For the Westgate Tarlton power lines, the preferred corridor remains Corridor 1 in spite of the addition of new alternatives, for the following reasons:

- Corridor 1 is situated adjacent to existing power lines for almost its entire length
- This is advantageous from an avifaunal perspective for the same reasons as described above.

The newly proposed Corridor 7 is not preferred at all from an avifaunal perspective for the following reasons:

- It passes through and adjacent to the Krugersdorp Game Reserve (KGR)

- This area is open, and relatively undeveloped, with no existing linear infrastructure
- As such it would be an attractive area to several bird species, including grassland species such as korhaans, Secretarybird, storks, and various smaller birds. With development taking place in the surrounding areas, the KGR is likely to become even more important to these bird species with time.

It is strongly recommended that this corridor is not considered further for the purposes of the proposed power lines.

The following are observations regarding the new Corridor 8:

- The southern sections of this route, between Westgate and Tarlton, have no highly sensitive areas from an avifaunal perspective
- Certain of the sections between Tarlton and Kromdraai are not preferred. In particular the section corresponding to the original Corridor 4 and the new section on the farm Sterkfontein are not preferred as these areas are relatively open and free of existing infrastructure. New power lines would therefore have a significant impact on the avifauna.

In order to simplify the above recommendations, given the numerous available corridors, the following Figure 5 is provided to show the overall preferred corridor, corridors that are acceptable but not preferred, and corridors that should definitely not be used.

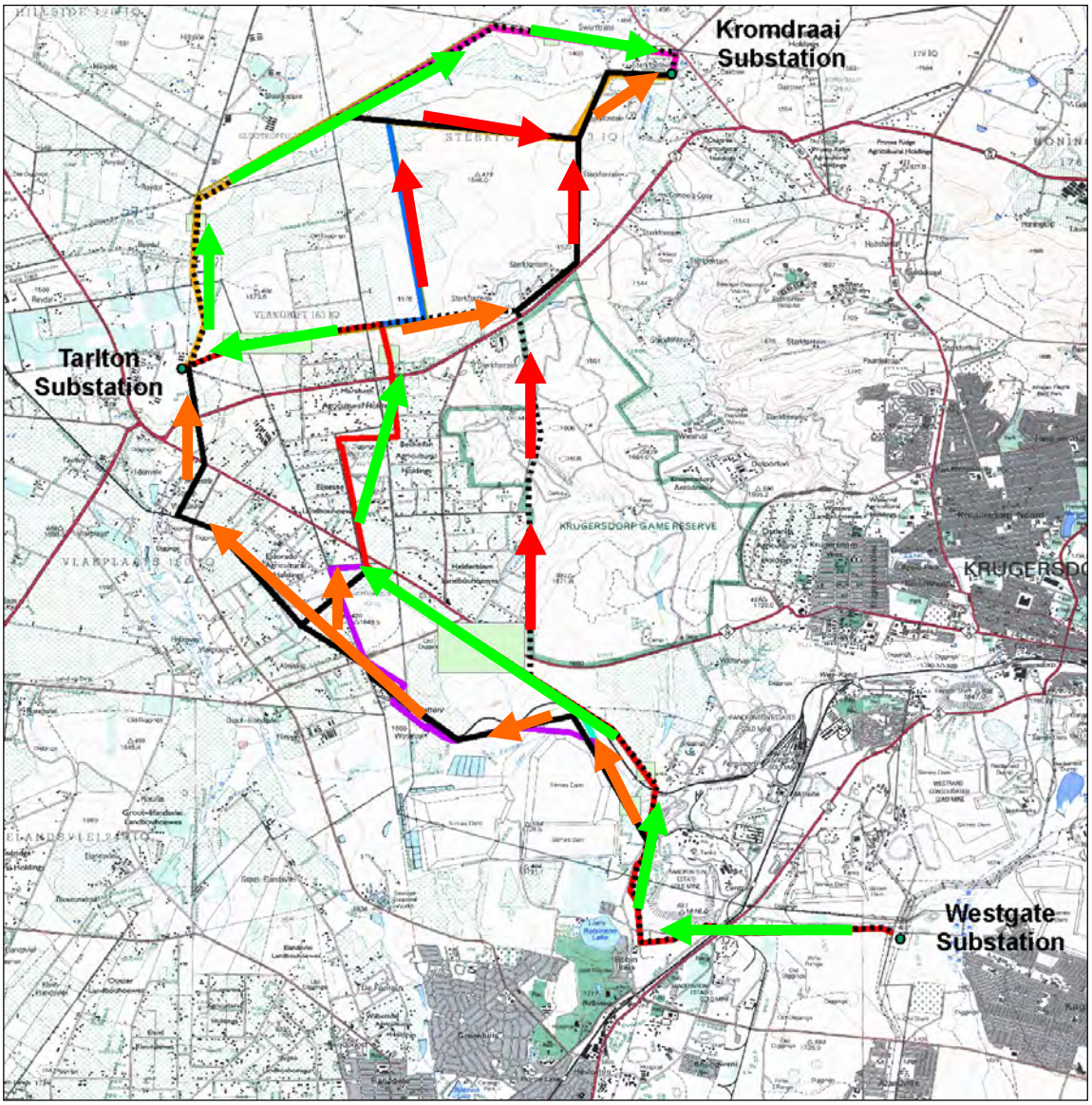

Figure 5. Consolidated view of the preference of the various corridors for Westgate Tarlton Kromdraai. The preferred route is shown with green arrows, the acceptable routes are shown in orange arrows, and the non preferred routes in red arrows.

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