OCTOBER 2016

ETNA-TRADE ROUTE 88KV POWER LINE DEVELOPMENT

SPECIALIST AVIFAUNAL IMPACT ASSESSMENT

DRAFTED BY:
MEGAN DIAMOND
FEATHERS ENVIRONMENTAL SERVICES
P.O. BOX 786962, SANDTON, 2146
MEGAN@FEATHERSENV.CO.ZA

PREPARED FOR:
MASALA MAHUMELA
NSOVO ENVIRONMENTAL CONSULTING
748 RICHARDS DRIVE
ELITE PARK, HALFWAY HOUSE, 1685
MASALA.MAHUMELA@NSOVO.CO.ZA

PROFESSIONAL EXPERIENCE

Megan completed a Bachelor of Science degree in Environmental Management from the University of South Africa and has been involved in conservation for 17 years. She has ten years worth of experience in the field of bird interactions with electrical infrastructure and during this time has completed impact assessments for at least 50 projects. In various roles (including Programme Manager) with the Endangered Wildlife Trust's Wildlife & Energy Programme and the Programme's primary project (Eskom-EWT Partnership) from 2006 to 2013, Megan was responsible for assisting the energy industry and the national utility in minimising the negative impacts (associated with 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 strategic guidance to industry through the development of best practice procedures and guidelines, reviewing and commenting on methodologies, specialist studies and EIA reports for Renewable Energy projects and well as providing specialist avifaunal input into renewable energy and power line developments within South Africa, elsewhere in Africa and across the globe. In addition, Megan has attended and presented at several conferences and facilitated workshops, as a subject expert, since 2007. Megan is a co-author of 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* 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. In 2011/2012, she chaired the Birds and Wind Energy Specialist Group in South Africa. From 2013 to 2015, Megan chaired the IUCN/SSC Crane Specialist Group's Crane and Powerline Network, 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.

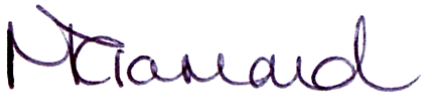
DECLARATION OF INDEPENDENCE

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

- Act as an independent specialist to Nsovo Environmental Consulting 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 Environmental Impact Assessment Regulations, 2010.
- 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 proposed 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 Environmental Impact Assessment Regulations, 2010.

INDEMNITY

- This report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken.
- This report is based on a desktop investigation using the available information and data related to the site to be affected; and a one day site visit to the study area on 22 October 2016. No long term investigation or monitoring has been conducted.
- The Precautionary Principle has been applied throughout this investigation.
- 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 specialist investigator 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 specialist investigator as specified above.
- Acceptance of this report, in any physical or digital form, serves to confirm acknowledgment of these terms and liabilities.



31 October 2016

EXECUTIVE SUMMARY

Eskom proposes to construct an 88kV power line, extending from the existing Etna and Lehae Substations to the Trade Route substation (currently under construction) located in the City of Johannesburg Metropolitan Municipality area, near Lenasia. Feathers Environmental Services was appointed to compile a specialist avifaunal assessment for the site earmarked for the proposed power line development.

The study area is located within the Grassland & Savanna Biomes and is comprised of the Carletonville Dolomite Grassland, Soweto Highveld Grassland and Gauteng Shale Mountain Bushveld vegetation types. Investigation of the immediate study area revealed the presence of grassland, woodland, waterbodies (rivers, dams, wetlands and drainage lines), rocky outcrops, urban areas and stands of Eucalyptus trees. The most sensitive of the micro habitats within the study area is the waterbodies and woodland vegetation which provide foraging and roosting habitat for the large diversity of waterbird and passerine species recorded in the area.

A fairly wide diversity of species (305 species) could be found in the broader area within which this site falls based on existing data sources. Although eight Red List species have been recorded in the broader study area, most of the site is already relatively highly impacted upon by human activities and the likelihood of these species utilizing the site is considered to be low for most species. This is particularly true of the Red List species, of which only a handful are likely to frequent the site itself.

In general terms, the impacts that could be associated with a project of this nature are: collision of birds on certain sections of the lines, particularly in the open grassland-type habitat and wetland areas; electrocution of large birds perched on the poles; destruction of habitat, and disturbance of birds. Relevant to this study area, these impacts are rated as being of low to medium significance as a result of relatively high existing levels of habitat degradation and disturbance and the low reporting rates for power line sensitive Red List species.

Taking the above information into account, it is anticipated that the proposed Etna – Trade Route 88kV power line development can proceed with acceptable levels of impact on the resident avifauna subject to the following recommendations:

- Small sections of power line marking will be required to mitigate for the collision impact, particularly in those areas that contain wetlands, dams and small waterbodies.
- The correct pole structure must be utilized to avoid electrocution.
- Construction activity should be restricted to the immediate footprint of the infrastructure.
- The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned.
- In addition to this, the normal suite of environmental good practices should be applied, such as ensuring strict control of staff, vehicles and machinery on site and limiting the creation of new roads as far as possible.

TABLE OF CONTENTS

1. INTRODUCTION

In order to fulfil their mandate of providing a high quality supply of electricity to support annual load growth and improve the operational flexibility of the existing network, Eskom proposes to construct a nine kilometre 88kV double circuit power line (to be constructed with 132kV specifications), connecting the existing Etna and Lehae substations to the Trade Route substation, which is currently under construction. The development of this power line will replace the existing 88kV power line extending from the Etna substation to the suburb of Lenasia. The existing power line will be decommissioned and the proposed power line will be constructed within the existing servitude. The project is located in Gauteng in the City of Johannesburg Metropolitan Municipality area (FIGURE 1).

The National Environmental Management Act (NEMBA) (Act 107 of 1998) requires that environmental assessments be conducted for any development which could have a significant effect on the environment, with the objective to identify, predict and evaluate the actual and potential impacts of these activities on ecological systems; identify alternatives; and provide recommendations for mitigation to minimize the negative impacts. In order to meet these requirements, Eskom Distribution has appointed Nsovo Environmental Consulting as independent environmental assessment practitioners to manage the Basic Assessment process for the proposed development. Feathers Environmental Services was subsequently appointed to compile a specialist avifaunal assessment report (based on a desktop review and a one-day site visit) which uses a set methodology and various data sets (discussed elsewhere) to determine which avian species regularly occur within the study area, the availability of bird micro habitats (i.e. avifaunal sensitive areas) and the possible impacts of the proposed development. In general terms, the impacts that could be associated with a project of this nature include: The collision of birds with the overhead cables; electrocution; and displacement of birds as a result of loss of habitat and disturbance.

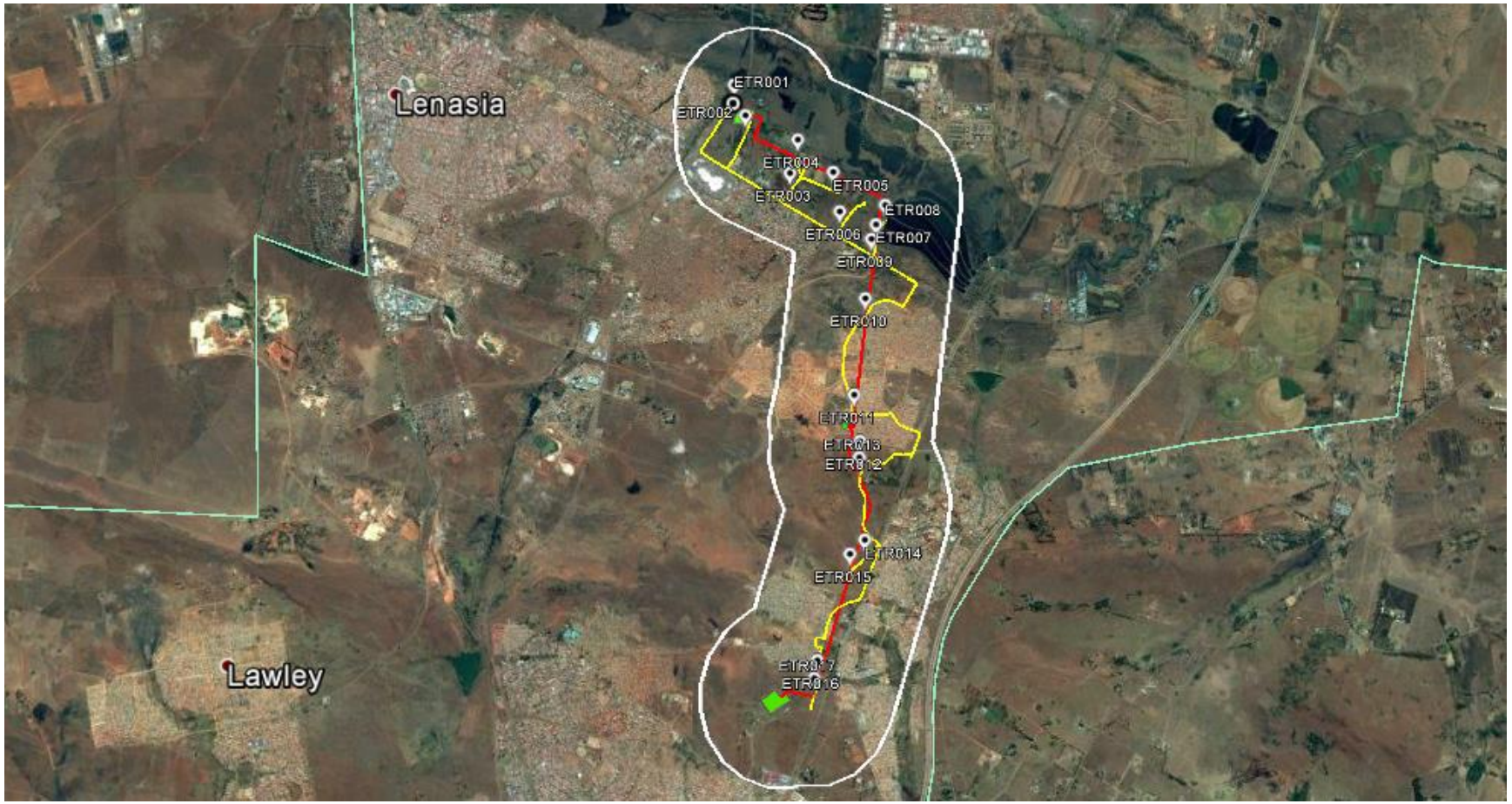


FIGURE 1: Geographical location of the study area and the proposed route alignment.

Proposed Etna-Trade Route 88kV power line = red line
Substation Sites = green polygons
2km Buffer = white polygon
Track Log (site visit – 22 October 2016) = yellow line
Survey points = white markers.

2 RELEVANT LEGISLATION AND GUIDELINES

The following pieces of legislation are applicable to the proposed development:

2.1 THE CONVENTION ON BIOLOGICAL DIVERSITY

The Convention on Biological Diversity is an international convention (to which South Africa is a signatory) and represents a commitment to sustainable development. The Convention has three main objectives: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources (http://www.cbd.int/convention/guide/). Although the convention has not developed specific recommendations or guidelines pertaining to birds and energy infrastructure interactions and impacts, it does make provision (in a general policy guideline) for keeping and restoring biodiversity. In addition to this the CBD is an ardent supporter of thorough assessment procedures (Strategic Environmental Assessments (SEA) and Environmental Impact Assessments (EIA)) and requires that Parties apply these processes when planning activities that will have a biodiversity impact. An important principle encompassed by the CBD is the precautionary principle which essentially states that where serious threats to the environment exist, lack of full scientific certainty should not be used a reason for delaying management of these risks. The burden of proof that the impact will *not* occur lies with the proponent of the activity posing the threat. In addition, the Aichi Biodiversity Targets (CBD 2011) address several priority issues i.e. the loss of biodiversity and its causes; reducing direct pressure on biodiversity; safeguarding ecosystems, species and genetic diversity and participatory planning to enhance implementation of biodiversity conservation. Each of these is relevant in the case of energy infrastructure and bird conservation through all project phases from planning to the implementation of mitigation measures for existing developments.

2.2 THE CONVENTION ON THE CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or the Bonn Convention) is an intergovernmental treaty and is the most appropriate instrument to deal with the conservation of terrestrial, aquatic and avian migratory species. The convention includes policy and guidelines with regards to the impacts associated with man-made infrastructure. CMS requires that Parties (South Africa is a signatory) take measures to avoid migratory species from becoming endangered (Art II, par. 1 and 2) and to make every effort to prevent the adverse effects of activities and obstacles that seriously impede or prevent the migration of migratory species (Art III, par. 4b and 4c). At CMS/CoP7 (2002) Res. 7.2 on Impact Assessment and Migratory Species was accepted, requesting Parties to apply appropriate SEA and EIA procedures for all proposed developments, including power lines. An agreement developed in the framework of CMS, in force since November 1999, brings the 119 Range States of the Africa Eurasian Waterbird Agreement (AEWA) region together in a common policy to protect migratory waterbirds that use the flyway from the Arctic to southern Africa.

2.3 THE AGREEMENT ON THE CONSERVATION OF AFRICAN-EURASIAN MIGRATORY WATER BIRDS

The Agreement on the Conservation of African-Eurasian Migratory Water birds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago. The AEWA covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle, including many species of divers, grebes, pelicans, cormorants, herons, storks, rails, ibises, spoonbills, flamingos, ducks, swans, geese, cranes, waders, gulls, terns, tropic birds, auks, frigate birds and even the South African penguin. The core activities carried out under AEWA are described in its Action Plan, which is legally binding for all countries that have joined the Agreement. The AEWA Action Plan details the various measures to be undertaken by Contracting Parties (South Africa included) to guarantee the conservation of migratory waterbirds within their national boundaries. These include species and habitat protection and the management of human activities as well as legal and emergency measures.

2.4 THE NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT

The National Environmental Management: Biodiversity Act (No. 10 of 2004), (NEMBA) regulations on Threatened and Protected Species (TOPS) provides for the consolidation of biodiversity legislation through establishing national norms and standards for the management of biodiversity across all sectors and by different management authorities. The national Act and several sets of provincial conservation legislation provide for among other things, the management and conservation of South Africa's biodiversity; protection of species and ecosystems that necessitate national protection and the sustainable use of indigenous biological resources.

3 STUDY METHODOLOGY

3.1 TERMS OF REFERENCE

The avifaunal specialist has conducted this assessment according to the following generic terms of reference:

- Describe the current state of avifauna in the study area, outlining important characteristics which may be influenced by the proposed infrastructure or which may influence the proposed infrastructure during construction and operation.
- Identify Red List species potentially affected by the proposed power line.
- Identify potential impacts (positive and negative, including cumulative impacts (if relevant) of the proposed development on avifauna during construction and operation.
- Provide a statement regarding the potential significance of the identified issues based on the evaluation of the impacts associated with the proposed development.
- Identify mitigation measures for enhancing benefits and avoiding or mitigating negative impacts and risks.
- Identify information gaps, limitations and additional information required.

- Identify and address any other aspects related to avifauna in the study area that should be incorporated into the reports.

3.2 METHODS

The following methodology was employed to compile this avifaunal assessment report:

- Various avifaunal data sets (listed below) were collected and examined to determine the location and abundance of sensitive Red List (as well as non-Red List) species that may be vulnerable to the impacts associated with the proposed activities.
- Avifaunal sensitive areas within the study area, where the above impacts are likely to occur, were identified using various GIS (Geographic Information System) layers, Google Earth imagery and personal observations made during the site visit (see track log and survey points in FIGURE 1).
- The impacts of the proposed activities on the avifaunal community were predicted on the basis of experience in gathering and analysing data on avian impacts with various forms of developments in southern Africa and supplemented with first hand data.
- Recommendations are made for the management and mitigation of significant impacts.

3.3 DATA SOURCES USED

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

- The Southern African Bird Atlas Project 2 (http://sabap2.adu.org.za/v1/index.php) - to determine which species occur within an area consisting of nine pentad grid cells within which the study area is situated. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. Between 2007 and 2016, a total of 210 full protocol cards (i.e. 210 bird surveys lasting a minimum of two hours each) have been completed for the study area and its immediate surrounds. The relevant pentads within the study area include: 2615_2745; 2615_2750; 2615_2755; 2620_2745; 2620_2750; 2620_2755; 2625_2745; 2625_2750 and 2625_2755.
- The Southern African Bird Atlas Project 1 (Harrison *et al*, 1997) - Quarter Degree Squares 2627BD.
- The Important Bird Areas report (IBA - Barnes 1998) was consulted to determine the location of the nearest IBA's and their importance for this study.
- The Co-ordinated Avifaunal Roadcount project (CAR – Young *et al*, 2003) data was consulted to obtain relevant data on large terrestrial bird report rates in the area.
- The Co-ordinated Waterbird Count (CWAC – Taylor *et al*, 1999) data was consulted determine if large concentrations of water birds, associated with South African wetlands, may occur within the study area.
- The conservation status and endemism information of all bird species occurring in the aforementioned pentads was then determined with the use of Taylor (2014), the IUCN 2013 Red List and the BirdLife South Africa Checklist of Birds in South Africa (2014).

- The latest vegetation classification of South Africa (Mucina & Rutherford, 2006) was consulted in order to determine which vegetation types occur on site.
- Satellite Imagery of the area was studied using Google Earth ©2016.
- The power line - bird mortality incident database of the Eskom/Endangered Wildlife Trust Strategic Partnership (1996 to present) was consulted to determine which of the species occurring in the study area are typically impacted upon by power lines, and the extent of the impact.
- KMZ. shapefiles detailing the location of the proposed study area were obtained from Nsovo Environmental Consulting.
- Personal observations related to avifaunal micro-habitat and species presence were made during a single site visit to the study area on 22 October 2016. These observations coupled with the author's experience gained from assessing other electrical infrastructure projects in the Gauteng region have been used to formulate a professional opinion of the species likely to occur in the study area and the likely impacts that the proposed development may have on the resident avifaunal community.

3.4 LIMITATIONS & ASSUMPTIONS

The author made the assumption that the sources of information used are reliable. However, it must be noted that there are limiting factors and these may potentially detract from the accuracy of the predicted results.

- The study area was defined by nine SABAP2 pentads. Although the proposed power line alignment is located largely within two pentads, a larger area is necessary to obtain a dataset that is large enough to ensure that reasonable conclusions about species diversity and densities, in a particular habitat type, can be drawn. Coverage by SABAP2 has been fairly extensive with a total of 210 full protocol data cards being completed for the broader study area and therefore the SABAP2 data is regarded as a reliable record of the avifauna likely to occur within the study area.
- This assessment relies heavily upon secondary data sources with regards to bird abundances such as the SABAP1 (Harrison *et al*, 1997), but this comprehensive dataset provides a valuable baseline against which any changes in species presence; abundance and distribution can be monitored. However, primary information on bird habitat was collected during the site visit and is used directly in determining which species of conservation importance are likely to occur where on site. Based on these findings, the specialist was able to assess the anticipated impacts and provide recommendations for mitigation.
- The core study area of the proposed power line was defined as a 2km zone around the proposed infrastructure.
- 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. It must also be noted that, it is often not possible to entirely eliminate the risk of the disturbance and displacement impacts associated with the activities proposed. Studies such as this attempt to minimise the risk as far as possible, and although the impacts will be unavoidable, they are likely to be temporary.

4 DESCRIPTION OF THE AFFECTED ENVIRONMENT

4.1 BIRD HABITAT CLASSES

Vegetation is one of the primary factors determining bird species distribution and abundance in an area. The following description of the vegetation on the site focuses on the vegetation structure and not species composition since it is widely accepted within ornithological circles that vegetation structure is more important in determining which bird species will occur there. The classification of vegetation types is from Mucina & Rutherford (2006), while from an avifaunal perspective, the Atlas of southern African Birds (SABAP1) recognises six primary vegetation divisions or biomes within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison *et al.* 1997). In addition to the description of vegetation, it is important to understand the habitats available to birds at a smaller spatial scale, i.e. micro habitats. Micro habitats are shaped by factors other than vegetation, such as topography, land use (CSIR, 2009), food sources and anthropogenic factors are critically important in mapping the site in terms of avifaunal sensitivity and ultimately informing the mitigation requirements.

Investigation of this study area revealed the following bird habitat classes (see APPENDIX 1 for photographs of each of the classes):

4.1.1. Grassland

A large proportion of the study area is located within the Grassland Biome and is comprised of the Carletonville Dolomite Grassland and Soweto Highveld Grassland vegetation types (APPENDIX 1; FIGURES 1, 2 and 3). The Carletonville Dolomite Grassland vegetation type is a species-rich mosaic of plant community types occurring on undulating plains dissected by rocky chert ridges. It is a vegetation type that is characterized by the presence of the species, *Aristida congesta, Brachiaria serrata, Cynodon dactylon, Digitaria tricholaenoides, Diheteropogon amplectens, Eragrostis chloromelas, Eragrostis racemosa, Heteropogon contortus, Loudetia simplex, Schizachyrium sanguineum, Setaria sphacelata, Themeda triandra,* and a wide variety of herbaceous forbs and other grasses (Mucina & Rutherford 2006). The Soweto Highveld Grassland vegetation type occurs on gently to moderately undulating landscape on the Highveld plateau, supporting short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra*. Relevant to this assessment, the grassland habitat in the study area has been largely transformed by urban sprawl (i.e. industrial and residential developments), subsistence agricultural practices and small scale pastoral activities.

Of South Africa's 841 bird species, 350 occur in the Grassland Biome. This includes 29 species of conservation concern (i.e. those species declining in numbers), ten endemics, and as many as 40 specialist species that are exclusively dependent on grassland habitat. Grasslands represent a significant feeding area for many bird species in densely populated areas. Specifically, open grassland patches could typically attract Secretarybird *Sagittarius serpentarius*, Denhams' Bustard *Neotis denhami*, Blue Crane *Anthropoides paradiseus*, White-bellied Korhaan

Eupodotis senegalensis, White Stork and a host of non-Red List species i.e. Red-crested Korhaan *Lophotis ruficrista,* Northern Black Korhaan *Afrotis afraoides* and Black-bellied Bustard *Lissotis melanogaster* that forage in these open areas. All the species mentioned above, are vulnerable to interactions with electrical infrastructure. Grasslands are also a favourite foraging area for game birds such as francolins and Helmeted Guineafowl *Numida meleagris*. This in turn attracts large raptors because of both the presence and accessibility of prey. SABAP2 reporting rates for the majority of Red List avifauna potentially occurring in grassland habitat in the study area are low (see TABLE 4-1), indicating that human activity has impacted on the avifauna and that levels of disturbance are high.

4.1.2. Savanna (Woodland)

A smaller proportion of the study area is located within the Savanna Biome which is defined by SABAP1 as having a grassy under-storey and a distinct woody upper-storey of trees and tall shrubs (Harrison *et al* 1997). Any remaining natural woodland occurring along the proposed power line alignment is likely to be comprised of the Gauteng Shale Mountain Bushveld vegetation type (APPENDIX 1; FIGURE 4). This particular woodland type occurs mainly on the ridge of the Gatsrand south of Carletonville–Westonaria–Lenasia. Typical species includes *Acacia caffra, Dombeya rotundifolia, Asparagus laricinus, Eragrostis curvula, Hyparrhenia dregeana* and *Kalanchoe rotundifolia* (Mucina & Rutherford 2006). Relevant to this assessment, this vegetation type has been largely transformed by urbanization, and the invasion of alien plant species.

The savanna biome contains a large variety of bird species (it is the most species-rich community in southern Africa) but very few bird species are restricted to this biome. Savanna is particularly rich in raptors, and forms the stronghold for Red List species (recorded in the study area) such as Cape Vulture, Verreaux's Eagle, Lanner Falcon and Red-footed Falcon. Apart from Red List species, it also supports several non-Red List raptor species, such as the Brown Snake-Eagle, Black-chested Snake-Eagle, and a multitude of medium-sized raptors, for example the migratory Steppe Buzzard *Buteo vulpinus*, African Harrier Hawk (Gymnogene) *Polyboroides typus* and Wahlberg's Eagle. Apart from raptors, savanna is suitable for a wide range of other power line sensitive birds, including Secretarybird. Similarly the SABAP2 reporting rates for the Red List avifauna potentially occurring in woodland habitat in the study area are low (see TABLE 4-1), indicating that human activity has impacted on the avifauna and that levels of disturbance are high.

4.1.3. Waterbodies (Rivers, Wetlands and Dams)

Most rivers in southern Africa are in the east and extreme south, in the higher rainfall areas. Thirteen species of water bird are mostly restricted to riverine habitat in southern Africa. Rivers and drainage lines are important corridors of microhabitat for waterbirds particularly as a source water that will be regularly utilised not only as a source of drinking water and food, but also for bathing. In addition the riparian vegetation provides cover for skulking species, e.g. African Finfoot *Podica senegalensis*, White-backed Night Heron *Gorsachius leuconotus*, Black-crowned Night Heron *Nycticorax nycticorax*, and the thick riverine woodland with large shady riparian trees, offers important breeding substrate for a variety of birds, including raptors.

The study area contains the Klip River which drains the southern Witwatersrand region. It flows primarily southwards until it joins the Vaal River at Vereeniging. Rivers and their tributaries are important habitat for birds in that they act as corridors of microhabitat for waterbirds, while the riparian vegetation on the banks provide potential cover for skulking species. A host of Red List and non-Red List species are dependent on rivers for food and shelter. Although this river is seen as one of the most heavily impacted river systems in South Africa and is subjected to almost every conceivable type of pollution (DWAF, 1999), several more common water dependent species e.g. Red-knobbed Coot *Fulica cristata*, Black-headed Heron *Ardea melanocephala*, African Darter *Anhinga rufa*, White-faced Duck *Dendrocygna viduata*, Yellow-billed Duck *Anas undulata*, Blacksmith Lapwing *Vanellus armatus,* African Sacred Ibis *Threskiornis aethiopicus* and Egyptian Goose *Alopochen aegyptiaca* may utilise the river system quite extensively.

Wetlands (APPENDIX 1; FIGURE 3 and 5) are characterized by slow flowing seasonal water (or permanently wet) and tall emergent vegetation (rooted or floating) and provide habitat for many water birds. The conservation status of many of the bird species that are dependent on wetlands reflects the critical status of wetlands nationally, with many having already been destroyed. There are several localized wetlands occurring in the study area, particularly the Klip River wetland system. These are likely to represent attractive areas for certain species year round – not only after rainfall. Of the collision sensitive species found within this study area, the African Marsh-Harrier *Circus ranivorus* is likely to use these wetlands extensively.

Many thousands of earthen and other dams exist in the southern African landscape. Whilst dams have altered flow patterns of streams and rivers, and affected many bird species detrimentally, a number of species have benefited from their construction. The construction of these dams has probably resulted in a range expansion for many water bird species that were formerly restricted to areas of higher rainfall. Man-made impoundments, although artificial in nature, can be very important for variety of birds, particularly water birds. Apart from the water quality, the structure of the dam, and specifically the margins and the associated shoreline and vegetation, plays a big role in determining the species that will be attracted to the dam. Common species in the study area that could use dams (APPENDIX 1; FIGURE 6) and dam edges include Red-knobbed, Black-headed Heron, African Darter, White-faced Duck, Yellow-billed Duck, Blacksmith Lapwing, African Sacred Ibis and Egyptian Goose. Red List species recorded in the study area by SABAP 2 that are likely to specifically be attracted to dams include Maccoa Duck and Greater Flamingo.

4.1.4. Ridges and Rocky outcrops

Examples of ridges and rocky outcrops are found within the study area (APPENDIX 1; FIGURE 8) and are potentially suitable foraging habitat for Verreaux's Eagle.

4.1.5. *Exotic Tree Plantations*

Although stands of *Eucalyptus* are strictly speaking invader species, they have become important refuges for certain species of raptors, particularly Amur Falcon *Falco Falco amurensis*, a Palearctic migrant, will commonly roost in small stand of *Eucalyptus* in suburbs of small towns (APPENDIX 1; FIGURE 9). Black Sparrowhawk *Accipiter melanoleucus* and Ovambo Sparrowhawk *Accipiter ovampensis* are another two species that use these trees for roosting and breeding purposes. All three of these species have been recorded in the broader study area during the SABAP 2 atlassing period.

4.1.6. *Built-up Residential Areas*

The majority of the study area is densely populated (APPENDIX 1; FIGURE 10), with significant habitat degradation and high volumes of disturbance associated with pedestrian and vehicle traffic. These densely populated urban areas are of very little value to sensitive Red List species, with the possible exception of Lanner Falcon *Falco biarmicus* which hunt feral pigeons and (possibly) free-ranging poultry. The impact of the dense human population also spills over in the adjacent habitat classes through the constant movement of pedestrians, cattle and dogs into those areas. This has implications for the avifauna, particularly the larger species, in that it acts as sources of potential disturbance.

TABLE 4.1 below, details the micro habitats that each Red List bird species (recorded in SABAP1 & SABAP2 data) typically frequents in the study area. It must be stressed that birds can and will, by virtue of their mobility, utilise almost any areas in a landscape from time to time. However, the analysis in TABLE 1 represents each species' most preferred or normal habitats. These locations are where most of the birds of that species will spend most of their time – so logically that is where impacts on those species will be most significant. APPENDIX 1 provides a photographic record of the bird habitats that occur within the study area.

4.2 RELEVANT BIRD POPULATIONS

4.2.1. *Important Bird Areas (IBA's)*

Some sites are exceptionally important for maintaining the taxa dependent upon the habitats and ecosystems in which they occur. Vigorous protection of the most critical sites is one important approach to conservation. Many species may be effectively conserved by this means. Patterns of bird distribution are such that, in most cases, it is possible to select sites that support many species. These sites, carefully identified on the basis of the bird numbers and species complements they hold, are termed Important Bird Areas (IBAs). IBAs are selected such that, taken together, they form a network throughout the species' biogeographic distributions. IBAs are key sites for conservation – small enough to be conserved in their entirety and often already part of a protected-area network. They are responsible for one (or more) of three factors:

- Hold significant numbers of one or more globally threatened species
- Are one of a set of sites that together hold a suite of restricted-range species or biome-restricted species
- Have exceptionally large numbers of migratory or congregatory species

There are no IBA's within the immediate study area. The closest IBA to the proposed project (SA022 – Suikerbosrand Nature Reserve) is located approximately 30km to the south-east. The diversity of habitats within the reserve supports a fairly significant diversity of bird species with more than 270 species being recorded in SABAP 2 to date. Several species of conservation concern occur within this IBA. These include the globally threatened Melodious Lark *Mirafra cheniana*, Blue Korhaan *Eupodotis caerulescens* and Secretarybird *Sagittarius serpentarius* (two pairs). Regionally threatened species include African Grass-Owl *Tyto capensis* (12–30 individuals) and White-bellied Korhaan *Eupodotis senegalensis*. In addition, Kalahari Scrub Robin *Erythropygia paena* and White-bellied Sunbird *Cinnyris talatala* are the only biome-restricted species in this IBA. Sentinel Rock Thrush *Monticola explorator* occurs in the east and Kalahari Scrub Robin, Red-headed Finch *Amadina erythrocephala*, Black-faced Waxbill *Estrilda erythronotos* and Violet-eared Waxbill *Uraeginthus granatinus* are regularly reported. The proximity of the IBA and the unlikely occurrence of the associated trigger species within the study area, means that the IBA will not have a significant impact on the routing of the alignment and was therefore not used as a criterion to assess the anticipated impacts in the study area.

4.2.2. Coordinated Avifaunal Road-count (CAR) data

Cranes, bustards, storks and other large birds that spend most of their time on the ground, need wide, open spaces and are certainly not restricted to protected areas. Agricultural habitats are used extensively for feeding, roosting and breeding, often because no natural, pristine habitats are available, and sometimes because the agricultural habitats are especially attractive to birds. The Co-ordinated Avifaunal Roadcounts (CAR) project monitors the populations of 21 species of large 'terrestrial' birds in agricultural habitats (Young *et.al.* 2003). Although CAR road counts do not give an absolute count of all the individuals in a population, they do provide a measure of relative abundance in a particular area. The study area does not contain any CAR routes; however CAR route GC04 is located within 6km of the study area. This route has recorded fairly significant numbers of Helmeted Guineafowl *Numida meleagri,* Black-headed Heron *Ardea melanocephala*, Northern Black Korhaan *Afrotis afraoides*, Spur-winged Goose *Plectropterus gambensis*, Secretarybird and White Stork *Ciconia ciconia* over the last nine years (2005 to 2014). Although the areas within which the proposed 88kV power line is located are heavily transformed and subject to significant industrial, residential, vehicle and pedestrian disturbance, the presence of these species in the open grassland areas in the broader study area cannot be ruled out.

4.2.3. Coordinated Waterbird count (CWAC) data

A CWAC site is any body of water, other than the oceans, which supports a significant number (set at approximately 500 individual waterbirds, irrespective of the number of species) of birds which use the site for feeding, and/or breeding and roosting (Harrison and Harebottle, 2002). This definition includes natural pans, vleis, marshes, lakes, rivers, as well as a range of manmade impoundments (i.e. sewage works). The presence of a CWAC site within the study area is an indication of a large number of bird species occurring there and the overall sensitivity of the area. There are no CWAC sites within close proximity (i.e. within 10 km) to the site. The closest site (approximately 30km to the East of the proposed power line) is the Vlakplaas Water Treatment Works. Good numbers of Red-knobbed Coot *Fulica cristata,* White-faced Duck *Dendrocygna viduata*, Greater Flamingo *Phoenicopterus ruber*, Spur-winged Goose, Little Grebe *Tachybaptus ruficollis*, Grey-headed Gull *Larus cirrocephalus*, Southern Pochard *Netta erythrophthalma,* Glossy Ibis *Plegadis falcinellus,* African Sacred Ibis *Threskiornis aethiopicus*, Ruff *Philomachus pugnax*, Whiskered Tern *Chlidonias hybrida*, White-winged Tern *Chlidonias leucopterus* and Blacksmith Lapwing *Vanellus armatus* occur regularly at this site. Although the proposed power line development will not impact on the bird species utilising the CWAC site, the site does provide an indication of the species that may occur in similar *wetland* habitats found within the study area.

4.2.4. Southern African Bird Atlas Project 1 and 2

A combined total of at least 305 bird species have been recorded within the relevant SABAP quarter degree squares and pentads (APPENDIX 2). The presence of these species in the broader area provides an indication of the diversity of species that could potentially occur along the proposed power line route. Of the 305 species, eight Red List species have been recorded in the relevant SABAP 2 pentads to date. It must be noted that the majority of these species have not been recorded in significant numbers with between one and two individuals having been recorded in the broader study area to date with the exception of White-bellied Korhaan. The majority of the Red List species that have been recorded in the broader study area are physically large species, meaning that they are capable of interacting directly with electrical infrastructure through collision. The low report rates of these Red List species can possibly be attributed to the fact that not all of the nine pentad grid cells have been surveyed extensively and/or a result of the fairly high levels of disturbance caused by the surrounding communities and land use practices in the broader area. The significant disturbance and habitat loss experienced in the study area is undoubtedly displacing various birds that would, under optimum conditions, inhabit these areas. The likelihood of the species in TABLE 1 frequenting the site is considered to be low. As a result, the impacts of the proposed project could be more important for the more common bird species, which are generally more tolerant of human disturbance and hence more likely to regularly make use of this site. These include waterfowl such as ibises, geese, ducks, herons and many others. In addition, the proposed study area does however support a diversity of more common small terrestrial species and development in these areas will undoubtedly displace these species either temporarily of perhaps more permanently through habitat transformation and disturbance associated with construction activities. However sufficient similar habitat is available within the broader study area, so it is highly unlikely that the displacement impact will be of regional or national significance. Although this impact assessment

focuses on Red List species, the impact on non-Red List species is also assessed, albeit in less detail. Furthermore, much of the mitigation recommended for Red List species will also protect non-Red List species in the study area. The non-Red List species that have been considered for this assessment include large eagles, buzzards, kestrels, herons, korhaans, geese, ibis and various water bird species. Red List species were not observed during the site visit. Species that were observed during the site visit are listed in APPENDIX 2.

5 GENERAL DESCRIPTION OF BIRD INTERACTIONS WITH ELECTRICAL INFRASTRUCURE

Because of their size and prominence, electrical infrastructures constitute an important interface between wildlife and man. Negative interactions between wildlife and electricity structures take many forms, but two common problems in southern Africa are electrocution of birds and birds colliding with power lines (Ledger & Annegarn 1981; Ledger 1983; Ledger 1984; Hobbs & Ledger 1986a; Hobbs & Ledger 1986b; Ledger, Hobbs & Smith, 1992; Verdoorn 1996; Kruger & Van Rooyen 1998; Van Rooyen 1998; Kruger 1999; Van Rooyen 1999; Van Rooyen 2000). Other impacts include disturbance and habitat destruction during construction and maintenance (operational) activities.

5.1 ELECTROCUTIONS

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). Electrocution risk is strongly influenced by the power line voltage of the and design of the pole structure and mainly affects larger, perching species, such as vultures, eagles and storks, easily 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. Although the proposed power line has a voltage size of 88kV, the power line will be constructed using the 132kV pole/tower specifications (APPENDIX 2). The clearance distance between phases of the 132kV pole structure should be sufficient to reduce the risk of phase – phase electrocutions of birds. However if a very large species attempts to perch on the stand-off insulators, they are potentially able to touch both the conductor and the earthed pole simultaneously which may result in a phase – earth electrocution. This is particularly true in instances where gregarious species, like vultures, attempt to perch on the same pole. It is highly unlikely that vultures will occur within the study area, therefore it can be concluded that electrocutions on the proposed 88kV power line is rated to be of **LOW** significance.

5.2 COLLISIONS

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

sensitive species are considered threatened in southern Africa. The Red Data species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. These species have not evolved to cope with high adult mortality, with the results that consistent high adult mortality over an extensive period could have a serious effect on a population's ability to sustain itself in the long or even medium term. Many of the anthropogenic threats to these species are non-discriminatory as far as age is concerned (e.g. habitat destruction, disturbance and power lines) and therefore contribute to adult mortality, and it is not known what the cumulative effect of these impacts could be over the long term. Collision of certain large flying bird species such as korhaans, ibises, egrets and herons with the proposed power line, is possible, particularly along sections of route that traverse the open grassland patches and wetland areas and is therefore rated to be of **MEDIUM** significance.

5.3 HABITAT TRANSFORMATION

During the construction phase and maintenance of power lines and substations, some habitat destruction and alteration inevitably takes place. This happens with the construction of access roads, the clearing of servitudes and the leveling of substation yards. Servitudes have to be cleared of excess vegetation at regular intervals in order to allow access to the line for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the conductors and to minimize the risk of fire under the line which can result in electrical flashovers. These activities have an impact on birds breeding, foraging and roosting in or in close proximity to the servitude, through the modification of habitat. It is important to note that the proposed power line will be constructed within the existing servitude (following the decommissioning of the existing power line) therefore the displacement impact as a result of habitat transformation is considered to be of **LOW** significance.

5.4 DISTURBANCE

Similarly, the above mentioned construction activities may displace birds through disturbance, particularly during breeding activities. This could lead to breeding failure if the disturbance happens during a critical part of the breeding season. Early in the breeding season the risk of desertion by the adults if disturbed are bigger than later, when the young bird is on the nest and being fed by the adults. At the end of the breeding season the young bird may be tempted to jump out of the nest and fly prematurely if disturbed, resulting in injury or even death. If nests are identified during an avifaunal walk down of the power line prior to construction, every attempt will have to be made to restrict the disturbance of these birds to a minimum during construction. In general the disturbance that will be caused by the construction activities will be temporary and this, coupled with the fact that there is currently considerable disturbance in the area, the construction of the power line should not lead to a species being permanently displaced from the area. As mentioned previously, the micro habitats within the study area are fairly common in the broader area and it is not envisaged that any Red List species will be permanently displaced by the habitat transformation or disturbance that will take place as a result of the construction of the proposed power line. The species that are most likely to be affected by the loss of habitat are the smaller, non-

threatened passerines that are potentially resident along the route alignment. This significance of this impact is rated as **LOW.**

6 ASSESSMENT OF EXPECTED IMPACTS

The assessment of each avifaunal impact is discussed. The aforementioned avifaunal impacts have been formally assessed, rated and presented in tabular format below for both pre- and post-mitigation according to set criteria (APPENDIX 4).

TABLE 6-1 Assessment of electrocution of birds on the proposed 88kV power line.

Nature: Electrocution of Red List species on the 88kV power line structures.		
	Without mitigation	**With mitigation**
Physical Extent	3	2
Duration	4	4
Magnitude	6	4
Probability	2	1
Significance	**26 - Low**	**10 - Low**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: An Eskom approved bird friendly pole design must be used (APPENDIX 3). The Distribution Technical Bulletin must be used in this regard. In addition, if a monopole structure is used, as this report has assumed, a Bird Perch must be installed on top of all poles, to provide safe perching substrate for birds well above the dangerous hardware.		
Cumulative impacts: High - The cumulative impacts of power lines on birds through electrocution are significant nationally. This particular area already has several existing distribution power lines. No effort should be spared to ensure that the new power line is built bird friendly and results in no additional impact on birds in the area.		

TABLE 6-2: Assessment of collision of birds with the proposed 88kV power line.

Nature: Red List species mortality due to collisions with the earthwire of the 88kV power line.		
	Without mitigation	**With mitigation**
Physical Extent	3	2
Duration	4	4
Magnitude	6	4
Probability	3	2
Significance	**39 - Medium**	**20 - Low**
Status (positive or negative)	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	

Mitigation:

Small sections of power line marking will be required to mitigate for the collision impact, particularly in those areas that contain wetlands and dams. Bird flight diverters must be installed on the full span length on each of the conductors (according to Eskom guidelines). Light and dark colour devices must be alternated so as to provide contrast against both dark and light backgrounds respectively. These devices must be installed as soon as the conductors are strung.

Cumulative impacts:

High - The cumulative impacts of power lines on birds through collision are significant. The broader study area already has several existing power lines. No effort should be spared to ensure that the new power line is built bird friendly and mitigated resulting in no additional impact on birds in the area

TABLE 6-3. Assessment of habitat destruction caused by the construction of the 88kV power line.

Nature: Displacement of sensitive and threatened species as a result of the destruction or transformation of natural bird habitat along the proposed power line alignment		
	Without mitigation	**With mitigation**
Physical Extent	1	1
Duration	2	2
Magnitude	2	1
Probability	3	2
Significance	**15 - Low**	**8 - Low**
Status (positive or negative)	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Partially - a certain amount of land surface will be impacted on.	
Mitigation: Construction activity should be restricted to the existing servitude and immediate footprint of the infrastructure. Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum. The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned.		
Cumulative impacts: High – the surrounding area is already heavily transformed as a result of urbanisation. Any addition infrastructure development will contribute to the absence of Red List species within the study area.		

TABLE 6-4. Assessment of disturbance of birds by the construction of the proposed power line.

Nature: Displacement of Red List species due to disturbance associated with the construction of the power line		
	Without mitigation	**With mitigation**
Physical Extent	1	1
Duration	1	1
Magnitude	2	1
Probability	3	2
Significance	**12 - Low**	**6 - Low**
Status (positive or negative)	Negative	Negative
Reversibility	Medium	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Partially	

Mitigation:

Construction activity should be restricted to the immediate footprint of the infrastructure. Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of Red List species. Measures to control noise should be applied according to current best practice in the industry.

It is unlikely that any species of conservation concern will be breeding within the study area and given the level of existing disturbance in the area, no additional mitigation measures are recommended.

Cumulative impacts:

High - In addition to the proposed power line, residential and industrial activities feature prominently both within the impact zone and the broader study area and are a significant source of existing disturbance. These activities, coupled with the habitat degradation within the proposed study area, are a likely cause of the absence of Red List species within the study area. Those species that have persisted have undoubtedly developed a tolerance for the current levels of disturbance and are likely to persist within the broader area despite the development of the power line.

7 CONCLUSION & IMPACT STATEMENT

In conclusion, the habitat through which the proposed Etna – Trade Route 88kV power line runs is moderately sensitive from a potential bird impact perspective. In recent years anthropogenic impacts, mostly in the form of urbanisation, have largely transformed the landscape resulting in a negative impact on avifaunal diversity and abundance. This is reflected in the low reporting rates for power line sensitive Red List species, which may also indicate that levels of disturbance is high. The construction of the proposed power line will result in various impacts of low to medium significance to the birds occurring in the vicinity of the new infrastructure, which can be reduced through the application of mitigation measures. Given the presence of existing habitat degradation and disturbance, it is anticipated that the Etna – Trade Route 88kV power line can be constructed within the study area with acceptable levels of impact on the resident avifauna subject to the following recommendations:

- Small sections of power line marking will be required to mitigate for the collision impact, particularly in those areas that contain wetlands, dams and small waterbodies.
- The correct pole structure must be utilized to avoid electrocution (APPENDIX 3).
- Construction activity should be restricted to the immediate footprint of the infrastructure.
- Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of avifaunal species.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- The recommendations of the ecological and botanical specialist studies must be strictly implemented, especially as far as limitation of the construction footprint and rehabilitation of disturbed areas is concerned.
- In addition to this, the normal suite of environmental good practices should be applied, such as ensuring strict control of staff, vehicles and machinery on site and limiting the creation of new roads as far as possible.

8 REFERENCES

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

BLSA 2016. http://www.birdlife.org.za/conservation/important-bird-areas/iba-directory

Endangered Wildlife Trust – Wildlife & Energy Programme (EWT-WEP). 2013. Eskom-EWT Strategic Partnership Central Incident Register.

Harrison, J.A., Allan, D.G., Underhill, L.G., Herremans, M., Tree, A.J., Parker, V and Brown, C.J. (eds). 1997. The atlas of southern African birds. Vol. 1&2. BirdLife South Africa: Johannesburg.

Hobbs, J.C.A. & Ledger J.A. 1986a. The Environmental Impact of Linear Developments; Power lines and Avifauna. (Third International Conference on Environmental Quality and Ecosystem Stability. Israel, June 1986).

Hobbs, J.C.A. & Ledger J.A. 1986b. "Power lines, Birdlife and the Golden Mean." Fauna and Flora, 44, pp 23-27.

Kruger, R. & Van Rooyen, C.S. 1998. Evaluating the risk that existing power lines pose to large raptors by using risk assessment methodology: the Molopo Case Study. (5th World Conference on Birds of Prey and Owls: 4 - 8 August 1998. Midrand, South Africa.)

Kruger, R. 1999. Towards solving raptor electrocutions on Eskom Distribution Structures in South Africa. M. Phil. Mini-thesis. University of the Orange Free State. Bloemfontein. South Africa.

Ledger, J. 1983. Guidelines for Dealing with Bird Problems of Transmission Lines and Towers. Escom Test and Research Division Technical Note TRR/N83/005.

Ledger, J.A. & Annegarn H.J. 1981. "Electrocution Hazards to the Cape Vulture (Gyps coprotheres) in South Africa". Biological Conservation, 20, pp15-24.

Ledger, J.A. 1984. "Engineering Solutions to the problem of Vulture Electrocutions on Electricity Towers." The Certificated Engineer, 57, pp 92-95.

Ledger, J.A., J.C.A. Hobbs & Smith T.V. 1992. Avian Interactions with Utility Structures: Southern African Experiences. (Proceedings of the International Workshop on Avian Interactions with Utility Structures, Miami, Florida, 13-15 September 1992. Electric Power Research Institute.)

Mucina. L. & Rutherford, M.C. (Eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.

Southern African Bird Atlas Project 2 (SABAP2). http://sabap2.adu.org.za. Accessed 26 April 2016.

Taylor, P.B., Navarro, R.A., Wren- Sargent, M., Harrison, J.A. & Kieswetter, S.L. 1999. TOTAL CWAC Report. Coordinated waterbird counts in South Africa, 1992-97. Avian Demography Unit, University of Cape Town.

Van Rooyen, C.S. & Ledger, J.A. 1999. "Birds and utility structures: Developments in southern Africa" in Ferrer, M. & G..F.M. Janns. (eds.) Birds and Power lines. Quercus: Madrid, Spain, pp 205-230

Van Rooyen, C.S. 1998. Raptor mortality on power lines in South Africa. (5th World Conference on Birds of Prey and Owls: 4 - 8 August 1998. Midrand, South Africa.)

Van Rooyen, C.S. 1999**.** An overview of the Eskom - EWT Strategic Partnership in South Africa. (EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999, Charleston, South Carolina.)

Van Rooyen, C.S. 2000. "An overview of Vulture Electrocutions in South Africa." Vulture News, 43, pp 5-22. Vulture Study Group: Johannesburg, South Africa.

Van Rooyen, C.S. 2004a. The Management of Wildlife Interactions with overhead lines. In The fundamentals and practice of Overhead Line Maintenance (132kV and above), pp217-245. Eskom Technology, Services International, Johannesburg.

Van Rooyen, C.S. 2004b. Investigations into vulture electrocutions on the Edwardsdam-Mareetsane 88kV feeder, Unpublished report, Endangered Wildlife Trust, Johannesburg.

Van Rooyen, C.S. & Taylor, P.V. 1999. Bird Streamers as probable cause of electrocutions in South Africa. (EPRI Workshop on Avian Interactions with Utility Structures 2-3 December 1999. Charleston, South Carolina)

APPENDIX 1
AVIFAUNAL HABITAT OBSERVED WITHIN THE STUDY AREA

FIGURE 1: Grassland habitat in the vicinity of the Etna substation

FIGURE 2: Degraded grassland habitat

FIGURE 3: Grassland habitat in the foreground and wetland habitat in the background (in the vicinity of the Trade Route substation)

FIGURE 4: Gauteng Shale Mountain Bushveld

FIGURE 5: Accumulated water in the wetland area in the vicinity of the Trade Route substation

FIGURE 6: An example of a large dam within the study area

FIGURE 7: An old farm reservoir.

FIGURE 8: Rocky outcrops above the Lehae substation

FIGURE 9: Exotic *Eucaplytus sp*. tree stands near the Trade Route substation

FIGURE 10: The existing servitude traverses through a residential area

FIGURE 11: Location of the Trade Route substation which is currently under construction

FIGURE 12: The Lehae substation and surrounding residential area

APPENDIX 2

SOUTH AFRICAN BIRD ATLAS PROJECT DATA (SABAP 1 & 2) FOR THE PROPOSED PROJECT

(SPECIES OBSERVED DURING THE 22 OCTOBER 2016 SITE VISIT ARE HIGHLIGHTED IN GREY)

SPECIES	TAXONOMIC NAME	CONS. STATUS	AVERAGE REPORT RATE	SABAP 1	SABAP 2
Apalis, Bar-throated	Apalis thoracica		8.1	x	x
Avocet, Pied	Recurvirostra avosetta		7.62	x	x
Barbet, Acacia Pied	Tricholaema leucomelas		9.52	x	x
Barbet, Black-collared	Lybius torquatus		36.67	x	x
Barbet, Crested	Trachyphonus vaillantii		49.05	x	x
Batis, Chinspot	Batis molitor		6.67	x	x
Bee-eater, European	Merops apiaster		14.76	x	x
Bee-eater, Swallow-tailed	Merops hirundineus		Adhoc/Incidental		x
Bee-eater, White-fronted	Merops bullockoides		1.43		x
Bishop, Southern Red	Euplectes orix		77.14	x	x
Bishop, Yellow	Euplectes capensis		Adhoc/Incidental		x
Bishop, Yellow-crowned	Euplectes afer		21.43	x	x
Bittern, Little	Ixobrychus minutus		2.86	x	x
Bokmakierie, Bokmakierie	Telophorus zeylonus		47.14	x	x
Boubou, Southern	Laniarius ferrugineus		3.33		x
Brubru, Brubru	Nilaus afer		2.86		x
Bulbul, African Red-eyed	Pycnonotus nigricans		2.86	x	x
Bulbul, Dark-capped	Pycnonotus tricolor		73.81	x	x
Bunting, Cape	Emberiza capensis		3.81	x	x
Bunting, Cinnamon-breasted	Emberiza tahapisi		7.14	x	x
Bunting, Golden-breasted	Emberiza flaviventris		Adhoc/Incidental	x	
Buzzard, Jackal	Buteo rufofuscus		0.48	x	x
Buzzard, Steppe	Buteo vulpinus		6.67	x	x
Canary, Black-throated	Crithagra atrogularis		44.76	x	x
Canary, Cape	Serinus canicollis		Adhoc/Incidental	x	
Canary, Yellow	Crithagra flaviventris		0.95	x	x
Canary, Yellow-fronted	Crithagra mozambicus		0.48	x	x
Chat, Anteating	Myrmecocichla formicivora		16.67	x	x
Chat, Familiar	Cercomela familiaris		1.43	x	x
Cisticola, Cloud	Cisticola textrix		30.95	x	x
Cisticola, Desert	Cisticola aridulus		8.57	x	x
Cisticola, Lazy	Cisticola aberrans		0.95	x	x
Cisticola, Levaillant's	Cisticola tinniens		64.29	x	x
Cisticola, Rattling	Cisticola chiniana		Adhoc/Incidental	x	
Cisticola, Wailing	Cisticola lais		25.24	x	x

Cisticola, Wing-snapping	Cisticola ayresii		16.67	x	x
Cisticola, Zitting	Cisticola juncidis		40.95	x	x
Cliff-chat, Mocking	Thamnolaea cinnamomeiventris		0.48	x	x
Cliff-swallow, South African	Hirundo spilodera		3.81	x	x
Coot, Red-knobbed	Fulica cristata		62.86	x	x
Cormorant, Reed	Phalacrocorax africanus		41.9	x	x
Cormorant, White-breasted	Phalacrocorax carbo		5.24	x	x
Coucal, Burchell's	Centropus burchellii		1.43	x	x
Coucal, White-browed	Centropus superciliosus		Adhoc/Incidental	x	
Courser, Temminck's	Cursorius temminckii		0.48	x	x
Crake, African	Crecopsis egregia		0.48		x
Crake, Baillon's	Porzana pusilla		Adhoc/Incidental	x	
Crake, Black	Amaurornis flavirostris		5.24	x	x
Crane, Blue	Anthropoides paradiseus	NT	Adhoc/Incidental	x	
Crombec, Long-billed	Sylvietta rufescens		1.9		x
Crow, Cape	Corvus capensis		Adhoc/Incidental	x	
Crow, Pied	Corvus albus		47.62	x	x
Cuckoo, Diderick	Chrysococcyx caprius		29.05	x	x
Cuckoo, Klaas's	Chrysococcyx klaas		0.48		x
Cuckoo, Red-chested	Cuculus solitarius		6.19	x	x
Darter, African	Anhinga rufa		13.33	x	x
Dove, Laughing	Streptopelia senegalensis		94.76	x	x
Dove, Namaqua	Oena capensis		2.86	x	x
Dove, Red-eyed	Streptopelia semitorquata		73.81	x	x
Dove, Rock	Columba livia		64.29	x	x
Drongo, Fork-tailed	Dicrurus adsimilis		Adhoc/Incidental		x
Duck, African Black	Anas sparsa		17.62	x	x
Duck, Comb	Sarkidiornis melanotos		0.48	x	x
Duck, Fulvous	Dendrocygna bicolor		1.43	x	x
Duck, Maccoa	Oxyura maccoa	NT	1.9	x	x
Duck, Mallard	Anas platyrhynchos		0.95	x	x
Duck, White-backed	Thalassornis leuconotus		0.48	x	x
Duck, White-faced	Dendrocygna viduata		22.38	x	x
Duck, Yellow-billed	Anas undulata		48.57	x	x
Eagle, Long-crested	Lophaetus occipitalis		Adhoc/Incidental		x
Eagle, Verreaux's	Aquila verreauxii	VU	0.48	x	x
Eagle-owl, Spotted	Bubo africanus		2.86	x	x
Eagle-owl, Verreaux's	Bubo lacteus		Adhoc/Incidental	x	
Egret, Cattle	Bubulcus ibis		76.19	x	x
Egret, Great	Egretta alba		Adhoc/Incidental	x	
Egret, Little	Egretta garzetta		7.62	x	x
Egret, Yellow-billed	Egretta intermedia		4.29	x	x

Falcon, Amur	Falco amurensis		13.81	x	x
Falcon, Lanner	Falco biarmicus	VU	Adhoc/Incidental		x
Falcon, Red-footed	Falco vespertinus	NT	0.48	x	x
Finch, Cuckoo	Anomalospiza imberbis		0.48		x
Finch, Red-headed	Amadina erythrocephala		14.29	x	x
Firefinch, African	Lagonosticta rubricata		0.48		x
Firefinch, Jameson's	Lagonosticta rhodopareia		0.95		x
Fiscal, Common (Southern)	Lanius collaris		91.9	x	x
Fish-eagle, African	Haliaeetus vocifer		Adhoc/Incidental	x	
Flamingo, Greater	Phoenicopterus ruber	NT	2.38	x	x
Flamingo, Lesser	Phoenicopterus minor	NT	Adhoc/Incidental	x	
Flufftail, Red-chested	Sarothrura rufa		0.95		x
Flycatcher, Fairy	Stenostira scita		0.95	x	x
Flycatcher, Fiscal	Sigelus silens		55.24	x	x
Flycatcher, Spotted	Muscicapa striata		6.19	x	x
Francolin, Orange River	Scleroptila levaillantoides		34.29	x	x
Francolin, Red-winged	Scleroptila levaillantii		0.95	x	x
Go-away-bird, Grey	Corythaixoides concolor		23.81	x	x
Goose, Egyptian	Alopochen aegyptiacus		50	x	x
Goose, Spur-winged	Plectropterus gambensis		18.57	x	x
Grass-owl, African	Tyto capensis	VU	Adhoc/Incidental	x	
Grassbird, Cape	Sphenoeacus afer		0.48	x	x
Grebe, Black-necked	Podiceps nigricollis		Adhoc/Incidental	x	
Grebe, Great Crested	Podiceps cristatus		2.38	x	x
Grebe, Little	Tachybaptus ruficollis		38.1	x	x
Green-pigeon, African	Treron calvus		Adhoc/Incidental		x
Greenshank, Common	Tringa nebularia		2.86	x	x
Guineafowl, Helmeted	Numida meleagris		55.24	x	x
Gull, Grey-headed	Larus cirrocephalus		32.38	x	x
Hamerkop, Hamerkop	Scopus umbretta		1.9	x	x
Harrier, Black	Circus maurus	EN	Adhoc/Incidental	x	
Harrier-Hawk, African	Polyboroides typus		Adhoc/Incidental		x
Helmet-shrike, White-crested	Prionops plumatus		0.48		x
Heron, Black	Egretta ardesiaca		3.81	x	x
Heron, Black-headed	Ardea melanocephala		47.62	x	x
Heron, Goliath	Ardea goliath		9.05	x	x
Heron, Grey	Ardea cinerea		20.48	x	x
Heron, Purple	Ardea purpurea		10	x	x
Heron, Squacco	Ardeola ralloides		3.33	x	x
Hobby, Eurasian	Falco subbuteo		0.95		x
Honey-buzzard, European	Pernis apivorus		0.48		x
Honeybird, Brown-backed	Prodotiscus regulus		1.9	x	x

Honeyguide, Greater	Indicator indicator		2.38		x
Honeyguide, Lesser	Indicator minor		6.67	x	x
Hoopoe, African	Upupa africana		23.81	x	x
House-martin, Common	Delichon urbicum		1.43	x	x
Ibis, African Sacred	Threskiornis aethiopicus		63.33	x	x
Ibis, Glossy	Plegadis falcinellus		50.48	x	x
Ibis, Hadeda	Bostrychia hagedash		80.48	x	x
Indigobird, Village	Vidua chalybeata		0.48		x
Jacana, African	Actophilornis africanus		0.48	x	x
Kestrel, Greater	Falco rupicoloides		1.9	x	x
Kestrel, Lesser	Falco naumanni		0.95	x	x
Kestrel, Rock	Falco rupicolus		0.95	x	x
Kingfisher, Brown-hooded	Halcyon albiventris		2.38		x
Kingfisher, Giant	Megaceryle maximus		4.76	x	x
Kingfisher, Malachite	Alcedo cristata		1.9	x	x
Kingfisher, Pied	Ceryle rudis		3.81	x	x
Kite, Black	Milvus migrans		Adhoc/Incidental	x	
Kite, Black	Milvus migrans		Adhoc/Incidental	x	
Kite, Black-shouldered	Elanus caeruleus		52.38	x	x
Kite, Yellow-billed	Milvus aegyptius		0.95	x	x
Korhaan, Northern Black	Afrotis afraoides		35.71	x	x
Korhaan, White-bellied	Eupodotis senegalensis	VU	7.62	x	x
Lapwing, African Wattled	Vanellus senegallus		33.33	x	x
Lapwing, Blacksmith	Vanellus armatus		88.1	x	x
Lapwing, Crowned	Vanellus coronatus		89.52	x	x
Lark, Agulhas Clapper	Mirafra marjoriae		Adhoc/Incidental	x	
Lark, Agulhas Long-billed	Certhilauda brevirostris	NT	Adhoc/Incidental	x	
Lark, Benguela Long-billed	Certhilauda benguelensis		Adhoc/Incidental	x	
Lark, Cape Clapper	Mirafra apiata		Adhoc/Incidental	x	
Lark, Cape Long-billed	Certhilauda curvirostris		Adhoc/Incidental	x	
Lark, Eastern Clapper	Mirafra fasciolata		10.48	x	x
Lark, Eastern Long-billed	Certhilauda semitorquata		2.38	x	x
Lark, Karoo Long-billed	Certhilauda subcoronata		Adhoc/Incidental	x	
Lark, Melodious	Mirafra cheniana		5.24	x	x
Lark, Pink-billed	Spizocorys conirostris		1.9	x	x
Lark, Red-capped	Calandrella cinerea		10.48	x	x
Lark, Rufous-naped	Mirafra africana		54.76	x	x
Lark, Sabota	Calendulauda sabota		0.95	x	x
Lark, Spike-heeled	Chersomanes albofasciata		24.76	x	x
Longclaw, Cape	Macronyx capensis		73.33	x	x
Mannikin, Bronze	Spermestes cucullatus		1.43	x	x
Marsh-harrier, African	Circus ranivorus	EN	1.43	x	x

Martin, Banded	Riparia cincta		4.29	x	x
Martin, Brown-throated	Riparia paludicola		37.14	x	x
Martin, Rock	Hirundo fuligula		12.86	x	x
Martin, Sand	Riparia riparia		1.43	x	x
Masked-weaver, Southern	Ploceus velatus		96.67	x	x
Moorhen, Common	Gallinula chloropus		36.67	x	x
Mousebird, Red-faced	Urocolius indicus		58.1	x	x
Mousebird, Speckled	Colius striatus		53.81	x	x
Mousebird, White-backed	Colius colius		5.24	x	x
Myna, Common	Acridotheres tristis		94.76	x	x
Neddicky, Neddicky	Cisticola fulvicapilla		64.76	x	x
Night-Heron, Black-crowned	Nycticorax nycticorax		1.9	x	x
Nightjar, Rufous-cheeked	Caprimulgus rufigena		0.95	x	x
Olive-pigeon, African	Columba arquatrix		10		x
Oriole, Black-headed	Oriolus larvatus		0.95		x
Ostrich, Common	Struthio camelus		1.9		x
Owl, Barn	Tyto alba		1.43	x	x
Owl, Marsh	Asio capensis		4.76	x	x
Palm-swift, African	Cypsiurus parvus		36.67	x	x
Paradise-flycatcher, African	Terpsiphone viridis		9.05	x	x
Paradise-whydah, Long-tailed	Vidua paradisaea		0.48	x	x
Peacock, Common	Pavo cristatus		0.95		x
Pigeon, Speckled	Columba guinea		66.67	x	x
Pipit, African	Anthus cinnamomeus		60	x	x
Pipit, Buffy	Anthus vaalensis		Adhoc/Incidental	x	
Pipit, Long-billed	Anthus similis		10	x	x
Pipit, Plain-backed	Anthus leucophrys		4.29	x	x
Plover, Common Ringed	Charadrius hiaticula		Adhoc/Incidental	x	
Plover, Kittlitz's	Charadrius pecuarius		0.48		x
Plover, Three-banded	Charadrius tricollaris		22.38	x	x
Pochard, Southern	Netta erythrophthalma		8.57	x	x
Pratincole, Black-winged	Glareola nordmanni	NT	Adhoc/Incidental	x	x
Prinia, Black-chested	Prinia flavicans		66.67	x	x
Prinia, Tawny-flanked	Prinia subflava		23.33	x	x
Puffback, Black-backed	Dryoscopus cubla		0.48	x	x
Pytilia, Green-winged	Pytilia melba		Adhoc/Incidental	x	
Quail, Common	Coturnix coturnix		0.48	x	x
Quailfinch, African	Ortygospiza atricollis		19.52	x	x
Quelea, Red-billed	Quelea quelea		13.33	x	x
Rail, African	Rallus caerulescens		5.71	x	x
Reed-warbler, African	Acrocephalus baeticatus		9.52	x	x
Reed-warbler, Great	Acrocephalus arundinaceus		1.43	x	x

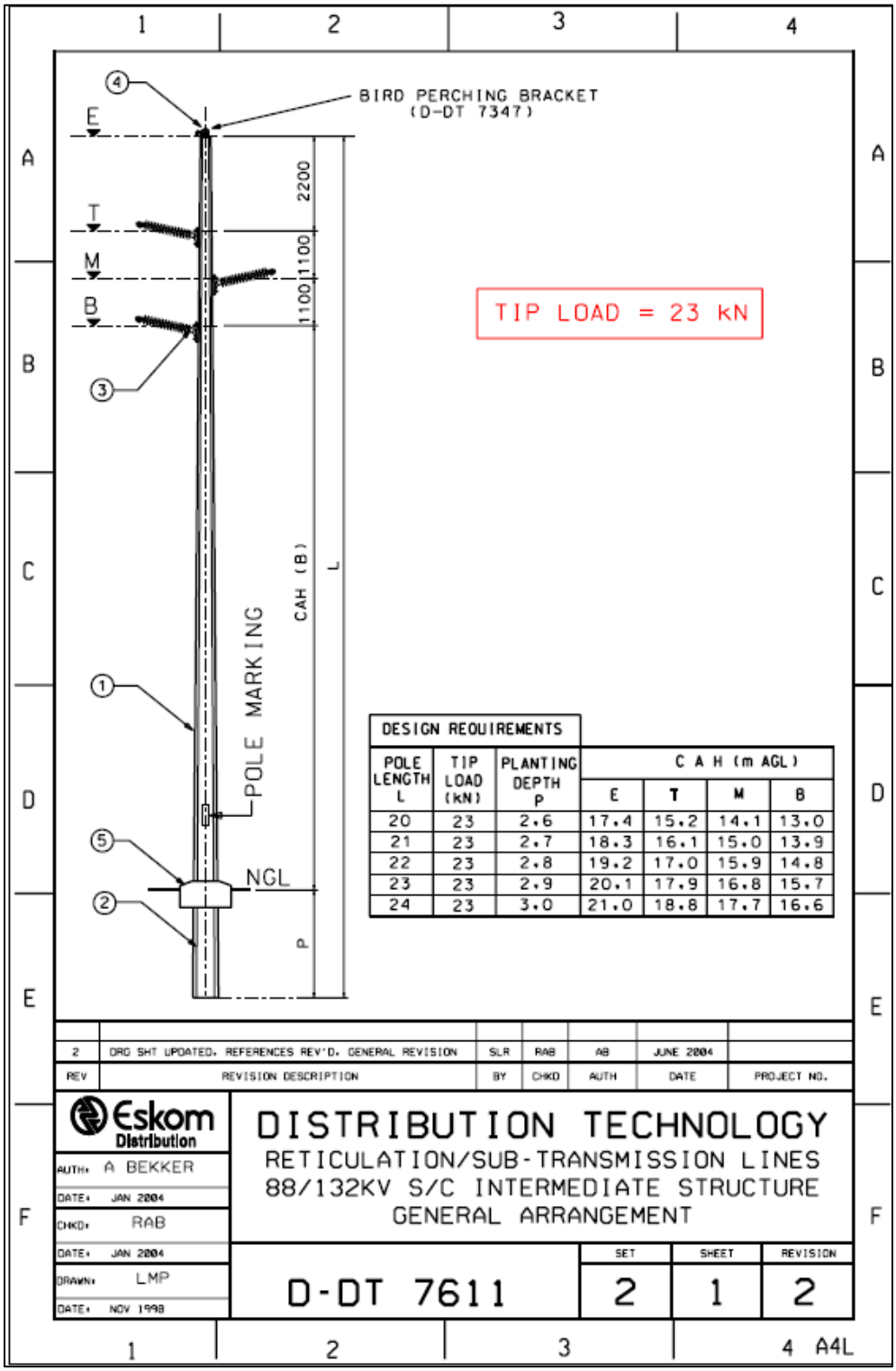
Robin-chat, Cape	Cossypha caffra		52.86	x	x
Rock-thrush, Sentinel	Monticola explorator		1.43	x	x
Roller, European	Coracias garrulus	NT	0.48	x	x
Roller, Lilac-breasted	Coracias caudatus		Adhoc/Incidental	x	
Ruff, Ruff	Philomachus pugnax		6.19	x	x
Rush-warbler, Little	Bradypterus baboecala		19.52	x	x
Sandpiper, Common	Actitis hypoleucos		2.38	x	x
Sandpiper, Curlew	Calidris ferruginea		Adhoc/Incidental	x	
Sandpiper, Marsh	Tringa stagnatilis		0.48	x	x
Sandpiper, Wood	Tringa glareola		6.67	x	x
Scimitarbill, Common	Rhinopomastus cyanomelas		2.86		x
Scrub-robin, Kalahari	Cercotrichas paena		2.38	x	x
Secretarybird, Secretarybird	Sagittarius serpentarius	VU	1.9	x	x
Seedeater, Streaky-headed	Crithagra gularis		38.57	x	x
Shelduck, South African	Tadorna cana		6.67	x	x
Shikra, Shikra	Accipiter badius		Adhoc/Incidental	x	
Shoveler, Cape	Anas smithii		5.71	x	x
Shrike, Crimson-breasted	Laniarius atrococcineus		3.33		x
Shrike, Lesser Grey	Lanius minor		1.9	x	x
Shrike, Red-backed	Lanius collurio		3.81	x	x
Snake-eagle, Black-chested	Circaetus pectoralis		Adhoc/Incidental	x	
Snipe, African	Gallinago nigripennis		17.62	x	x
Sparrow, Cape	Passer melanurus		91.43	x	x
Sparrow, House	Passer domesticus		56.67	x	x
Sparrow, Northern Grey-headed	Passer griseus		Adhoc/Incidental	x	
Sparrow, Southern Grey-headed	Passer diffusus		20.95	x	x
Sparrow-weaver, White-browed	Plocepasser mahali		51.43	x	x
Sparrowhawk, Black	Accipiter melanoleucus		0.95		x
Sparrowhawk, Ovambo	Accipiter ovampensis		2.86		x
Sparrowlark, Chestnut-backed	Eremopterix leucotis		Adhoc/Incidental	x	
Spoonbill, African	Platalea alba		2.38	x	x
Spurfowl, Swainson's	Pternistis swainsonii		34.29	x	x
Starling, Cape Glossy	Lamprotornis nitens		63.33	x	x
Starling, Common	Sturnus vulgaris		0.95		x
Starling, Pied	Spreo bicolor		64.29	x	x
Starling, Red-winged	Onychognathus morio		9.52	x	x
Starling, Wattled	Creatophora cinerea		9.05	x	x
Stilt, Black-winged	Himantopus himantopus		14.29	x	x
Stint, Little	Calidris minuta		2.38	x	x
Stonechat, African	Saxicola torquatus		79.05	x	x
Stork, Abdim's	Ciconia abdimii	NT	Adhoc/Incidental	x	
Stork, White	Ciconia ciconia		1.43	x	x

Sunbird, Amethyst	Chalcomitra amethystina		15.24	x	x
Sunbird, Greater Double-collared	Cinnyris afer		2.86	x	x
Sunbird, Malachite	Nectarinia famosa		3.33	x	x
Sunbird, White-bellied	Cinnyris talatala		20.48	x	x
Swallow, Barn	Hirundo rustica		50.95	x	x
Swallow, Greater Striped	Hirundo cucullata		58.57	x	x
Swallow, Lesser Striped	Hirundo abyssinica		0.48		x
Swallow, Pearl-breasted	Hirundo dimidiata		0.48		x
Swallow, Red-breasted	Hirundo semirufa		1.43	x	x
Swallow, White-throated	Hirundo albigularis		40.48	x	x
Swamp-warbler, Lesser	Acrocephalus gracilirostris		41.9	x	x
Swamphen, African Purple	Porphyrio madagascariensis		10.48	x	x
Swift, African Black	Apus barbatus		0.48	x	x
Swift, Alpine	Tachymarptis melba		Adhoc/Incidental	x	
Swift, Common	Apus apus		1.43	x	x
Swift, Horus	Apus horus		1.43	x	x
Swift, Little	Apus affinis		30.48	x	x
Swift, White-rumped	Apus caffer		48.1	x	x
Tchagra, Brown-crowned	Tchagra australis		4.29		x
Teal, Cape	Anas capensis		0.48	x	x
Teal, Hottentot	Anas hottentota		7.14	x	x
Teal, Red-billed	Anas erythrorhyncha		22.38	x	x
Tern, Whiskered	Chlidonias hybrida		4.29	x	x
Tern, White-winged	Chlidonias leucopterus		3.33	x	x
Thick-knee, Spotted	Burhinus capensis		20.95	x	x
Thrush, Groundscraper	Psophocichla litsipsirupa		Adhoc/Incidental	x	
Thrush, Karoo	Turdus smithi		46.67	x	x
Thrush, Kurrichane	Turdus libonyanus		2.38		x
Thrush, Olive	Turdus olivaceus		Adhoc/Incidental	x	
Tit, Ashy	Parus cinerascens		3.33	x	x
Tit-babbler, Chestnut-vented	Parisoma subcaeruleum		9.05		x
Turtle-dove, Cape	Streptopelia capicola		91.9	x	x
Wagtail, African Pied	Motacilla aguimp		0.48	x	x
Wagtail, Cape	Motacilla capensis		54.29	x	x
Wagtail, Yellow	Motacilla flava		Adhoc/Incidental	x	
Warbler, Garden	Sylvia borin		0.48	x	x
Warbler, Icterine	Hippolais icterina		0.48		x
Warbler, Marsh	Acrocephalus palustris		4.76	x	x
Warbler, Sedge	Acrocephalus schoenobaenus		Adhoc/Incidental	x	
Warbler, Willow	Phylloscopus trochilus		8.1	x	x
Waxbill, Blue	Uraeginthus angolensis		0.48		x
Waxbill, Common	Estrilda astrild		30.48	x	x

Waxbill, Orange-breasted	Amandava subflava		9.52	x	x
Weaver, Cape	Ploceus capensis		10.95	x	x
Weaver, Thick-billed	Amblyospiza albifrons		13.81	x	x
Weaver, Village	Ploceus cucullatus		Adhoc/Incidental	x	
Wheatear, Capped	Oenanthe pileata		26.67	x	x
Wheatear, Mountain	Oenanthe monticola		39.52	x	x
White-eye, Cape	Zosterops virens		49.52	x	x
White-eye, Orange River	Zosterops pallidus		Adhoc/Incidental	x	
Whitethroat, Common	Sylvia communis		Adhoc/Incidental		x
Whydah, Pin-tailed	Vidua macroura		42.86	x	x
Widowbird, Fan-tailed	Euplectes axillaris		1.43		x
Widowbird, Long-tailed	Euplectes progne		70.48	x	x
Widowbird, Red-collared	Euplectes ardens		41.43	x	x
Widowbird, White-winged	Euplectes albonotatus		5.24		x
Wood-hoopoe, Green	Phoeniculus purpureus		18.57	x	x
Woodpecker, Cardinal	Dendropicos fuscescens		6.19	x	x
Woodpecker, Golden-tailed	Campethera abingoni		0.95		x
Wryneck, Red-throated	Jynx ruficollis		30.48	x	x

APPENDIX 3

RECOMMENDED 132KV STRUCTURE TYPE (STEEL MONOPOLE)



APPENDIX 4
METHOD OF ASSESSING THE SIGNIFICANCE OF POTENTIAL ENVIRONMENTAL IMPACTS

The objective of the assessment of impacts is to identify and assess all the significant impacts that may arise as a result of the proposed paper mill. The process of assessing the impacts of the project encompasses the following four activities:

- Identification and assessment of potential impacts
- Prediction of the nature, magnitude, extent and duration of potentially significant impacts
- Identification of mitigation measures that could be implemented to reduce the severity or significance of the impacts of the activity
- Evaluation of the significance of the impact after the mitigation measures have been implemented i.e. the significance of the residual impact.

In accordance with GNR 543, promulgated in terms of section 24 of the National Environmental Management Act, 1998 (Act 107 of 1998), specialists will be required to assess the significance of potential impacts in terms of the following criteria:

- Cumulative impacts
- Nature of the impact
- Extent of the impact
- Intensity of the impact
- Duration of the impact
- Probability of the impact occurring
- Impact non-reversibility
- Impact on irreplaceable resources
- Confidence level

Issues are assessed in terms of the following criteria:

- The nature, a description of what causes the effect, what will be affected and how it will be affected
- The physical extent, wherein it is indicated whether:

  1 - the impact will be limited to the site

  2 - the impact will be limited to the local area

  3 - the impact will be limited to the region

  4 - the impact will be national

  5 - the impact will be international

- The duration, wherein it is indicated whether the lifetime of the impact will be:

  1 - of a very short duration (0–1 years)

  2 - of a short duration (2-5 years)

  3 - medium-term (5–15 years)

  4 - long term (> 15 years)

  5 – permanent

- The magnitude of impact on ecological processes, quantified on a scale from 0-10, where a score is assigned:

  0 - small and will have no effect on the environment

  2 - minor and will not result in an impact on processes

  4 - low and will cause a slight impact on processes

  6 - moderate and will result in processes continuing but in a modified way

  8 - high (processes are altered to the extent that they temporarily cease)

  10 - very high and results in complete destruction of patterns and permanent cessation of processes

- The probability of occurrence, which describes the likelihood of the impact actually occurring. Probability is estimated on a scale where:

  1 - very improbable (probably will not happen

  2 - improbable (some possibility, but low likelihood)

  3 - probable (distinct possibility)

  4 - highly probable (most likely)

  5 - definite (impact will occur regardless of any prevention measures)

- The significance, which is determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high.

- The status, which is described as either positive, negative or neutral.

- The degree to which the impact can be reversed.

- The degree to which the impact may cause irreplaceable loss of resources.

- The degree to which the impact can be mitigated.

The significance is determined by combining the criteria in the following formula:

S = (E + D + M) * P

The significance weightings for each potential impact are as follows:

< 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area);

30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated);

> 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).