# BIRD IMPACT ASSESSMENT REPORT

SEKGAME 132kV POWER LINES

**October 2016**


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## PROFESSIONAL EXPERIENCE

**Chris van Rooyen**

Chris has 20 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-EWT Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in numerous power line and wind generation projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is currently (2016) accepted as the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

## DECLARATION OF INDEPENDENCE

I, Chris van Rooyen as duly authorised representative of Chris van Rooyen Consulting, and working under the supervision of and in association with Albert Froneman (SACNASP Zoological Science Registration number 400177/09) as stipulated by the Natural Scientific Professions Act 27 of 2003, hereby confirm my independence (as well as that of Chris van Rooyen Consulting) as a specialist and declare that neither I nor Chris van Rooyen Consulting have any interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which Landscape Dynamics Environmental Consultants was appointed as environmental assessment practitioner in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), other than fair remuneration for worked performed, specifically in connection with the Environmental Impact Assessment for the proposed Sekgwane - Bulkop 132kV power line and associated infrastructure.

Full Name: Chris van Rooyen
Title / Position: Director

# EXECUTIVE SUMMARY

Landscape Dynamics Environmental Consultants (Landscape Dynamics) has been appointed by Eskom to undertake an Environmental Impact Assessment for the proposed Sekgame 132kV power lines development.

The project involves the construction of two new 132kV power lines:

- A ±6km 132kV power line from the new Sekgame Switching Station to the existing Bulkop/Ferrum 132kV line
- A ±6km 132kV power line from the new Sekgame Switching Station to the existing Ferrum/Sishen 132kV line.

It furthermore entails the decommissioning of two existing power lines:

- A section of the existing 132kV Bulkop-Ferrum powerline line as well as a section of the existing Ferrum-Sishen power line will be decommissioned. The lines to be decommissioned run from the Ferrum Substation up to the connection point of the new lines as proposed with the existing Bulkop-Ferrum and Ferrum-Sishen lines.

Above-mentioned lines will be constructed adjacent to each other. This project is located near Kathu in the Northern Cape Province.

In general, the habitat through which the proposed Sekgame 132kV alignments run is low to moderately sensitive from a potential bird impact perspective. The natural habitat is moderately to heavily disturbed woodland and is likely to attract a very limited number of Red Data power line sensitive species. Anthropogenic impacts such as mining activities and the presence of a major provincial road has had a negative impact on avifaunal diversity and abundance in the study area, which is reflected in the low reporting rates for power line sensitive Red Data species. The construction of the proposed power lines will result in various, but very limited potential impacts on the birds occurring near the new infrastructure. The proposed power line poses a **very low** collision risk which will not require the application of mitigation measures. The electrocution risk is assessed as **low**, due to the proposed structure type, and can be reduced to **very low** with appropriate mitigation. The habitat transformation and disturbance associated with the construction of the proposed Sekgame power lines and de-commissioning of the existing 132kV Bulkop-Ferrum and 132kV Ferrum-Sishen should have a **low** impact, which could be reduced to **very low** with appropriate mitigation.

The four proposed Sekgame powerline alternatives are very similar in terms of envisaged impacts on avifauna, as they are located very closely together on both sides of the N14 road in similar habitat, namely moderately to heavily disturbed woodland. No preferred alternative can therefore be identified, as all four alternatives are acceptable options from a bird impact perspective

The project can proceed subject to the implementation of the following recommendations:

- An avifaunal walk through of the final power line route should be conducted prior to construction, to identify any Red Data species that may be breeding on the site or within the immediate surrounds and to ensure that any impacts likely to affect Red Data breeding species (if any) are adequately managed.
- An avifaunal walk-through should likewise be conducted for the sections of the existing 132kV Bulkop-Ferrum and 132kV Ferrum-Sishen powerlines which are to be dismantled, to identify any Red Data species that may be breeding on the site or within the immediate surrounds and to ensure that any impacts likely to affect Red Data breeding species (if any) are adequately managed.
- The correct bird-friendly pole structure must be utilized to avoid electrocution (APPENDIX 2).

- In addition to this, the normal suite of environmental good practices should be applied, such as ensuring strict control of staff, vehicles and machinery on site and limiting the creation of new roads as far as possible.

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# 1 INTRODUCTION

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This project is located near Kathu in the Northern Cape Province.

Landscape Dynamics has appointed Chris van Rooyen Consulting to compile a specialist avifaunal assessment report (based on a desktop review and a one-day site visit, conducted on 19 September 2016) detailing the sensitive bird habitats within the study area and the potential bird related impacts associated with the proposed new sub-transmission line and associated infrastructure.

See Figures 1 and 2 below for maps showing the location of the project and the proposed route alignment.

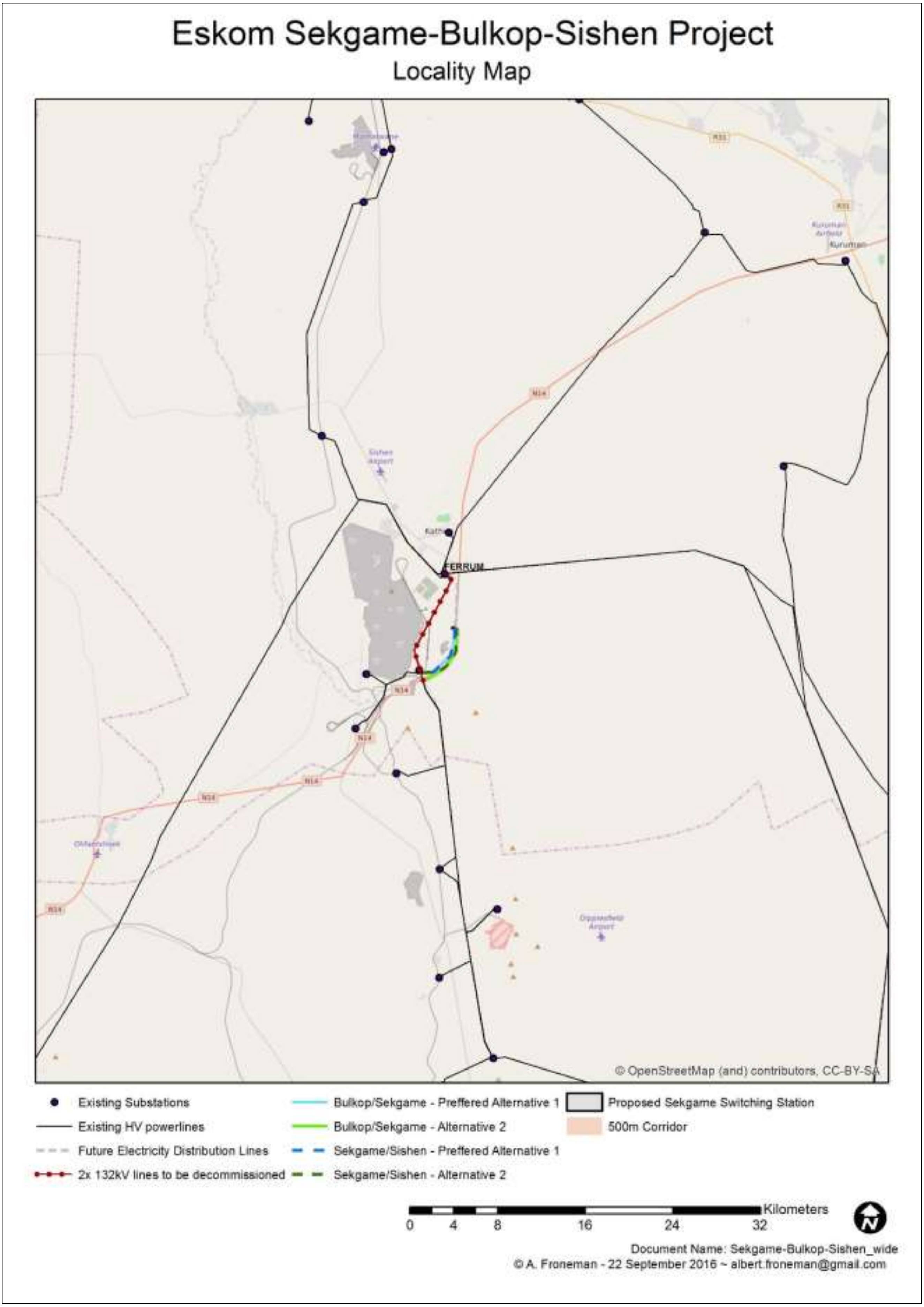


**Figure 1:** Regional map showing the approximate location of the study area

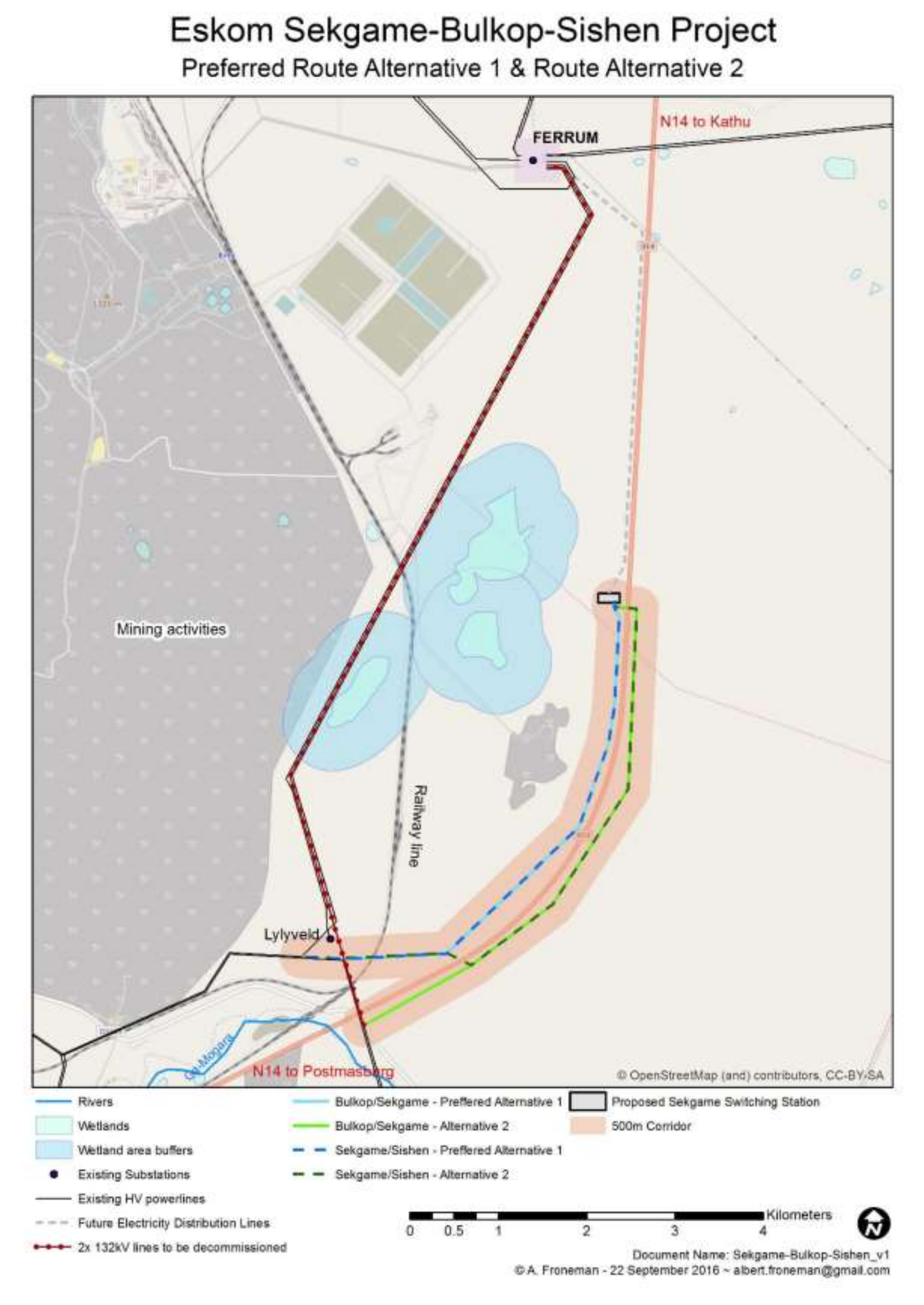


**Figure 2:** Close-up view of the study area and proposed alignments.

# 2 BACKGROUND AND BRIEF

The terms of reference for this bird impact assessment study are as follows:

- Describe the affected environment;
- Indicate how birdlife will be affected;
- Discuss gaps in baseline data;
- Data and assess the expected impacts; and
- Provide recommendations for mitigating measures.

# 3 STUDY APPROACH

## 3.1 Sources of information

The study made use of the following data sources:

- Bird distribution data of the South African Bird Atlas 2 (SABAP2) was obtained from the Animal Demography Unit of the University of Cape Town, to ascertain which species occur within the broader area i.e. within a block consisting of nine pentad grid cells within which the study area is situated. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. Between 2007 and 2016, a total of 42 full protocol cards (i.e. 42 bird surveys lasting a minimum of two hours each, or longer) have been completed for the study area and its immediate surrounds (see Figure 3 below).
- The Important Bird Areas project data was consulted to get an overview of potential important bird areas (IBAs) and species diversity in the study area (Marnewick *et al*. 2015).
- The power line bird mortality incident database of the Endangered Wildlife Trust (1996 to 2007) was consulted to determine which of the species potentially occurring in the study area are typically impacted upon by power lines (Jenkins *et al.* 2010).
- Data on vegetation types in the study area was obtained from the Vegetation Map of South Africa, (Mucina & Rutherford 2006).
- The conservation status of all species considered likely to occur in the area was determined as per the most recent iteration of the South African Red Data for birds (Taylor *et al.* 2015), and the most recent and comprehensive summary of southern African bird biology (Hockey *et al.* 2005).
- Personal observations, especially experience from other projects which the author worked on in the Northern Cape Province since 1996, have also been used to supplement the data that is available from SABAP2, and has been used extensively in forming a professional opinion of likely bird/habitat associations.
- A field visit to the study area was conducted on 19 September 2016 to form a first-hand impression of the micro-habitat on site. This information, together with the SABAP2 data was used to compile a comprehensive dataset of species that could occur in the study area.


**Figure 3:** The SABAP2 pentads within which the study area is located.

### 3.2 Limitations & assumptions

This study made the following assumptions:

- The SABAP2 data is regarded as a comprehensive record of the avifauna due to the substantial number of full protocol data cards (n = 42) which have been completed to date for the area.
- Assessments 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; therefore, professional judgment played an important role in this assessment. It should also be noted that the impact of power lines on birds has been well researched with a robust body of published research stretching over thirty years.

## 4. STUDY AREA

### 4.1 Important Bird Areas

The study area does not overlap with any Important Bird Areas (IBAs). The closest IBA is the Spitskop Dam IBA (SA 028) which is located 160km to the east of the study area (Marnewick *et al.* 2015). The proposed development should therefore not have any direct impact on the Spitskop Dam IBA or the species that it supports.

### 4.2 Primary vegetation divisions (biomes)

The study area extends over a single primary vegetation division, namely savanna (woodland) (Mucina & Rutherford 2006). It is generally accepted that vegetation structure, rather than the actual plant species, influences bird species distribution and abundance (Harrison *et al.* 1997). From an avifaunal perspective, the Atlas of southern African Birds (SABAP1) recognises six primary vegetation divisions or biomes within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison *et al.* 1997). These vegetation descriptions do not focus on lists of plant species, but rather on factors which are relevant to bird distribution. The criteria used by the SABAP1 authors to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations.

### 4.3 Description of bird habitat classes

The following bird habitat classes were recorded in the study area (vegetation descriptions based largely on Harrison *et al.* 1997 and Mucina & Rutherford 2006):

#### *4.3.1 Savanna*

The study area is situated in the savanna biome and the natural woodland consists of mainly of Kathu Bushveld (Muchina & Rutherford 2006). Kathu Bushveld is characterised by medium-tall tree layer with *Acacia erioloba* in places, but mostly open and including *Boscia albitrunca* as the prominent trees. The shrub layer is generally most important with, for example, *A. mellifera*, *Diospyros lycioides* and *Lycium hirsutum*. The grass layer is variable in cover. The study area receives summer and autumn rainfall with very dry winters. Mean annual precipitation is about 220–380 mm with frequent frost in winter. Mean monthly maximum and minimum temperatures for Sishen is 37.0°C and –2.2°C for December and July, respectively (Muchina & Rutherford 2006).

The natural woodland in the study area has been disturbed, and in some places completely eradicated by mining operations and associated infrastructure (roads, pipelines and utility lines). The area east of the N14 is less transformed. The remaining woodland areas are utilised for live-stock grazing and game farming.

SABAP2 reporting rates for large power line sensitive Red Data avifauna potentially occurring in woodland habitat in the study area are very low (see Table 4-1). Many species which would be expected to occur in undisturbed woodland of this nature, especially large raptors, is entirely absent from the SABAP2 dataset, indicating that human activity has impacted on the habitat and that levels of disturbance are high. Red Data species that could potentially be found in this habitat in the study area are Lanner Falcon, Martial Eagle, Kori Bustard, Ludwig's Bustard, White-backed Vulture and Secretarybird.

#### *4.3.2 Rivers*

The study area contains one ephemeral river, the Gamagara River. Drainage lines are important habitat for birds in that they act as corridors of microhabitat for waterbirds and woodland species. Ephemeral rivers generally only flow for short periods in the rainy season, but pools of water can persist for many months and aquatic organisms that occur in those pools could provide potential sources of food for various species. The pools in the Gamagara River could attract Red Data Black Stork and Abdim's Stork as well as many other non-threatened waterbirds, and the surrounding riverine woodland, which often contain some of the last remaining large trees, could support many non-Red Data woodland species. Raptors and vultures, including Martial Eagle and White-backed Vulture could also use the pools in the river for drinking and bathing.

#### *4.3.3 Pans*

A feature of the arid landscape where the proposed site is located is the presence of pans. Pans are endorheic wetlands having closed drainage systems; water usually flows in from small catchments but with no outflow from the pan basins themselves. They are typical of poorly drained, relatively flat and dry regions. Water loss is mainly through evaporation, sometimes resulting in saline conditions, especially in the most arid regions. Water depth is shallow (<3m), and flooding characteristically ephemeral (Harrison et al. 1997). The study area contains three large pans (see Figure 2). When these pans hold water (which is only likely after exceptional rainfall events), waterbird movement between these pans is possible, including Greater Flamingo and Lesser Flamingo. The pans, when full, could also attract Red Data waterbirds such as Black Stork, Maccoa Duck, and Abdim's Stork, as well as Martial Eagle and White-backed Vulture who could use it for drinking and bathing. When the pans are dry, they are covered with grass. During these periods the pans could be attractive to Kori Bustard, Ludwig's Bustard, Burchell's Courser, Secretarybird and Black Harrier.

See APPENDIX 1 for a photographic record of the bird habitats in the study area.

### 4.4 Power line sensitive species occurring in the study area

A total of fourteen Red Data species could potentially occur in the study area (Table 4-1). For each species, the potential for occurring in a specific habitat class is indicated, as well as the type of impact on the species that could potentially be inflicted by the proposed powerlines as currently aligned. The probability of the impact occurring is discussed in Section 6.

**Table 4-1: Red Data species that could potentially occur in the study area.**

CR = Critically endangered EN = Endangered VU = Vulnerable NT = Near-threatened

| Name | Conservation status (Taylor *et al.*, 2015) | Consolidated SABAP2 reporting rate in the 9 pentads % | Rivers | Pans | Savanna | Collisions | Electrocutions | Displacement through disturbance | Displacement through habitat destruction |
|---|---|---|---|---|---|---|---|---|---|
| Duck, Maccoa *Oxyura maccoa* | NT | 0 | - | x | - | - | - | - | - |
| Eagle, Martial *Polemaetus bellicosus* | EN | 2.38 | x | x | x | x | - | - | - |
| Falcon, Lanner *Falco biarmicus* | VU | 0 | - | x | x | x | - | - | - |
| Harrier, Black *Circus maurus* | EN | 0 | - | x | x | x | - | - | - |
| Bustard, Kori *Ardeotis kori* | NT | 0 | x | x | x | x | - | - | - |

| Name | Conservation status (Taylor *et al.*, 2015) | Consolidated SABAP2 reporting rate in the 9 pentads % | Rivers | Pans | Savanna | Collisions | Electrocutions | Displacement through disturbance | Displacement through habitat destruction |
|---|---|---|---|---|---|---|---|---|---|
| Secretarybird *Sagittarius serpentarius* | VU | 0 | - | x | x | x | - | - | - |
| Stork, Abdim's *Ciconia abdimii* | NT | 2.38 | x | x | x | x | - | - | - |
| Courser, Burchell's *Cursorius rufus* | VU | 0 | - | x | - | - | - | - | - |
| Stork, Black *Ciconia nigra* | VU | 2.38 | x | x | - | - | - | - | - |

| Name | Conservation status (Taylor *et al.* 2015) | Consolidated SABAP2 reporting rate in the 9 pentads % | Rivers | Pans | Savanna | Collisions | Electrocutions | Displacement through disturbance | Displacement through habitat destruction |
|---|---|---|---|---|---|---|---|---|---|
| Flamingo, Greater *Phoenicopterus ruber* | NT | 0 | - | x | - | - | - | - | - |
| Flamingo, Lesser *Phoeniconaias minor* | NT | 0 | - | x | - | - | - | - | - |
| Vulture, White-backed *Gyps africanus* | CR | 0 | - | x | x | x | - | - | - |
| Bustard, Ludwig's *Neotis ludwigii* | EN | 0 | - | x | x | x | - | - | - |

## 5. DESCRIPTION OF EXPECTED IMPACTS

Because of their 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 and Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs and Ledger 1986a; Hobbs and Ledger 1986b; Ledger, Hobbs and Smith, 1992; Verdoorn 1996; Kruger and Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000; Anderson 2001; Shaw 2013).

### 5.1 Electrocutions

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 electrocution risk is largely determined by the pole/tower design. The tower design that has been proposed for this project is the steel monopole (see APPENDIX 2).

Clearance between phases on the same side of the 132kV pole structure is approximately 2.2m for this type of design, and the clearance on strain structures is 1.8m. The length of the stand-off insulators is approximately 1.6m. This clearance should be sufficient to reduce the risk of phase – phase electrocutions of birds on the towers to negligible for all species except vultures. If vultures attempt to perch on the stand-off insulators, they are potentially able to touch both the conductor and the earthed pole simultaneously potentially resulting in a phase – earth electrocution. This is particularly likely when more than one bird attempts to sit on the same pole, which may happen with vultures. Vultures are unlikely to occur regularly within the study area, but sporadic occurrence cannot be ruled out. The only envisaged high risk scenario would be when a carcass becomes available within a few hundred metres of the line, attracting White-backed Vultures which may cluster on a few poles. This is likely to be a very rare event in the study area. Furthermore, there are several other higher high voltage lines in the study area which offers a more attractive perching and roosting substrate, due to their height and design.

In summary, it is concluded that the risk of electrocution posed to avifauna by the steel monopole design is likely to be very limited and restricted to vultures, but it cannot be ruled out entirely.

### 5.2 Collisions

Collisions are probably the biggest single threat posed by transmission lines to birds in southern Africa (van Rooyen 2004; Shaw 2013). 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; Shaw 2013).

In a recent PhD study, Shaw (2013) provides a concise summary of the phenomenon of avian collisions with power lines:

"The collision risk posed by power lines is complex and problems are often localised. While any bird flying near a power line is at risk of collision, this risk varies greatly between different groups of birds, and depends on the interplay of a wide range of factors (APLIC 1994). Bevanger (1994) described these factors in four main groups – biological, topographical, meteorological and technical. Birds at highest risk are those that are both susceptible to collisions and frequently exposed to power lines, with waterbirds, gamebirds, rails, cranes and bustards usually the most numerous reported victims (Bevanger 1998, Rubolini *et al*. 2005, Jenkins *et al*. 2010).

The proliferation of man-made structures in the landscape is relatively recent, and birds are not evolved to avoid them. Body size and morphology are key predictive factors of collision risk, with large-bodied birds with high wing loadings (the ratio of body weight to wing area) most at risk (Bevanger 1998, Janss 2000). These birds must fly fast to remain airborne, and do not have sufficient manoeuvrability to avoid unexpected obstacles. Vision is another key biological factor, with many collision-prone birds principally using lateral vision to navigate in flight, when it is the low-resolution and often restricted, forward vision that is useful to detect obstacles (Martin & Shaw 2010, Martin 2011, Martin *et al*. 2012). Behaviour is important, with birds flying in flocks, at low levels and in crepuscular or nocturnal conditions at higher risk of collision (Bevanger 1994). Experience affects risk, with migratory and nomadic species that spend much of their time in unfamiliar locations also expected to collide more often (Anderson 1978, Anderson 2002). Juvenile birds have often been reported as being more collision-prone than adults (e.g. Brown *et al.* 1987, Henderson *et al.* 1996).

Topography and weather conditions affect how birds use the landscape. Power lines in sensitive bird areas (e.g. those that separate feeding and roosting areas, or cross flyways) can be very dangerous (APLIC 1994, Bevanger 1994). Lines crossing the prevailing wind conditions can pose a problem for large birds that use the wind to aid take-off and landing (Bevanger 1994). Inclement weather can disorient birds and reduce their flight altitude, and strong winds can result in birds colliding with power lines that they can see but do not have enough flight control to avoid (Brown *et al*. 1987, APLIC 1994).

The technical aspects of power line design and siting also play a big part in collision risk. Grouping similar power lines on a common servitude, or locating them along other features such as tree lines, are both approaches thought to reduce risk (Bevanger 1994). In general, low lines with short span lengths (i.e. the distance between two adjacent pylons) and flat conductor configurations are thought to be the least dangerous (Bevanger 1994, Jenkins *et al.* 2010). On many higher voltage lines, there is a thin earth (or ground) wire above the conductors, protecting the system from lightning strikes. Earth wires are widely accepted to cause most collisions on power lines with this configuration because they are difficult to see, and birds flaring to avoid hitting the conductors often put themselves directly in the path of these wires (Brown *et al.* 1987, Faanes 1987, Bevanger 1994)."

As mentioned by Shaw (2013) in the extract above, several factors are thought to influence avian collisions, including the manoeuvrability of the bird, topography, weather conditions and power line configuration. An important additional factor that previously has received little attention is the visual capacity of birds; i.e. whether they can see obstacles such as power lines, and whether they are looking ahead to see obstacles with enough time to avoid a collision. In addition to helping explain the susceptibility of some species to collision, this factor is essential to planning effective mitigation measures. Recent research provides the first evidence that birds can render themselves blind in the direction of travel during flight through voluntary head movements (Martin & Shaw 2010). Visual fields were determined in three bird species representative of families known to be subject to high levels of mortality associated with power lines i.e. Kori Bustards, Blue Cranes and White Storks. In all species the frontal visual fields showed narrow and vertically long binocular fields typical of birds that take food items directly in the bill under visual guidance. However, these species differed markedly in the vertical extent of their binocular fields and in the extent of the blind areas which project above and below the binocular fields in the forward-facing hemisphere. The importance of these blind areas is that when in flight, head movements in the vertical plane (pitching the head to look downwards) will render the bird blind in the direction of travel. Such movements may frequently occur when birds are scanning below them (for foraging or roost sites, or for conspecifics). In bustards and cranes pitch movements of only 25° and 35° respectively are sufficient to render the birds blind in the direction of travel; in storks head movements of 55° are necessary. That flying birds can render themselves blind in the direction of travel has not been previously recognised and has important implications for the effective mitigation of collisions with human artefacts including wind turbines and power lines. These findings have applicability to species outside of these families especially raptors (*Accipitridae*) which are known to have small binocular fields and large blind areas similar to those of bustards and cranes, and are also known to be vulnerable to power line collisions.

Thus, visual field topographies which have evolved primarily to meet visual challenges associated with foraging may render certain bird species particularly vulnerable to collisions with human artefacts, such as power lines and wind turbines that extend into the otherwise open airspace above their preferred habitats. For these species placing devices upon power lines to render them more visible may have limited success since no matter what the device the birds may not see them. It may be that in certain situations it may be necessary to distract birds away from the obstacles, or encourage them to land nearby (for example using decoy models of conspecifics, or the provision of sites attractive for roosting) since increased marking of the obstacle cannot be guaranteed to render it visible if the visual field configuration prevents it being detected. Perhaps most importantly, the results indicate that collision mitigation may need to vary substantially for different collision prone species, taking account of species specific behaviours, habitat and foraging preferences, since an effective all-purpose marking device is probably not realistic if some birds do not see the obstacle at all (Martin & Shaw 2010).

Despite speculation that line marking might be ineffective for some species due to differences in visual fields and behaviour, or have only a small reduction in mortality in certain situations for certain species, particularly bustards (Martin & Shaw 2010; Barrientos *et al.* 2012; Shaw 2013), it is generally accepted that marking a line with PVC spiral type Bird Flight Diverters (BFDs) can reduce the collision mortality rates (Sporer *et al.* 2013; Barrientos *et al.* 2012, Alonso & Alonso 1999; Koops & De Jong 1982). Regardless of statistical significance, a slight mortality reduction may be very biologically relevant in areas, species or populations of high conservation concern (e.g. Ludwig's Bustard) (Barrientos *et al.* 2012). Beaulaurier (1981) summarised the results of 17 studies that involved the marking of earth wires and found an average reduction in mortality of 45%. A recent study reviewed the results of 15 wire marking experiments in which transmission or distribution wires were marked to examine the effectiveness of flight diverters in reducing bird mortality. The presence of flight diverters was associated with a decrease in bird collisions. At unmarked lines, there were 0.21 deaths/1000 birds (n = 339,830) that flew among lines or over lines. At marked lines, the mortality rate was 78% lower (n = 1,060,746) (Barrientos *et al.* 2011). Koops and De Jong (1982) found that the spacing of the BFDs was critical in reducing the mortality rates - mortality rates are reduced up to 86% with a spacing of 5 metres, whereas using the same devices at 10 metre intervals only reduces the mortality by 57%. Line markers should be as large as possible, and highly contrasting with the background. Colour is probably less important, as during the day the background will be brighter than the obstacle with the reverse true at lower light levels (e.g. at twilight, or during overcast conditions). Black and white interspersed patterns are likely to maximise the probability of detection (Martin *et al.* 2010).

A potential impact of the proposed 132kV sub-transmission lines is collisions with the earth wire of the proposed lines. Quantifying this impact in terms of the likely number of birds that will be impacted, is very difficult because such a huge number of variables play a role in determining the risk, for example weather, rainfall, wind, age, flocking behaviour, power line height, light conditions, topography, population density and so forth. However, from incidental record keeping by the Endangered Wildlife Trust, it is possible to give a measure of what species are likely to be impacted upon (see Figure 4 below - Jenkins *et al.* 2010). This only gives a measure of the general susceptibility of the species to power line collisions, and not an absolute measurement for any specific line.

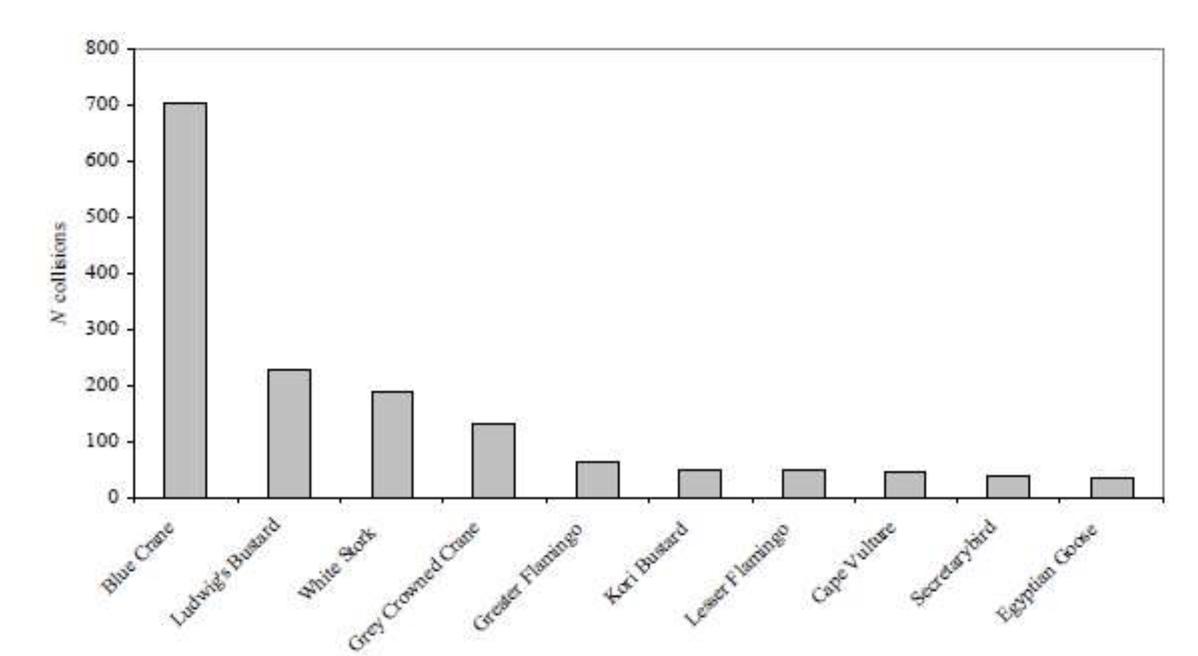


**Figure 4:** The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/EWT Strategic Partnership central incident register 1996 - 2008 (Jenkins *et al.* 2010)

See table 4-1 for potential candidates for collision mortality in the woodland habitat on the proposed power line. Collisions are likely to be few and far between, as there are no specific areas where one would expect a concentration of birds in the woodland habitat. Vultures would be most at risk of collision if they descend to a carcass near the line. This is not likely to be a regular event, given the fact that the occurrence of vultures is likely to be the exception rather than the rule. Furthermore, all the alignments are situated next to a busy road, which acts as a natural deterrent to Red Data powerline sensitive species.

During periods when the pans hold water, several Red Data waterbirds and raptors might potentially be at risk of collisions (see table 4-1). However, none of the potential alignments are running between the pans themselves, which means the risk of waterbirds commuting between the three pans being exposed to potential powerline collisions is eliminated. The closest alignment is approximately 1.4km from the nearest pan, which is a fairly substantial distance, and it is not situated across any obvious flight paths between the three pans.

There is also a potential collision risk associated with the ephemeral Gamagara River where it is expected that waterbirds could commute up and down the drainage line when it is flowing or when it contains large pools of standing water, and raptors and vulture could descend to pools in the river to drink and bath. However, none of the alignments cross the river, therefore this source of collisions is also effectively eliminated.

In summary, the risk of collision posed to Red Data avifauna by the proposed power lines is likely to be of very limited significance.

### 5.3 Displacement due to habitat destruction and disturbance

During the construction phase and maintenance of power lines and associated infrastructure, some habitat destruction and transformation inevitably takes place. Servitudes must be cleared of excess vegetation at regular intervals 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 near the servitude through transformation of habitat, which could result in temporary or permanent displacement.

In the present instance, the risk of displacement of Red Data species due to habitat transformation is likely to be limited given the low reporting rate for Red Data species in the study area. The biggest potential impact would be the removal of large trees that could potentially serve as nesting substrate for large Red Data raptors such as Martial Eagle (and many other non-threatened avifauna), although again it is noted that reporting rates for large raptors are very low, and that the area where the proposed alignments is situated contains very few (if any) suitable trees. Furthermore, the proximity of the busy N14 road and mining operations makes it unlikely that large raptors will breed in the study area. Most remaining large trees in the study area are found in riparian woodland along the Gamagara River, which will not be affected by the powerline. The proposed construction of the new power line should therefore have a very limited habitat transformation impact from an avifaunal perspective.

Apart from direct habitat destruction, the above-mentioned construction and maintenance activities also impact on birds through **disturbance**; this could lead to breeding failure if the disturbance happens during a critical part of the breeding cycle. Construction activities near a nest could be a source of disturbance and could lead to temporary breeding failure or even permanent abandonment of nests[1]. The low reporting rates for Red Data species in the study area are an indication that they are not regularly utilising the area for breeding, for reasons already stated namely, habitat transformation and the fact that all the alignments are situated next to a busy road, which acts as a natural deterrent to Red Data powerline sensitive species. The potential impact of disturbance is therefore likely to be very limited as far as Red Data species are concerned.

# 6 ASSESSMENT OF EXPECTED IMPACTS

## 6.1 Assessment criteria

Impacts are described and then evaluated in terms of the criteria given below.

| Criteria | Rating Scales | Notes |
|---|---|---|
| **Nature** | **Positive** | This is an evaluation of the type of effect the construction, operation and management of the proposed development would have on the affected environment. Would it be positive, negative or neutral? |
| | **Negative** | |
| | **Neutral** | |
| **Extent** | **Footprint** | Site-specific, affects only the development footprint |
| | **Site** | The impact could affect the whole or a significant portion of the site. |
| | **Regional** | The impact could affect the area including the neighbouring farms, the transport routes and adjoining towns or cities. |
| **Duration** | **Short** | The impact will be relevant through to the end of the construction phase. |
| | **Medium** | The impact will last up to the end of the development phases, where after it will be entirely negated. |
| | **Long term** | The impact will continue or last for the entire operational lifetime of the development |

[1] The same principle is valid for the disturbance caused by the dismantling activities when a powerline is de-commissioned.

| Criteria | Rating Scales | Notes |
|---|---|---|
| **Severity** | **Low** | Where the impact affects the environment in such a way that natural, cultural and social functions and processes are minimally affected |
| | **Medium** | Where the affected environment is altered but natural, cultural and social functions and processes continue albeit in a modified way; and valued, important, sensitive or vulnerable systems or communities are negatively affected |
| | **High** | Where natural, cultural or social functions and processes are altered to the extent that the impact will temporarily or permanently cease; and valued, important, sensitive or vulnerable systems or communities are substantially affected. |
| **Potential for impact on irreplaceable resources** | **No** | No irreplaceable resources will be impacted. |
| | **Yes** | Irreplaceable resources will be impacted. |
| **Consequence** | **Extremely detrimental** | A combination of extent, duration, intensity and the potential for impact on irreplaceable resources. |
| | **Highly detrimental** | |
| | **Moderately detrimental** | |
| | **Slightly detrimental** | |
| | **Negligible** | |
| | **Slightly beneficial** | |
| | **Moderately beneficial** | |
| **Probability** | **Improbable** | Improbable. It is highly unlikely or less than 50 % likely that an impact will occur. |
| | **Probable** | Distinct possibility. It is between 50 and 70 % certain that the impact will occur. |
| | **Definite** | Most likely. It is more than 75 % certain that the impact will occur or it is definite that the impact will occur. |
| **Significance** | **Very high - negative** | A function of Consequence and Probability |
| | **High - negative** | |

| Criteria | Rating Scales | Notes |
|---|---|---|
| | **Moderate - negative** | |
| | **Low - negative** | |
| | **Very low** | |
| | **Low - positive** | |
| | **Moderate - positive** | |
| | **High - positive** | |
| | **Very high - positive** | |

- ***Nature:*** This is an evaluation of the type of effect the construction, operation and management of the proposed development would have on the affected environment. Will the impact change in the environment be positive, negative or neutral?

- ***Extent or scale:*** This refers to the spatial scale at which the impact will occur. Extent of the impact is described as: footprint (affecting only the footprint of the development), site (limited to the site) and regional (limited to the immediate surroundings and closest towns to the site).

- ***Duration:*** The lifespan of the impact is indicated as short, medium and long term.

- ***Severity:*** This is a relative evaluation within the context of all the activities and the other impacts within the framework of the project. Does the activity destroy the impacted environment, alter its functioning, or render it slightly altered?

- ***Impact on irreplaceable resources:*** This refers to the potential for an environmental resource to be replaced, should it be impacted. A resource could possibly be replaced by natural processes (e.g. by natural colonisation from surrounding areas), through artificial means (e.g. by reseeding disturbed areas or replanting rescued species) or by providing a substitute resource, in certain cases. In natural systems, providing substitute resources is usually not possible, but in social systems substitutes are often possible (e.g. by constructing new social facilities for those that are lost). Should it not be possible to replace a resource, the resource is essentially irreplaceable e.g. Red Data species that are restricted to a particular site or habitat of very limited extent.

- ***Consequence:*** The consequence of the potential impacts is a summation of above criteria, namely the extent, duration, intensity and impact on irreplaceable resources.

- ***Probability of occurrence:*** The probability of the impact occurring based on professional experience of the specialist with environments of a similar nature to the site and/or with similar projects. It is important to distinguish between probability of the impact occurring and probability that the activity causing a potential impact will occur. Probability is defined as the probability of the impact occurring, not as the probability of the activities that may result in the impact. The fact that an activity will occur does not necessarily imply that an impact will occur. For instance, the fact that a road will be built does not necessarily imply that it will impact on a wetland. If the road is properly routed to avoid the wetland, the impact may not occur at all, or the probability of the impact will be low, even though it is certain that the activity will occur.

- ***Significance:*** Impact significance is defined to be a combination of the consequence (as described below) and probability of the impact occurring. The relationship between consequence and probability highlights that the risk (or impact significance) must be evaluated in terms of the seriousness (consequence) of the impact, weighted by the probability of the impact occurring. The following analogy provides an illustration of the relationship between consequence and probability. The use of a vehicle may result in an accident (an impact) with multiple fatalities, not only for the driver of the vehicle, but also for passengers and other road users. There are certain mitigation measures (e.g. the use of seatbelts, adhering to speed limits, airbags, anti-lock braking, etc.) that may reduce the consequence or probability or both. The probability of the impact is low enough that millions of vehicle users are prepared to accept the risk of driving a vehicle daily. Similarly, the consequence of an aircraft crashing is very high, but the risk is low enough that thousands of passengers happily accept this risk to travel by air daily. In simple terms, if the consequence and probability of an impact is high, then the impact will have a high significance. The significance defines the level to which the impact will influence the proposed development and/or environment. It determines whether mitigation measures need to be identified and implemented and whether the impact is important for decision-making.

- ***Degree of confidence in predictions:*** The specialist must provide an indication of the degree of confidence (low, medium or high) that there is in the predictions made for each impact, based on the available information and their level of knowledge and expertise. Degree of confidence is not considered in the determination of consequence or probability.

- ***Mitigation measures:*** Mitigation measures are designed to reduce the consequence or probability of an impact, or to reduce both consequence and probability. The significance of impacts has been assessed both with mitigation and without mitigation.

## 6.2 Assessment tables

The assessment of each impact is discussed and presented in tabular format as shown below for both “pre” and “post” mitigation. The different phases (Construction, Operation, and Decommissioning) are treated separately:

### *6.2.1 Construction phase*

| ***Impact*** | *Nature* | *Extent* | *Duration* | *Severity* | *Impact on Irreplaceable Resources* | *Consequence* | *Probability* | *Significance* | *Confidence* |
|---|---|---|---|---|---|---|---|---|---|
| **Impact: Displacement of Red Data species due to habitat destruction and disturbance associated with the construction of the power lines** | | | | | | | | | |
| Impact Description: Displacement of Red Data species may occur during the construction phase of the power lines, and may be caused by the noise and movement associated with the construction activities. | | | | | | | | | |
| Without Mitigation | Negative | Site | Short | Medium | No | Slightly detrimental | Probable | Low - negative | High |
| Mitigation Description:<br>• Construction activity should be restricted to the immediate footprint of the infrastructure.<br>• Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of Red Data species.<br>• Measures to control noise should be applied per current best practice in the industry.<br>• Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.<br>• The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned. | | | | | | | | | |

- The final powerline alignment must be inspected on foot by the avifaunal specialist prior to construction to ascertain if any Red Data species nests are present. All relevant detail must be recorded i.e. species, coordinates and nest status. Should any nests be recorded, it would require management of the potential impacts on the breeding birds once construction commences, which would necessitate the involvement of the avifaunal specialist and the Environmental Control Officer. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a construction schedule which will enable him/her to ascertain when and where such breeding Red Data species could be impacted by the construction activities. This could then be addressed through the timing of construction activities during critical periods of the breeding cycle, once it has been established that a nest is active.

| ***Impact*** | *Nature* | *Extent* | *Duration* | *Severity* | *Impact on Irreplaceable Resources* | *Consequence* | *Probability* | *Significance* | *Confidence* |
|---|---|---|---|---|---|---|---|---|---|
| With Mitigation | Negative | Site | Short | Low | No | Negligible | Improbable | Very low - Negative | High |

Cumulative Impact:

Although each power line probably affects a relatively small proportion of the landscape, there are already several existing activities and infrastructure in this area that has resulted in significant habitat transformation, and additional infrastructure in the form of power lines and substations will add further cumulative impact. It is important therefore to try to limit the effects of the new power lines as much as possible, by applying the mitigations described above.

### *6.2.2 Operational phase*

| ***Impact*** | *Nature* | *Extent* | *Duration* | *Severity* | *Impact on Irreplaceable Resources* | *Consequence* | *Probability* | *Significance* | *Confidence* |
|---|---|---|---|---|---|---|---|---|---|
| **Impact: Electrocution of Red Data species on the 132kV lines** | | | | | | | | | |
| Impact Description: Electrocution of Red Data species on the steel monopole structure. | | | | | | | | | |
| Without Mitigation | Negative | Regional | Long term | Low | Yes | Slightly detrimental | Improbable | Low-negative | High |
| Mitigation Description: An Eskom approved bird friendly pole design must be used (APPENDIX 2). The Distribution Technical Bulletin must be used in this regard. In addition, if a monopole structure is used, as this report has assumed, a Bird Perch must be installed on top of all poles, to provide safe perching substrate for birds well above the dangerous hardware. | | | | | | | | | |
| ***Impact*** | *Nature* | *Extent* | *Duration* | *Severity* | *Impact on Irreplaceable Resources* | *Consequence* | *Probability* | *Significance* | *Confidence* |
| With Mitigation | Negative | Regional | Long term | Low | No | Negligible | Improbable | Very Low-Negative | High |

Cumulative Impact:

The cumulative impacts of power lines on birds through electrocution are significant nationally. No effort should be spared to ensure that the new power lines are built bird friendly and results in no additional impact on birds in the area. Due to the low risk of electrocution, the envisaged cumulative impact is also likely to be low.

| *Impact* | *Nature* | *Extent* | *Duration* | *Severity* | *Impact on Irreplaceable Resources* | *Consequence* | *Probability* | *Significance* | *Confidence* |
|---|---|---|---|---|---|---|---|---|---|
| **Impact: Collision of Red Data species with the earthwire of the 132kV lines** | | | | | | | | | |
| Impact Description: Red Data species mortality due to collisions with the earthwire of the power lines. | | | | | | | | | |
| Without Mitigation | Negative | Regional | Long term | Low | Yes | Slightly detrimental | Improbable | Very low-negative | High |
| Mitigation: Due to the very low collision risk posed by the powerlines to powerline sensitive Red Data species, no mitigation is required specifically for potential collision mortality. | | | | | | | | | |
| *Impact* | *Nature* | *Extent* | *Duration* | *Severity* | *Impact on Irreplaceable Resources* | *Consequence* | *Probability* | *Significance* | *Confidence* |
| Not applicable | Negative | Regional | Long term | Low | Yes | Slightly detrimental | Improbable | Very low-negative | High |

Cumulative Impact:

The cumulative impacts of power lines on birds through collision are significant nationally. However, the low reporting rates for Red Data species in the study area indicates that the collision impact of existing powerlines in the study area is likely to be low to start with, due to the location of the study area. The cumulative impact of collisions on the proposed line is therefore regarded to be negligible.

### *6.2.3 De-commissioning phase*

| *Impact* | *Nature* | *Extent* | *Duration* | *Severity* | *Impact on Irreplaceable Resources* | *Consequence* | *Probability* | *Significance* | *Confidence* |
|---|---|---|---|---|---|---|---|---|---|
| **Impact: Displacement of Red Data species due to disturbance associated with the decommissioning of the existing 132kV Bulkop-Ferrum and 132kV Ferrum-Sishen** | | | | | | | | | |

Impact Description:

Displacement of Red Data species may occur during the decommissioning of the existing Bulkop – Ferrum and Ferrum – Sishen 132kV lines and may be caused by the noise and movement associated with the dismantling activities.

<table>
<tr><td>Without Mitigation</td><td>Negative</td><td>Site</td><td>Short</td><td>Low</td><td>No</td><td>Slightly detrimental</td><td>Improbable</td><td>Low - negative</td><td>High</td></tr>
<tr><td colspan="10">
<ul>
<li>Decommissioning activity should be restricted to the immediate footprint of the infrastructure.</li>
<li>Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of Red Data species.</li>
<li>Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.</li>
<li>The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as rehabilitation of disturbed areas is concerned.</li>
<li>The powerlines must be inspected on foot by the avifaunal specialist prior to dismantling to ascertain if any Red Data species nests are present. All relevant detail must be recorded i.e. species, coordinates and nest status. Should any nests be recorded, it would require management of the potential impacts on the breeding birds once dismantling commences. An effective communication strategy should be implemented whereby the avifaunal specialist is provided with a dismantling schedule which will enable him/her to ascertain when and where such breeding Red Data species could be impacted by the dismantling activities. This could then be addressed through the timing of dismantling activities during critical periods of the breeding cycle, once it has been established that a nest is active.</li>
</ul>
</td></tr>
<tr><td>With Mitigation</td><td>Negative</td><td>Site</td><td>Short</td><td>Low</td><td>No</td><td>Negligible</td><td>Improbable</td><td>Very Low - Negative</td><td>High</td></tr>
<tr><td colspan="10">Cumulative Impact: Very low</td></tr>
</table>

## 7 SELECTION OF PREFERRED ALTERNATIVE

The four proposed Sekgame powerline alternatives are very similar in terms of envisaged impacts on avifauna, as they are located very closely together on both sides of the N14 road in similar habitat, namely moderately to heavily disturbed woodland. No preferred alternative can therefore be identified, as all four alternatives are acceptable options from a bird impact perspective.

## 8 CONCLUSIONS

In general, the habitat through which the proposed Sekgame 132kV alignments run is low to moderately sensitive from a potential bird impact perspective. The natural habitat is moderately to heavily disturbed woodland and is likely to attract a very limited number of Red Data power line sensitive species. Anthropogenic impacts such as mining activities and the presence of a major provincial road has had a negative impact on avifaunal diversity and abundance in the study area, which is reflected in the low reporting rates for power line sensitive Red Data species. The construction of the proposed power lines will result in various, but very limited potential impacts on the birds occurring near the new infrastructure. The proposed power line poses a **very low** collision risk which will not require the application of mitigation measures. The electrocution risk is assessed as **low**, due to the proposed structure type, and can be reduced to **very low** with appropriate mitigation. The habitat transformation and disturbance associated with the construction of the proposed Sekgame power lines and de-commissioning of the existing 132kV Bulkop-Ferrum and 132kV Ferrum-Sishen should have a **low** impact, which could be reduced to **very low** with appropriate mitigation.

The project can proceed subject to the implementation of the following recommendations:

- An avifaunal walk through of the final power line route should be conducted prior to construction, to identify any Red Data species that may be breeding on the site or within the immediate surrounds and to ensure that any impacts likely to affect Red Data breeding species (if any) are adequately managed.
- An avifaunal walk-through should likewise be conducted for the sections of the existing 132kV Bulkop-Ferrum and 132kV Ferrum-Sishen powerlines which are to be dismantled, to identify any Red Data species that may be breeding on the site or within the immediate surrounds and to ensure that any impacts likely to affect Red Data breeding species (if any) are adequately managed.
- The correct bird-friendly pole structure must be utilized to avoid electrocution (APPENDIX 2).
- In addition to this, the normal suite of environmental good practices should be applied, such as ensuring strict control of staff, vehicles and machinery on site and limiting the creation of new roads as far as possible.

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**APPENDIX 1: BIRD HABITATS**

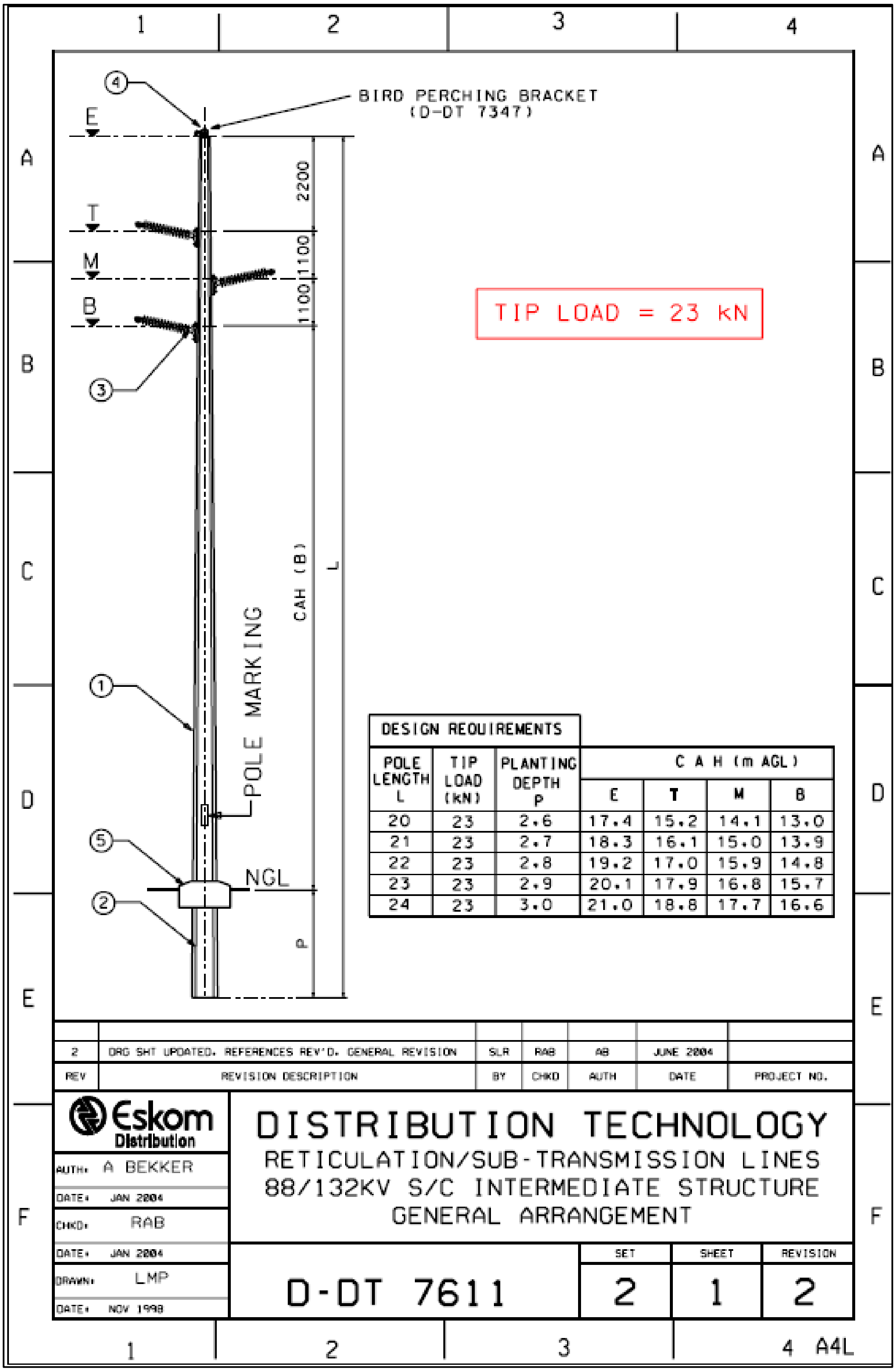
**Figure 1:** A typical example of Kathu Bushveld along the N14 where all four alignments are situated.

**Figure 2:** Large trees are scarce in the study area.

**Figure 3:** One of the three large pans found in the study area.

Figure 4: Existing 132kV Bulkop-Ferrum (left) and 132kV Ferrum-Sishen (middle) high voltage lines in the study area.

**APPENDIX 2: STRUCTURE TYPES**




| POLE LENGTH L | TIP LOAD (kN) | PLANTING DEPTH P | C A H (m AGL) E | T | M | B |
|---|---|---|---|---|---|---|
| 20 | 23 | 2.6 | 17.4 | 15.2 | 14.1 | 13.0 |
| 21 | 23 | 2.7 | 18.3 | 16.1 | 15.0 | 13.9 |
| 22 | 23 | 2.8 | 19.2 | 17.0 | 15.9 | 14.8 |
| 23 | 23 | 2.9 | 20.1 | 17.9 | 16.8 | 15.7 |
| 24 | 23 | 3.0 | 21.0 | 18.8 | 17.7 | 16.6 |