MAHIKENG MAIN TRANSMISSION SUBSTATION & PLUTO-MAHIKENG 400KV POWER LINE

SITE SPECIFIC CONSTRUCTION & OPERATIONAL ENVIRONMENTAL MANAGEMENT PROGRAMME REPORT (AVIFAUNA)

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PROFESSIONAL EXPERIENCE

Ms. Megan Diamond completed a Bachelor of Science degree in Environmental Management from the University of South Africa and has been involved in conservation for 22 years. She has 20 years' worth of experience in the field of bird interactions with electrical infrastructure and during this time has completed impact assessments for over 300 projects. During her tenure at the Endangered Wildlife Trust's Wildlife & Energy Programme and the Programme's primary project (i.e. the Eskom-EWT Strategic Partnership) from 2006 to 2013, Megan was responsible for assisting the energy industry and the national utility in minimising the negative impacts, associated with the construction and operation of electrical infrastructure, on wildlife through the provision of strategic guidance, risk and impact assessments, training and research. Megan (SACNASP Environmental Science Registration number 300022/14) currently owns and manages *Feathers Environmental Services* and is tasked with providing guidance to industry through the development of best practice procedures and avifaunal specialist studies for various developments including renewable energy facilities, power lines, power stations and substation infrastructure in addition to railway infrastructure and residential developments within South Africa and elsewhere within Africa. Megan has attended and presented at several conferences and facilitated workshops, as a subject expert, since 2007. Megan has authored and co-authored several academic papers, research reports and energy industry related guidelines, including the *BirdLife South Africa/ Endangered Wildlife Trust best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa* and the *Avian Wind Farm Sensitivity Map for South Africa* (2015), and played an instrumental role in facilitating the endorsement of these two products by the South African Wind Energy Association (SAWEA), IAIAsa (International Association for Impact Assessment South Africa) and Eskom. She chaired the Birds and Wind Energy Specialist Group in South Africa (2011/2012) and the IUCN/SSC Crane Specialist Group's Crane and Power line Network (2013-2015), a working group comprised of subject matter experts from across the world, working in partnership to share lessons, develop capacity, pool resources, and accelerate collective learning towards finding innovative solutions to mitigate this impact on threatened crane populations. She is currently a member of the IUCN Stork, Ibis and Spoonbill Specialist Group and the Eskom-EWT Strategic Partnership Ludwig's Bustard Working Group.

DECLARATION OF INDEPENDENCE

I, Megan Diamond, in my capacity as a specialist avifaunal consultant, hereby declare that I:

- Act as an independent specialist to *Vhubvo Archaeo-Heritage Consultants CC* for this project.
- Do not have any personal or financial interest in the project except for financial compensation for specialist investigations completed in a professional capacity as specified by the Amendment to Environmental Impact Assessment Regulations, 2017.
- Will not be affected by the outcome of the environmental process, of which this report forms part of.
- Do not have any influence over the decisions made by the governing authorities.
- Do not object to or endorse the authorised developments but aim to present facts and our best scientific and professional opinion with regard to the impacts of the development.
- Undertake to disclose to the relevant authorities any information that has or may have the potential to influence its decision or the objectivity of any report, plan, or document required in terms of the Amendment to Environmental Impact Assessment Regulations, 2017.

INDEMNITY

- This site-specific Construction Environmental Management Programme (CEMPr) and Operational Environmental Management Programme (OEMPr) report is based on a nine-day site visit to the authorised development area (16-26 March 2026) and supplemented with a desktop review of the available information and data related to the site to be affected. No long-term investigation or monitoring has been conducted.
- The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information at the time of study.
- Additional information may become known or available during a later stage of the process for which no allowance could have been made at the time of this report.
- The avifaunal specialist reserves the right to modify this report, recommendations and conclusions at any stage should additional information become available.
- Information, recommendations and conclusions in this report cannot be applied to any other area without proper investigation.
- This report, in its entirety or any portion thereof, may not be altered in any manner or form or for any purpose without the specific and written consent of the avifaunal specialist as specified above.
- Acceptance of this report, in any physical or digital form, serves to confirm acknowledgment of these terms and liabilities.



24 April 2026

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1 INTRODUCTION

1.1 Background

The Watershed Strengthening Phase 3 project is a strategically important transmission initiative identified in Eskom's Transmission Development Plans (2016-2025 and 2019-2028), aimed at addressing existing network constraints within South Africa's power system. Specifically, the project seeks to alleviate capacity limitations and improve voltage regulation at the Watershed Substation, thereby enhancing overall network performance and reliability. Implemented by the National Transmission Company South Africa (NTCSA), the development includes the establishment of the Mafikeng Main Transmission Substation (MTS) and the associated Pluto-Mahikeng 400kV transmission power line, forming part of a broader, long-term strategy to reinforce the national 400kV network and support increased capacity for both power evacuation and regional distribution.

The project was granted Environmental Authorisation on 4 February 2019. However, owing to funding constraints that delayed the commencement of construction, as well as protracted land negotiations and servitude acquisition processes, the authorisation lapsed. Following approval of an amendment application, the Environmental Authorisation was reinstated on 21 February 2024 and extended for a further five-year period.

In accordance with applicable environmental legislation, and informed by the findings and recommendations of the avifauna and fauna specialist studies undertaken during the Environmental Impact Assessment (EIA) phase, the development of a site-specific Environmental Management Programme (EMPr) is required prior to the commencement of both construction and operational activities for the *Mahikeng MTS* and the *Pluto–Mahikeng 400kV Power Line*. To this end, NTCSA appointed *Vhubvo Archaeo-Heritage Consultants CC* (hereafter referred to as *Vhubvo*) as the independent environmental assessment practitioner responsible for the compilation of the site-specific Construction and Operational EMPr (CEMPr and OEMPr) for the authorised project components.

Vhubvo subsequently appointed Feathers Environmental Services CC in the capacity of Avifaunal Specialist to undertake the avifaunal assessment and compile the relevant component of the CEMPr and OEMPr. This assessment is informed by field observations obtained during a nine-day site walk-through survey conducted between 16 and 25 March 2026, during the austral summer period.

This report identifies and evaluates the anticipated avifaunal impacts associated with the construction and operation of the authorised *Mahikeng MTS* and *Pluto–Mahikeng 400kV Power Line*, and provides targeted, site-specific mitigation measures to address these impacts. The recommendations presented herein are based on the final approved *Mahikeng MTS* development footprint and the *Pluto–Mahikeng 400kV Power Line* route alignment, as provided by *Vhubvo* on 16 March 2026.

1.2 Review of previous reports relevant to this project

Avifauna and Fauna Report for the proposed Mahikeng Main Transmission Substation & proposed 400kV Pluto-Mahikeng Powerline

In April 2018 an avifaunal impact assessment study was compiled, by *Pachnoda Consulting CC,* that informed the EIA Report (EIAr) required for the Environmental Authorisation (EA) for the *Mahikeng MTS and Pluto–Mahikeng 400kV Power Line*, undertaken by *Baagi Environmental Consultancy*.

A series of site visits undertaken between September 2017 and March 2018 provided a comprehensive understanding of the receiving environment across the power line corridors. These surveys confirmed the presence of three vulture species of high conservation concern (White-backed Vulture *Gyps africanus*, Cape Vulture *Gyps coprotheres* and Lapped-faced Vulture *Torgos tracheliotos*) all of which are particularly vulnerable to collision and electrocution risks associated with powerline infrastructure. Records were concentrated in the north-western extent of the study area, broadly between Mahikeng, Lichtenburg and Ventersdorp. The assessment noted that Corridor 2a overlapped with Cape Vulture foraging habitat (as indicated by satellite tracking data), highlighting an elevated collision risk, but that this corridor is already characterised by existing powerline infrastructure and associated cumulative impacts. In contrast, Corridor 1 traversed a higher number of wetland features, increasing its attractiveness to waterbirds and waders and, consequently, its sensitivity from an avifaunal perspective.

The avifaunal assessment further noted that the study area supported a mosaic of habitats, including mixed bushveld, *microphyllous* woodland, open grassland, perennial drainage systems and valley bottom wetlands, all of which contribute to relatively high avifaunal diversity. Of particular importance are mature *Vachellia erioloba* stands within the woodland areas, which provide nesting and roosting opportunities for large raptors (Tawny Eagle *Aquila rapax*) and scavengers, while open grasslands support a suite of terrestrial species such as Secretarybird *Sagittarius serpentarius*, Blue Crane *Anthropoides paradiseus* and White-bellied Korhaan *Eupodotis senegalensis*. Azonal features (including dams, pans) further enhanced habitat heterogeneity by providing important foraging and refuge areas for waterbirds, including species such as Maccoa Duck *Oxyura maccoa* and both Greater Flamingo *Phoenicopterus roseus* and Lesser Flamingos *Phoeniconaias minor*. At the same time, transformed habitats such as arable lands and secondary bushveld offer ephemeral foraging opportunities for large terrestrial birds, including Kori Bustard, which are themselves susceptible to powerline collisions.

Overall, both corridor alternatives were associated with unavoidable impacts to avifauna, and neither could be considered inherently "low risk." However, from a cumulative impact perspective, routing the line alongside existing infrastructure (i.e. Corridor 2a) was considered preferable, as it consolidates impacts within an already transformed corridor. With respect to the substation siting, options B and C were considered least favourable

due to their location within intact woodland supporting large trees and ephemeral depressions that function as important roosting, nesting and foraging habitat, thereby increasing the likelihood of avifaunal mortality. Substation option A emerged as the preferred alternative, as it is located within previously disturbed, secondary woodland, despite still supporting some foraging habitat for collision-prone species. It was further recommended that the substation be positioned as close as possible to the N18, within already transformed or cultivated areas, to minimise additional habitat disturbance and ecological risk.

It is anticipated that the *Mahikeng MTS* and *Pluto–Mahikeng 400kV Power Line* can be constructed with acceptable levels of impact on the resident avifauna, subject to the following recommendations:

1. *A "walk-through" of the selected route must be conducted prior to the construction phase:*
    - *The "walk-through" will aim to identify areas where marking of lines by means of "bird flight deterrent devices" is considered to be beneficial or compulsory;*
    - *All intact grassland, river/stream and drainage line crossings should by default be marked (the spanning of pans should be avoided);*
    - *Where the line crosses a wetland/river the actual crossover span as well as one span on either side of the wetland/river/ should be marked;*
    - *At least two consecutive spans of the alignment should be marked by means of appropriate "deterrent devices" (including the nocturnal LED solar-charged devices such as the 'overhead warning light') where the alignment is in close proximity to any dam or pan;*
    - *Default marking devices to be used should include large Double Loop Bird Flight Diverters and the nocturnal LED solar-charged devices such as the 'overhead warning light'; and*
    - *Double Loop Bird Flight Diverters should be applied in a staggered fashion to the phase while alternating between black and white diverters. The maximum distance between the diverters should not exceed 5 m.*
2. *Mandatory measures to be implemented during the construction phase:*
    - *All construction sites must be confined to disturbed areas or those identified with low conservation importance. All construction sites must be demarcated on site layout plans (preferably), and no construction personnel or vehicles may leave the demarcated area except those authorised to do so. Those areas surrounding the construction sites that are not part of the demarcated development area should be considered as "no-go" areas for employees, machinery or even visitors;*
    - *A natural buffer zone (to be announced by the wetland specialist) should be allowed between the line servitude and any wetland/river/stream;*
    - *All road networks must be planned with care to minimize dissection or fragmentation of important avifaunal habitat type. Where possible, the use of existing roads is encouraged. Access must be determined during the "walk-through" process;*

- *The breeding and roosting status of threatened and near threatened species corresponding to the servitude, in particular birds of prey, vultures, bustards, African Grass-owl and White-bellied Korhaan, should be evaluated prior to construction/decommissioning. If breeding is confirmed, the nest site must be barricaded and appropriately buffered (by at least 200 m or as proposed by the specialist). Construction/decommissioning activities shall only commence once the fledglings are successfully reared and has left the nesting site;*
- *It is recommended that the "cross-rope suspension" type tower be used for the transmission line;*
- *Open fires are strictly prohibited and only allowed at designated areas; and*
- *Killing or poaching of any bird species should be avoided by means of awareness programs presented to the labour force. The labour force should be made aware of the conservation issues pertaining to the bird taxa occurring on the study area. Any person found deliberately harassing any bird species in any way should face disciplinary measures, following the possible dismissal from the site.*

It is important that this site specific CEMPr and OEMPr report be read in conjunction with the *Avifauna and Fauna Report for the proposed Mahikeng MTS & proposed 400kV Pluto-Mahikeng Powerline,* compiled by Pachnoda Consulting CC in April 2018.

2 RELEVANT LEGISLATION

The following pieces of legislation, policies and guidelines are applicable to this applicable to this CEMPr and OEMPr:

2.1 Agreements and Conventions

South Africa is party to various agreements and conventions which are relevant to the conservation of avifauna (BirdLife International, 2022), these include:

* African-Eurasian Waterbird Agreement (AEWA) – Regional
* Convention on Biological Diversity (CBD), Nairobi, 1992 – Global
* Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979 – Global
* Convention on the International Trade in Endangered Species of Wild Flora and Fauna (CITES), Washington DC, 1973 – Global
* Ramsar Convention on Wetlands of International Importance, Ramsar, 1971 – Global
* Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia – Regional

2.2 National & Provincial Legislation

The following pieces of national legislation, provincial legislation and best practice guidelines (TABLE 2) are applicable:

- The National Environmental Management Act 107 of 1998 (NEMA) – National
- The National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA) and the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations) – National
- The National Environmental Management: Protected Areas Act 57 of 2003 – National
- The National Environmental Management Act 107 of 1998 (NEMA) Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal and or Avifaunal Species – National
- Species Environmental Assessment Guideline: Guidelines for the implementation of the Terrestrial Flora (3c) & Terrestrial Fauna (3d) Species Protocols for environmental impact assessments in South Africa – National
- Standard for the Development and Expansion of Power Lines and Substations within Identified Geographical Areas (Revision 2). Department of Forestry, Fisheries and the Environment (DFFE), 2022, Pretoria, South Africa – National
- The North West Biodiversity Management Act No.4 of 2016 & the North West Biodiversity Management Amendment Bill of 2017 – Provincial
- The Gauteng Biodiversity Conservation Plan, Version 3.3 - Provincial
- Gauteng Department of Agriculture & Rural Development (GDARD) Requirements for Biodiversity Assessments version 3 March 2014 - Provincial

3 STUDY METHODOLOGY

3.1 Terms of Reference

The avifaunal specialist has conducted this site specific CEMPr and OEMPr according to the following terms of reference:

- Review existing literature related to the project;
- Perform a review of the *Mahikeng MTS* footprint and the *Pluto–Mahikeng 400kV Power Line* route alignment and each tower footprint by means of an avifaunal walk-through;
- Identify avifaunal related impacts and their location; and
- Provide recommendations for suitable mitigation measures, both during construction and operation of the *Mahikeng MTS* and *Pluto–Mahikeng 400kV Power Line*, in particular the identification of raptor nests within the existing power line infrastructure (if any) and the spans of power line that require the installation of collision mitigation.

3.2 Methods

This site specific CEMPr and OEMPr followed the following steps:

- A review of available avifaunal literature and data sets pertaining to avifaunal interactions with the *Mahikeng MTS* footprint and the *Pluto–Mahikeng 400kV Power Line* infrastructure to determine the likelihood of these interactions occurring within and along the authorised substation footprint and power line respectively;
- Where possible, each tower position was inspected during the site walk-through conducted on 16-26 March 2026 and the surrounding representative habitat was photographed for reference purposes. These observations were complemented by Geographic Information System (GIS) layers and Google Earth Pro ©2026 imagery; and
- Recommendations are made for the management and mitigation of impacts associated with both the construction and operational phases of the *Mahikeng MTS* and the *Pluto–Mahikeng 400kV Power Line*

3.3 Data Sources Used

The following data sources and reports were used in varying levels of detail for this study:

- Observations made the during the nine-day walk-through on 16-26 March 2026;
- Google Earth Pro ©2026 satellite Imagery of the area, supplemented with observations made during the walk-through;
- Avifauna and Fauna Report for the proposed Mahikeng Main Transmission Substation & proposed 400kV Pluto-Mahikeng Powerline compiled by Pachnoda Consulting CC in April 2018;
- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the Animal Demography Unit of the University of Cape Town on 24 April 2026, to identify species of conservation concern that may occur within the authorised development area;
- Vulture breeding, colony and restaurant location data, received from Vulpro April, 2026;
- The power line - bird mortality incident database of the Eskom/Endangered Wildlife Trust Strategic Partnership (1996 to 2007) was consulted to determine which of the species occurring in the authorised development area are typically impacted upon by power lines, and the extent of the impact; and
- KML. shapefiles detailing the *Mahikeng MTS* final footprint and the *Pluto–Mahikeng 400kV Power Line* final route alignment and tower positions were obtained from *Vhubvo* on 16 March 2026.

3.4 Limitations and Assumptions

The final *Mahikeng MTS* footprint and the *Pluto–Mahikeng 400kV Power Line* route alignment and tower positions were obtained from *Vhubvo* on 16 March 2026. It is assumed that these positions are correct and will not be changed prior to the construction of the *Mahikeng MTS* and the *Pluto–Mahikeng 400kV Power Line*.

Predictions in this study are based on experience of these and similar species in different parts of South Africa, through the authors' experience working in the avifaunal specialist field since 2006. However, bird behaviour can't be reduced to formulas that will hold true under all circumstances.

4 SITE SPECIFIC IMPACT MITIGATION

4.1 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). Electrocution risk is strongly influenced by the power line voltage and design of the tower/pole structure and mainly affects larger, perching species that are capable of spanning the spaces between energized components. 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. It can be concluded that electrocutions on the *Pluto–Mahikeng 400kV Power Line* will not be possible through conventional mechanisms.

Electrocutions within the *Mahikeng MTS* are possible, but should not affect the more sensitive Red List species as these species are unlikely to use the infrastructure within the substation yards for perching or roosting. Since it is difficult to predict with any certainty where birds are likely to nest within the substation yards, coupled with the costs associated with insulating the entire substation, electrocutions can be mitigated using site-specific recommendations if they occur.

4.1.1 Site Specific Construction (CEMPr) Recommendations

* No construction electrocution mitigatory requirements for the *Pluto–Mahikeng 400kV Power Line* are recommended.

4.1.2 Site Specific Operational (OEMPr) Recommendations

* *Eskom* MTS Managers are requested to report all bird electrocutions encountered during routine inspections of the *Mahikeng MTS* to the *Eskom-Endangered Wildlife Trust Strategic Partnership,* who will provide additional site-specific mitigation recommendations if required.
* Suitable insulation mitigation to be applied reactively according to industry standards & specifications.

* All insulation mitigation (if installed) must be maintained for the duration of the operational lifespan of the *Mahikeng MTS*.

4.2 Collisions

Relevant to this power line development, collisions are likely to be linked to specific habitat types and/or specific sets of circumstances. The rivers, drainage lines, waterbodies (pans and dams), grassland habitat ad vulture roosts present themselves as potential collision scenarios within the authorised development area. A significant portion of the authorised alignment is located adjacent to the Hera-Watershed 275kV and Pluto-Watershed 275kV powerline. While the parallel routing of the authorised power line with existing infrastructure is advantageous from a cumulative impact perspective and may partially mitigate collision risk through increased overall visibility (APLIC 2012; Sundar & Choudhury 2005), it does not eliminate risk. Careful consideration must be given to the differences in structural design and height of the conductors.

4.2.1 Site Specific Construction (CEMPr) Recommendations

* It is recommended that Bird Flights Diverters (BFDs) be installed on the earth wires between the towers detailed in the *Pluto–Mahikeng 400kV Power Line Mitigation Matrix* that accompanies this report (APPENDIX 1).
* Bird Flight Diverters (BFDs) must be installed ten metres apart, on the earth wires in an alternating black and white/yellow pattern (APPENDIX 2). BFDs must be installed on the entire length of the earth wire span to ensure maximum collision protection for the movement of vultures when roosting on the towers. BFDs must be installed on the earth wires as soon as possible after stringing.

4.2.2 Site Specific Operational (OEMPr) Recommendations

* *Eskom* Line and Servitude Managers are requested to report all bird collisions encountered during routine line patrols of the *Pluto–Mahikeng 400kV Power Line* to the *Eskom-Endangered Wildlife Trust Strategic Partnership*, who will provide additional site-specific mitigation recommendations, if required.
* All Bird Flight Diverters must be maintained for the duration of the operational lifespan of the *Pluto–Mahikeng 400kV Power Line*.

4.3 Displacement as a result of disturbance

During the construction and maintenance of substations, power lines and access roads disturbance inevitably takes place. These activities have an impact on birds breeding (in particular large raptors, that may be utilizing the existing infrastructure or breeding in the immediate vicinity, which could result in temporary or permanent displacement. No raptor nests were recorded during the walk-down survey. This absence is likely attributable to the relatively high levels of existing disturbance associated with surrounding agricultural, industrial, urban, and peri-urban land uses within the immediate vicinity of the authorised power line route, which may reduce

habitat suitability for nesting raptors. However, the alignment traverses, or occurs in close proximity to, designated nature reserves, and the potential for nesting cannot be discounted, particularly where localised habitat features remain suitable. Importantly, a significant colony of White-backed Vulture occurs approximately 40km west and south-west of the authorised alignment near Mareetsane. This colony persists within a landscape dominated by intensive agriculture, demonstrating that, despite prevailing disturbances, suitable conditions can still support breeding raptors.

Two sizeable Sociable Weaver *Philetairus socius* nests were recorded within 250 m of Tower 13. Although this species is not formally protected, its communal nesting structures are long-lived and ecologically significant. The species is resilient and generally tolerant of some environmental disturbance; however, care should still be taken in the vicinity of these nests to avoid unnecessary disturbance, particularly during periods of breeding activity.

4.3.1 Site Specific Construction (CEMPr) Recommendations

- Should a raptor nest be identified within or in close proximity to the alignment after the walk-down phase (i.e. established prior to or during construction), all construction activities in the immediate vicinity must be temporarily halted. The Environmental Control Officer (ECO) must appoint a suitably qualified avifaunal specialist to assess the nest and provide site-specific management recommendations, including appropriate buffer distances and activity restrictions. Implementation of these measures may necessitate a delay or rescheduling of construction activities to avoid disturbance, particularly where the nest is active.
- Minimise disturbance in the vicinity of known nesting structures (i.e. Sociable Weaver nests) to prevent displacement; construction-related activities (including access, vehicle movement, and noise) near these sites should be avoided or restricted, particularly during the breeding period, even where no direct vegetation removal is proposed.

4.3.2 *Site Specific Operational (OEMPr) Recommendations*

- Should raptor nests be identified during the operational phase, *Eskom* Line and Servitude Managers must report these to the Environmental Manager, who will in turn notify the *Eskom-Endangered Wildlife Trust Strategic Partnership* for site-specific guidance. Recommendations provided must be implemented, including the delineation of appropriate buffer distances and the postponement/rescheduling of maintenance activities, where required, to prevent disturbance-related nest abandonment or breeding failure.
- It is recommended that all operational/maintenance activities be carried out according to generally accepted environmental best practices.

4.4 Displacement as a result of habitat transformation

During the construction phase and maintenance of power lines and substations, some habitat transformation and disturbance inevitably take place. This happens with the construction of access roads, the clearing of servitudes and the levelling of substation yards. These activities have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through transformation of habitat, which could result in temporary or permanent displacement. Unfortunately, very little mitigation can be applied to reduce the significance of this impact as the total permanent transformation of the natural habitat within the construction footprint of the *Mahikeng MTS* infrastructure is unavoidable. In the case of the *Pluto–Mahikeng 400kV Power Line*, the direct habitat transformation is limited to the tower footprints and the narrow access road/track under the power line. The habitat in the study area is highly uniform from a bird impact perspective. The loss of habitat due to direct habitat transformation associated with the construction of the authorised 400kV power line is likely to be fairly minimal.

4.4.1 Site Specific Construction (CEMPr) Recommendations

- Avoid removal of sensitive vegetation types. The recommendations of the botanical CEMPr must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned.
- Construction activity should be restricted to the immediate footprint of the *Mahikeng MTS* and the *Pluto–Mahikeng 400kV Power Line* infrastructure. This is especially relevant to vegetation clearing undertaken to facilitate access during construction, which should be carefully managed to prevent inadvertent disturbance or loss of nesting habitat.
- All construction activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment.
- All temporary disturbed areas should be rehabilitated according to the site's rehabilitation plan, following construction.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.

4.4.2 *Site Specific Operational (OEMPr) Recommendations*

- Mitigation requirements detailed in the site specific botanical OEMPr report must be strictly implemented to ensure minimal habitat impact.
- Existing roads must be used as far as possible for access during the operational lifespan of the project.
- All operational activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment.

4.5 Impact on the quality of supply

Both bird streamers and bird pollution related faulting occur as a result of birds perching on towers, often directly above live conductors. Tower design plays an important role with respect to bird streamer related faults. Vertically configured designs experience fewer faults compared to horizontally configured designs. The *Pluto–Mahikeng 400kV Power Line* will be constructed using the 520B structure type (Guyed-V Suspension Tower) and 517 and 518 (Self-Supporting Strain and Suspension Towers). As a result, streamer and faecal pollution induced faulting is possible and the following recommendations are made:

4.5.1 Site Specific Operational (CEMPr) Recommendations

- The installation of bird guards, in accordance with the *Eskom Transmission Bird Perch Guidelines Unique Identifier 41-332* (APPENDIX 3), above the insulator strings of the Self-Supporting Strain and Suspension Towers as well as the intermediate Guyed-V Suspension Towers as detailed in the mitigation matrix (APPENDIX 1), is highly recommended.

4.5.2 Site Specific Operational (OEMPr) Recommendations

- All bird guards should be maintained for the duration of the operational lifespan of the *Pluto–Mahikeng 400kV Power Line*.
- *Eskom* Line and Servitude Managers are requested to report all bird related faulting on the *Pluto–Mahikeng 400kV Power Line* infrastructure to the *Eskom-Endangered Wildlife Trust Strategic Partnership*, who will provide site-specific mitigation recommendations if required.

4.6 Nesting & Roosting

While the additional nesting substrate offered by the power line and substation infrastructure could be viewed as a positive impact for the resident avifauna, nest material may pose a significant risk to the structural integrity of the towers through added weight (i.e. Sociable Weaver nests), and an increased fire risk due to the fuel load of nests. In addition, nest material can cause faulting as it intrudes into the air gap causing equipment damage and loss of supply, particularly as far as crows are concerned, as they often use wires as part of their nest material. The Guyed-V and Self-Supporting towers have proven a very suitable nesting structure. As this is a positive impact on the avifaunal species in the area, no construction mitigation is recommended.

4.6.1 Site Specific Operational (CEMPr) Recommendations

- No construction mitigatory requirements for *Mahikeng MTS* and the *Pluto–Mahikeng 400kV Power Line* infrastructure is recommended.

4.6.2 Site Specific Operational (OEMPr) Recommendations

- While it is not illegal to remove an unoccupied nest that is posing a quality of supply risk, the removal of nests that contain eggs, chicks or adult birds will require a permit to do so. *Eskom* are requested to notify the *Eskom-Endangered Wildlife Trust Strategic Partnership* in these instances to arrange for the translocation or removal of the nest.

5 RESPONSIBILITIES

The overall responsibility lies with the appointed Environmental Control Officer (ECO) and various NTCSA representatives, including but not limited to, the Environmental Manager, Mahikeng MTS Manager and Lines and Servitude Manager to ensure that the construction and operation mitigation recommendations contained within this report and its appendices adhered to and all mitigation devices are installed correctly.

6 PENALTIES

The specialist insists on strict adherence to recommendations and specifications provided in this report and its appendices.

7 MITIGATION SUMMARY

Objective:	Protection of avifauna through the mitigation of direct mortality and displacement impacts caused by the construction and operation of the Mahikeng MTS and the Pluto-Mahikeng 400kV Power Line infrastructure
Project component/s	Mahikeng MTS 400kV & Pluto-Mahikeng 400kV Power Line
Potential Impact	* Mortality of local populations of Red List and non-Red List avifauna as a result of collisions with the Pluto-Mahikeng 400kV Power Line spans. * Mortality as a result of electrocution within the substation. * Permanent displacement of Red List avifaunal species from the development area as a result of habitat loss and disturbance.
Activity/risk source	* Unmitigated construction and operation activities associated with the Mahikeng MTS and the Pluto-Mahikeng 400kV Power Line infrastructure within the proposed development area that supports priority (Red List and non-Red List substation and power line susceptible) avian populations.

Mitigation: Target/Objective	* Minimise avian mortality as a result of collisions with the Pluto-Mahikeng 400kV Power Line spans. * Minimise avian mortality as a result of electrocutions within the substation. * Minimise natural habitat loss or transformation during construction of the Mahikeng MTS and the Pluto-Mahikeng 400kV Power Line. * Minimise the number of electrical faults within the Mahikeng MTS and the Pluto-Mahikeng 400kV Power Line caused by avifauna.
Performance Indicator	* Sustainable levels of avian mortalities are reported on a monthly basis and the necessary mitigation measures are implemented. * No undue destruction or alteration of natural habitat. * No bird related faulting within the Mahikeng MTS and the Pluto-Mahikeng 400kV Power Line once in operation.
Monitoring	* Environmental Control Officer to ensure that construction activities are confined to the site footprint to avoid any additional impacts on bird species residing in the broader area. * Eskom Environmental Manager and/or line servitude staff to conduct standard line patrols of the Mahikeng MTS and the Pluto-Mahikeng 400kV Power Line to record the number of mortalities, nesting activity and faecal matter fouling and determine the effectiveness of the mitigation actions taken.

CONSTRUCTION PHASE (CEMPr)					
Pole/Tower No.	Impact	Feature	Mitigation Recommendation	Impact significance (post mitigation)	Timeframe & Responsibilities
All Towers	Bird mortality due to electrocution	Presence of raptor species within the development area	Given voltage size, no construction mitigatory requirements for the Pluto-Mahikeng 400kV Power Line are recommended	Low	TIMEFRAME N/A RESPONSIBILITIES N/A
Minimum Marking Requirements See Mitigation Matrix (APPENDIX 1)	Bird mortality due to collision	Rivers Drainage Lines Flood Plains Pans Dams Grassland Vulture Roosts Collision Mortalities	It is recommended that Bird Flights Diverters be installed on both earth wire between the towers detailed in the Pluto-Mahikeng 400kV Power Line *Mitigation Matrix* that accompanies this report (APPENDIX 1). Bird flight diverters must be installed on the full span length on the earthwires, at 10m intervals, using alternating light and dark colours, to provide contrast against both dark and light backgrounds respectively. Refer to Eskom Transmission Bird Collision Prevention Guideline (Eskom Unique Identifier 41-335) (APPENDIX 2). These devices must be installed as soon as the conductors and earthwires are strung.	Low-Medium	TIMEFRAME From the commencement of construction (inclusive of all project components) to the completion of construction. RESPONSIBILITIES Contractor, Eskom Construction Manager and Environmental Control Officer
All Towers *Tower 13* Sociable Weaver nests	Displacement due to disturbance.	Active and seasonally inactive nests	Should a Red List species nest be identified within or in close proximity to the alignment (i.e. nest established prior to or during construction), all construction activities in the immediate vicinity must be temporarily halted. ECO must appoint a suitably qualified avifaunal specialist to assess the nest and provide site-specific management recommendations, including appropriate buffer distances and activity restrictions. Implementation of	Low	TIMEFRAME From the commencement of construction (inclusive of all project components) to the completion of construction. RESPONSIBILITIES Contractor, Eskom Construction Manager and

CONSTRUCTION PHASE (CEMPr)					
Pole/Tower No.	Impact	Feature	Mitigation Recommendation	Impact significance (post mitigation)	Timeframe & Responsibilities
			these measures may necessitate a delay or rescheduling of construction activities to avoid disturbance, particularly where the nest is active. Minimise disturbance in the vicinity of known nesting structures (i.e. Sociable Weaver nests) to prevent displacement; construction-related activities (including access, vehicle movement, and noise) near these sites should be avoided or restricted, particularly during the breeding period, even where no direct vegetation removal is proposed.		Environmental Control Officer Avifaunal specialist
Mahikeng MTS All Pluto-Mahikeng 400kV Power Line Towers Spans	Displacement due to habitat transformation	The Pluto-Mahikeng 400kV Power Line alignment is situated in sensitive avian habitats	Avoid removal of sensitive vegetation types. The recommendations of the botanical study must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned. Construction activity should be restricted to the immediate footprint of the infrastructure. All construction activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment. All temporary disturbed areas should be rehabilitated according to the site's rehabilitation plan, following construction. Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.	Low	TIMEFRAME From the commencement of construction (inclusive of all project components) to the completion of construction. RESPONSIBILITIES Contractor, Eskom Construction Manager and Environmental Control Officer

CONSTRUCTION PHASE (CEMPr)					
Pole/Tower No.	Impact	Feature	Mitigation Recommendation	Impact significance (post mitigation)	Timeframe & Responsibilities
All Towers	Impact on the quality of the electrical supply	Nesting, streamers and fecal pollution, could result in a poorer quality of electrical supply to the end user	The installation of bird guards above the insulator strings of the supporting strain and suspension and Guyed-V suspension structures is highly recommended in accordance with the *Eskom Transmission Bird Perch Guidelines Unique Identifier 41-332* (APPENDIX 3). It is also recommended that bird guards be fitted to the earth peaks of these structures to prevent roosting on these areas of the towers, thereby reducing the collision risk further.	Low	TIMEFRAME From the commencement of construction (inclusive of all project components) to the completion of construction. RESPONSIBILITIES Contractor, Eskom Construction Manager and Environmental Control Officer

OPERATIONAL PHASE (OEMPr)					
Pole/Tower No.	Impact	Feature	Mitigation Recommendation	Impact significance (post mitigation)	Timeframe & Responsibilities
Mahikeng MTS	Bird mortality due to electrocution	Potential presence of perching and/or roosting species	Eskom MTS Managers are requested to report all bird electrocutions encountered during routine inspections of the Mahikeng MTS to the Eskom-Endangered Wildlife Trust Strategic Partnership, who will provide additional site-specific mitigation recommendations if required. Suitable insulation mitigation to be applied reactively according to industry standards & specifications. All insulation mitigation (if installed) must be maintained for the duration of the operational lifespan of the Mahikeng MTS	Low	TIMEFRAME For the duration of the operational life-span of the Mahikeng MTS RESPONSIBILITIES Eskom Environmental Manager, Substation Manager, Environmental Control Officer & Eskom-Endangered Wildlife Trust Strategic Partnership.
Pluto-Mahikeng 400kV Power Line spans	Bird mortality due to collision	Presence of suitable habitat (rivers, waterbodies, grassland vegetation, roost locations) within close proximity to the power line	Eskom Line and Servitude Managers are requested to report all bird collisions encountered during routine line patrols of the Pluto-Mahikeng 400kV Power Line to the Eskom-Endangered Wildlife Trust Strategic Partnership, who will provide additional site-specific mitigation recommendations if required. All Bird Flight Diverters (if installed) must be maintained for the duration of the operational lifespan of the Pluto-Mahikeng 400kV Power Line	Low	TIMEFRAME For the duration of the operational life-span of the Pluto-Mahikeng 400kV Power Line RESPONSIBILITIES Eskom Environmental Manager, Line & Servitude Manager, Environmental Control Officer & Eskom-Endangered Wildlife Trust Strategic Partnership.

OPERATIONAL PHASE (OEMPr)					
Pole/Tower No.	Impact	Feature	Mitigation Recommendation	Impact significance (post mitigation)	Timeframe & Responsibilities
All Towers	Displacement due to disturbance.	Presence of active Red List raptor nests	Should raptor nests be identified during the operational phase, *Eskom* Line and Servitude Managers must report these to the Environmental Manager, who will in turn notify the *Eskom-Endangered Wildlife Trust Strategic Partnership* for site-specific guidance. Recommendations provided must be implemented, including the delineation of appropriate buffer distances and the rescheduling of maintenance activities, where required, to prevent disturbance-related nest abandonment or breeding failure. It is recommended that all operational/maintenance activities be carried out according to generally accepted environmental best practices.	Low	TIMEFRAME For the duration of the operational life-span of the Pluto-Mahikeng 400kV Power Line RESPONSIBILITIES Eskom Environmental Manager, Line & Servitude Manager, and Environmental Control Officer
All Towers & Spans	Displacement due to habitat transformation	Presence of suitable habitat (rivers, waterbodies) within close proximity to the power line.	It is recommended that all operational/maintenance activities be carried out according to generally accepted environmental best practices. Mitigation requirements detailed in the site specific Botanical OEMPr report must be implemented to ensure minimal impact in potential sensitive areas.	Low	TIMEFRAME For the duration of the operational life-span of the Mahikeng MTS and Pluto-Mahikeng 400kV Power Line RESPONSIBILITIES Eskom Environmental Manager, Line & Servitude Manager and Environmental Control Officer
All Towers	Quality of Supply Impact as a result of streamers & faecal pollution	Presence of raptor species within the proposed development area	Eskom Line & Servitude Managers are requested to report all bird related faulting on the Pluto-Mahikeng 400kV Power Line to the Eskom-Endangered Wildlife Trust Strategic	Low	TIMEFRAME For the duration of the operational life-span of the Pluto-Mahikeng 400kV Power Line

OPERATIONAL PHASE (OEMPr)					
Pole/Tower No.	Impact	Feature	Mitigation Recommendation	Impact significance (post mitigation)	Timeframe & Responsibilities
			Partnership, who will provide additional site-specific mitigation recommendations if required.		RESPONSIBILITIES Eskom Environmental Manager, Line & Servitude Manager, Environmental Control Officer & Eskom-Endangered Wildlife Trust Strategic Partnership.
Mahikeng MTS All Towers	Nesting and Roosting	Presence of a high density of raptors and corvids within the proposed development area	While it is not illegal to remove an unoccupied nest that is posing a quality of supply risk, the removal of nests that contain eggs, chicks or adult birds will require a permit to do so. Eskom are requested to notify the Eskom-Endangered Wildlife Trust Strategic Partnership in these instances to arrange for the translocation or removal of the nest.	Low	TIMEFRAME For the duration of the operational life-span of the Mahikeng MTS and Pluto-Mahikeng 400kV Power Line RESPONSIBILITIES Eskom Environmental Manager, Line & Servitude Manager, Environmental Control Officer & Eskom-Endangered Wildlife Trust Strategic Partnership.

8 CONCLUSIONS

This CEMPr and OEMPr report provides site-specific recommendations for the mitigation of avian impacts, following the final walk-through survey conducted on 16-26 March 2026. The information contained within this report must be incorporated into the project EMPr, to ensure that the construction and operation of the *Mahikeng MTS* and the *Pluto–Mahikeng 400kV Power Line* are conducted in a manner that acknowledges the identified impacts and guarantees commitment to the mitigation strategies detailed in this report.

9 REFERENCES

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APPENDIX 1: PLUTO-MAHIKENG 400KV POWER LINE MITIGATION MATRIX

TOWER POSITION	LATITUDE	LONGITUDE	DESCRIPTION	PERIOD	RANKING	AVIFAUNAL MITIGATION 1 Collision (BFDs)	AVIFAUNAL MITIGATION 2	AVIFAUNAL MITIGATION 3
Gantry, 400kV, 20m	25° 41' 12.67" S	025° 33' 52.53" E						
1, 517F , 20m	25° 41' 10.91" S	025° 33' 53.16" E						
2, 517F , 20m	25° 41' 2.37" S	025° 33' 56.2" E						
3, 518H , 22m	25° 40' 53.9" S	025° 33' 50.86" E						
4, 517E , 19,5m	25° 40' 45.02" S	025° 33' 45.26" E						
5, 517F , 23m	25° 40' 34.5" S	025° 33' 45.03" E	Pan & Borrow Pit	Construction	High	Start marking with BFDs		Bird Guards
6, 520B , 25,5m	25° 40' 26.37" S	025° 33' 54.74" E	Pan & Borrow Pit	Construction	High	Mark with BFDs		Bird Guards
7, 520B , 28,5m	25° 40' 18.5" S	025° 34' 4.15" E	Pan & Borrow Pit	Construction	High	End marking with BFDs		Bird Guards
8, 520B , 30m	25° 40' 8.21" S	025° 34' 16.45" E						
9, 520B , 33m	25° 39' 58.21" S	025° 34' 28.4" E						
10, 517E , 31m	25° 39' 49.01" S	025° 34' 39.4" E						
11, 520B , 25,5m	25° 39' 38.92" S	025° 34' 51.45" E	Pan	Construction	High	Start marking with BFDs		Bird Guards
12, 520B , 27m	25° 39' 29.91" S	025° 35' 2.21" E	Pan	Construction	High	End marking with BFDs		Bird Guards
13, 520B , 27m	25° 39' 20.4" S	025° 35' 13.57" E	Active Sociable Weaver Nests (Large)				Avoid disturbance when accessing the alignment	
14, 520B , 27m	25° 39' 11.48" S	025° 35' 24.22" E						
15, 520B , 33m	25° 39' 1.28" S	025° 35' 36.42" E						
16, 520B , 30m	25° 38' 50.47" S	025° 35' 49.32" E						
17, 520B , 28,5m	25° 38' 40.06" S	025° 36' 1.75" E						
18, 520B , 33m	25° 38' 29.27" S	025° 36' 14.64" E						
19, 520B , 25,5m	25° 38' 19.12" S	025° 36' 26.76" E						
20, 520B , 24m	25° 38' 10.37" S	025° 36' 37.21" E						
21, 520B , 25,5m	25° 38' 1.47" S	025° 36' 47.82" E						
22, 520B , 25,5m	25° 37' 52.39" S	025° 36' 58.67" E						
23, 517E , 22m	25° 37' 44.45" S	025° 37' 8.15" E						
24, 520B , 27m	25° 37' 41.48" S	025° 37' 21.5" E						
25, 520B , 27m	25° 37' 38.22" S	025° 37' 36.2" E						
26, 520B , 25,5m	25° 37' 35.03" S	025° 37' 50.53" E						
27, 520B , 27m	25° 37' 32.09" S	025° 38' 3.74" E						
28, 520B , 30m	25° 37' 28.55" S	025° 38' 19.68" E						
29, 517E , 20m	25° 37' 25.92" S	025° 38' 31.5" E						
30, 520B , 30m	25° 37' 29.01" S	025° 38' 45.39" E						
31, 520B , 31,5m	25° 37' 32.7" S	025° 39' 1.97" E						
32, 520B , 30m	25° 37' 36.32" S	025° 39' 18.28" E						
33, 520B , 33m	25° 37' 40.18" S	025° 39' 35.68" E						
34, 520B , 27m	25° 37' 43.56" S	025° 39' 50.87" E						
35, 520B , 25,5m	25° 37' 46.88" S	025° 40' 5.85" E	Pans	Construction	High	Start marking with BFDs		Bird Guards
36, 520B , 27m	25° 37' 50.14" S	025° 40' 20.51" E	Pans	Construction	High	Mark with BFDs		Bird Guards
37, 520B , 31,5m	25° 37' 53.81" S	025° 40' 37.05" E	Pans	Construction	High	Mark with BFDs		Bird Guards
38, 520B , 28,5m	25° 37' 57.31" S	025° 40' 52.82" E	Pans	Construction	High	Mark with BFDs		Bird Guards
39, 520B , 30m	25° 38' 0.87" S	025° 41' 8.85" E	Pans	Construction	High	Mark with BFDs		Bird Guards
40, 520B , 31,5m	25° 38' 4.59" S	025° 41' 25.6" E	Pans	Construction	High	Mark with BFDs		Bird Guards
41, 520B , 31,5m	25° 38' 8.31" S	025° 41' 42.38" E	Pans	Construction	High	Mark with BFDs		Bird Guards
42, 520B , 30m	25° 38' 12.02" S	025° 41' 59.12" E	Pans	Construction	High	End marking with BFDs		Bird Guards
43, 520B , 31,5m	25° 38' 15.75" S	025° 42' 15.93" E						
44, 520B , 33m	25° 38' 19.51" S	025° 42' 32.9" E						
45, 520B , 31,5m	25° 38' 23.24" S	025° 42' 49.74" E						
46, 520B , 33m	25° 38' 26.98" S	025° 43' 6.61" E						
47, 517F , 20m	25° 38' 30.12" S	025° 43' 20.74" E						
48, 520B , 28,5m	25° 38' 40.75" S	025° 43' 27.13" E						
49, 520B , 28,5m	25° 38' 53.32" S	025° 43' 34.68" E	Pan	Construction	High	Start marking with BFDs		Bird Guards
50, 520B , 28,5m	25° 39' 6.28" S	025° 43' 42.46" E	Pan	Construction	High	End marking with BFDs		Bird Guards
51, 520B , 27m	25° 39' 18.0" S	025° 43' 49.5" E						
52, 520B , 27m	25° 39' 30.4" S	025° 43' 56.94" E						
53, 520B , 31,5m	25° 39' 43.58" S	025° 44' 4.86" E						
54, 520B , 31,5m	25° 39' 57.42" S	025° 44' 13.18" E						
55, 520B , 30m	25° 40' 11.03" S	025° 44' 21.36" E	Pans, Borrow Pit & Irrigated Cultivation	Construction	High	Start marking with BFDs		Bird Guards
56, 520B , 28,5m	25° 40' 23.99" S	025° 44' 29.14" E	Pans, Borrow Pit & Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
57, 520B , 28,5m	25° 40' 37.02" S	025° 44' 36.97" E	Pans, Borrow Pit & Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
58, 520B , 27m	25° 40' 49.52" S	025° 44' 44.48" E	Pans, Borrow Pit & Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
59, 520B , 24m	25° 41' 1.21" S	025° 44' 51.51" E	Pans, Borrow Pit & Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
60, 517E , 18m	25° 41' 9.6" S	025° 44' 56.55" E	Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
61, 520B , 25,5m	25° 41' 21.19" S	025° 44' 56.52" E	Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
62, 520B , 27m	25° 41' 35.02" S	025° 44' 56.48" E	Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
63, 520B , 31,5m	25° 41' 50.04" S	025° 44' 56.44" E	Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
64, 520B , 27m	25° 42' 5.38" S	025° 44' 56.4" E	Irrigated Cultivation	Construction	High	End marking with BFDs		Bird Guards
65, 520B , 28,5m	25° 42' 19.98" S	025° 44' 56.36" E						
66, 520B , 31,5m	25° 42' 35.28" S	025° 44' 56.31" E						
67, 520B , 33m	25° 42' 50.91" S	025° 44' 56.27" E						
68, 520B , 27m	25° 43' 4.17" S	025° 44' 56.23" E						
69, 520B , 27m	25° 43' 16.38" S	025° 44' 56.2" E	Wetland & Open Grassland (fallow)	Construction	High	Start marking with BFDs		Bird Guards
70, 520B , 31,5m	25° 43' 31.62" S	025° 44' 56.16" E	Wetland & Open Grassland (fallow)	Construction	High	Mark with BFDs		Bird Guards
71, 520B , 30m	25° 43' 47.54" S	025° 44' 56.11" E	Wetland & Open Grassland (fallow)	Construction	High	Mark with BFDs		Bird Guards
72, 520B , 33m	25° 44' 3.2" S	025° 44' 56.07" E	Wetland & Open Grassland (fallow)	Construction	High	Mark with BFDs		Bird Guards
73, 517E , 18,5m	25° 44' 15.73" S	025° 44' 56.03" E		Construction	High	Mark with BFDs		Bird Guards
74, 520B , 33m	25° 44' 28.18" S	025° 44' 54.23" E	Wetland	Construction	High	Mark with BFDs		Bird Guards
75, 520B , 30m	25° 44' 43.77" S	025° 44' 51.97" E	Wetland	Construction	High	Mark with BFDs		Bird Guards
76, 520B , 27m	25° 44' 56.66" S	025° 44' 50.1" E	Wetland	Construction	High	Mark with BFDs		Bird Guards
77, 520B , 28,5m	25° 45' 10.8" S	025° 44' 48.05" E	Wetland	Construction	High	Mark with BFDs		Bird Guards
78, 520B , 31,5m	25° 45' 26.43" S	025° 44' 45.78" E	Wetland	Construction	High	Mark with BFDs		Bird Guards
79, 520B , 31,5m	25° 45' 42.51" S	025° 44' 43.45" E	Wetland	Construction	High	Mark with BFDs		Bird Guards
80, 520B , 30m	25° 45' 57.49" S	025° 44' 41.28" E	Wetland	Construction	High	Mark with BFDs		Bird Guards
81, 520B , 30m	25° 46' 12.56" S	025° 44' 39.09" E	Wetland	Construction	High	End marking with BFDs		Bird Guards
82, 520B , 30m	25° 46' 27.99" S	025° 44' 36.86" E						
83, 520B , 33m	25° 46' 43.91" S	025° 44' 34.55" E						
84, 520B , 33m	25° 46' 59.23" S	025° 44' 32.33" E						
85, 520B , 31,5m	25° 47' 15.0" S	025° 44' 30.04" E						
86, 520B , 31,5m	25° 47' 30.82" S	025° 44' 27.74" E						
87, 520B , 31,5m	25° 47' 46.38" S	025° 44' 25.49" E						
88, 517F , 18m	25° 47' 58.28" S	025° 44' 23.76" E						
89, 520B , 22,5m	25° 48' 5.92" S	025° 44' 31.05" E						
90, 520B , 30m	25° 48' 16.37" S	025° 44' 41.03" E						
91, 520B , 28,5m	25° 48' 27.26" S	025° 44' 51.43" E						
92, 520B , 28,5m	25° 48' 38.04" S	025° 45' 1.73" E						
93, 520B , 31,5m	25° 48' 49.85" S	025° 45' 13.0" E						
94, 520B , 27m	25° 49' 0.82" S	025° 45' 23.49" E						
95, 520B , 27m	25° 49' 11.36" S	025° 45' 33.55" E						

TOWER POSITION	LATITUDE	LONGITUDE	DESCRIPTION	PERIOD	RANKING	AVIFAUNAL MITIGATION 1 Collision (BFDs)	AVIFAUNAL MITIGATION 2	AVIFAUNAL MITIGATION 3
96, 520B , 30m	25° 49' 22.56" S	025° 45' 44.25" E						
97, 520B , 30m	25° 49' 33.74" S	025° 45' 54.94" E	Wetland	Construction	High	Start marking with BFDs		Bird Guards
98, 520B , 30m	25° 49' 45.46" S	025° 46' 6.14" E	Wetland	Construction	High	Mark with BFDs		Bird Guards
99, 517E , 30m	25° 49' 56.94" S	025° 46' 17.1" E	Wetland	Construction	High	End marking with BFDs		Bird Guards
100, 520B , 30m	25° 50' 8.52" S	025° 46' 28.17" E						
101, 520B , 33m	25° 50' 20.38" S	025° 46' 39.5" E						
102, 520B , 31,5m	25° 50' 32.46" S	025° 46' 51.04" E						
103, 520B , 28,5m	25° 50' 43.77" S	025° 47' 1.86" E	Molopo River Crossing	Construction	High	Start marking with BFDs		Bird Guards
104, 518D , 18m	25° 50' 51.93" S	025° 47' 9.66" E	Molopo River Crossing	Construction	High	Mark with BFDs		Bird Guards
105, 520B , 27m	25° 51' 4.15" S	025° 47' 3.71" E	Molopo River Crossing	Construction	High	Mark with BFDs		Bird Guards
106, 520B , 30m	25° 51' 16.13" S	025° 46' 57.87" E	Molopo River Crossing	Construction	High	Mark with BFDs		Bird Guards
107, 520B , 30m	25° 51' 29.16" S	025° 46' 51.53" E	Mafikeng Game Reserve - Vultures	Construction	High	Mark with BFDs		Bird Guards
108, 520B , 31,5m	25° 51' 43.66" S	025° 46' 44.46" E	Mafikeng Game Reserve - Vultures	Construction	High	Mark with BFDs		Bird Guards
109, 520B , 27m	25° 51' 57.41" S	025° 46' 37.76" E	Mafikeng Game Reserve - Vultures	Construction	High	Mark with BFDs		Bird Guards
110, 520B , 25,5m	25° 52' 10.32" S	025° 46' 31.47" E	Mafikeng Game Reserve - Vultures	Construction	High	Mark with BFDs		Bird Guards
111, 520B , 25,5m	25° 52' 22.57" S	025° 46' 25.5" E	Mafikeng Game Reserve - Vultures	Construction	High	Mark with BFDs		Bird Guards
112, 520B , 28,5m	25° 52' 35.69" S	025° 46' 19.1" E	Mafikeng Game Reserve - Vultures	Construction	High	Mark with BFDs		Bird Guards
113, 520B , 31,5m	25° 52' 49.35" S	025° 46' 12.44" E	Mafikeng Game Reserve - Vultures	Construction	High	Mark with BFDs		Bird Guards
114, 517E , 18m	25° 53' 1.3" S	025° 46' 6.62" E	Mafikeng Game Reserve - Vultures	Construction	High	Mark with BFDs		Bird Guards
115, 520B , 24m	25° 53' 7.54" S	025° 45' 56.75" E	Mafikeng Game Reserve - Vultures	Construction	High	Mark with BFDs		Bird Guards
116, 520B , 27m	25° 53' 15.04" S	025° 45' 44.86" E	Mafikeng Game Reserve - Vultures	Construction	High	Mark with BFDs		Bird Guards
117, 520B , 27m	25° 53' 22.37" S	025° 45' 33.25" E	Mafikeng Game Reserve - Vultures	Construction	High	Mark with BFDs		Bird Guards
118, 517F , 30m	25° 53' 28.14" S	025° 45' 24.12" E	Vulture Presence	Construction	High	Mark with BFDs		Bird Guards
119, 520B , 22,5m	25° 53' 38.66" S	025° 45' 24.56" E	Vulture Presence	Construction	High	Mark with BFDs		Bird Guards
120, 520B , 22,5m	25° 53' 49.56" S	025° 45' 25.01" E	Vulture Presence	Construction	High	Mark with BFDs		Bird Guards
121, 517F , 27m	25° 54' 0.59" S	025° 45' 25.47" E	Vulture Presence	Construction	High	End marking with BFDs		Bird Guards
122, 520B , 28,5m	25° 54' 8.36" S	025° 45' 35.07" E						
123, 520B , 23m	25° 54' 17.18" S	025° 45' 45.98" E						
124, 520B , 23m	25° 54' 25.01" S	025° 45' 55.66" E						
125, 517F , 18m	25° 54' 31.91" S	025° 46' 4.19" E						
126, 520B , 31,5m	25° 54' 44.39" S	025° 46' 5.35" E						
127, 520B , 31,5m	25° 54' 59.72" S	025° 46' 6.77" E						
128, 520B , 27m	25° 55' 14.61" S	025° 46' 8.16" E						
129, 520B , 24m	25° 55' 27.75" S	025° 46' 9.38" E						
130, 520B , 24m	25° 55' 40.3" S	025° 46' 10.55" E						
131, 520B , 27m	25° 55' 53.59" S	025° 46' 11.79" E						
132, 520B , 28,5m	25° 56' 7.4" S	025° 46' 13.07" E						
133, 520B , 25,5m	25° 56' 20.18" S	025° 46' 14.26" E						
134, 517E , 22,5m	25° 56' 31.49" S	025° 46' 15.31" E						
135, 520B , 31,5m	25° 56' 44.7" S	025° 46' 12.17" E	Drainage Line	Construction	High	Start marking with BFDs		Bird Guards
136, 520B , 31,5m	25° 57' 0.46" S	025° 46' 8.41" E	Drainage Line	Construction	High	Mark with BFDs		Bird Guards
137, 520B , 30m	25° 57' 15.6" S	025° 46' 4.81" E	Drainage Line	Construction	High	Mark with BFDs		Bird Guards
138, 520B , 30m	25° 57' 30.77" S	025° 46' 1.2" E	Drainage Line	Construction	High	End marking with BFDs		Bird Guards
139, 520B , 27m	25° 57' 44.22" S	025° 45' 58.0" E						
140, 520B , 27m	25° 57' 56.82" S	025° 45' 54.99" E						
141, 520B , 30m	25° 58' 11.18" S	025° 45' 51.58" E						
142, 520B , 33m	25° 58' 26.88" S	025° 45' 47.84" E						
143, 520B , 25,5m	25° 58' 41.55" S	025° 45' 44.34" E						
144, 520B , 24m	25° 58' 54.03" S	025° 45' 41.37" E						
145, 520B , 25,5m	25° 59' 6.86" S	025° 45' 38.31" E						
146, 520B , 27m	25° 59' 20.43" S	025° 45' 35.08" E						
147, 520B , 25,5m	25° 59' 33.93" S	025° 45' 31.86" E						
148, 520B , 28,5m	25° 59' 46.53" S	025° 45' 28.86" E						
149, 517F , 31,5m	26° 00' 0.16" S	025° 45' 25.62" E						
150, 517F , 26m	26° 00' 12.98" S	025° 45' 33.61" E						
151, 520B , 24m	26° 00' 16.56" S	025° 45' 47.89" E						
152, 520B , 28,5m	26° 00' 20.35" S	025° 46' 3.04" E						
153, 520B , 31,5m	26° 00' 24.5" S	025° 46' 19.61" E						
154, 520B , 31,5m	26° 00' 28.68" S	025° 46' 36.31" E						
155, 520B , 31,5m	26° 00' 32.98" S	025° 46' 53.53" E						
156, 520B , 28,5m	26° 00' 37.13" S	025° 47' 10.09" E						
157, 520B , 31,5m	26° 00' 41.26" S	025° 47' 26.62" E						
158, 520B , 30m	26° 00' 45.48" S	025° 47' 43.5" E						
159, 520B , 31,5m	26° 00' 49.75" S	025° 48' 0.55" E						
160, 520B , 31,5m	26° 00' 53.97" S	025° 48' 17.47" E	Wetland & Pans	Construction	High	Start marking with BFDs		Bird Guards
161, 520B , 28,5m	26° 00' 58.17" S	025° 48' 34.24" E	Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
162, 520B , 31,5m	26° 01' 2.36" S	025° 48' 51.01" E	Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
163, 520B , 28,5m	26° 01' 6.5" S	025° 49' 7.58" E	Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
164, 520B , 27m	26° 01' 10.48" S	025° 49' 23.52" E	Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
165, 520B , 24m	26° 01' 14.07" S	025° 49' 37.88" E	Wetland & Pans	Construction	High	End marking with BFDs		Bird Guards
166, 520B , 27m	26° 01' 17.7" S	025° 49' 52.43" E						
167, 520B , 25,5m	26° 01' 21.43" S	025° 50' 7.35" E						
168, 520B , 30m	26° 01' 25.36" S	025° 50' 23.11" E						
169, 520B , 31,5m	26° 01' 29.64" S	025° 50' 40.23" E						
170, 520B , 28,5m	26° 01' 33.74" S	025° 50' 56.67" E	Open Grassland (fallow) large terrestial bird activity	Construction	High	Start marking with BFDs		Bird Guards
171, 520B , 27m	26° 01' 37.63" S	025° 51' 12.26" E	Open Grassland (fallow) large terrestial bird activity	Construction	High	Mark with BFDs		Bird Guards
172, 520B , 30m	26° 01' 41.62" S	025° 51' 28.24" E	Open Grassland (fallow) large terrestial bird activity	Construction	High	Mark with BFDs		Bird Guards
173, 520B , 30m	26° 01' 45.81" S	025° 51' 45.03" E	Open Grassland (fallow) large terrestial bird activity	Construction	High	Mark with BFDs		Bird Guards
174, 517E , 19m	26° 01' 49.3" S	025° 51' 59.01" E	Open Grassland (fallow) large terrestial bird activity	Construction	High	Mark with BFDs		Bird Guards
175, 520B , 22,5m	26° 01' 54.92" S	025° 52' 9.47" E	Open Grassland (fallow) large terrestial bird activity	Construction	High	Mark with BFDs		Bird Guards
176, 520B , 24m	26° 02' 1.05" S	025° 52' 20.89" E	Pan	Construction	High	Mark with BFDs		Bird Guards
177, 520B , 25,5m	26° 02' 7.73" S	025° 52' 33.34" E	Pan	Construction	High	Mark with BFDs		Bird Guards
178, 520B , 25,5m	26° 02' 14.49" S	025° 52' 45.93" E	Open Grassland (fallow) large terrestial bird activity	Construction	High	Mark with BFDs		Bird Guards
179, 520B , 25,5m	26° 02' 20.18" S	025° 52' 56.52" E	Open Grassland (fallow) large terrestial bird activity	Construction	High	Mark with BFDs		Bird Guards
180, 520B , 22,5m	26° 02' 26.29" S	025° 53' 7.91" E	Pan	Construction	High	Mark with BFDs		Bird Guards
181, 517E , 19m	26° 02' 33.06" S	025° 53' 20.52" E	Pan	Construction	High	Mark with BFDs		Bird Guards
182, 520B , 27m	26° 02' 40.13" S	025° 53' 28.58" E	Open Grassland (fallow) large terrestial bird activity	Construction	High	Mark with BFDs		Bird Guards
183, 520B , 25,5m	26° 02' 49.68" S	025° 53' 39.47" E	Pan	Construction	High	Mark with BFDs		Bird Guards
184, 520B , 27m	26° 02' 59.02" S	025° 53' 50.12" E	Pans, Open Grassland (fallow)	Construction	High	Mark with BFDs		Bird Guards
185, 520B , 31,5m	26° 03' 9.88" S	025° 54' 2.51" E	Pans, Open Grassland (fallow)	Construction	High	Mark with BFDs		Bird Guards
186, 520B , 28,5m	26° 03' 20.96" S	025° 54' 15.16" E	Pans, Open Grassland (fallow)	Construction	High	Mark with BFDs		Bird Guards
187, 520B , 28,5m	26° 03' 30.95" S	025° 54' 26.56" E	Pans, Open Grassland (fallow)	Construction	High	Mark with BFDs		Bird Guards
188, 520B , 30m	26° 03' 41.69" S	025° 54' 38.81" E	Pans, Open Grassland (fallow)	Construction	High	Mark with BFDs		Bird Guards
189, 520B , 28,5m	26° 03' 52.28" S	025° 54' 50.89" E	Pans, Open Grassland (fallow)	Construction	High	Mark with BFDs		Bird Guards
190, 520B , 27m	26° 04' 2.46" S	025° 55' 2.51" E	Pans, Open Grassland (fallow)	Construction	High	Mark with BFDs		Bird Guards
191, 520B , 28,5m	26° 04' 12.71" S	025° 55' 14.21" E	Pans, Open Grassland (fallow)	Construction	High	Mark with BFDs		Bird Guards
192, 520B , 30m	26° 04' 23.25" S	025° 55' 26.24" E	Pans, Open Grassland (fallow)	Construction	High	Mark with BFDs		Bird Guards
193, 520B , 30m	26° 04' 32.96" S	025° 55' 37.32" E	Pans & Fallow Lands	Construction	High	Mark with BFDs		Bird Guards

TOWER POSITION	LATITUDE	LONGITUDE	DESCRIPTION	PERIOD	RANKING	AVIFAUNAL MITIGATION 1 Collision (BFDs)	AVIFAUNAL MITIGATION 2	AVIFAUNAL MITIGATION 3
194, 520B , 28,5m	26° 04' 43.59" S	025° 55' 49.46" E	Pans & Fallow Lands	Construction	High	Mark with BFDs		Bird Guards
195, 520B , 33m	26° 04' 54.54" S	025° 56' 1.95" E	Pans & Fallow Lands	Construction	High	Mark with BFDs		Bird Guards
196, 518E , 27m	26° 05' 5.63" S	025° 56' 14.61" E	Pans & Fallow Lands	Construction	High	End marking with BFDs		Bird Guards
197, 520B , 33m	26° 05' 16.58" S	025° 56' 27.12" E						
198, 520B , 27m	26° 05' 27.78" S	025° 56' 39.91" E						
199, 520B , 30m	26° 05' 38.22" S	025° 56' 51.83" E						
200, 520B , 27m	26° 05' 48.62" S	025° 57' 3.7" E						
201, 520B , 31,5m	26° 05' 59.07" S	025° 57' 15.65" E						
202, 520B , 30m	26° 06' 10.13" S	025° 57' 28.28" E						
203, 520B , 30m	26° 06' 20.99" S	025° 57' 40.68" E						
204, 520B , 31,5m	26° 06' 32.12" S	025° 57' 53.39" E						
205, 520B , 31,5m	26° 06' 43.2" S	025° 58' 6.06" E						
206, 520B , 30m	26° 06' 54.1" S	025° 58' 18.51" E						
207, 520B , 30m	26° 07' 4.97" S	025° 58' 30.93" E	Pans & Irrigated Cultivation	Construction	High	Start marking with BFDs		Bird Guards
208, 520B , 27m	26° 07' 15.38" S	025° 58' 42.83" E	Pans & Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
209, 517E , 18,5m	26° 07' 23.85" S	025° 58' 52.51" E	Pans & Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
210, 520B , 28,5m	26° 07' 29.86" S	025° 58' 55.66" E	Pans & Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
211, 520B , 30m	26° 07' 44.44" S	025° 59' 3.31" E	Pans & Irrigated Cultivation	Construction	High	End marking with BFDs		Bird Guards
212, 520B , 31,5m	26° 07' 52.49" S	025° 59' 7.53" E						
213, 520B , 31,5m	26° 08' 7.54" S	025° 59' 15.42" E						
214, 520B , 30m	26° 08' 21.31" S	025° 59' 22.65" E						
215, 520B , 33m	26° 08' 36.22" S	025° 59' 30.47" E						
216, 517F , 27m	26° 08' 50.19" S	025° 59' 37.8" E	Wetland Area	Construction	High	Start marking with BFDs		Bird Guards
217, 520B , 30m	26° 08' 53.78" S	025° 59' 52.12" E	Wetland Area	Construction	High	Mark with BFDs		Bird Guards
218, 520B , 25,5m	26° 08' 57.55" S	026° 00' 7.18" E	Wetland Area	Construction	High	Mark with BFDs		Bird Guards
219, 520B , 27m	26° 09' 0.84" S	026° 00' 20.32" E	Wetland Area	Construction	High	Mark with BFDs		Bird Guards
220, 518H , 31m	26° 09' 4.68" S	026° 00' 35.65" E	Wetland Area	Construction	High	Mark with BFDs		Bird Guards
221, 517E , 24m (common to	26° 09' 8.53" S	026° 00' 51.04" E	Wetland Area	Construction	High	Mark with BFDs		Bird Guards
221, 517E , 24m (common to	26° 09' 8.52" S	026° 00' 51.1" E	Wetland Area					
222, 518H , 25,5m	26° 09' 11.9" S	026° 01' 0.48" E	Wetland Area	Construction	High	Mark with BFDs		Bird Guards
223, 520B , 27m	26° 09' 16.82" S	026° 01' 14.13" E	Wetland Area	Construction	High	End marking with BFDs		Bird Guards
224, 517F , 18m	26° 09' 20.51" S	026° 01' 24.37" E						
225, 518H , 25,5m	26° 09' 15.6" S	026° 01' 35.92" E						
226, 518H , 28,5m	26° 09' 9.64" S	026° 01' 49.95" E						
227, 520B , 31,5m	26° 09' 2.93" S	026° 02' 5.74" E						
228, 520B , 31,5m	26° 08' 56.47" S	026° 02' 20.91" E						
229, 520B , 30m	26° 08' 49.66" S	026° 02' 36.92" E	Pans	Construction	High	Start marking with BFDs		Bird Guards
230, 518H , 33m	26° 08' 42.9" S	026° 02' 52.81" E	Pans	Construction	High	Mark with BFDs		Bird Guards
231, 518H , 30m	26° 08' 36.21" S	026° 03' 8.56" E	Pans	Construction	High	Mark with BFDs		Bird Guards
232, 518H , 33m	26° 08' 29.96" S	026° 03' 23.25" E	Pans	Construction	High	Mark with BFDs		Bird Guards
233, 518H , 30m	26° 08' 22.71" S	026° 03' 40.28" E	Pans	Construction	High	End marking with BFDs		Bird Guards
234, 518H , 25,5m	26° 08' 16.69" S	026° 03' 54.43" E						
235, 518H , 24m	26° 08' 11.57" S	026° 04' 6.47" E						
236, 518H , 27m	26° 08' 6.16" S	026° 04' 19.19" E						
237, 517E , 31,5m	26° 08' 0.9" S	026° 04' 31.54" E						
238, 517F , 23m	26° 07' 56.2" S	026° 04' 42.58" E	Vulture Roost	Construction	High	Start marking with BFDs		Bird Guards
239, 520B , 30m	26° 07' 45.12" S	026° 04' 47.36" E	Vulture Roost	Construction	High	Start marking with BFDs		Bird Guards
240, 520B , 27m	26° 07' 32.19" S	026° 04' 52.94" E	Vulture Roost	Construction	High	Start marking with BFDs		Bird Guards
241, 520B , 28,5m	26° 07' 19.51" S	026° 04' 58.41" E	Vulture Roost	Construction	High	Start marking with BFDs		Bird Guards
242, 517F , 32m	26° 07' 8.12" S	026° 05' 3.33" E	Vulture Roost	Construction	High	Start marking with BFDs		Bird Guards
243, 517E , 32m	26° 07' 5.36" S	026° 05' 10.9" E	Vulture Roost	Construction	High	Start marking with BFDs		Bird Guards
244, 520B , 31,5m	26° 06' 59.71" S	026° 05' 26.45" E	Vulture Roost	Construction	High	Start marking with BFDs		Bird Guards
245, 520B , 28,5m	26° 06' 54.16" S	026° 05' 41.71" E	Vulture Roost	Construction	High	Start marking with BFDs		Bird Guards
246, 520B , 30m	26° 06' 49.04" S	026° 05' 55.76" E	Vulture Roost	Construction	High	Start marking with BFDs		Bird Guards
247, 520B , 33m	26° 06' 42.97" S	026° 06' 12.45" E	Vulture Roost	Construction	High	Start marking with BFDs		Bird Guards
248, 520B , 33m	26° 06' 37.15" S	026° 06' 28.44" E	Vulture Roost	Construction	High	End marking with BFDs		Bird Guards
249, 517F , 28,5m	26° 06' 32.82" S	026° 06' 40.34" E						
250, 517E , 32,5m	26° 06' 39.56" S	026° 06' 57.74" E						
251, 520B , 33m	26° 06' 49.61" S	026° 07' 9.47" E						
252, 520B , 33m	26° 06' 58.96" S	026° 07' 20.38" E						
253, 520B , 31,5m	26° 07' 9.99" S	026° 07' 33.26" E						
254, 520B , 33m	26° 07' 20.79" S	026° 07' 45.85" E						
255, 517F , 18m	26° 07' 29.69" S	026° 07' 56.25" E	Drainage Line, Floodplain & Waterbodies	Construction	High	Start marking with BFDs		Bird Guards
256, 520B , 25,5m	26° 07' 29.62" S	026° 08' 6.39" E	Drainage Line, Floodplain & Waterbodies	Construction	High	Mark with BFDs		Bird Guards
257, 520B , 28,5m	26° 07' 29.54" S	026° 08' 18.21" E	Drainage Line, Floodplain & Waterbodies	Construction	High	Mark with BFDs		Bird Guards
258, 520B , 30m	26° 07' 29.42" S	026° 08' 36.2" E	Drainage Line, Floodplain & Waterbodies	Construction	High	Mark with BFDs		Bird Guards
259, 518D , 18m	26° 07' 29.33" S	026° 08' 49.92" E	Drainage Line, Floodplain & Waterbodies	Construction	High	Mark with BFDs		Bird Guards
260, 520B , 27m	26° 07' 22.05" S	026° 08' 54.16" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
261, 520B , 33m	26° 07' 8.75" S	026° 09' 1.93" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
262, 520B , 33m	26° 06' 54.03" S	026° 09' 10.52" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
263, 520B , 28,5m	26° 06' 41.04" S	026° 09' 18.1" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
264, 520B , 28,5m	26° 06' 27.79" S	026° 09' 25.83" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
265, 520B , 31,5m	26° 06' 14.08" S	026° 09' 33.83" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
266, 520B , 31,5m	26° 05' 59.99" S	026° 09' 42.05" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
267, 520B , 31,5m	26° 05' 46.94" S	026° 09' 49.66" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
268, 520B , 31,5m	26° 05' 33.03" S	026° 09' 57.78" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
269, 520B , 33m	26° 05' 19.57" S	026° 10' 5.63" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
270, 520B , 31,5m	26° 05' 5.72" S	026° 10' 13.71" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
271, 518C , 35m	26° 04' 54.51" S	026° 10' 20.25" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
272, 518D , 35m	26° 04' 47.97" S	026° 10' 24.06" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
273, 520B , 30m	26° 04' 44.01" S	026° 10' 40.41" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
274, 520B , 28,5m	26° 04' 40.28" S	026° 10' 55.77" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
275, 520B , 27m	26° 04' 36.6" S	026° 11' 10.96" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
276, 520B , 25,5m	26° 04' 32.91" S	026° 11' 26.18" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
277, 517E , 20,5m	26° 04' 29.87" S	026° 11' 38.73" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
278, 520B , 22,5m	26° 04' 29.45" S	026° 11' 49.24" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
279, 520B , 24m	26° 04' 28.94" S	026° 12' 1.99" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
280, 520B , 33m	26° 04' 28.33" S	026° 12' 17.39" E	Lichtenburg NR, Active Vulture Restautant, Vulture Prese	Construction	High	Mark with BFDs		Bird Guards
281, 520B , 33m	26° 04' 27.65" S	026° 12' 34.54" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
282, 520B , 31,5m	26° 04' 26.94" S	026° 12' 52.23" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
283, 520B , 28,5m	26° 04' 26.26" S	026° 13' 9.41" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
284, 520B , 28,5m	26° 04' 25.64" S	026° 13' 24.76" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
285, 520B , 30m	26° 04' 25.03" S	026° 13' 40.05" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
286, 520B , 30m	26° 04' 24.35" S	026° 13' 57.16" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
287, 520B , 31,5m	26° 04' 23.67" S	026° 14' 14.03" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
288, 520B , 31,5m	26° 04' 22.97" S	026° 14' 31.58" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
289, 520B , 33m	26° 04' 22.26" S	026° 14' 49.33" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
290, 520B , 31,5m	26° 04' 21.56" S	026° 15' 6.69" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards

TOWER POSITION	LATITUDE	LONGITUDE	DESCRIPTION	PERIOD	RANKING	AVIFAUNAL MITIGATION 1 Collision (BFDs)	AVIFAUNAL MITIGATION 2	AVIFAUNAL MITIGATION 3
291, 520B , 33m	26° 04' 20.84" S	026° 15' 24.65" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
292, 520B , 27m	26° 04' 20.18" S	026° 15' 41.03" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
293, 520B , 31,5m	26° 04' 19.52" S	026° 15' 57.34" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
294, 520B , 31,5m	26° 04' 18.82" S	026° 16' 14.8" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
295, 520B , 28,5m	26° 04' 18.14" S	026° 16' 31.69" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
296, 520B , 27m	26° 04' 17.5" S	026° 16' 47.36" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
297, 520B , 27m	26° 04' 16.91" S	026° 17' 2.13" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
298, 518H , 25,5m	26° 04' 16.3" S	026° 17' 17.19" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
299, 520B , 28,5m	26° 04' 15.74" S	026° 17' 31.13" E	Vulture Roost, Open Bushveld, Game, Large Terrestrial B	Construction	High	Mark with BFDs		Bird Guards
300, 520B , 24m	26° 04' 15.16" S	026° 17' 45.36" E	Vulture Roost, Open Bushveld, Game, Large Terrestrial B	Construction	High	Mark with BFDs		Bird Guards
301, 520B , 22,5m	26° 04' 14.65" S	026° 17' 58.09" E	Vulture Roost, Open Bushveld, Game, Large Terrestrial B	Construction	High	Mark with BFDs		Bird Guards
302, 517E , 20m	26° 04' 14.2" S	026° 18' 9.19" E	Vulture Roost, Open Bushveld, Game, Large Terrestrial B	Construction	High	Mark with BFDs		Bird Guards
303, 517F , 18m	26° 04' 13.01" S	026° 18' 19.63" E	Vulture Roost, Open Bushveld, Game, Large Terrestrial B	Construction	High	Mark with BFDs		Bird Guards
304, 517F , 21,5m	26° 04' 15.91" S	026° 18' 24.08" E	Vulture Roost, Open Bushveld, Game, Large Terrestrial B	Construction	High	End marking with BFDs		Bird Guards
305, 520B , 25,5m	26° 04' 27.18" S	026° 18' 28.73" E						
306, 520B , 30m	26° 04' 40.88" S	026° 18' 34.38" E						
307, 520B , 31,5m	26° 04' 55.59" S	026° 18' 40.45" E						
308, 520B , 30m	26° 05' 10.11" S	026° 18' 46.45" E	Pans	Construction	High	Start marking with BFDs		Bird Guards
309, 520B , 28,5m	26° 05' 24.72" S	026° 18' 52.48" E	Pans	Construction	High	Mark with BFDs		Bird Guards
310, 520B , 28,5m	26° 05' 38.91" S	026° 18' 58.33" E	Pans	Construction	High	Mark with BFDs		Bird Guards
311, 517E , 18m	26° 05' 49.79" S	026° 19' 2.82" E	Pans	Construction	High	End marking with BFDs		Bird Guards
312, 520B , 30m	26° 05' 57.89" S	026° 19' 11.79" E						
313, 520B , 28,5m	26° 06' 8.69" S	026° 19' 23.74" E						
314, 520B , 27m	26° 06' 19.02" S	026° 19' 35.17" E						
315, 520B , 28,5m	26° 06' 29.33" S	026° 19' 46.59" E						
316, 520B , 25,5m	26° 06' 39.33" S	026° 19' 57.66" E						
317, 517F , 21m	26° 06' 47.04" S	026° 20' 6.19" E	Wetland, waterbodies	Construction	High	Start marking with BFDs		Bird Guards
318, 520B , 27m	26° 06' 46.8" S	026° 20' 19.1" E	Wetland, waterbodies	Construction	High	Mark with BFDs		Bird Guards
319, 518H , 27m	26° 06' 46.55" S	026° 20' 32.2" E	Wetland, waterbodies	Construction	High	Mark with BFDs		Bird Guards
320, 518H , 31,5m	26° 06' 46.33" S	026° 20' 43.28" E	Wetland, waterbodies	Construction	High	Mark with BFDs		Bird Guards
321, 518H , 31,5m	26° 06' 45.97" S	026° 21' 2.15" E	Wetland, waterbodies	Construction	High	Mark with BFDs		Bird Guards
322, 517E , 28m	26° 06' 45.73" S	026° 21' 14.98" E	Wetland, waterbodies	Construction	High	Mark with BFDs		Bird Guards
323, 520B , 33m	26° 06' 47.2" S	026° 21' 32.09" E	Wetland, waterbodies	Construction	High	Mark with BFDs		Bird Guards
324, 520B , 33m	26° 06' 48.68" S	026° 21' 49.4" E	Wetland, waterbodies	Construction	High	Mark with BFDs		Bird Guards
325, 520B , 30m	26° 06' 50.16" S	026° 22' 6.56" E	Wetland, waterbodies, vulture roost	Construction	High	Mark with BFDs		Bird Guards
326, 520B , 30m	26° 06' 51.62" S	026° 22' 23.56" E	Wetland, waterbodies, vulture roost	Construction	High	Mark with BFDs		Bird Guards
327, 518H , 28,5m	26° 06' 53.02" S	026° 22' 39.94" E	Wetland, waterbodies, vulture roost	Construction	High	Mark with BFDs		Bird Guards
328, 520B , 19,5m	26° 06' 54.19" S	026° 22' 53.55" E	Wetland, waterbodies, vulture roost	Construction	High	Mark with BFDs		Bird Guards
329, 518H , 24m	26° 06' 55.19" S	026° 23' 3.84" E	Wetland, waterbodies	Construction	High	Mark with BFDs		Bird Guards
330, 518H , 31,5m	26° 06' 56.72" S	026° 23' 19.45" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
331, 520B , 28,5m	26° 06' 58.38" S	026° 23' 36.45" E	Likely Vulture Presence	Construction	High	Mark with BFDs		Bird Guards
332, 520B , 31,5m	26° 07' 0.04" S	026° 23' 53.44" E	Likely Vulture Presence	Construction	High	Mark with BFDs		Bird Guards
333, 520B , 31,5m	26° 07' 1.72" S	026° 24' 10.66" E	Likely Vulture Presence	Construction	High	Mark with BFDs		Bird Guards
334, 520B , 30m	26° 07' 3.4" S	026° 24' 27.91" E	Likely Vulture Presence	Construction	High	Mark with BFDs		Bird Guards
335, 520B , 30m	26° 07' 5.08" S	026° 24' 45.13" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
336, 520B , 30m	26° 07' 6.75" S	026° 25' 2.21" E	Likely Vulture Presence	Construction	High	Mark with BFDs		Bird Guards
337, 520B , 28,5m	26° 07' 8.26" S	026° 25' 17.69" E	Likely Vulture Presence	Construction	High	Mark with BFDs		Bird Guards
338, 520B , 27m	26° 07' 9.61" S	026° 25' 31.62" E	Likely Vulture Presence	Construction	High	Mark with BFDs		Bird Guards
339, 520B , 28,5m	26° 07' 11.15" S	026° 25' 47.42" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
340, 517E , 20m	26° 07' 12.54" S	026° 26' 1.66" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
341, 520B , 31,5m	26° 07' 12.39" S	026° 26' 15.8" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
342, 520B , 31,5m	26° 07' 12.21" S	026° 26' 33.51" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
343, 520B , 25,5m	26° 07' 12.05" S	026° 26' 49.81" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
344, 520B , 25,5m	26° 07' 11.89" S	026° 27' 5.1" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
345, 520B , 28,5m	26° 07' 11.73" S	026° 27' 20.94" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
346, 520B , 28,5m	26° 07' 11.56" S	026° 27' 37.37" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
347, 520B , 30m	26° 07' 11.39" S	026° 27' 54.09" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
348, 520B , 31,5m	26° 07' 11.2" S	026° 28' 11.65" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
349, 520B , 33m	26° 07' 11.02" S	026° 28' 29.11" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
350, 517E , 18m	26° 07' 10.87" S	026° 28' 43.42" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
351, 520B , 27m	26° 07' 12.39" S	026° 28' 56.47" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
352, 520B , 25,5m	26° 07' 14.09" S	026° 29' 11.03" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
353, 520B , 24m	26° 07' 15.81" S	026° 29' 25.81" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
354, 520B , 24m	26° 07' 17.46" S	026° 29' 39.98" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
355, 520B , 27m	26° 07' 19.17" S	026° 29' 54.74" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
356, 520B , 25,5m	26° 07' 20.97" S	026° 30' 10.18" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
357, 520B , 33m	26° 07' 22.82" S	026° 30' 26.07" E	Vulture Roost, Wetland & Pans	Construction	High	Mark with BFDs		Bird Guards
358, 520B , 31,5m	26° 07' 24.94" S	026° 30' 44.29" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
359, 520B , 28,5m	26° 07' 26.57" S	026° 30' 58.36" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
360, 517E , 20,5m	26° 07' 27.69" S	026° 31' 7.97" E	Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
361, 518H , 33m	26° 07' 23.42" S	026° 31' 20.93" E	Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
362, 518H , 33m	26° 07' 17.57" S	026° 31' 38.65" E	Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
363, 517E , 27m	26° 07' 13.53" S	026° 31' 50.9" E	Irrigated Cultivation	Construction	High	Mark with BFDs		Bird Guards
364, 520B , 28,5m	26° 07' 13.82" S	026° 32' 7.65" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
365, 520B , 33m	26° 07' 14.11" S	026° 32' 24.2" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
366, 520B , 31,5m	26° 07' 14.41" S	026° 32' 41.8" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
367, 520B , 25,5m	26° 07' 14.71" S	026° 32' 58.72" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
368, 520B , 22,5m	26° 07' 14.94" S	026° 33' 12.55" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
369, 520B , 25,5m	26° 07' 15.19" S	026° 33' 27.13" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
370, 520B , 28,5m	26° 07' 15.46" S	026° 33' 42.48" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
371, 520B , 31,5m	26° 07' 15.76" S	026° 34' 0.04" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
372, 520B , 25,5m	26° 07' 16.04" S	026° 34' 16.78" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
373, 517E , 18,5m	26° 07' 16.27" S	026° 34' 29.84" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
374, 520B , 30m	26° 07' 20.72" S	026° 34' 42.82" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
375, 520B , 27m	26° 07' 25.79" S	026° 34' 57.59" E	Vulture Roost, vulture & large terrestrial bird presence	Construction	High	Mark with BFDs		Bird Guards
376, 520B , 22,5m	26° 07' 30.63" S	026° 35' 11.73" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
377, 517E , 21m	26° 07' 33.5" S	026° 35' 20.1" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
378, 517E , 25,5m	26° 07' 36.49" S	026° 35' 30.35" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
379, 520B , 30m	26° 07' 39.33" S	026° 35' 46.84" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
380, 520B , 31,5m	26° 07' 42.32" S	026° 36' 4.27" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
381, 520B , 31,5m	26° 07' 45.15" S	026° 36' 20.77" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
382, 517E , 26m	26° 07' 47.92" S	026° 36' 36.86" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
383, 520B , 25,5m	26° 07' 51.39" S	026° 36' 50.26" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
384, 520B , 25,5m	26° 07' 55.01" S	026° 37' 4.26" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
385, 520B , 27m	26° 07' 58.54" S	026° 37' 17.9" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
386, 520B , 33m	26° 08' 2.7" S	026° 37' 33.93" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
387, 517E , 20,5m	26° 08' 6.43" S	026° 37' 48.37" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
388, 520B , 30m	26° 08' 9.63" S	026° 38' 3.49" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards

TOWER POSITION	LATITUDE	LONGITUDE	DESCRIPTION	PERIOD	RANKING	AVIFAUNAL MITIGATION 1 Collision (BFDs)	AVIFAUNAL MITIGATION 2	AVIFAUNAL MITIGATION 3
389, 520B , 28,5m	26° 08' 13.0" S	026° 38' 19.44" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
390, 520B , 30m	26° 08' 16.52" S	026° 38' 36.13" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
391, 520B , 33m	26° 08' 20.06" S	026° 38' 52.87" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
392, 518E , 27m	26° 08' 23.66" S	026° 39' 9.94" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
393, 520B , 33m	26° 08' 27.24" S	026° 39' 26.89" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
394, 520B , 28,5m	26° 08' 30.62" S	026° 39' 42.92" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
395, 520B , 28,5m	26° 08' 34.04" S	026° 39' 59.13" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
396, 520B , 30m	26° 08' 37.59" S	026° 40' 15.93" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
397, 520B , 28,5m	26° 08' 41.01" S	026° 40' 32.16" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
398, 520B , 25,5m	26° 08' 44.29" S	026° 40' 47.72" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
399, 520B , 24m	26° 08' 47.33" S	026° 41' 2.13" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
400, 520B , 28,5m	26° 08' 50.37" S	026° 41' 16.54" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
401, 520B , 28,5m	26° 08' 53.7" S	026° 41' 32.32" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
402, 520B , 28,5m	26° 08' 56.94" S	026° 41' 47.71" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
403, 520B , 33m	26° 09' 0.54" S	026° 42' 4.79" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
404, 520B , 30m	26° 09' 4.11" S	026° 42' 21.72" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
405, 520B , 31,5m	26° 09' 7.64" S	026° 42' 38.49" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
406, 520B , 31,5m	26° 09' 11.23" S	026° 42' 55.53" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
407, 520B , 28,5m	26° 09' 14.61" S	026° 43' 11.56" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
408, 520B , 24m	26° 09' 17.57" S	026° 43' 25.6" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
409, 517E , 18m	26° 09' 19.96" S	026° 43' 36.99" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
410, 520B , 28,5m	26° 09' 18.94" S	026° 43' 49.4" E	Vulture Roost, Vulture presence	Construction	High	Mark with BFDs		Bird Guards
411, 520B , 31,5m	26° 09' 17.53" S	026° 44' 6.59" E	Vulture Roost, Open grassland habitat	Construction	High	Mark with BFDs		Bird Guards
412, 520B , 31,5m	26° 09' 16.05" S	026° 44' 24.57" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
413, 520B , 31,5m	26° 09' 14.65" S	026° 44' 41.57" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
414, 520B , 31,5m	26° 09' 13.22" S	026° 44' 59.0" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
415, 520B , 33m	26° 09' 11.77" S	026° 45' 16.53" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
416, 517E , 26m	26° 09' 10.33" S	026° 45' 34.1" E	Vulture presence	Construction	High	Mark with BFDs		Bird Guards
417, 520B , 28,5m	26° 09' 8.13" S	026° 45' 49.03" E	Vulture presence	Construction	High	Mark with BFDs		Bird Guards
418, 520B , 25,5m	26° 09' 5.89" S	026° 46' 4.3" E	Vulture presence	Construction	High	Mark with BFDs		Bird Guards
419, 520B , 24m	26° 09' 3.69" S	026° 46' 19.23" E	Vulture presence	Construction	High	Mark with BFDs		Bird Guards
420, 520B , 28,5m	26° 09' 1.51" S	026° 46' 34.08" E	Vulture presence	Construction	High	Mark with BFDs		Bird Guards
421, 520B , 28,5m	26° 08' 59.0" S	026° 46' 51.12" E	Vulture presence	Construction	High	Mark with BFDs		Bird Guards
422, 520B , 28,5m	26° 08' 56.47" S	026° 47' 8.28" E	Vulture presence	Construction	High	Mark with BFDs		Bird Guards
423, 520B , 25,5m	26° 08' 54.16" S	026° 47' 24.01" E	Vulture presence	Construction	High	Mark with BFDs		Bird Guards
424, 520B , 28,5m	26° 08' 51.86" S	026° 47' 39.64" E	Vulture presence	Construction	High	End Marking with BFDs		Bird Guards
425, 520B , 30m	26° 08' 49.46" S	026° 47' 55.95" E						
426, 520B , 31,5m	26° 08' 46.81" S	026° 48' 13.89" E						
427, 517E , 26,5m	26° 08' 44.85" S	026° 48' 27.21" E						
428, 520B , 33m	26° 08' 45.86" S	026° 48' 44.32" E						
429, 520B , 30m	26° 08' 46.89" S	026° 49' 1.78" E	Pan	Construction	High	Start marking with BFDs		Bird Guards
430, 520B , 31,5m	26° 08' 47.93" S	026° 49' 19.46" E	Pan	Construction	High	Mark with BFDs		Bird Guards
431, 520B , 30m	26° 08' 48.97" S	026° 49' 37.09" E	Pan	Construction	High	Mark with BFDs		Bird Guards
432, 520B , 31,5m	26° 08' 50.01" S	026° 49' 54.7" E	Grassland	Construction	High	Mark with BFDs		Bird Guards
433, 520B , 30m	26° 08' 51.05" S	026° 50' 12.34" E	Grassland	Construction	High	Mark with BFDs		Bird Guards
434, 520B , 31,5m	26° 08' 52.05" S	026° 50' 29.44" E	Grassland	Construction	High	Mark with BFDs		Bird Guards
435, 520B , 33m	26° 08' 53.12" S	026° 50' 47.62" E	Pan	Construction	High	Mark with BFDs		Bird Guards
436, 520B , 33m	26° 08' 54.13" S	026° 51' 4.72" E	Pan	Construction	High	Mark with BFDs		Bird Guards
437, 520B , 33m	26° 08' 55.16" S	026° 51' 22.36" E	Pan	Construction	High	Mark with BFDs		Bird Guards
438, 520B , 31,5m	26° 08' 56.17" S	026° 51' 39.57" E	Grassland	Construction	High	Mark with BFDs		Bird Guards
439, 520B , 30m	26° 08' 57.22" S	026° 51' 57.48" E	Grassland	Construction	High	Mark with BFDs		Bird Guards
440, 520B , 30m	26° 08' 58.21" S	026° 52' 14.26" E	Grassland	Construction	High	End marking with BFDs		Bird Guards
441, 520B , 31,5m	26° 08' 59.22" S	026° 52' 31.52" E						
442, 520B , 30m	26° 09' 0.25" S	026° 52' 49.12" E						
443, 520B , 31,5m	26° 09' 1.27" S	026° 53' 6.59" E						
444, 520B , 33m	26° 09' 2.3" S	026° 53' 24.22" E						
445, 517E , 30m	26° 09' 3.31" S	026° 53' 41.42" E						
446, 520B , 28,5m	26° 09' 10.15" S	026° 53' 55.1" E						
447, 520B , 28,5m	26° 09' 15.81" S	026° 54' 6.4" E						
448, 520B , 33m	26° 09' 23.14" S	026° 54' 21.06" E						
449, 520B , 33m	26° 09' 30.97" S	026° 54' 36.71" E						
450, 517E , 18,5m	26° 09' 37.27" S	026° 54' 49.3" E						
451, 520B , 25,5m	26° 09' 40.38" S	026° 55' 1.53" E	Pan & Irrigated cultivation	Construction	High	Start marking with BFDs		Bird Guards
452, 520B , 31,5m	26° 09' 44.24" S	026° 55' 16.72" E	Pan & Irrigated cultivation	Construction	High	Mark with BFDs		Bird Guards
453, 520B , 27m	26° 09' 48.43" S	026° 55' 33.2" E	Pan & Irrigated cultivation	Construction	High	End marking with BFDs		Bird Guards
454, 520B , 25,5m	26° 09' 52.12" S	026° 55' 47.7" E						
455, 520B , 30m	26° 09' 56.14" S	026° 56' 3.51" E						
456, 520B , 31,5m	26° 10' 0.43" S	026° 56' 20.42" E						
457, 520B , 27m	26° 10' 3.78" S	026° 56' 33.61" E						
458, 520B , 28,5m	26° 10' 7.58" S	026° 56' 48.53" E						
459, 520B , 33m	26° 10' 11.99" S	026° 57' 5.9" E						
460, 517E , 25m	26° 10' 15.23" S	026° 57' 18.68" E	Vulture Roost	Construction	High	Start marking with BFDs		Bird Guards
461, 520B , 27m	26° 10' 15.72" S	026° 57' 33.82" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
462, 520B , 25,5m	26° 10' 16.17" S	026° 57' 48.07" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
463, 517E , 18m	26° 10' 16.54" S	026° 57' 59.62" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
464, 520B , 27m	26° 10' 17.29" S	026° 58' 12.56" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
465, 520B , 28,5m	26° 10' 18.1" S	026° 58' 26.61" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
466, 520B , 28,5m	26° 10' 19.01" S	026° 58' 42.28" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
467, 520B , 24m	26° 10' 19.88" S	026° 58' 57.45" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
468, 520B , 25,5m	26° 10' 20.72" S	026° 59' 12.01" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
469, 520B , 28,5m	26° 10' 21.64" S	026° 59' 28.03" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
470, 520B , 30m	26° 10' 22.59" S	026° 59' 44.36" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
471, 520B , 31,5m	26° 10' 23.57" S	027° 00' 1.5" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
472, 520B , 33m	26° 10' 24.58" S	027° 00' 18.99" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
473, 520B , 30m	26° 10' 25.58" S	027° 00' 36.48" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
474, 520B , 30m	26° 10' 26.52" S	027° 00' 52.74" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
475, 520B , 31,5m	26° 10' 27.51" S	027° 01' 9.99" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
476, 520B , 30m	26° 10' 28.49" S	027° 01' 27.12" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
477, 517E , 21,5m	26° 10' 29.35" S	027° 01' 42.06" E	VULTURE COLLISION	Construction	High	Mark with BFDs		Bird Guards
478, 520B , 25,5m	26° 10' 27.83" S	027° 01' 55.07" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
479, 520B , 30m	26° 10' 25.94" S	027° 02' 11.35" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
480, 520B , 31,5m	26° 10' 24.01" S	027° 02' 27.9" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
481, 520B , 33m	26° 10' 21.9" S	027° 02' 45.94" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
482, 520B , 33m	26° 10' 19.99" S	027° 03' 2.33" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
483, 520B , 33m	26° 10' 17.99" S	027° 03' 19.47" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
484, 520B , 31,5m	26° 10' 16.04" S	027° 03' 36.17" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
485, 520B , 33m	26° 10' 14.01" S	027° 03' 53.58" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
486, 520B , 28,5m	26° 10' 12.03" S	027° 04' 10.56" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards

TOWER POSITION	LATITUDE	LONGITUDE	DESCRIPTION	PERIOD	RANKING	AVIFAUNAL MITIGATION 1 Collision (BFDs)	AVIFAUNAL MITIGATION 2	AVIFAUNAL MITIGATION 3
487, 520B , 31,5m	26° 10' 10.01" S	027° 04' 27.82" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
488, 520B , 33m	26° 10' 8.04" S	027° 04' 44.73" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
489, 520B , 31,5m	26° 10' 6.02" S	027° 05' 2.03" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
490, 520B , 30m	26° 10' 4.18" S	027° 05' 17.72" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
491, 520B , 28,5m	26° 10' 2.27" S	027° 05' 34.07" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
492, 520B , 31,5m	26° 10' 0.41" S	027° 05' 49.99" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
493, 520B , 28,5m	26° 09' 58.4" S	027° 06' 7.17" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
494, 520B , 25,5m	26° 09' 56.62" S	027° 06' 22.4" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
495, 520B , 24m	26° 09' 54.63" S	027° 06' 39.34" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
496, 520B , 33m	26° 09' 52.65" S	027° 06' 56.3" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
497, 520B , 28,5m	26° 09' 50.67" S	027° 07' 13.21" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
498, 520B , 31,5m	26° 09' 48.74" S	027° 07' 29.63" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
499, 520B , 30m	26° 09' 46.57" S	027° 07' 48.13" E	Vultures Roosting on existing power lines	Construction	High	Mark with BFDs		Bird Guards
500, 520B , 28,5m	26° 09' 44.6" S	027° 08' 4.98" E	River Crossing	Construction	High	Mark with BFDs		Bird Guards
501, 520B , 28,5m	26° 09' 42.66" S	027° 08' 21.55" E	River Crossing	Construction	High	Mark with BFDs		Bird Guards
502, 520B , 27m	26° 09' 40.97" S	027° 08' 35.9" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
503, 520B , 31,5m	26° 09' 39.2" S	027° 08' 51.04" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
504, 520B , 33m	26° 09' 37.39" S	027° 09' 6.39" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
505, 517E , 29,5m	26° 09' 35.64" S	027° 09' 21.38" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
506, 520B , 33m	26° 09' 31.8" S	027° 09' 38.37" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
507, 520B , 31,5m	26° 09' 28.04" S	027° 09' 55.06" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
508, 520B , 30m	26° 09' 24.19" S	027° 10' 12.11" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
509, 520B , 28,5m	26° 09' 20.52" S	027° 10' 28.38" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
510, 520B , 31,5m	26° 09' 16.82" S	027° 10' 44.79" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
511, 520B , 31,5m	26° 09' 12.94" S	027° 11' 1.95" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
512, 520B , 28,5m	26° 09' 9.36" S	027° 11' 17.83" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
513, 520B , 31,5m	26° 09' 5.75" S	027° 11' 33.8" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
514, 520B , 31,5m	26° 09' 1.71" S	027° 11' 51.72" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
515, 520B , 28,5m	26° 08' 58.17" S	027° 12' 7.38" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
516, 520B , 28,5m	26° 08' 54.65" S	027° 12' 22.96" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
517, 520B , 33m	26° 08' 50.86" S	027° 12' 39.72" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
518, 520B , 31,5m	26° 08' 46.91" S	027° 12' 57.2" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
519, 520B , 33m	26° 08' 43.11" S	027° 13' 14.03" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
520, 518D , 21m	26° 08' 39.61" S	027° 13' 29.5" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
521, 520B , 22,5m	26° 08' 47.13" S	027° 13' 37.43" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
522, 520B , 27m	26° 08' 56.59" S	027° 13' 47.4" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
523, 520B , 22,5m	26° 09' 5.63" S	027° 13' 56.94" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
524, 520B , 27m	26° 09' 15.72" S	027° 14' 7.58" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
525, 520B , 25,5m	26° 09' 25.78" S	027° 14' 18.2" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
526, 520B , 30m	26° 09' 36.61" S	027° 14' 29.62" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
527, 520B , 33m	26° 09' 48.04" S	027° 14' 41.68" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
528, 518C , 35m	26° 09' 58.25" S	027° 14' 52.46" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
529, 518C , 35m	26° 10' 2.91" S	027° 14' 57.38" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
530, 520B , 33m	26° 10' 5.27" S	027° 15' 15.07" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
531, 520B , 30m	26° 10' 7.18" S	027° 15' 29.48" E	Vulture Roost, Protected Area	Construction	High	Mark with BFDs		Bird Guards
532, 520B , 30m	26° 10' 9.38" S	027° 15' 45.98" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
533, 520B , 31,5m	26° 10' 11.63" S	027° 16' 2.91" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
534, 520B , 33m	26° 10' 13.84" S	027° 16' 19.56" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
535, 520B , 31,5m	26° 10' 16.17" S	027° 16' 37.09" E	Vulture Roost, Pan	Construction	High	Mark with BFDs		Bird Guards
536, 520B , 25,5m	26° 10' 18.21" S	027° 16' 52.45" E	Vulture Roost, Pan	Construction	High	Mark with BFDs		Bird Guards
537, 520B , 25,5m	26° 10' 19.99" S	027° 17' 5.83" E	Vulture Roost, Waterbody	Construction	High	Mark with BFDs		Bird Guards
538, 520B , 25,5m	26° 10' 21.84" S	027° 17' 19.79" E	Vulture Roost, Waterbody	Construction	High	Mark with BFDs		Bird Guards
539, 520B , 24m	26° 10' 23.58" S	027° 17' 32.85" E	Vulture Roost, Waterbody	Construction	High	Mark with BFDs		Bird Guards
540, 520B , 30m	26° 10' 25.51" S	027° 17' 47.39" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
541, 520B , 31,5m	26° 10' 27.78" S	027° 18' 4.5" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
542, 520B , 31,5m	26° 10' 30.08" S	027° 18' 21.8" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
543, 520B , 30m	26° 10' 32.35" S	027° 18' 38.96" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
544, 520B , 30m	26° 10' 34.51" S	027° 18' 55.26" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
545, 517E , 27m	26° 10' 36.66" S	027° 19' 11.44" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
546, 520B , 33m	26° 10' 38.85" S	027° 19' 28.77" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
547, 520B , 30m	26° 10' 40.97" S	027° 19' 45.61" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
548, 520B , 30m	26° 10' 43.1" S	027° 20' 2.52" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
549, 520B , 31,5m	26° 10' 45.28" S	027° 20' 19.77" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
550, 520B , 33m	26° 10' 47.46" S	027° 20' 37.05" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
551, 520B , 31,5m	26° 10' 49.62" S	027° 20' 54.2" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
552, 520B , 30m	26° 10' 51.82" S	027° 21' 11.66" E	Vulture Roost	Construction	High	End Marking with BFDs		Bird Guards
553, 520B , 31,5m	26° 10' 53.98" S	027° 21' 28.8" E						
554, 520B , 31,5m	26° 10' 56.12" S	027° 21' 45.83" E						
555, 520B , 30m	26° 10' 58.28" S	027° 22' 3.03" E						
556, 520B , 31,5m	26° 11' 0.44" S	027° 22' 20.15" E						
557, 520B , 30m	26° 11' 2.62" S	027° 22' 37.46" E	Pan	Construction	High	Start marking with BFDs		Bird Guards
558, 520B , 31,5m	26° 11' 4.77" S	027° 22' 54.59" E	Pan	Construction	High	Mark with BFDs		Bird Guards
559, 520B , 31,5m	26° 11' 7.0" S	027° 23' 12.28" E	Pan	Construction	High	End marking with BFDs		Bird Guards
560, 520B , 31,5m	26° 11' 9.16" S	027° 23' 29.46" E						
561, 520B , 28,5m	26° 11' 11.32" S	027° 23' 46.67" E						
562, 520B , 28,5m	26° 11' 13.33" S	027° 24' 2.67" E						
563, 517F , 18m	26° 11' 14.98" S	027° 24' 15.83" E						
564, 520B , 24m	26° 11' 23.06" S	027° 24' 23.48" E						
565, 520B , 27m	26° 11' 32.6" S	027° 24' 32.51" E						
566, 520B , 24m	26° 11' 42.23" S	027° 24' 41.64" E						
567, 517F , 20m	26° 11' 50.01" S	027° 24' 49.01" E						
568, 520B , 31,5m	26° 11' 51.8" S	027° 24' 58.94" E						
569, 520B , 22,5m	26° 11' 53.67" S	027° 25' 9.32" E	Vulture Roost	Construction	High	Start marking with BFDs		Bird Guards
570, 517E , 18m	26° 11' 55.24" S	027° 25' 18.08" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
571, 520B , 24m	26° 11' 56.09" S	027° 25' 24.57" E	Vulture Roost	Construction	High	Mark with BFDs		Bird Guards
572, 517E , 33m	26° 11' 57.84" S	027° 25' 37.85" E	Vulture Roost	Construction	High	End marking with BFDs		Bird Guards
573, 517F , 33m	26° 11' 59.04" S	027° 25' 45.2" E						
574, 518H , 33m	26° 12' 8.81" S	027° 25' 56.13" E	Pan	Construction	High	Start marking with BFDs		Bird Guards
575, 518H , 31,5m	26° 12' 16.03" S	027° 26' 4.22" E	Pan	Construction	High	Mark with BFDs		Bird Guards
576, 520B , 22,5m	26° 12' 25.24" S	027° 26' 14.55" E	Pan	Construction	High	Mark with BFDs		Bird Guards
577, 520B , 18m	26° 12' 33.93" S	027° 26' 24.27" E	Pan	Construction	High	End marking with BFDs		Bird Guards
578, 520B , 24m	26° 12' 42.4" S	027° 26' 33.77" E						
579, 518C , 35m	26° 12' 51.08" S	027° 26' 43.49" E						
580, 518C , 35m	26° 12' 51.67" S	027° 26' 50.32" E						
581, 520B , 27m	26° 12' 52.83" S	027° 27' 3.89" E						
582, 518D , 20m	26° 12' 53.65" S	027° 27' 13.47" E						
583, 518D , 20m	26° 12' 55.76" S	027° 27' 14.35" E						
Gantry, 400kV, 20m	26° 12' 56.72" S	027° 27' 13.88" E						

APPENDIX 2: ESKOM TRANSMISSION BIRD COLLISION PREVENTION GUIDELINE

Eskom Transmission	GUIDELINE	Disclosure Classification: CONTROLLED DISCLOSURE

Title:	TRANSMISSION BIRD COLLISION PREVENTION GUIDELINE	Unique Identifier:	41-335
		Area of Applicability:	T
		Document Type:	GL
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1 Introduction

A bird collision incident happens when a bird physically strikes either the overhead conductor or the overhead ground wire of a power line. In the case of transmission lines, the overhead ground wire is usually involved. It is generally accepted that birds usually avoid the highly visible bundled conductors but often fail to see the thin ground wire. In South Africa, bird collisions with Transmission lines are a major form of unnatural mortality among several threatened species. Research is ongoing to attempt to gauge the effect of this form of mortality on these species, especially cranes. Preliminary results indicate that the mortality could be unsustainable for regional population of species such as Blue Crane in the central Karoo. When a bird incident is recorded via the EWT helpline (0860111535) recommendations for mitigation will follow these guidelines.

2 Supporting Clauses

2.1 Scope

This document covers the subject of birds colliding with Transmission lines and gives information about the application of bird flight diverters (BFD).

2.1.1 Purpose

The purpose of this document is to describe the problem of bird collisions with transmission lines and to indicate which mitigation methods are available to address the problem.

2.1.2 Applicability

This guideline shall apply throughout Transmission Division.

2.2 Normative/Informative References

Parties using this guideline shall apply the most recent edition of the documents listed below

2.2.1 Normative

Anderson, M.D. 2001. The effectiveness of two different marking devices to reduce large terrestrial bird collisions with overhead electricity cables in the eastern Karoo, South Africa. Draft report to Eskom Resources and Strategy Division. Johannesburg. South Africa.

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2.3 Definitions

Red Data Species: A compilation of endangered wildlife species.

2.4 Abbreviations

EWT: Endangered Wildlife Trust

2.5 Roles and Responsibilities

The Line and Servitude managers of each Grid shall be responsible to ensure compliance with this document.

2.6 Implementation Date

The implementation date is April 2010.

2.7 Process for monitoring

The line and Servitude managers of each grids shall monitor servitudes for evidence of bird collisions and inform the EWT accordingly.

2.8 Related / Supporting Documents

N/A

3 Document Content

3.1 Document Specification

3.1.1 Background and extent of the problem of bird 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 water birds. 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 graph below shows the number of collisions reported per species on Transmission lines from August 1996 to present (EWT unpublished data). Most of the heavily affected species are Red Data species. It should be noted that these are only the reported mortalities, it is suspected that a large number of mortalities go unreported. It is also important to note that the mortalities recorded by Anderson (2001) as discussed below are not included in the graph below.

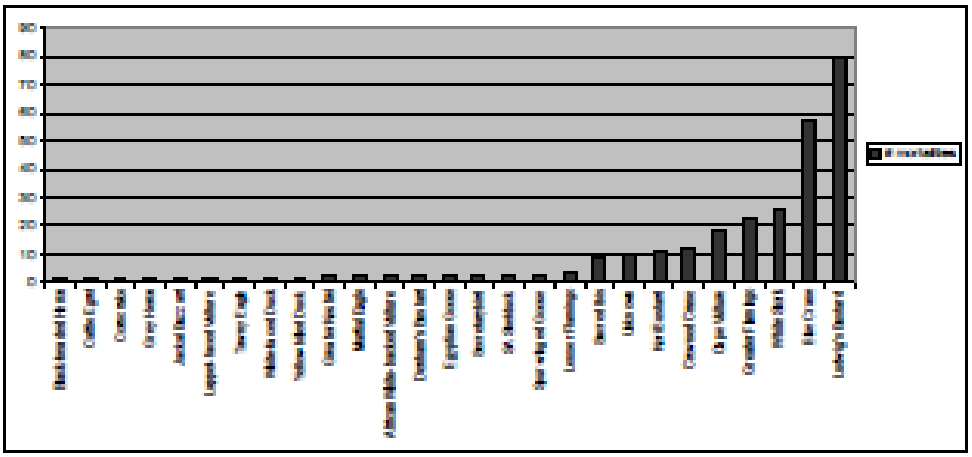


Figure 1: Number of reported collisions per species on transmission lines from August 1996 to the present (EWT unpublished data).

Although significant in itself, figure 1 is not a true reflection of the extent of the problem, because few of the collision localities were closely monitored over a substantial period of time. Where long term monitoring did happen, the picture is disturbing. In one instance, where bi-monthly monitoring did take place, a single 10 km section of 132kV distribution line killed 59 Blue Cranes, 29 Ludwig's Bustard, and 13 White Storks in a three year period (van Rooyen unpubl. data). In 2004, fifty-four Blue Crane carcasses were discovered near Graaf-Reinett in the Northern Cape province under 3.7km of distribution line.

Data collected in the Northern Cape province between 1997 and 1999 provides further evidence of the gravity of the problem. During an initial clearing of transects, a total of 194 large bird carcasses were found under 40km of Transmission line (220 and 400kV) near De Aar in the Northern Cape. Subsequent monitoring of 140 km of power lines (transects of 10km each from 22kV up to 400kV) in the same area over a period of 12 months produced another 196 carcasses (mostly cranes and bustards) the majority under transmission lines (Anderson 2001).

The Red Data species vulnerable to power line collisions are generally long-lived, slow reproducing species under natural conditions. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. A good example of this is the two flamingo species that occur in southern Africa, which have experienced hardly any successful breeding attempts at Etosha Pan in Namibia for several decades. Another example is the Great White Pelican that only breeds successfully at Dassen Island in the Western Cape. 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.

Using Vortex computer modelling, the South African Crane Working Group estimated that an annual mortality rate of 150 adult Blue Cranes could reduce the eastern population of Blue Cranes (app. 2000 individuals in Mpumalanga and KwaZulu-Natal) by 90% by the end of the 21st century (McCann *et.al.* 2001). At that stage the population would be functionally extinct.

From the figures quoted above, it is clear that power lines are a major cause of avian mortality among power line sensitive species, especially Red Data species.

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Furthermore, the cumulative effects of power lines and other sources of unnatural mortality might only manifest itself decades later, when it might be too late to reverse the trend. It is therefore imperative to reduce any form of unnatural mortality in these species, regardless of how insignificant it might seem at the present moment in time.

3.2 General Document Guideline

3.2.1 Solutions to the problems of bird collisions

3.2.2 Background

A measure that has been proved to be reasonably successful in reducing collisions is to fit the earth wire with anti-collision devices.



Figure 2: The installation of flappers on the shield wire from a helicopter.

Success rates of up to 60% reduction in mortality and even more have been documented (Ferrer and Janns, 1999). There are several devices available in southern Africa for the marking of power lines. These devices will be described below and the advantages and disadvantages discussed. The fitting of the marking devices are typically done from a helicopter, which adds considerably to the cost of any project.

3.2.3 Static Devices

Static devices are mechanically more durable than dynamic devices because they lack the element of wear and tear that moving parts inevitably have. However, in South Africa, static devices, particularly the so called Bird Flight Diverter (also known as the pigtail) has had limited success (Anderson 2001). The most obvious reason seems to be that they are simply less visible, especially the small ones (see figure 5). A better option would be to use the bigger pigtail (see figure 5, right), although it is still not the preferred option.



Figure 3: Example of static devices.

3.2.4 Dynamic Devices

Dynamic devices (usually called bird flappers), have moving parts as opposed to static devices where there are none.. Dynamic devices are very effective in reducing collisions as the birds seem to see them very well (van Rooyen unp. data) probably because of the movement that attracts attention. The disadvantage of dynamic devices is that they are subject to extensive wear and tear, inevitably limiting the lifespan of the device. Wear and tear has been observed on both those devices as well as recently on ADLASH optical fibres. In the latter case solution is in hand yet other than to avoid earth wires and placing devices on one shield wire only.



Figure 4: Examples of the dynamic bird flapper devices

This has obvious cost implications if a line needs to be re-marked at intervals of a few years. No solution to that problem has been found to date and it must be accepted as a constraint. Figure 4 shows examples of bird flappers currently available on the market.

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3.2.5 Reflective devices

A new product that shows great potential is the Inotec BFD88, a reflective stainless steel sphere of 70mm diameter. Experiments have shown the visibility of this device to be superior to coloured (red, yellow, white, black) objects especially during the low light conditions at dawn and dusk when birds may be flying from roosting areas to feeding areas and back. Due to the spherical shape, the device reflects any available light in all directions and is therefore visible from all directions including above or below the diverter. The diverter does not require direct sunlight and is effective during overcast conditions and the low light conditions before sunrise and after sunset (Van Rooyen, pers obs.) When viewed during these low light conditions the device is particularly visible against dark backgrounds such as the ground, trees or high ground. It is also particularly visible against bright cloud when viewed from below.



Figure 5: A Reflective Bird Diverter (left) installed on a line with conventional bird flappers (right).



Figure 6: An example of reflective diverters on a test line at dusk with white conventional bird flappers in between

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An option could be to string the Inotec NFD88 diverters close enough to form a dotted line on each earth wire on those spans crossing the river (see figure 6). Due to the relatively small size of the spheres, it would need to be spaced very close together to make it effective, maximum 5 metres apart on both earth wires.

3.2.6 Spacing intervals

Research in the Netherlands has shown that spacing intervals have a major influence on the effectiveness of anti-collision devices. In South Africa, the same has been found. See Figure 7 for a suggested marking method with Bird Flappers. In the case of the Inotec BFD88 diverters, a similar 5 metre interval is suggested.

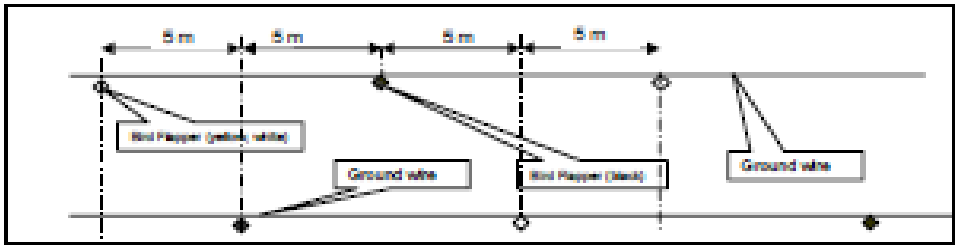


Figure 7: Marking method with Bird Flappers on overhead ground wires (viewed from above)

NB. It is important to alternate the colours (yellow-white) in order for maximum contrast.

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3.2.7 Portion of span to be marked

Only the middle 60% of each span needs to be marked as this is where most of the collisions occur.

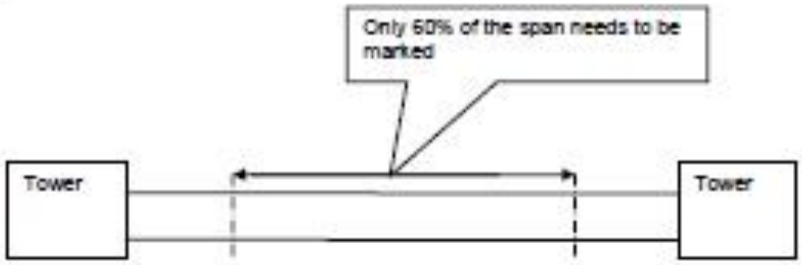


Figure 8: The section that needs to be marked

3.2.8 Illuminated devices

A specific problem is posed by birds that fly at night, for example flamingos that migrate great distances at night. A device is available for this problem, namely the Mace Bird Lite, which is a Perspex tube with a fluorescent tube inside.

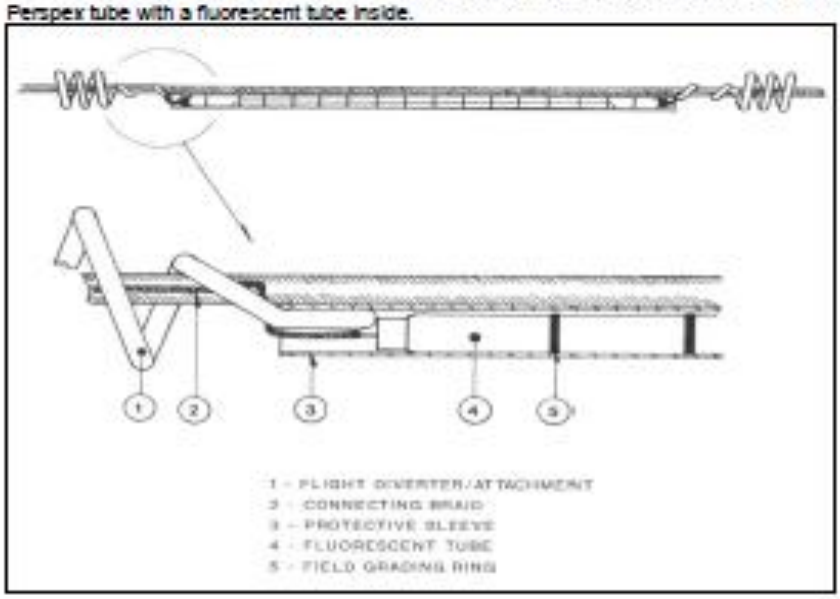


Figure 9: The Mace Bird Lite

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It is mounted on the overhead ground wire and the light is energized by the ambient electrical field generated by the conductors. It has been used in South Africa and Botswana and is reported to have worked well for curbing flamingo mortality on power lines. No scientific data is available on the effectiveness but it is generally claimed to be effective.

3.3 Revision Control

A contract exists between ESKOM Transmission and EWT for reporting of any wildlife interactions with the power lines including bird collision.

4 Authorisation

This document has been seen and accepted by:

Name	Designation
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J. Machinjike	GM (Grids)

5 Revisions

Date	Rev.	Remarks
November 2014	1	Review document and update to new format

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APPENDIX 3: ESKOM TRANSMISSION BIRD GUARD (BIRD PERCH) GUIDELINE

Eskom Transmission	GUIDELINE	Disclosure Classification: CONTROLLED DISCLOSURE

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1 Introduction

Various types of birds use power line structures for perching and nesting purposes. These structures often are the only (or superior) substrate.

The principle to be followed in perch management is not to prevent birds from roosting on towers, but rather to prevent them from roosting on critical parts of the tower. The provision of adequate alternative roosting space on the tower will enhance the success of the intervention.

2 Supporting Clauses

2.1 Scope

This document serves as a guideline with regards to the management of perching and roosting behaviour of large birds on Transmission lines. The presence of large birds and the associated streamer activity has a profound impact on quality of supply.

2.1.1 Purpose

The document helps the reader to identify streamer problems and suggests mitigation measures. It also specifies dimensions, materials and the attachment methods of bird guards.

2.1.2 Applicability

This document shall apply to all Transmission power line structures.

2.2 Normative/Informative References

2.2.1 Normative

ISO 9001:2000 Quality Management Systems

2.2.2 Informative

Refer to the latest research report published on Hyperwave.

2.3 Definitions

Perch management
This term refers to the method of managing the roosting and perching behaviour of large birds on Transmission towers and other structures. It is applied to prevent streamer faults and electrocutions on smaller lines. It is also used in conjunction with the management of nests on power lines. Whilst not intended, perch management also results in reduced pollution of insulators. Perch management is also used to prevent birds such as vultures from causing damage to fibre optic cables.

Micro fitting strategy
This term refers to the positioning of bird guards on specific parts of the tower.
This decision will be based on the particular design of the tower as well as the bird species that are targeted.

Macro fitting strategy
This term refers to the determination of which towers to fit with bird guards on a particular Transmission line. During the National Bird guard project, both comprehensive as well as partial fitting strategies were followed.

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2.4 Abbreviations

None

2.5 Roles and Responsibilities

The Line and Servitude Managers for each Grid shall be responsible for the installation of any bird guards in their respective Grids and for the implementation of this guideline.

2.6 Implementation Date

The implementation date is June 2010.

2.7 Process for monitoring

The Line and Servitude Managers for each Grid shall be responsible for the monitoring and application to this guideline.

2.8 Related / Supporting Documents

N/A

3 Document Content

3.1 Document Specification

3.1.1 Recognizing bird induced faulting: pollution vs. streamers

In generic terms, an electrical fault is caused by pollution, coupled with appropriate moisture, when pollutant build-up takes place on the insulator disks. The coating of pollutant (which could range from marine, agricultural or industrial pollution or to bird droppings) compromises the insulation properties of the insulator and under appropriate wet conditions, a phase-earth flashover may result ***across the insulator string.***

In the case of a bird streamer induced fault, the fault normally initiates on the live side hardware and it propagates vertically towards the tower. The fault appears to flash across the air gap and ***does not*** follow an insulator creepage path as observed on pollution faults.

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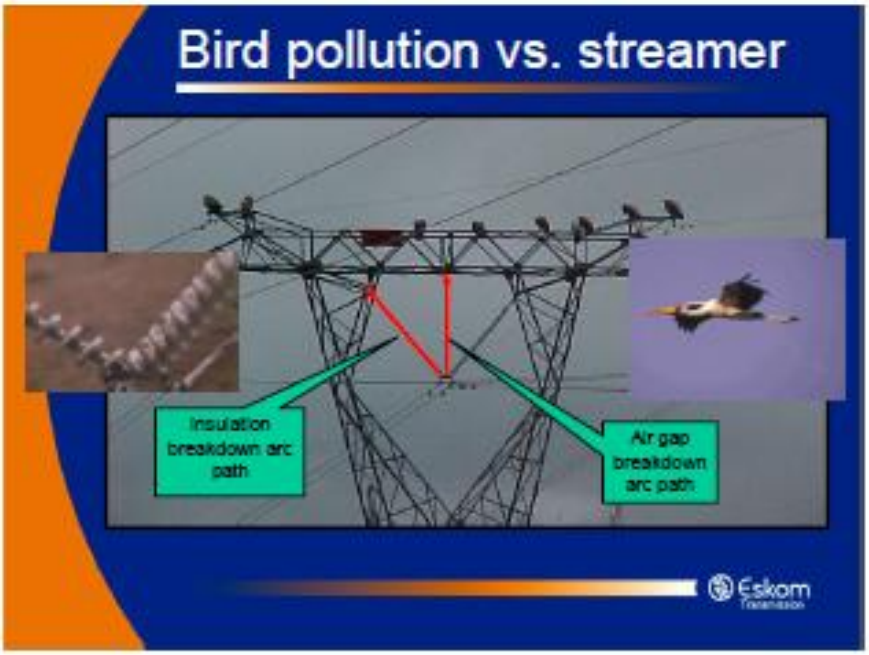


Figure 1: A picture showing the differences between a classical bird pollution vs streamer fault in a tower.

3.1.2 Typical indicators of bird streamer faulting problem

3.1.3 Position of flash marks

The flash marks of a bird streamer fault are highly characteristic, but difficult to spot. Typically, the flash marks will be situated on the steelwork directly above the live hardware and at the live end of the insulator string, i.e. on the yoke plate, first insulator disk or corona ring. *There are no burn marks at the dead end of the insulator as would be the case with a pollution-induced fault.* In the case of strain towers, the burn marks are similarly situated on the jumper cable and on the tower steelwork directly above.

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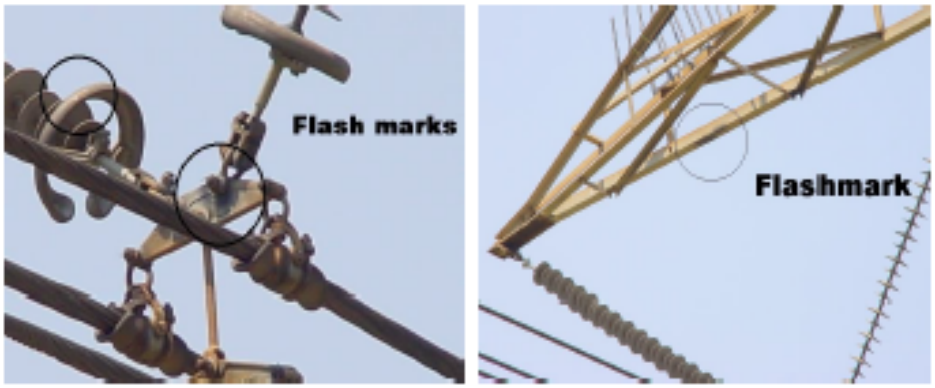


Figure 2: A figure indicating the flash marks caused by bird streamers on a live hardware (left) and earthed tower members (right).

3.1.4 Time of faults

Bird streamer faults follow a highly distinctive bimodal, temporal pattern with ***peaks usually occurring in the early evening between 18h00 and 23h00 and again in the morning, between 04h00 and 08h00.*** A possible explanation for this lies in the natural foraging behaviour of birds, in that they tend to forage away from the line during the day, returning in the early evening to roost until the next morning. It is important to note that the provision of artificial food sources, e.g. vulture feeding stations, could change the roosting behaviour of the birds and result in a changed pattern of faulting.

3.1.5 Window size

The window size determines the ***size of the air gap, which in turn influences the probability of a streamer induced flashover.*** In one instance, excessive faulting was experienced on one of the two parallel 400kV lines of similar design, with the only difference being that of 3.2m vs. 4.2m window size. Despite vultures utilizing both lines, faulting happened only on the line with the smaller air gap. The most likely explanation for this is that the streamer could not bridge the larger air gap.

3.1.6 Faulting Phase

A dominant faulting phase is a strong indication of bird streamer related faulting. **Bird streamer related faults tend to be prevalent on the phase which is situated below the *highest and/or most convenient* perching space on the tower.** On vertically configured designs, this usually results in the top phase (or phases in the case of double circuit towers) faulting disproportionately to the other phases , as the birds tend to roost on the highest cross-arm. With horizontally configured designs, the middle phase is usually the dominant faulting phase. In South Africa, the middle phase on 275kV self-supporting towers is the dominant bird streamer related faulting phase due to the tower design which makes is difficult for birds to roost above the outside phases.

3.1.7 Presence of certain bird species

Large predatory birds tend to create the biggest risk of flashovers. Species such as ***vultures, herons, certain ibises and stork species, eagles and large hawks*** are high risk species. The presence of these birds on the towers is a strong indicator that bird streamers faults could be present.

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Figure 3: Some of the better known birds which pose a streamer risk to Transmission lines.

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3.1.8 Presence of dead birds under towers

Although electrocution as a result of a bird streamer induced fault is a rare occurrence, however it does occur. If dead birds with burn marks are found under structures *with sufficient clearances to preclude any possibility of the bird having physically bridged the air gap with its body or wings*, it is a strong indication that it was electrocuted via a bird streamer flashover.

3.1.9 Clustering of faults in certain areas

The clustering of streamer faults in certain areas could point to birds being attracted to certain sections of the line. This could be related to *food* e.g. vulture feeding stations or recently burnt veld (herons), *wetlands* and/or *agricultural activity* or irruptions of insects or rodents. It could also be related to *nesting* activity on the towers e.g. heronries or large raptor nests or *topography* – vultures prefer to roost on towers that are situated on high topographical features such as hills and mountain ridges.

3.1.10 Bird droppings and pellets

The presence of *bird droppings* on electrical infrastructure is an indication that it is being used by birds for roosting purposes. Careful examination of the locality of the heaviest pollution could give an indication of where the favourite roosting spots are. The presence of *regurgitated pellets and prey remains* under transmission towers is also evidence that the structure is used by large birds for roosting. Analysis of the pellets can aid in the identification of the species.



Figure 4: Pictures showing the presence of bird droppings and dead remains underneath the tower.

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3.1.11 Seasonality of faults

Nesting habits: Seasonal upsurges in faults are often related to an influx of migratory or nomadic birds into an area. In South Africa, with a temperate climate, the ***onset of summer (the rainy season for most of the country) is associated with a significant increase in bird numbers and bird streamer faults.***

As a result of the highly dynamic nature of the presence of bird in the vicinity of power lines, it is recommended that a stock of bird guards be kept by the region to permit fast response when bird faults present themselves on lines not fitted with bird guards.

3.2 General Document Guideline

3.2.1 Fitting Strategies

3.2.2 Micro fitting strategy

The tower configuration and design will determine the placement of bird guards. Care must be taken not to create new perches for birds during the installation process. Bird guards installed on near vertical tower members will result in this situation.

3.2.3 Tower Design

The tower design plays a major role with respect to bird streamer related faults. Vertically configured designs with ***ample perching space on top of the tower away from the cross-arms***, experience fewer faults than horizontally configured designs. The reason for this is that with the latter, the birds roost relatively closer to the conductors, therefore increasing the risk of flashovers. With the former, depending on the design, the birds first utilize the available space on top of the tower, thereby reducing the risk of flashovers. Similarly almost ***no bird streamer faulting is experienced on the cross-rope suspension type towers***, presumably due to the unavailability of convenient perching space for birds above the conductors.

Transmission uses a variety of tower designs, with each design having as much as ten variations. As a result, broad guidelines will be given in this document. Final fitting strategies will have to be confirmed with subject specialist for final vetting.



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Figure 5: A picture showing the tower designs vulnerable to bird streamer faults.

Horizontal strain towers are the most vulnerable to streamer faults, followed by horizontal suspension towers. Delta towers are generally much less vulnerable with suspension towers being the least vulnerable.

Initial research showed that air gaps of just under one-meter, on either side of the conductor would be needed to protect from potential bird streamers. Because bird guards are made in lengths of 500mm, 750mm and 1000mm for practical reasons, fitting them **one meter** on both sides of the centerline of the conductor has become the standard at all voltages. (Refer to **critical distance** in picture below). No gap of greater than 150mm should be left between two adjacent bird guards.

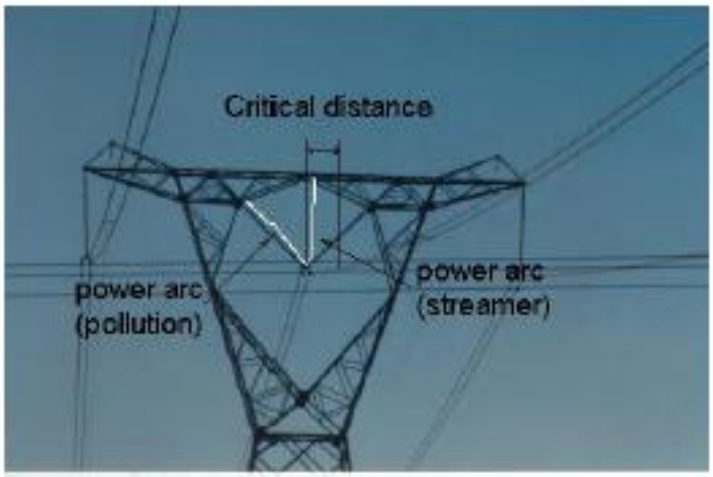


Figure 6 : A distance of one meter either side of the conductor is regarded as critical in protection against streamer faults.

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3.2.4 Fitting on Outer Phases

Experience revealed that faults occurred on the outer phases where the landing plates were not fully protected, which left roosting space for birds. Care must be taken not to leave any roosting space at the outer phase extremes of towers.



Figure 7: Picture of incorrect fitting leaving the landing plates exposed

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3.2.5 V-strings and I-strings

Although V-strings on centre phases were originally thought of as more vulnerable to streamer faults than the I-strings, experience has now shown that the latter are equally vulnerable and should also be protected with bird guards.

3.2.6 Protecting the inside of the boat

Faults have also occurred where birds had entered and roosted inside the boat of the tower. Hadeda Ibis and Black Eagle in particular have been observed exploiting the inside of the boat or lattice member within the critical area, which was not fitted with bird guards.

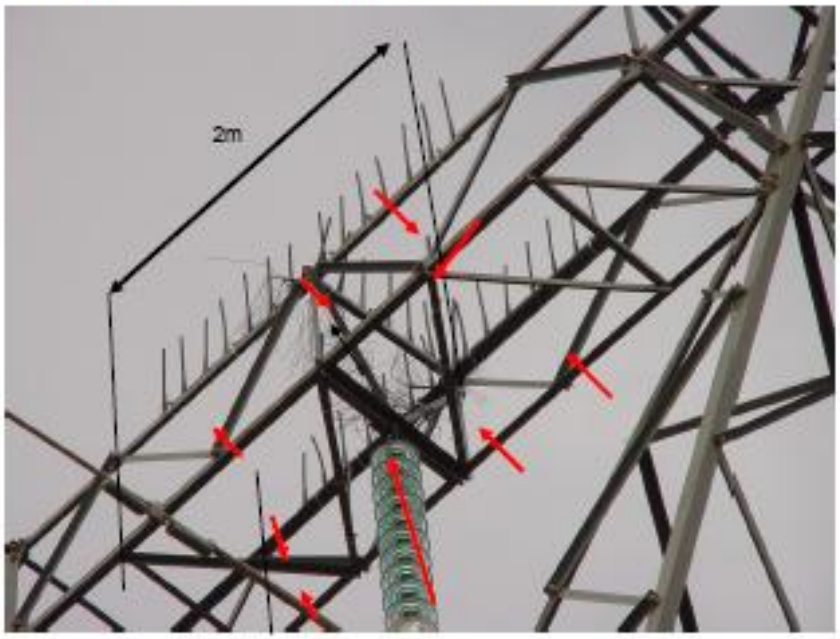


Figure 8: A picture showing an example of insufficient fitting on inside of boat indicated by the red arrows.

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Figure 9: Comprehensive fitting strategy as implemented on the Hendrina- Kriel 400kV line.

3.2.7 Macro fitting strategy

Whilst a comprehensive fitting strategy is the safest, it also carries a high cost. Results from partial fitting were generally good when comparing risk of streamer fault with cost of installation. It must be pointed out that dependable knowledge of the habitat through which the line runs is critical when partial fitting of a line is contemplated.

The decision to fit bird guards to a line is in the first instance an economical one. It is based on

- the dip sensitive load that the line carries and the effect that these faults are having on the customers and
- the number of bird faults that it experiences (determined from its fault history) .

Secondly, the habitat through which the line passes and the bird species present in that habitat, and more specifically their behaviour, influences the macro fitting strategy. Bird behaviour refers to aspects such as migration, feeding and roosting habits. This strategy is affected by topography, land use, and type and availability of food sources. The help of subject specialist should be used in this regard.

3.2.8 Consideration of adjacent lines

It has been reported that where bird guards resulted in a decrease of roosting space, birds have moved to adjacent lines and streamer faults have occurred there. The increase in birds (and streamer faults) must however also be seen against the influence of wet weather cycles or other phenomena and the general increase in bird population numbers for an area. It is recommended that these factors be considered where lines without bird guards run adjacent to the targeted line.

3.2.9 Special circumstances

Results to date on lines that have been fitted with bird guards have resulted in an average of 80% reduction in bird faulting, and some lines have had a 100% reduction in bird related faulting. It is important to note bird guards are not a 100% solution under all circumstances, isolated instances have been recorded where birds have managed to wedge themselves between bird guards. These incidents

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are always associated with extreme densities of birds on a particular tower or towers, and are often associated with super-abundance of food. To date the following examples have been recorded:

- Cape Vultures roosting in large numbers on towers at a vulture restaurant. The birds are very large and if they repeatedly force themselves between the bird guards, it will eventually result in bird guards collapsing.
- Large concentrations of Black-headed Herons have been observed on the Nyl River floodplain after the annual flooding. These birds roost in large numbers on the towers during this period, and individuals have managed to wedge themselves between the bird guards when many birds are roosting on one tower.
- One incident has been recorded where a Bald Ibis roosted in a steel bird guard. These birds habitually roost on transmission towers in large numbers and it must be assumed that that could happen, especially as the steel bird guards have bigger gaps between the rods than the plastic bird guards. It is not clear at this stage whether the same will happen with the standard plastic bird guards.

Special circumstances require special solutions, and each incident must be investigated with the help of an ornithologist to arrive at a solution. In doing so it must also be considered whether the level of faulting caused by these "special events" justifies the cost and effort to device a solution that will result in a 100% elimination of faults, especially if the faulting levels are very low and restricted to a short period of time each year."

3.2.10 Bird guard specifications

General specifications for bird guards are listed below

The types of devices to be used will prevent birds from perching on transmission structures by forming a barrier to birds on the affected parts of the structure. The device will consist of a base with upright shafts as described below and will have no moving parts or anything else that will harm birds. Three devices have been used successfully as part of the National bird guard project and are recommended for future use. These are:

- BeeTee Bird guard.
- Mission Bird guard
- Lulatec Bird guard

The latter company no longer manufactures bird guards.

3.2.11 General aspects

The device required is intended to prevent birds from perching on designated areas of power pylons. It should consist of a square base with upright prongs and should be made from a long life, non-conductive material and should not pose any danger to live line workers or birds. An organic polymer such as high-density polyethylene should be used. These polymers should be treated to enable it to withstand typical environmental conditions found in South Africa for a period in excess of 15 years.

3.2.12 Dimensions

The device should come in three lengths: 500mm, 750mm and 1000mm. The vertical rods should be about 500mm high, with a spacing of between 125-190mm and an outside diameter of about 20mm. The base should have dimensions of 40mmx40mm.

3.2.13 Materials to be used

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The raw materials used by the manufacturer of bird guards should be sourced from a reputable supplier who shall issue a guarantee with regards to:

- the chemical composition of the materials (DOW HDPE M5010 or similar)
- the additives for ensuring suitable life of the product and estimated life. (The Ciba stabilizing system consisting of 2% minimum level of pigment type carbon black, Irganox B225 @ 0,1% and Tinuvin T783 @ 0,4% or similar system should be used. Eskom will have to approve the stabilizing system before production starts.)

- the proper blending of the raw material with UV inhibitors and other additives, that they supply. the manufacturing process that is followed must be sanctioned by the Supplier and Eskom to ensure quality of the product. This includes the adding of any non-virgin material. Not more than 10% of own reground material will be permitted.

3.2.14 Quality assurance

All devices shall carry a batch number and date. Eskom must be able to determine the materials used for the manufacture of the particular batch.

Unannounced, random samples of the materials may be taken during the processing for testing. Contracts will be terminated with any manufacturer that does not comply with the quality standards, and costs will be recovered for the removal and refitting of bird guards of a suitable quality. Ciba can do analysis of samples.

Rapid aging and other tests will be required that will indicate the specific properties of the device. Refer to details below. The device should be mechanically sound.

An ongoing programme should be followed to observe and track any deterioration of bird guards.

3.2.15 Attachment Methods

Due to the variety in tower designs it is not possible to be prescriptive with respect to the installation of bird guards. The information below is therefore presented so the installer can make the best possible choice during the installation process.

The conventional method of fitting bird guards is by means of stainless steel straps as shown in Figure 11. This method is effective but has the disadvantage that the guards can only be removed during live line work by cutting the strap. This results in a situation where in some instances bird guards are removed and not replaced by live line teams (damage to bird guards caused during the installation of optical fibre cables, for instance, have been reported). Poor attachment has been observed as the single biggest reason for failure of bird guards as shown in Figure 12.

In order to facilitate live-line work, quick release straps were designed and manufactured by a number of suppliers. These however are expensive and sometimes not efficient if not installed properly.

The number of straps per bird guard varies depending on the specific tower, size of the member and the position on the tower. Installers should ensure that the bird guard is securely attached to the tower member. As a general rule the following guidelines may be used:

Length	Number of straps
One meter	3
750 mm	2
500mm	2

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Figure 10: An example of a quick release strap

These straps permit the partial removal of the bird guard by relaxing the tension on the strap and by pushing the guard out of the way but without causing it to fall from the tower. Upon completion of the work, the bird guard is returned into position and the strap is re-tensioned.

Bird guards may selectively be attached by means of a quick release mechanism in areas where live line work is anticipated. This mechanism should enable live line workers to move the bird guard out of the way but without the device being able to drop from the top of the tower or onto the conductors.

Alternative UV protected polymer straps are also used by overseas companies. It must be pointed out that conventional cable ties look the same as the UV protected straps but have a very short life. These conventional cable ties must therefore not be used and only certified UV protected polymer straps are permissible.

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Figure 11: An example of a stainless steel strap and tensioning tool.



Figure 12: The arrow indicates an example of a poorly installed bird guard.

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Another problem associated with poor installation is caused by bird guards being placed on top of bolts and nuts or where the angle iron is taller than the bird guard. This has the effect that the bird guards are not held in place by the strap. American companies have developed a clip that raises the bird guard, provides a firm base and allows the device to be strapped securely. These clips may be obtained from Mission Environmental.



Figure 13: Plastic clips lift the bird guard above obstructions such as bolts and nuts and also improves the ability of the strap to hold the bird guard next to angled members of the tower.

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3.3 Revision Control

4 Authorisation

This document has been seen and accepted by:

Name	Designation
W. Majola	GM (Asset Management)
J. Machinjike	GM (Grids)
R. Gamede	Acting GM(Engineering and Projects)

5 Revisions

Date	Rev.	Remarks
November 2014	1	Review document and update to new format

6 Development team

H.F.Vosloo
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S. Mansingh
Ravi Govender
B Vockerodt
B Phewa
Eric Greyling
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SPECIALIST CV

MEGAN
DIAMOND

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Megan Diamond

PROFILE

Ms. Megan Diamond completed a Bachelor of Science degree in Environmental Management from the University of South Africa and has been involved in conservation for 20 years. During her tenure at the Endangered Wildlife Trust's Wildlife & Energy Programme and the Programme's primary project (i.e. the Eskom-EWT Strategic Partnership) from 2006 to 2013, she was responsible for assisting the energy industry and the national utility in minimising the negative impacts, associated with the construction and operation of electrical infrastructure, on wildlife through the provision of strategic guidance, risk and impact assessments, training and research. Megan currently owns and manages *Feathers Environmental Services*, an avifaunal consultancy that provides guidance to industry through the development of best practice procedures and avifaunal specialist studies for various developments including renewable energy facilities, power lines, power stations and substation infrastructure in addition to railway infrastructure and residential properties within South Africa and elsewhere within Africa. Megan has attended and presented at several conferences and facilitated workshops, as a subject expert, since 2007. Megan has authored and co-authored academic papers, research reports and energy industry related guidelines, including the *BirdLife South Africa/ Endangered Wildlife Trust best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa* and the *Avian Wind Farm Sensitivity Map for South Africa* (2015), and played an instrumental role in facilitating the endorsement of these two products by the South African Wind Energy Association (SAWEA), IAIAsa (International Association for Impact Assessment South Africa) and Eskom. She chaired the Birds and Wind Energy Specialist Group in South Africa (2011/2012) and the IUCN/SSC Crane Specialist Group's Crane and Power line Network (2013-2015), a working group comprised of subject matter experts from across the world, working in partnership to share lessons, develop capacity, pool resources, and accelerate collective learning towards finding innovative solutions to mitigate this impact on threatened crane populations. I am currently a member of the IUCN Stork, Ibis and Spoonbill Specialist Group and the Eskom-EWT Strategic Partnership Ludwig's Bustard Working Group, in addition to an Eskom-led working group that will result in the development of a national standard and specification for all Medium Voltage power lines constructed both in South Africa and across the continent.

PERSONAL DETAILS

Date of Birth | 7 December 1978
Driver's License | Code A and B
Home Language | English
Other Languages | Afrikaans

EDUCATION

BSc Environmental Management | University of South Africa (UNISA)
2002 – 2009

ACCREDITATION

South African Council for Natural Scientific Professions | Environmental Science
REGISTRATION NUMBER: 300022/14

EXPERIENCE

Director & Avifaunal Specialist | Feathers Environmental Services
JULY 2013 – PRESENT

* Perform specialist avifaunal assessment studies to minimise the impact of industrial infrastructure on birds and their habitats;
* Provide strategic guidance to industry through the development of best practice procedures and guidelines;
* Review and comment on methodologies, specialist studies and EIA reports for Renewable Energy projects;
* Provide input into renewable energy and power line developments elsewhere in Africa and internationally;
* Attendance of specialist integration meetings;
* Stakeholder liaison;
* Manage the collection and collation of relevant and complete desktop and/or field datasets;
* Manage pre- and post-construction avifaunal monitoring data collected at wind and solar energy facilities;
* Site assessments, either as part of the project team or independently; and
* Preparation of reports according to project deadlines, including the use of Geographic Information Systems (GIS) to portray data.

Wildlife & Energy Programme Manager | Endangered Wildlife Trust
OCTOBER 2006 – JUNE 2013

Programme management

* Annual review of the programme's conservation and research strategic objectives in accordance with the EWT's and programme's vision and mission
* Compile and manage programme budgets, monthly reports, work plans and strategy;
* Formulate, prioritise and approve relevant research and conservation projects;
* Ensure quality delivery of all projects and their outputs;
* Participate in international network liaison;
* Produce regular popular articles & media releases on programme projects and outputs;

* Establish and maintain a network with relevant national & international stakeholders;
* Deliver presentations at relevant meetings, functions, workshops & conferences on behalf of the programme; and
* Identify & establish partnerships to achieve conservation goals.

Eskom –EWT Strategic Partnership

* Effective and sustainable management of the strategic partnership against its goals;
* Manage staff in this division;
* Develop and maintain relationships with Eskom;
* Negotiate the terms of reference for the annual service level agreements between EWT and Eskom, to ensure the sustainability of the relationship;
* Compile annual report to Eskom Corporate Environment and Sustainability;
* Produce monthly reports to Eskom's regional grids on the status of incident follow-up;
* Attend applicable forums to interact with Eskom stakeholders;
* Participate in international network liaison;
* Maintain a network with all relevant local and regional level stakeholders through meetings, forums and workshops;
* Identify research needs relating to the management of wildlife interaction with power lines;
* Conduct research projects on wildlife and power line interaction and present the results at national and international conferences and workshops;
* Development and implementation of training for Eskom field services staff (at various levels) in the management of wildlife interactions; and
* Conduct special investigations on power lines relating to wildlife induced faulting.

Environmental Impact Assessment Division

* Ensure that this division operates effectively and efficiently at all times and manage staff in this division; and
* Conduct specialist avifaunal studies for new power lines developments including: tendering/quoting for the projects, conducting field work, preparing reports, presenting results & negotiating the acceptance of recommendations, final "walk through" as part of Environmental Management Plans; general project management, all liaison with clients, Eskom, authorities, Interested and Affected Parties etc.

Programme Administrator & Assistant Research Officer | TRAFFIC East/Southern Africa: South Africa
AUGUST 2002 – SEPTEBER 2006

* Providing administrative support to the Project Manager & National Representative
* Co-coordinating and reporting to the Project Steering Committee and the Donor (DANIDA) on a budget of R3,5 million.
* The completion of data-capture process for the CITES permit database as well as assisting with the transformation of the permit database from DBase into Microsoft Access format.
* Liaise directly with Government environmental departments, regarding permit collection and queries.
* Providing information relating to CITES permits wildlife trade to interested parties i.e. Government departments and Provincial Nature Conservation authorities.
* Assisting the National Representative and Programme Officers of TRAFFIC East/Southern Africa: South Africa with their research or other general work as directed.

Front of House Manager/Receptionist/Reservationist| Lion Sands Private Game Reserve
OCTOBER 2001 – MAY 2002

- Co-ordination and management of reception staff, shift schedules and leave cycles.
- Data capturing, statistics, guest liaison and orientation, collation of guest accounts, relevant administration and documentation flow.
- Training and development of frontline staff. Switchboard, Reception and Reservations duties

Personal Assistant| Appliance Trend Setters
MAY 2000 – SEPTEMBER 2001

- PA duties in addition to conducting the book keeping requirements of the company

CONFERENCE ATTENDANCE

- Society for Conservation Biology 21st Annual Meeting (1-5 July 2007)
- The 6th TAWIRI Scientific Conference (3 – 6 December 2007) **Presented a paper titled "Co-operative management of wildlife and power line conflicts: an African solution"**
- Pan-African Ornithological Congress (7-12 September 2008)
- International Conference on Overhead Lines, Design, Construction, Inspection & Maintenance, Fort Collins Colorado USA. (29 March – 1 April 2010) **Presented a paper titled "Bird's eye view: how birds see is key to avoiding power line collision"**
- Windaba 2011 – Implementing South African Wind Energy (27-29 September 2011)
- Pan African Vulture Summit (16-20 April 2012) **Presented a paper titled "Electrification in Africa – Are our vultures being strung along"**
- 4th Wind Power Africa Conference & Renewable Energy Exhibition (28-30 May 2012) **Presented a paper titled "Wind Energy in Africa – what does this really mean for our continent's birds"**
- 13th Pan-African Ornithological Congress (14-21 October 2012) **Presented a paper titled "Stringing South Africa's Terrestrial Birds Along - Monitoring of Bird Interactions with Power Line and Experimental Testing of Bird Collision Mitigation at the Karoo Long Term Monitoring Site"**
- AEWA Single Species Action-Planning Workshop for the Conservation of the Grey Crowned Crane (10-13 September 2013) **Presented and participated in the workshop as a subject expert (energy and bird interactions)**

AUTHORED & CO-AUTHORED PAPERS

Jenkins, A.R., Smallie, J. & **Diamond, M.** 2009. Balls, flashers, flappers and coils: South African perspectives on a global search for ways to prevent avian collisions with overhead lines. In: Harebottle, D.M., Craig, A.J.F.K., Anderson, M.D., Rakatomonana, H. & Muchai, M. (eds). Proceedings of the 12th Pan-African Ornithological Congress, 2008. Cape Town, Animal Demography Unit.

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Retief, E.F., **Diamond, M**., Anderson, M.D., Smit, H.A., Jenkins, A.R., Brooks, M. 2011. Avian Wind Farm Sensitivity Map for South Africa.

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industry: sustainable management of large raptors nesting on power infrastructure. Bird Conservation International (2013) 23:232 – 246.

Diamond, M., Harris, J., Mirande, C. and Austin, J. 2014. People of a feather flock together: A global initiative to address crane and power line interactions. 13th North American Crane Workshop Summary. Lafayette, Louisiana.

Page-Nicholson, S., Tate, G., Hoogstad, C., Murison, M., **Diamond, M.**, Blofield, A., Pretorius, M., Michael, M.D. 2018. Mitigating the Impact of Large Mammals on Wooden Electrical Distribution Poles in the Kruger National Park, South Africa. African Journal of Wildlife Research.

Diamond, M. and Hoogstad, C. (in press) Collisions and habitat loss associated with utility lines and wind turbines. IUCN SSC Crane Specialist Group – Crane Conservation Strategy.

REFERENCES

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