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AN AVIAN BIODIVERSITY ASSESSMENT FOR A PROPOSED HEKPOORT-CASHAN SUBSTATION AND POWERLINE SERVITUDE

AC Kemp PhD PrSciNat

Commissioned by

SRK CONSULTING
October 2013
Revised October 2014

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by

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Commissioned by:

SRK Consulting

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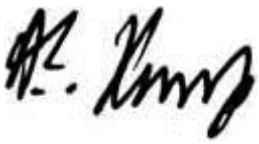
DECLARATION OF PROFESSIONAL STANDING AND INDEPENDENCE:

I, Alan Charles Kemp (RSA ID 4405075033081) declare that I:

- hold a Ph.D. in the biological sciences, which allowed registration by SACNASP (SA Council for National Scientific Professions) as a Professional Zoological and Ecological scientist and sanctions me to function independently as a specialist consultant,
- declare that, as per prerequisites of the Natural Scientific Professions Act No. 27 of 2003, this project was my work from its inception, reflects exclusively my observations and unbiased scientific interpretations, and was executed to the best of my ability,
- abide by the Code of Ethics of the SACNASP,
- am committed to biodiversity conservation but concomitantly recognize the need for economic development,
- appreciate opportunities to learn through constructive criticism and debate,
- I reserve the right to form and hold my own opinions within the constraints of my training and experience, and therefore will not submit willingly to the interests of other parties or change my statements to appease them,
- am subcontracted as a specialist consultant by EcoAgent CC for the project "An avian biodiversity assessment for a proposed hekpoort-cashan substation and powerline servitude" as described in this report,
- have no financial interest in the proposed development other than remuneration for the work performed,
- do not and will not have any vested or conflicting interests in the proposed development,
- undertake to disclose to EcoAgent CC and its client(s), as well as to any competent authority, all material information with the potential to influence any decisions by the competent authorities, as required in terms of the Environmental Impact Assessment Regulations 2010,
- reserve the right to only transfer my intellectual property contained in this report to the client(s), (party or company that commissioned the work) on full payment of the contract fee. Upon transfer of the intellectual property, I recognise that written consent from the client(s) will be required for me to release any part of this report to third parties.



A. C. Kemp

EXECUTIVE SUMMARY

Birds

The main conservation objectives for birds along this proposed Hekpoort-Cashan power line are to retain as much as possible of the natural bush- and grassveld, together with what little drainage, watercourse and wetland habitats might be affected by the development. The main concern is for any birds that make use of the ranges in the Magaliesberg and Witwatersberg Important Bird Area, which may visit the study area and be at risk from the power line development. No threatened species expected for the area seem likely to be negatively affected by the proposed alternative power lines. Wherever necessary, Eskom should apply their normal expertise is designing support poles that minimise electrocution risk and suitably mark lines where avian collisions are most likely, as indicated in this report.

PROJECT BACKGROUND AND STUDY AREA

The route the Alternative 1 power line runs from the proposed new Cashan substation eastwards along a small farm road, pass south of a small farm dam, runs along a furrow that feeds the dam, crosses the furrow and a spruit and runs through or along dense bush and eventually turns north along the R563, mainly along cultivated fields, then turns north-eastwards along the R560 and finally turns southwards to the existing Hekpoort substation, where it also crosses a small spruit before entering the substation.

The route of the Alternative 2 power line runs from the proposed new Cashan power (similar to Alternative 1) line eastwards along a small farm road, pass south of a small farm dam, runs along a furrow that feeds the dam, crosses the furrow and a spruit and runs through or along dense bush. It does however not turn northwards along the R563, but crosses the R563, remains along the small road until it reaches the Hekpoort substation.

Most of both the Alternative power lines run through Gauteng Province, within the City of Tshwane Metropolitan Municipality, while the eastern end of the line and Hekpoort substation apparently fall within North West Province and the Bojanala Platinum District Municipality (Fig. 1).

The R560 road in this area runs more or less parallel to the Magaliesberg range to the north and the Witwatersberg (linking eastwards to the Daspoortrand) to the south, and passes just south of the Magaliesrivier that drains the valley between the ranges as it runs northeast into the Hartebeestpoort Dam (Fig. 2). The power line will pass through a series of properties that are engaged in various forms of agriculture, based mainly in the sandy and loamy soils that have accumulated from the northern slopes of the Witwatersberg, and these sands are also quarried closer to the range. Water runs north off the Witwatersberg in small northwest-draining tributaries to the Magaliesrivier, besides forming seepages in the deep sands along the base of the Witwatersberg. The power line is apparently intended to conduct additional power to Hekpoort village, including the informal settlements evident on its eastern side and around the proposed new western substation.

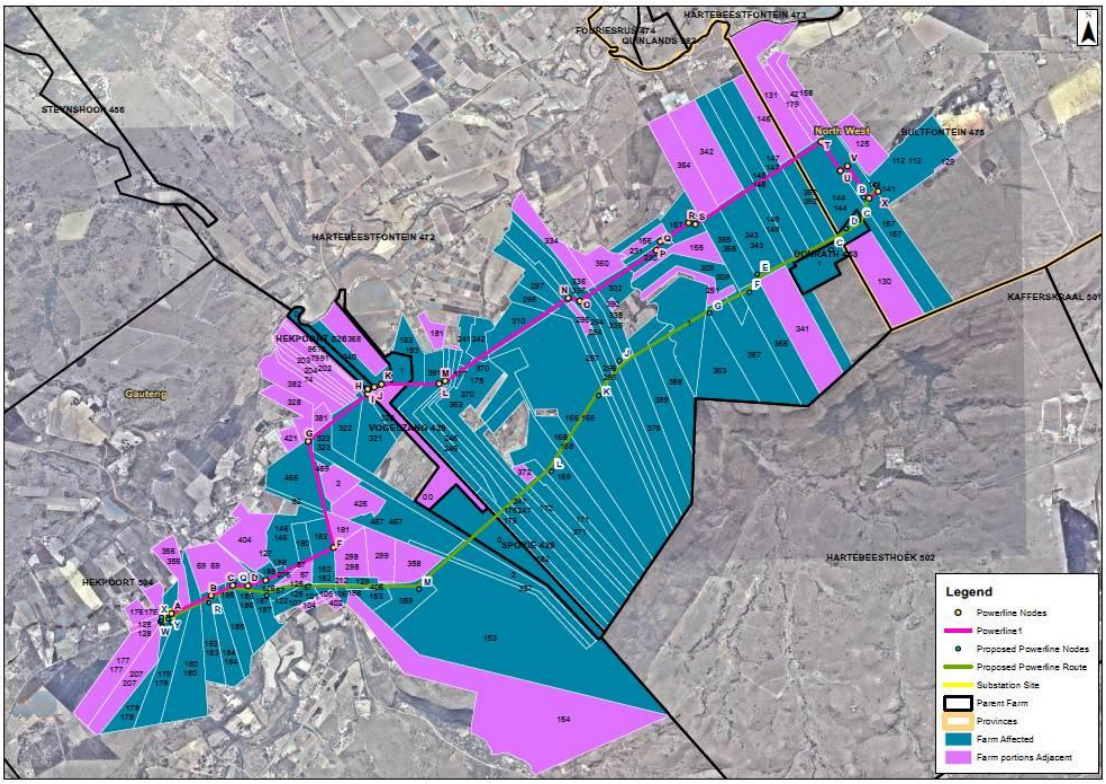


Figure 1: Image showing the alignment of the initially proposed power line 1 (purple line), extended to the south-west; and the newly proposed power line (green line)

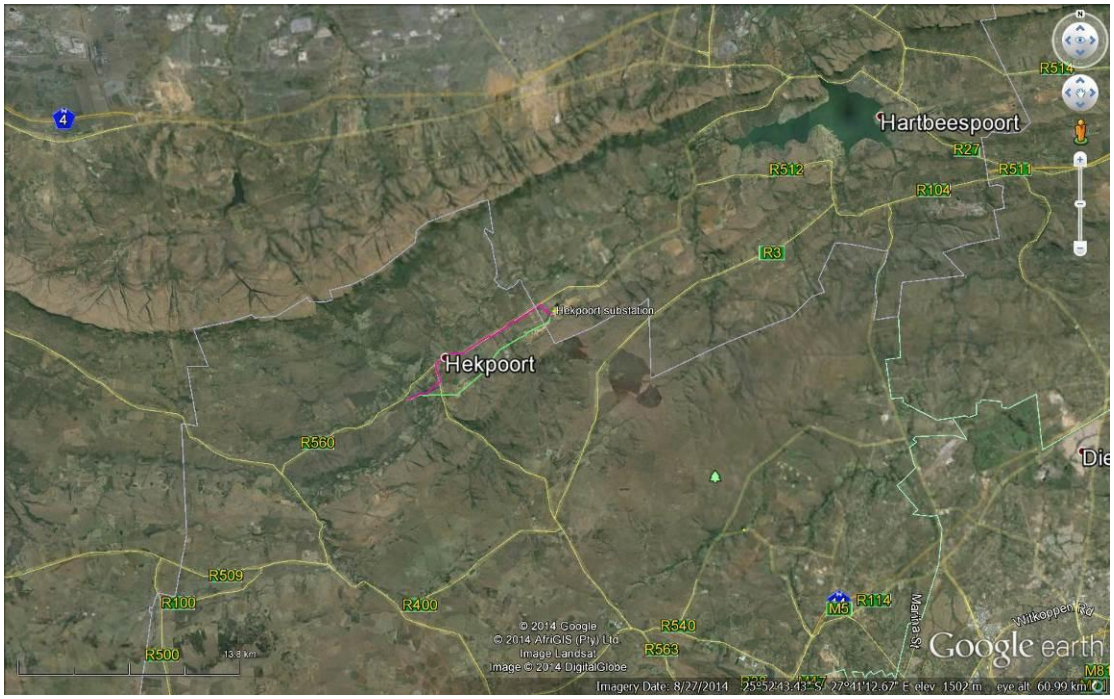
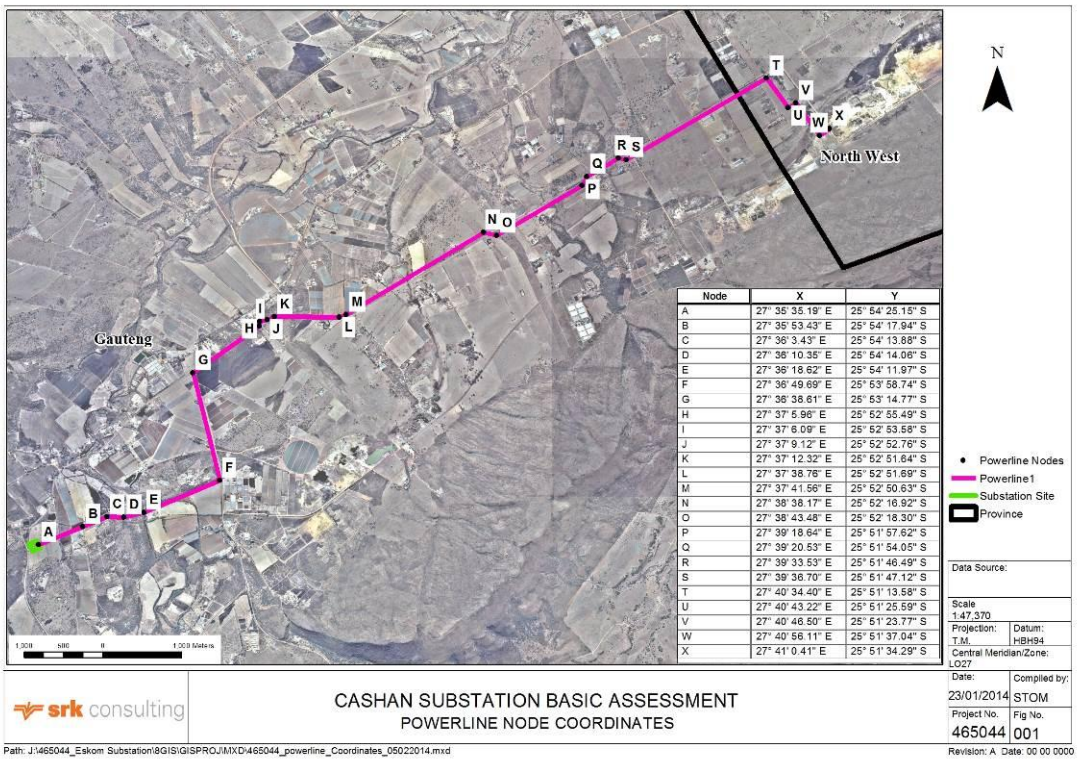
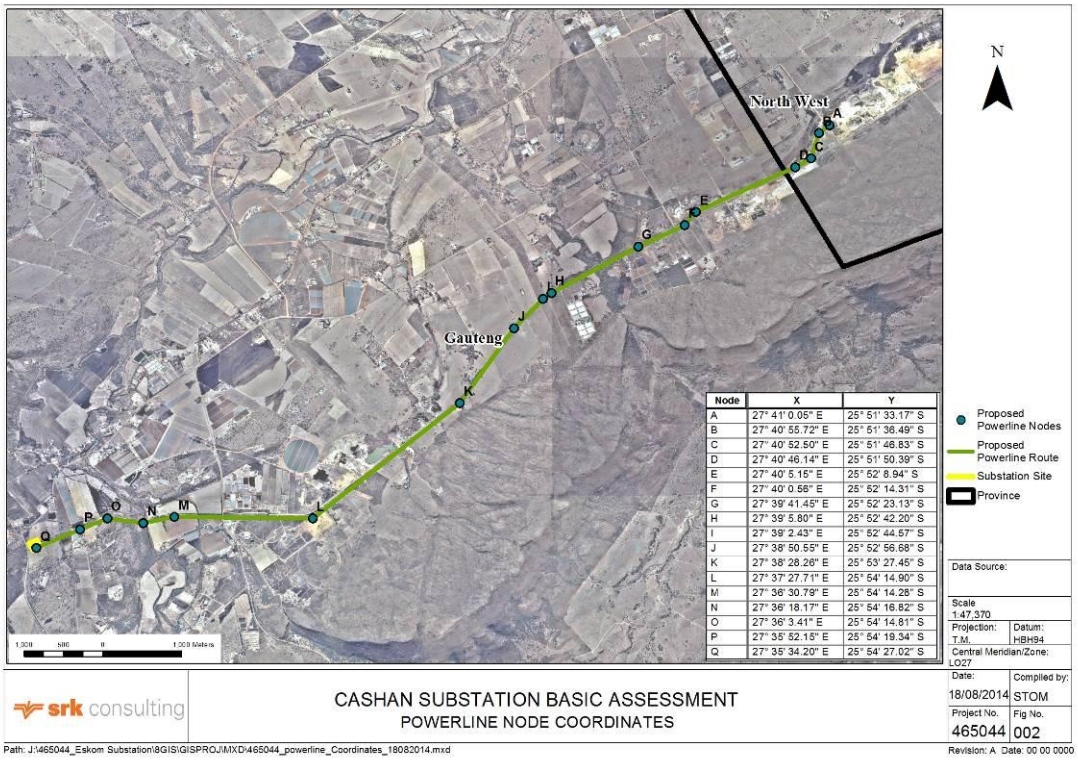


Figure 2: Satellite image showing the approximate position of the general study site area relative to the Magaliesberg and Witwatersrand ranges, Hartebeestpoort Dam and major road network



Node	X	Y
A	27° 35' 35.19" E	25° 54' 25.15" S
B	27° 35' 53.43" E	25° 54' 17.94" S
C	27° 36' 3.43" E	25° 54' 13.88" S
D	27° 36' 10.35" E	25° 54' 14.06" S
E	27° 36' 18.62" E	25° 54' 11.97" S
F	27° 36' 49.69" E	25° 53' 58.74" S
G	27° 36' 38.61" E	25° 53' 14.77" S
H	27° 37' 5.96" E	25° 52' 55.49" S
I	27° 37' 6.09" E	25° 52' 53.58" S
J	27° 37' 9.12" E	25° 52' 52.76" S
K	27° 37' 12.32" E	25° 52' 51.64" S
L	27° 37' 38.76" E	25° 52' 51.69" S
M	27° 37' 41.56" E	25° 52' 50.63" S
N	27° 38' 38.17" E	25° 52' 16.92" S
O	27° 38' 43.48" E	25° 52' 18.30" S
P	27° 39' 18.64" E	25° 51' 57.62" S
Q	27° 39' 20.53" E	25° 51' 54.05" S
R	27° 39' 33.53" E	25° 51' 46.49" S
S	27° 39' 36.70" E	25° 51' 47.12" S
T	27° 40' 34.40" E	25° 51' 13.58" S
U	27° 40' 43.22" E	25° 51' 25.59" S
V	27° 40' 46.50" E	25° 51' 23.77" S
W	27° 40' 56.11" E	25° 51' 37.04" S
X	27° 41' 0.41" E	25° 51' 34.29" S



Node	X	Y
A	27° 41' 0.05" E	25° 51' 33.17" S
B	27° 40' 55.72" E	25° 51' 36.49" S
C	27° 40' 52.50" E	25° 51' 46.83" S
D	27° 40' 46.14" E	25° 51' 50.39" S
E	27° 40' 5.15" E	25° 52' 8.94" S
F	27° 40' 0.58" E	25° 52' 14.31" S
G	27° 39' 41.45" E	25° 52' 23.13" S
H	27° 39' 5.80" E	25° 52' 42.20" S
I	27° 39' 2.43" E	25° 52' 44.57" S
J	27° 38' 50.55" E	25° 52' 56.68" S
K	27° 38' 28.26" E	25° 53' 27.45" S
L	27° 37' 27.71" E	25° 54' 14.90" S
M	27° 36' 30.79" E	25° 54' 14.28" S
N	27° 36' 18.17" E	25° 54' 16.82" S
O	27° 36' 3.41" E	25° 54' 14.81" S
P	27° 35' 52.15" E	25° 54' 19.34" S
Q	27° 35' 34.20" E	25° 54' 27.02" S

Figure 3: The co-ordinates of the proposed alternative power lines

The line passes through a series of properties engaged in various forms of agriculture (Fig. 1), based in the loamy and sandy soils that have accumulated from the northern slopes of the Witwatersberg, and these sands are also quarried closer to the range. These sands also drain off water in small northwest-running tributaries to the Magaliesrivier, besides forming seepages along the southern base of the Witwatersberg.

The co-ordinates of the two Alternative power lines are given in Figure 3.

The present report combines a site visit on 4 October 2013 (accompanied by a botanist) and a further site visit during October 2014, with a subsequent desktop study to assess possible impacts of the development and suggest possible mitigation options should it be approved.

The exact voltage, pole/pylon type and average line height for the proposed power line was not available to us at the time of this survey, so our observations focussed mainly on the types of habitats to be crossed and the avifauna expected therein.

1. ASSIGNMENT – General Protocol

EcoAgent was appointed to assess the avifaunal habitats and make a bird diversity assessment for the power line and its surroundings (hereafter “the site”). The purpose of this bio-survey is to provide background information, augment any existing Environmental Impact Assessments (EIAs) or Environmental Management Plans (EMPs), and recommend priorities with respect to the on-going management of any priority and/or sensitive areas or species. This assignment is conducted in accordance with the 2010 Environmental Impact Assessment (EIA) Regulations (No. R. 543-546, DEAT, Department of Environmental Affairs and Tourism, 18 June 2010) that emanate from Chapter 5 of NEMA, the National Environmental Management Act, 1998 (Act No. 107 of 1998).

On 25 August 2014 the scope of work on the Cashan project has changed and an alternative line has now been included in the project. A further quote to include the second alignment and change in substation position had to be submitted. This revised report includes the first and second alignments.

The assignment is interpreted as: Compile a study of the habitats and avifauna of the site and its surroundings, with emphasis on Red Data bird species that occur or may occur on the site. In order to compile this, the following had to be done:

1.1. Initial preparations:

- Obtain all relevant maps and information on the natural environment of the area concerned, including on threatened and/or Red Data habitats and bird species that may occur in the area.

1.2. Habitat survey:

- Examine the diversity and structure of the plants (trees, shrubs, grasses and herbaceous species) present, to delimit those plant communities and ecosystems relevant to avian distributions and abundance.
- Identify potentially threatened, sensitive and/or Red Data habitats and vegetation.
- Prepare a sensitivity map of the plant communities recognised, if relevant.

1.3. Avifaunal assessment

- Obtain lists of the general avifauna and especially any Red Data bird species that can be expected in the area.
- Assess the quantitative and qualitative condition of suitable habitats for the Red-listed bird species that may occur in the area.
- Assess the possibility and probability of Red-listed avifauna being present on the study site.
- Compile a list of occurrences.

1.4. General

- Identify and describe natural areas of particular ecological sensitivity, e.g. wetlands, pans, rivers, forest and ridges.
- Identify transformed areas in need of special treatment or management, e.g. bush encroachment, erosion, water pollution, degradation and/or reclamation.
- Recommend aspects that should be monitored before, during and/or after development.

- Provide information on Red Data bird species that may occur or be expected in the area.

2. RATIONALE

It is widely recognised that the natural resources on Earth are essential in providing the ecological processes and life support systems that maintain healthy and viable populations of plants and animals, including humans. Therefore, for any sustainable development to take place, all possible impacts of such development on the environment must be considered before it can be approved by the relevant authorities. This has led to various and increasing legislation that protects the natural environment in South Africa. In 1992, the Convention of Biological Diversity (CBD), a landmark international convention, was signed by >90 % of members of the United Nations. In South Africa, the Environmental Conservation Act (ECA, Act 73 of 1989), the National Environmental Management Act (NEMA, Act 107 of 1998) and the National Environmental Management Biodiversity Act (NEMBA, Act 10 0f 2004) ensure the protection of ecological processes, natural systems and natural beauty, as well as the preservation of biotic diversity within the natural environment. They also ensure the protection of the environment against disturbance, deterioration, defacement or destruction as a result of man-made structures, installations, processes, products or activities. In support of these Acts, a draft list of Threatened Ecosystems was published (Government Gazette 2009), as part of the NEMBA (Act 10 of 2004), and details of these Threatened Ecosystems have been described by SANBI & DEAT (2009). International and national Red Data lists have also been produced for various threatened plant and animal taxa.

At a proposed development site, all components of the ecosystems, abiotic (e.g. geology, topography, climate) and biotic (e.g. vegetation, animals) are interrelated and interdependent. A holistic approach is therefore imperative to include effectively the development, utilisation and, where necessary, conservation of the given natural resources within an integrated development plan that will address the needs of a modern human population (Bredenkamp & Brown 2001).

This makes it necessary to make a thorough inventory of the biodiversity on the site, and to evaluate the ecosystems, habitats and possibility of threatened species. This inventory should then serve as a scientific and ecological basis for planning, initiating, managing and, where necessary, terminating the development. Birds, being among the most visible and best studied group of animals, are an ideal group of so-called 'indicator' species that might signal the health and importance of any terrestrial and/or aquatic habitats.

This development of a power transmission line connecting the existing Eskom Hekpoort substation to a new substation on the eastern outskirts of the village of Hekpoort is obviously important for the local communities. If the development can proceed without any significant addition to the environmental impacts in what is already a largely transformed and developed area, then it offers important community benefits, in particular supplying power to Hekpoort village and surrounding infrastructure, and power/tax fees for the local municipality.

3. SCOPE AND OBJECTIVES OF THE STUDY

- To assess qualitatively, and describe quantitatively where possible, the significance of the habitat components and current general conservation status of the site.
- To comment on ecologically sensitive areas.
- To comment on connectivity with natural vegetation and habitats on adjacent sites.
- To recommend suitable buffer zones, if relevant.
- To provide a list of bird species, which do or might occur on site and that may be affected by the development, and to identify species of conservation concern.
- To highlight potential impacts of the proposed development on the bird species of the study site.
- To provide management recommendations that might mitigate negative and enhance positive impacts, should the proposed development be approved.

4. THE RECEIVING PHYSICAL ENVIRONMENT (mainly ex Mucina & Rutherford 2006)

Regional Climate

The study area experiences austral summer rainfall and very dry winters, the mean annual precipitation being 650-700 mm. Extreme temperatures (at Pretoria) are from 33.6^{o}C in January to -3.1^{o}C in June, and frost is frequent in winter.

Geology and soils

Soils in the Magaliesrivier valley derive from the ranges on either side, stony with patches of clay and loam on the higher slopes, but sandier lower down before the more apedal and clayey soils on the valley floor and closer to the river. The deep yellow and red sands are exposed along the northern base of the Witwatersberg where the ground cover has been removed for commercial sand extraction (Fig. 4).

Topography and drainage

The Magaliesrivier valley is at an altitude of about 1300-1250 m a.s.l. It slopes and drains to the northeast, where it enters the Hartebeestpoort Dam. The main runoff into the river comes from the shallow and wider northern slopes of the Witwatersberg to the south, with less from the steep and narrower southern slopes of the Magaliesberg to the north. Runoff across the study site is predominately to the north, beginning as seeps within the sandy soils accumulated at the base of the Witwatersberg and then forming a few deeper drainage lines as southern tributaries to the Magaliesrivier.

Land Use

The predominant land use on and around the study site is agriculture, with few small patches of relatively natural vegetation remaining. The habitat has been transformed by everything from heavy grazing and mowing to ploughed croplands, many of them now fallow for different periods. Much of the remaining grassland is secondary, interspersed with the altered habitats around farmyards and the various hospitality and chicken-rearing operations.

Vegetation Types

The floor of the valley supports Moot Plains Bushveld (vegetation type SVcb8 of Mucina & Rutherford 2006); with the mountain ranges on either side supporting Gold Reef

Mountain Bushveld (SVcb9). The sour, mixed bushveld on the valley floor of the Magaliesrivier is dominated by various *Acacia* species, generally denser on the more clayey soils along the drainage slopes and lines, and more open with a well-developed grass layer in the higher, flatter and sandier areas. This grades into and becomes more wooded towards the adjoining mountain bushveld on either side, habitat that does not occur on the site and is best developed along the steeper southern aspects of the ranges.

Conservation status of habitats

The valley floor habitat is classified as 'vulnerable', mainly due to development resulting from its higher agricultural potential, as exhibited by the extensive transformation along the study site, but also due to the invasion of a range of alien plant species evident on site. Signs of erosion were generally few, except in the southern areas where sand extraction had removed the ground cover. The mountain habitats on either side are much better conserved and only 'least threatened', especially within the extensive Magaliesberg Nature Area to the north, but with other smaller conservancies of importance to the south such as the Cradle of Humankind World Heritage Site and the Rhino and Lion Nature Reserve.

5. METHODS

During a site visit, selected roads and tracks on the site were driven, with regular stops to record avian diversity and habitat types and conduct random walking transects. Coordinates were taken at localities of note, and attention was paid to the biological condition and diversity within 500 meters on adjoining properties.

5.1. Bird Habitats

While bird distributions have been related to broad vegetation types, there is a general consensus internationally that vegetation structure, rather than floral composition, is the primary parameter in most bird habitats associated with community structure, although not with density (Allan *et al*. in Harrison *et al*. 1997 and references therein). The principal regional units identified for bird communities in South Africa, based primarily on similarity in vegetation structure rather than composition, are divided into four major habitat

groups **Karoo** (subdivided into Succulent, Nama and Grassy), **Grassland** (Sweet, Mixed, Sour and Alpine), **Kalahari** (South and Central), and **Woodland** (Arid, Moist and Mopane), plus the discrete and smaller areas of **Fynbos**, **Valley Bushveld**, **East Coast Littoral** and **Afromontane Forest** (Allan *et al*. in Harrison et al. 1997).

Of course vegetation structure is determined by and offers a surrogate for a wide variety of abiotic factors (of which soils and climate, and in South Africa particularly rainfall and temperature, are most important). The habitats occupied by flying birds differ from those of most terrestrial vertebrates in being three-dimensional, especially for aerial-feeding species and those regularly using airspace above landscapes with low relief and/or short vegetation, but in the two horizontal dimensions birds depend most on vegetation structure and substrate texture and colour (except of a minority of species with particular food/nest requirements of substrate, foliage, flowers, fruit or seeds). Although plant species composition is the main criterion used to delimit most vegetation biomes and units described for South Africa, the most recent analyses also take into account and offer good synopses of the abiotic factors that underlie such divisions as landscape structure and topography, geology and soil types, and climate, besides details of the vegetation units, their community structure and composition and their conservation status (Mucina & Rutherford 2006).

The principal habitats on site were identified and stratified into relatively homogeneous units based on recent satellite (Google Earth) images of the area, including any particular natural features and/or indications of transformed habitats (croplands, mining, buildings). Within each homogeneous unit, a description was made, illustrated by images, of the principal features that might influence bird distribution (vegetation structure, composition, quality and extent; water-related moist patches, marshes and areas of open water; topographical and geological features such as steep slopes, deep valleys or rocky outcrops; or man-made plantations or structures that might provide roost/nest sites).

The biodiversity significance of an area relates to its species diversity, endemism (of species or ecological processes) and significant occurrence of threatened/legally-protected species or ecosystems. The following conservation priorities were used for each avian habitat type recognised on site or nearby:

High: Ecologically sensitive and valuable land, with high species richness, sensitive ecosystems or Red Data species, that should be conserved and no development allowed.

Medium-high: Land where sections are disturbed but that is still ecologically sensitive to development/disturbance.

Medium: Land on which low-impact development with limited impact on the ecosystem could be considered, but where it is still recommended that certain portions of the natural habitat be maintained as open spaces.

Medium-low: Land on which small sections could be considered for conservation but where the area in general has little conservation value.

Low: Land that has little conservation value and that could be considered for developed with little to no impact on the habitats or avifauna.

Only **High or Low sensitivity** is indicated for the habitats, with no development allowed on areas of High sensitivity, applying the following criteria:

High: High and Medium-High conservation priority categories mentioned above are considered to have a High sensitivity and development should not be supported. These include sensitive ecosystems with low inherent resistance and/or resilience to disturbance factors, or highly dynamic, often patchy systems important for maintenance of ecosystem integrity. Most such systems represent ecosystems with high connectivity to other important ecological systems and/or support high species diversity and provide suitable habitat for a number of threatened or rare species.

Low: Medium, Medium-Low and Low conservation priority categories mentioned above are considered to have a Low sensitivity and development may be supported. Portions of habitat with a Medium conservation priority should be conserved as open areas and/or buffers wherever possible**.** These are slightly modified systems that occur along disturbance gradients of low-medium intensity, with some degree of connectivity with other ecological systems and/or ecosystems with intermediate levels of species diversity that include potential ephemeral habitat for threatened species. Low sensitivity habitats are degraded,

highly disturbed and/or transformed systems with little ecological function and low species diversity.

5.2. Bird Species

The presence of bird species wes recorded on the site visit, or the probability of their occurrence based on the habitat types recognized on and around the study site assessed. This was done with due regard to the well-recorded general distributions of southern African birds at the quarter-degree grid cell (QDGC) scale (SABAP 1, Harrison *et al*. 1997) or the pentad (5' lat. x 5' long) scale (SABAP 2, on-going, www.sabap2.org.za), coupled to my assessment and experience of the qualitative and quantitative nature of the habitats recognized on site. Due to the mobility of most birds, I also scanned at least 500 m of adjoining properties for important faunal habitats and avian species, and took note of the extent and proximity of other major areas of natural habitat and conservation potential within the normal flying distance of the bird species expected. I also extended my assessment of the extent, qualities, and limits of the various habitat types, both on site and on adjacent properties, by studying satellite images from Google Earth. While the QDGC mapping of South African bird species provides the best current information of what birds to expect where, the roughly 26-23 km (west-east) x 27.3 km grid area usually far exceeds the area of most assessment sites and can only be expected to support regularly a subset of the QDGC species recorded, depending on the subset of possible QDGC habitats available on site. Furthermore, the bird species listed for each QDGC are only those recorded during the atlas survey period and not necessarily as comprehensive as they may appear, with biases neglecting cryptic species and less accessible grids. The SABAP 2 distribution data offers a 9-times higher resolution than the SABAP 1 data, useful for smaller sites when the pentad has been repeatedly surveyed, but still on-going and only comparable when reduced back to the QDGC resolution.

5.3. Field Survey

Birds are a relatively visible and audible group of homoeothermic vertebrates, active throughout the day/night and year, and with distributions and habitat preferences that we can evaluate both by reference to the comprehensive literature available and by the subset of species detected during a field survey done at a particular season and time of

day/night. Such information and personal experience also informs searches for particular species of conservation concern.

Bird species were identifies by visual sightings during random transect walks and drives across the site, attempting to visit and search samples of all recognised habitat types, with special attention to any unusual features within each habitat. No trapping or mist netting was conducted, since the terms of reference did not require such intensive work. The presence of some species was recognised by their calls or inferred from old nests, moulted feathers, food remains, droppings and/or tracks. Where possible, local people were questioned to try and confirm occurrence or absence of particular species.

5.4. Desktop Survey

Three criteria were used to gauge the probability of occurrence of bird species on the study site: their known distribution range, their habitat preference(s) and the quality and extent of suitable habitat(s) detected on site. Initially, I derived and compared lists of bird species expected to occur on site from the QDGC records presented in atlases of Transvaal and/or southern African birds (Tarboton *et al*. 1987; Harrison et al. 1997; www.sabap2.org.za). Based on an assessment of the habitats present on site, and on the most recent regional field guide(s) for the area (Marais & Peacock 2008; Sinclair *et al*. 2011), the list was then reduced to those species recorded on site during this study, or expected subjectively to occur within those habitats as either resident species or regular visitors.

The **probability of occurrence** of a bird species on site was based primarily on its geographical distribution and the suitability of on-site habitats, taking into account that birds use their mobility to make intermittent use of habitats available when these are in a particular condition (e.g. during or after rain, flood, drought, burning, grazing, seeding, flowering) or season (e.g. regional, intra-African or inter-continental summer/winter migrants and nomads). Of course, during a site visit, species of all levels of probability might be recorded because this estimate is only a subjective estimate. I assessed the overall expectation of each species on site as:

- **High probability:** Applies to a species with a distributional range overlying the study site plus the presence of prime habitat on site. Another consideration for inclusion in this category is the tendency for the species to be ‘common’, i.e. to occur normally at a high population density.

- **Medium probability:** Applies to a species with a distributional range that peripherally overlaps the study site and/or the required habitat on site being sub-optimal. The extent of suitable habitat on site, related to its likelihood to sustain a viable breeding or non-breeding population, and its geographical isolation from other suitable habitat are also taken into consideration. Species categorized as 'medium' normally do not occur at high population densities, but cannot be deemed rare.
- **Low probability:** Means that the species' distributional range is peripheral to the study site and/or the habitats are sub-optimal. Furthermore, some bird species categorized as 'low' are generally deemed rare.

Due to the considerable aerial mobility of birds, one might expect a number of additional species as either infrequent nomads or rare vagrants, some of which may even be recorded by chance during the site visit. For these **Unlikely** species, I judged that the habitats available would offer no significant material support or conservation assistance to them, other than a temporary stopover, and that even if they did occur it would only be briefly and in insignificant numbers.

No objective assessment of the carrying capacity of the habitat for or density of any species was made, since this varies through time, birds are capable of arriving or departing as conditions change, and our ability to detect them varies seasonally. Such an assessment would require a much longer time and greater expense, and even then not all possible species are likely to be adequately recorded. However, special attention was paid to species considered as threatened internationally or nationally, so-called Red Data or Red-listed species (Birdlife International website www.birdlife.org; DEAT 2007; Barnes, 2000), and so for any threatened species expected even to visit the area The category assigned to them was elevated based on the Precautionary Principle.

6. RESULTS

A site visit was made on 4 October 2013 as part of an EcoAgent team led by Prof G.J. Bredenkamp (botanist). The visit was made in early summer just after the first Palaearctic and intra-African migrant bird species had arrived. The weather during the

visit was warm to hot, clear and with only a slight breeze. The impact assessment was updated during October2014, in accordance with the prescribed format of SRK Consulting.

6.1. Regional Bird Habitats

Details of the vegetation communities and flora on site are the subject of a separate specialist report.

The habitats at the site as identified for bird community distributions occur within the Arid Woodland biome (Allan *et al*. in Harrison *et al*. 1997) and more specifically the Moot Plains Bushveld vegetation unit of the Central Bushveld division of the Savanna Biome (unit SVcb8 of Mucina *&* Rutherford 2006). Much of the study site and surrounding area has been developed for agricultural activities, with little untransformed natural vegetation remaining and much of what remains being still used for grazing (Fig 4).

The aerial mobility of birds also demands attention to the principal habitats surrounding the study site and their conservation status, not just those along the immediate borders but also more distant habitats that might provide sources for species visiting the site and sinks for those breeding on site. In this context, extensive and mountainous Magaliesberg range and Nature Area is the predominant feature, augmented by the Witwatersberg with its adjacent Cradle of Humankind World Heritage Site and the Rhino and Lion Nature Reserve. The nearby Hartebeestpoort Dam and its feeder rivers are also relevant for the water birds they attract and the riparian corridors provided. Several smaller private and official reserves are also found in the general area.

6.2. On-site Bird Habitat Assessment

Images of the habitats at intervals along the power line routes are provided as Appendix 1. The four principal habitat types detected on and/or adjacent to the site, and considered most relevant to bird ecology and community structure, were:

1) **Croplands, ploughed and fallow.** The greatest area along and around the power line route was ploughed or fallow cropland. Only a few irrigated fields had growing crops (lucerne), most active fields were ploughed but still dry and unplanted, while fallow fields ranged from last season's weeds and annual grasses to secondary grassland-like areas dominated by *Hyparrhenia hirta,* and/or *Cynodon dactylon,* often invaded latterly by small *Acacia karroo* and *Asparagus sp.* bushes. No termite mounds were detected.

2) **Bushveld grazing.** More wooded habitat patches occurred where at least some of the natural vegetation had been retained, ranging from dense tree and bush clumps with sparse ground cover to more open and scattered woody plants with a variable grass layer depending mainly on grazing and trampling pressure. The latter graded into and was often inseparable from the grasslands on the older fallow areas, especially around inhabited areas where additional wooded plants had been added artificially. The natural woody vegetation was dominated by *Acacia karroo, Searsia lancea* and *Euclea natalensis*, with *A. robusta, Searsia pyroides, Zizyphus mucronata, Celtis africana* and *Olea europaea (*var. *africana)* also evident.

3) **Watercourses and associated Wetlands.** Those actually on site were small and minor, except that they cut across the line servitude in several places. The two draining from the Witwatersberg are narrow, deep and seasonal watercourses, with only a few *Combretum erythrophyllum* trees indicative of natural vegetation along their banks but with various alien trees, especially *Melia*, more dominant. One is dammed to form small areas of open water that support more *Typha* bulrushes as marginal vegetation than along the rest of the drainage lines. The other wetland is formed mainly from seepage immediately below the sandpits near the Hekpoort substation, with sufficient soil moisture even at the end of the dry season to support stands of sedges, bulrushes and, in more distant areas, tall reeds.

4) **Scattered Manmade Structures and Habitats.** There are various patches of manmade habitat scattered through the area, mostly active or abandoned farmhouses and yards, informal settlements adjacent to Hekpoort, and various

enterprises from chicken farms to hospitality centres. Most support stands of larger trees that structurally resemble bushveld or taller woodland, except that many of the plants are exotic aliens and there are also watered gardens and/or mown lawns and adjacent fields. Alien woody plants include *Pinus, Cypressus* and *Schinus*, and especially *Melia* and *Eucayptus* that have spread widely into the natural vegetation. Other power lines and utility poles, culverts and bridges associated with the roads, and excavations, such as sand pits and test shafts, provided additional unnatural habitats for some bird species.

Otherwise, the broader habitats adjacent to the study sites are mainly extensions of those present on site, or mentioned specifically in the habitat types described above. I generally did not assign aerial-feeding species, such as swifts, martins and swallows, to a specific habitat on site, except for those habitats that offered potential nesting habitats, since they feed wherever aerial wind-borne plankton is available.

Table 1: Rating of recognised on-site avian habitats (site + 500 m buffer) along the proposed power line servitude between Hekpoort village and substation.

Avian Habitats	Conservation Priority					Sensitivity	
	High	Medium -high	Medium	Medium -low	Low	High	Low
1. Croplands					X		X
2. Bushveld				X			X
3. Wetlands			X				X
4. Manmade					X		X

6.3. Expected and Observed Bird Species Diversity

Out of the 300-306 species expected for the site, based on the QDGC (Hekpoort 2527DC; Sabap 1) or equivalent pentads (2550_2740; Sabap 2) respectively, I assessed that 246 bird species have a **high**, **medium** or **low probability** to occur on site, based on the habitats available, and of these I confirmed the presence of only 33 species (13%), which offers a small sample in support of general species:habitat correlations (Table 2). The number would surely have been higher if we had spent more days/seasons in search of species, if the surveys had started earlier and extended later

in the day/night, and if we had covered every sector in more detail. I scored 123 species (50%) as having a highly probability of occurrence, 78 species (32%) a medium probability and 45 species (18%) a low probability, and of these I confirmed the presence of only 33 high-probability species. The total number of species expected would be much larger if other **unlikely** species that are only recorded as rare vagrants to the area were not excluded from this analysis due to inadequate availability of their preferred habitat(s).

The four different habitat types that I distinguished either support or are expected to support somewhat different species of birds (Table 2). Only 10 generalist species (4%) are expected to use all four habitat-types, excluding the 18 species (7%) classed as aerial feeders and expected to range across all habitats when feeding. For the 228 non-aerial species, while only 10 species (7%) preferred four habitats, 54 (24%) preferred three, 82 (36%) preferred two, and another 82 (36%) only a single habitat type. Based on a total of 532 assessments of predicted habitat preference, watercourses and wetlands were potentially the richest and most distinctive habitat, predicted to be used by 169 (32%) for the expected species, closely followed by bushveld being preferred by an estimated 161 species (30%), with croplands still attracting 116 species (22%) but the manmade habitats only 86 species (16%). The 18 aerial-feeding species are included within the above analysis, not only for all the habitats they range across when feeding, but also if there are terrestrial habitats that some might use for breeding. Overall, watercourses and bushveld supported the highest diversity, with croplands at various stages of transformation and recovery the next highest and manmade habitats the lowest.

Table 2: Bird species diversity observed and expected on and around the proposed power line servitude between Hekpoort village and substation, Gauteng and North West Provinces (2227DC). Based on the national list and annotations of Birdlife South Africa (2011), sorted in the order of 'Roberts VII' (Hockey *et al*. 2005), with probability of occurrence and habitat preferences assessed after a site visit on 3 October 2013 and comparison with lists from SABAP 1&2 (Harrison *et al*., 1997; www.sabap2.org).

Common English Name	Scientific Name	Status Codes (see below)			Probability of occurrence (see 5.4 above)			Preferred Habitats (see 6.2 above)
		RD	S	E	High	Medium	Low	
Coqui Francolin	*Peliperdix coqui*				H	M		1,2
Crested Francolin	*Dendroperdix sephaena*					M		2,3
Orange River francolin	*Scleroptila levaillantoides*				H			1,2
Swainson's Spurfowl	*Pternistis swainsonii*				H			1,2
Common Quail	*Coturnix coturnix*		**NBM**			M		1,2
Helmeted Guineafowl	*Numida meleagris*				H			1,2,3,4
White-faced Duck	*Dendrocygna viduata*					M		3
Egyptian Goose	*Alopochen aegyptiaca*				H			3
Spur-winged Goose	*Plectropterus gambensis*					M		3
Yellow-billed Duck	*Anas undulata*					M		3
Red-billed Teal	*Anas erythrorhyncha*						L	3
Kurrichane Buttonquail	*Turnix sylvaticus*				H			1,2
Greater Honeyguide	*Indicator indicator*				H			2,3,4
Lesser Honeyguide	*Indicator minor*				H			2,3,4
Brown-backed Honeybird	*Prodotiscus regulus*					M		2,3
Red-throated Wryneck	*Jynx ruficollis*				H			2,4
Golden-tailed Woodpecker	*Campethera abingoni*				H			3,4
Cardinal Woodpecker	*Dendropicos fuscescens*				H			2,3,4
Yellow-fronted Tinkerbird	***Pogoniulus chrysoconus***				**H**			**2,3**
Acacia Pied Barbet	***Tricholaema leucomelas***				**H**			**2,3**
Black-collared Barbet	***Lybius torquatus***				**H**			**2,3,4**
Crested Barbet	***Trachyphonus vaillantii***				**H**			**2,3,4**
Southern Yellow-billed Hornbill	*Tockus leucomelas*					M		2,3
African Grey Hornbill	*Tockus nasutus*				H			2,3,4
African Hoopoe	*Upupa africana*				H			1,2,4
Green Wood-hoopoe	*Phoeniculus purpureus*				H			2,3,4
Common Scimitarbill	*Rhinopomastus cyanomelas*					M		2
European Roller	*Coracias garrulus*		**NBM**				L	1,2
Lilac-breasted Roller	*Coracias caudatus*				H			1,2
Malachite Kingfisher	*Alcedo cristata*					M		3
African Pygmy-Kingfisher	*Ispidina picta*		**BM**				L	2,3
Brown-hooded Kingfisher	*Halcyon albiventris*				H			2,3,4
White-fronted Bee-eater	*Merops bullockoides*				H			1,2,4
Little Bee-eater	*Merops pusillus*					M		2,3
Swallow-tailed Bee-eater	*Merops hirundineus*						L	2,3
European Bee-eater	*Merops apiaster*		**B/NB**			M		2,3
White-backed Mousebird	*Colius colius*						L	2,3,4

Speckled Mousebird	***Colius striatus***				**H**			**2,3,4**
Red-faced Mousebird	***Urocolius indicus***				**H**			**2,3,4**
Jacobin Cuckoo	*Clamator jacobinus*		**BM**			M		2,3,4
Levaillant's Cuckoo	*Clamator levaillantii*		**BM**			M		2,3,4
Great Spotted Cuckoo	*Clamator glandarius*		**BM**				L	2,3,4
Red-chested Cuckoo	*Cuculus solitarius*		**BM**		H			3,4
Black Cuckoo	*Cuculus clamosus*		**BM**		H			2,3,4
Klaas's Cuckoo	*Chrysococcyx klaas*					M		2,3,4
Diderick Cuckoo	*Chrysococcyx caprius*		**BM**		H			1,2,3,4
Burchell's Coucal	*Centropus burchellii*					M		3,4
African Palm-Swift	***Cypsiurus parvus***				**H**			**Aerial, 4**
Alpine Swift	*Tachymarptis melba*		**BM**			M		Aerial
Common Swift	*Apus apus*		**NBM**				L	Aerial
African Black Swift	*Apus barbatus*					M		Aerial
Little Swift	*Apus affinis*				H			Aerial, 4
Horus Swift	*Apus horus*					M		Aerial, 3
White-rumped Swift	***Apus caffer***		**BM**		**H**			**Aerial, 4**
Grey Go-away-bird	***Corythaixoides concolor***				**H**			**2,3,4**
Barn Owl	*Tyto alba*				H			1,2,3,4
Southern White-faced Scops-Owl	*Ptilopsis granti*						L	2
Spotted Eagle-Owl	*Bubo africanus*				H			1,2,3,4
Pearl-spotted Owlet	*Glaucidium perlatum*					M		2,3,4
Marsh Owl	*Asio capensis*						L	3
Fiery-necked Nightjar	*Caprimulgus pectoralis*				H			1,2
Rufous-cheeked Nightjar	*Caprimulgus rufigena*		**BM**				L	1,2,3
European Nightjar	*Caprimulgus europaeus*					M		3,4
Rock Dove	*Columba livia*				H			4
Speckled Pigeon	*Columba guinea*					M		4
Laughing Dove	***Streptopelia senegalensis***				**H**			**1,2,3,4**
Cape Turtle-Dove	*Streptopelia capicola*				H			1,2,3
Red-eyed Dove	*Streptopelia semitorquata*				H			3,4
Emerald-spotted Wood-Dove	*Turtur chalcospilos*					M		2
Namaqua Dove	*Oena capensis*					M		1,2
Northern Black Korhaan	*Afrotis afraoides*					M		1,2
White-bellied Korhaan	*Eupodotis senegalensis*	**Vul**					L	1,2
Red-chested Flufftail	*Sarothrura rufa*					M		3
African Rail	*Rallus caerulescens*				H			3
African Crake	*Crecopsis egregia*		**BM**			M		3
Corn Crake	*Crex crex*	**Vul**	**NBM**				L	3
Black Crake	*Amaurornis flavirostra*				H			3
Baillon's Crake	*Porzana pusilla*					M		3

Common Moorhen	*Gallinula chloropus*				H			3
Red-knobbed coot	*Fulica cristata*						L	3
African Snipe	*Gallinago nigripennis*					M		3
Marsh Sandpiper	*Tringa stagnatilis*		**NBM**				L	3
Common Greenshank	*Tringa nebularia*		**NBM**			M		3
Wood Sandpiper	*Tringa glareola*		**NBM**		H			3
Common Sandpiper	*Actitis hypoleucos*		**NBM**		H			3
Ruff	*Philomachus pugnax*		**NBM**			M		3
Spotted Thick-knee	*Burhinus capensis*				H			1,2,4
Black-winged Stilt	*Himantopus himantopus*						L	3
Kittlitz's Plover	*Charadrius pecuarius*						L	3
Three-banded Plover	*Charadrius tricollaris*				H			3
Blacksmith Lapwing	***Vanellus armatus***				**H**			**1,3**
African Wattled Lapwing	*Vanellus senegallus*				H			3
Crowned Lapwing	***Vanellus coronatus***				**H**			**1,2**
Temminck's Courser	*Cursorius temminckii*					M		1,2
Black-shouldered Kite	***Elanus caeruleus***				**H**			**1,2,3,4**
Black Kite	*Milvus migrans*		**NBM**		H			2,3
Cape Vulture	*Gyps coprotheres*	**Vul**					L	1,2
Black-chested Snake-Eagle	*Circaetus pectoralis*					M		1,2
Brown Snake-Eagle	*Circaetus cinereus*						L	2
African Marsh-Harrier	*Circus ranivorus*	**Vul**					L	3
African Harrier-Hawk	*Polyboroides typus*					M		2,3,4
Lizard Buzzard	*Kaupifalco monogrammicus*						L	2
Gabar Goshawk	*Melierax gabar*				H			1,2,3
Shikra	*Accipiter badius*					M		2,3,4
Little Sparrowhawk	*Accipiter minullus*						L	3,4
Ovambo Sparrowhawk	*Accipiter ovampensis*					M		3,4
Steppe Buzzard	*Buteo buteo*		**NBM**		H			1,2
Jackal Buzzard	*Buteo rufofuscus*			**(*)**			L	1,2
Wahlberg's Eagle	*Hieraaetus wahlbergi*		**BM**				L	2,3
Secretarybird	*Sagittarius serpentarius*	**Vul**				M		1,2
Rock Kestrel	*Falco rupicolus*				H			1,2
Greater Kestrel	*Falco rupicoloides*					M		1,2
Amur Falcon	*Falco amurensis*		**NBM**			M		1,2
Lanner Falcon	*Falco biarmicus*	**NT**				M		1,2,4
Peregrine Falcon	*Falco peregrinus*	**NT**					L	1,2
Little Grebe	*Tachybaptus ruficollis*				H			3
African Darter	*Anhinga rufa*						L	3
Reed Cormorant	*Phalacrocorax africanus*					M		3
Little Egret	*Egretta garzetta*						L	3

Grey Heron	*Ardea cinerea*					M		3
Black-headed Heron	*Ardea melanocephala*				H			1,2,3
Purple Heron	*Ardea purpurea*					M		3
Cattle Egret	*Bubulcus ibis*				H			1,2
Squacco Heron	*Ardeola ralloides*					M		3
Hamerkop	*Scopus umbretta*						L	3
Hadeda Ibis	*Bostrychia hagedash*				H			3,4
African Sacred Ibis	*Threskiornis aethiopicus*					M		3
African Spoonbill	*Platalea alba*						L	3
Black Stork	*Ciconia nigra*	NT					L	3
White Stork	*Ciconia ciconia*		**NBM**			M		1,2
Black-headed Oriole	*Oriolus larvatus*					M		3,4
Fork-tailed Drongo	*Dicrurus adsimilis*				H			2,3,4
African Paradise-Flycatcher	*Terpsiphone viridis*				H			3,4
Brubru	*Nilaus afer*					M		2
Black-backed Puffback	*Dryoscopus cubla*				H			2,3,4
Black-crowned Tchagra	***Tchagra senegalus***				**H**			**2,3,4**
Brown-crowned Tchagra	*Tchagra australis*				H			2,3,4
Southern Boubou	*Laniarius ferrugineus*				H			3,4
Crimson-breasted Shrike	*Laniarius atrococcineus*				H			2
White-crested Helmet-Shrike	*Prionops plumatus*						L	2,4
Chinspot Batis	*Batis molitor*				H			2,3,4
Cape Crow	*Corvus capensis*						L	1,2
Pied crow	***Corvus albus***				**H**			**1,2,3,4**
Red-backed Shrike	*Lanius collurio*		**NBM**		H			1,2
Lesser Grey Shrike	*Lanius minor*		**NBM**			M		1,2
Common Fiscal	***Lanius collaris***				**H**			**1,2,4**
Southern Black Tit	*Parus niger*				H			2,4
Ashy Tit	*Parus cinerascens*						L	2,3,4
Brown-throated Martin	*Riparia paludicola*					M		Aerial, 3
Banded Martin	*Riparia cincta*						L	Aerial, 1
Barn Swallow	*Hirundo rustica*		**NBM**		H			Aerial
White-throated Swallow	***Hirundo albigularis***		**BM**		**H**			**Aerial, 4**
Pearl-breasted Swallow	*Hirundo dimidiata*		BM			M		Aerial, 1
Greater Striped Swallow	*Cecropis cucullata*		**BM**		H			Aerial, 4
Lesser Striped Swallow	*Cecropis abyssinica*		**BM**			M		Aerial, 4
Red-breasted Swallow	*Cecropis semirufa*					M		Aerial, 4
South African cliff-Swallow	*Petrochelidon spilodera*			**B(*)**		M		Aerial, 4
Rock Martin	*Hirundo fuligula*				H			Aerial, 4
Common House-Martin	*Delichon urbicum*		**NBM**			M		Aerial
Dark-capped Bulbul	***Pycnonotus tricolor***				**H**			**2,3,4**

African Red-eyed Bulbul	*Pycnonotus nigricans*						L	2,4
Fairy Flycatcher	*Stenostira scita*			**(*)**		M		2
Long-billed crombec	*Sylvietta rufescens*				H			2,4
Burnt-necked Eremomela	*Eremomela usticollis*						L	2
Little Rush-Warbler	*Bradypterus baboecala*				H			3
Sedge Warbler	*Acrocephalus schoenobaenus*		**NBM**			M		3
African Reed-Warbler	*Acrocephalus baeticatus*		**BM**		H			3
Great Reed-Warbler	*Acrocephalus arundinaceus*		**NBM**		H			3
Lesser Swamp-Warbler	*Acrocephalus gracilirostris*				H			3
Icterine Warbler	*Hippolais icterina*		**NBM**			M		3,4
Willow Warbler	*Phylloscopus trochilus*		**NBM**		H			2,3,4
Arrow-marked Babbler	*Turdoides jardineii*				H			2,3,4
Chestnut-vented Tit-Babbler	*Sylvia subcaerulea*				H			2
Garden Warbler	*Sylvia borin*		**NBM**			M		2,3,4
Cape White-eye	***Zosterops capensis***			**(*)**	**H**			**2,3,4**
Rattling Cisticola	***Cisticola chiniana***				**H**			**1,2**
Levaillant's Cisticola	*Cisticola tinniens*					M		3
Neddicky	***Cisticola fulvicapilla***				**H**			**2,3,4**
Zitting Cisticola	*Cisticola juncidis*				H			1,2
Desert Cisticola	*Cisticola aridulus*				H			1
Tawny-flanked Prinia	*Prinia subflava*				H			2,3,4
Black-chested Prinia	***Prinia flavicans***				**H**			**2,4**
Grey-backed Camaroptera	*Camaroptera brevicaudata*						L	3,4
Barred Wren-Warbler	*Calamonastes fasciolatus*						L	2
Rufous-naped Lark	*Mirafra africana*				H			1,2
Sabota Lark	*Calendulauda sabota*					M		2
Chestnut-backed Sparrowlark	*Eremopterix leucotis*					M		1
Red-capped Lark	*Calandrella cinerea*				H			1
Groundscraper Thrush	*Psophocichla litsitsirupa*					M		2,4
Kurrichane Thrush	*Turdus libonyanus*				H			2,3,4
Karoo Thrush	*Turdus smithi*			**(*)**		M		3,4
Marico flycatcher	*Bradornis mariquensis*				H			2
Fiscal Flycatcher	*Sigelus silens*			**(*)**	H			2,3,4
Spotted flycatcher	*Muscicapa striata*		**NBM**		H			2,3,4
Cape Robin-Chat	*Cossypha caffra*				H			2,3,4
White-throated Robin-Chat	*Cossypha humeralis*						L	2,3
White-browed Scrub-Robin	*Erythropygia leucophrys*						L	2,3
Kalahari Scrub-Robin	*Erythropygia paena*					M		2
African StoneChat	*Saxicola torquatus*				H			3
Mountain Wheatear	*Oenanthe monticola*						L	4
Capped Wheatear	*Oenanthe pileata*				H			1,2

Familiar Chat	*Cercomela familiaris*				H			4
Ant-eating Chat	*Myrmecocichla formicivora*					M		1,2
Mocking cliff-Chat	*Thamnolaea cinnamomeiventris*						L	4
Red-winged Starling	***Onychognathus morio***				**H**			**3,4**
Cape Glossy Starling	***Lamprotornis nitens***				**H**			**2,3,4**
Pied Starling	*Lamprotornis bicolor*			**(*)**		M		1,2
Wattled Starling	*Creatophora cinerea*				H			1,2,3,4
Common Myna	*Acridotheres tristis*		**I**		H			4
Amethyst Sunbird	*Chalcomitra amethystina*				H			2,3,4
White-bellied Sunbird	***Cinnyris talatala***				**H**			**2,3,4**
Marico Sunbird	*Cinnyris mariquensis*					M		2,3,4
White-browed Sparrow-Weaver	***Plocepasser mahali***				**H**			**1,2**
Cape Weaver	*Ploceus capensis*			**(*)**		M		3,4
Southern Masked-Weaver	***Ploceus velatus***				**H**			**1,2,3,4**
Village Weaver	*Ploceus cucullatus*						L	3,4
Red-billed Quelea	*Quelea quelea*				H			1,2
Yellow-crowned Bishop	*Euplectes afer*				H			3
Southern Red Bishop	*Euplectes orix*				H			1,2,3
White-winged Widowbird	*Euplectes albonotatus*				H			1,2,3,4
Red-collared Widowbird	*Euplectes ardens*					M		3
Green-winged Pytelia	*Pytelia melba*						I	2
Orange-breasted Waxbill	*Amandava subflava*					M		3
African Quailfinch	*Ortygospiza fuscocrissa*				H			1,2
Red-headed Finch	*Amadina erythrocephala*				H			1,2
Common Waxbill	*Estrilda astrild*				H			2,3,4
Violet-eared Waxbill	*Uraeginthus granatinus*					M		2
Blue Waxbill	*Uraeginthus angolensis*				H			2
Green-winged Pytilia	*Pytilia melba*				H			2
Red-billed Firefinch	*Lagonosticta senegala*					M		2
Jameson's Firefinch	*Lagonosticta rhodopareia*				H			2,3
Bronze Mannikin	*Spermestes cucullata*					M		4
Pin-tailed Whydah	*Vidua macroura*				H			1,2
Long-tailed Paradise-Whydah	*Vidua paradisaea*					M		2
Village Indigobird	*Vidua chalybeata*					M		2
House Sparrow	***Passer domesticus***		**I**		**H**			**4**
Cape Sparrow	***Passer melanurus***				**H**			**2,4**
Southern Grey-headed Sparrow	*Passer diffusus*				H			2,3,4
Cape Wagtail	*Motacilla capensis*				H			3
Cape Longclaw	*Macronyx capensis*					M		1,2,3
African Pipit	***Anthus cinnamomeus***				**H**			**1,2**
Plain-backed Pipit	*Anthus leucophrys*					M		1

Buffy Pipit	*Anthus vaalensis*				H			1
Yellow-fronted Canary	***Crithagra mozambica***				**H**			**2,3,4**
Black-throated Canary	***Crithagra atrogularis***				**H**			**1,2,3**
Yellow Canary	*Crithagra flaviventris*						L	1,2
Streaky-headed Seedeater	*Crithagra gularis*				H			2,3,4
Cinnamon-breasted Bunting	*Emberiza tahapisi*				H			1,2
Golden-breasted Bunting	*Emberiza flaviventris*						L	2,3

Red Status	Status in south Africa (S)	Endemism in South Africa (E)
T = Threatened	BM = breeding migrant	Endemism in South Africa (E) (not southern Africa as in field guides)
NT = Near-Threatened	NBM = non-breeding migrant	
Vul = Vulnerable	V = vagrant	* = endemic
E = Endangered	I = introduced	
CE = Critically Endangered	R = rare	(*) = near endemic (i.e. ~70% or more of population in RSA)
RE = Regionally Extinct	PRB = probable rare breeder	B* = breeding endemic
§ = Refer to footnote	RB = rare breeder	B(*) = breeding near endemic
	RV = rare visitor	W* = winter endemic
Red Status is from *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland, Barnes (2000).*		

6.4. Threatened and Red-Listed Bird Species

During the site visit, the study site was surveyed visually and its habitats assessed for the potential occurrence of priority Red Data avifauna, according to national and especially GDARD's requirements for Biodiversity Assessments, Version 2 (June 2012) and C-Plan Version 3.3 (2011), as well as for any other Red Data avifaunal species.

Eight species of international and/or national conservation concern (IUCN Red Data species from Birdlife International 2012, Barnes 2000), ranging from Near Threatened to Vulnerable, were considered as possible to occur on site, although none was recorded during the survey. Most of these threatened species fall into a few obvious categories by habitat preference (Table 3) and their likelihood of occurrence on site (Table 4).

Table 3: List of threatened species that will possibly make use of the habitats on and around the proposed power line servitude between Hekpoort village and substation, showing their preferred habitat types. Note one species may have more than one habitat preference.

Threatened Status	Species	Preferred Habitat Type(s)			
		Croplands	Watercourses	Bushveld	Manmade
Near Threatened	Lanner Falcon	X		X	
	Peregrine Falcon	X		X	
	Black Stork		X		
Vulnerable	White-bellied Korhaan	X		X	
	Corn Crake			X	
	Cape Vulture	X		X	
	African Marsh Harrier		X		
	Secretarybird	X		X	
TOTALS	**8**	**5**	**2**	**6**	**0**

Table 4: The expected frequency of occurrence of threatened bird species on and around the proposed power line servitude between Hekpoort village and substation, based on the quantity and quality of habitats available.

Threatened Status	Species	Expected frequency of occurrence on site			
		Regular resident	Frequent visitor	Erratic visitor	Infrequent vagrant
Near Threatened	Lanner Falcon		X		
	Peregrine Falcon			X	
	Black Stork				X
Vulnerable	White-bellied Korhaan		X		
	Corn Crake			X	
	Cape Vulture			X	
	African Marsh Harrier				X
	Secretarybird		X		
TOTALS	**8**	**0**	**3**	**3**	**2**

These analyses indicate that by far the most important habitats to conserve for threatened species are the natural bushveld areas plus any associated fallow croplands, especially those at more advanced stages of recovery. Any additional natural habitat that can be conserved around the watercourses and wetlands will also further increase their conservation value. This is mainly because several of the species that may use the wetlands and their larger trees will still need the surrounding bushveld for finding their prey.

No threatened species are expected to be regular residents, but three are expected to be frequent visitors from their cliff-nesting sites along the Magaliesberg, even if only flying over the area. Three others are expected as erratic visitors, and two are expected as only infrequent vagrants due to the small areas and low quality of their preferred habitats.

One threatened species (**Corn Crake**) is expected because it is a non-breeding summer migrant from the northern hemisphere, which ranges widely in search of food and roost sites, and for which some suitable habitats exists from time to time. The rest are resident species in South Africa, whose habitats on the property are potentially suitable but seem to lack certain factors that are expected to prevent permanent or even regular residence on site. For example, the wetland habitats are too small in area, disturbed and/or inferior in quality for **African Marsh-Harrier** or **Black Stork** to permit regular residence, even though the former will range down the Magaliesrivier valley and the latter breeds on cliffs in the mountain ranges nearby and feeds at the wetlands below. Two species that are primarily terrestrial in their daily activities and feeding (**White-bellied Korhaan, Secretarybird**) prefer the open bushveld and those adjacent areas transformed into degraded grasslands, and the korhaan may sometimes even nest there on the ground or the Secretarybird on top of a low tree. Management to improve these natural habitats will of course improve the frequency and duration that such habitats can be used by these threatened but frequent visitors.

Three carnivorous species nest nearby on the cliffs of the Magaliesberg and will visit the study area if and when their animal prey is available, small to medium-sized birds for the **Lanner** and **Peregrine Falcons** and carrion from large mammal carcasses for the **Cape Vulture**. Only the more common and least specialised Lanner Falcon is expected as a

frequent visitor, the rarer and more specialised Peregrine and the more-particular Cape Vulture only as erratic visitors.

7. ENVIRONMENTAL IMPACT ASSESSMENT

7.1. The ecological importance of the study site

Overall the study site has a low ecological importance, given the extent to which its habitats has been transformed, degraded and/or invaded. However the Moot Plains Bushveld is an under-conserved habitat, and proper protection and/or management of any remaining natural areas can only be beneficial. Most importantly, the study site lies immediately below the Magaliesberg and Witwatersberg ranges, significant conservation areas recognised globally as Important Bird Area SA025 by BirdLife International (Barnes 1998), and from where a variety of birds range out to forage and risk the various threats associated with modern agriculture and development, especially habitat alteration and/or degradation in its various forms.

7.2 General impacts associated with transmission line construction

Pre-construction: No pre-construction impacts are envisaged on vegetation or fauna.

Construction phase: During construction the vegetation will be cleared, especially at the position of the pylons, but often also along the route of the line.

POTENTIAL ENVIRONMENTAL IMPACT (NATURE OF THE IMPACT)	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION						
	Consequence			Likelyhood (Probability)		Significance (Degree to which impact may cause irreplaceable loss of resources)	SRK Methodology		Consequence			Likelyhood (Probability)		Significance (Degree to which impact may cause irreplaceable loss of resources)	SRK Methodology
	Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact				Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
Loss and degradation of natural bird habitat	2	1	2	6	2	40	MH Maintain Current Management	Do not allow activities outside construction site	1	1	2	2	2	16	L No Management Required
Loss of specific bird threatened species	2	1	2	6	2	40	MH Maintain Current Management	River banks are ecologically sensitive Form an ecological flight corridor Use standard Eskom measures Rehabilitate if river banks were damaged during construction	2	1	2	2	2	20	L No Management Required

Operational phase:

Basically the loss of habitat, loss of connectivity and eccect on flight lines, electrocution and collision are the impacts of power lines on birds during the operational phase.

POTENTIAL ENVIRONMENTAL IMPACT (NATURE OF THE IMPACT)	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION							RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION						
	Consequence			Likelyhood (Probability)		Significance (Degree to which impact may cause irreplaceable loss of resources)	SRK Methodology		Consequence			Likelyhood (Probability)		Significance (Degree to which impact may cause irreplaceable loss of resources)	SRK Methodology
	Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact				Severity	Spatial	Duration	Frequency: Activity	Frequency: Impact		
Loss and degradation of natural bird habitat	1	1	1	2		6	L No Management Required	Do not allow activities outside construction site	1	1	1	2		6	L No Management Required
Electrocution	4	1	4	5	5	90	H Improve Current Management	Use standard Eskom measures to avoid electrocution	2	1	4	5		35	ML Maintain Current Management
Collision	4	1	4	5	5	90	H Improve Current Management	Use standard Eskom measures to avoid collision	2	1	1	5		20	L No Management Required
Loss of specific bird threatened species	3	3	1	2		14	L No Management Required	River banks are ecologically sensitive Form an ecological flight corridor Use standard Eskom measures Rehabilitate if river banks were damaged during construction	3	3	1	2		14	L No Management Required
						0	#N/A							0	#N/A
						0	#N/A							0	#N/A

7.3 Discussion

- **Effects of lines and associated structures** – Lines and their supporting poles/pylons intrude into previously open airspace. This has two new consequences for birds along their route. First it increases the risk of aerial collisions, and second it provides potential perch/roost/nest sites. The collision risks depend on a variety of factors, the biology of bird species in the area, the location of the lines in relation to normal bird flight paths, and the prominence and visibility by day/night of the structures relative to their surroundings. Use of the structures by birds has the potential for positive and negative consequences, positive in providing new perch/roost/nest sites safe from human and other disturbance, such as hunting perches for raptors or roost/nest sites inaccessible to predators, or negative in increasing the predation pressure on bird (and other animal) prey species living below. All these effects are most intense for the novelty they introduce into flat open treeless habitats, such as bushveld, grassland and desert.

  There is also a risk to birds of electrocution if they land/perch/take-off in such a way that they touch live and earth lines. This risk exists regardless of the voltage of the lines, but many/most modern line/pole/transformer designs by Eskom have

reduced this risk to a minimum, since short circuits not only kill birds but also cause power outages.

Effects from collisions with the lines and structures are also significant, especially for large ground-living birds (in this case White-bellied Korhaan and Secretarybird are obvious candidates) and fast night-flying birds (in this case particularly waterfowl). Once again, Eskom and its collaborators have the expertise and experience to attach bird-warning devices along dangerous section of the lines, with the wetlands the most obvious candidates for marking on site.

- **Loss and degradation of natural habitat** – The general effect of the construction of transmission lines on the habitats they traverse is low due to the small areas involved, basically the footprint at the base of each support pole/pylon. However, for safety purposes, such lines usually require a wide servitude (e.g. 11 m on each side of 88 kV lines). An access track normally runs along this servitude, for construction and subsequent maintenance, and vegetation has to be kept short (mown and/or cut) to avoid damage from fires, but these disturbances usually only occur at intervals during the year. Negative effects of electromagnetic radiation immediately below the lines on flora and fauna have also been proposed, but are unlikely from lower voltages. Effects of lines on habitats are mainly due to their prominence as perches and/or obstructions above sensitive habitats where high densities and/or diversities of birds concentrate, such as along updrafts on ridgelines or across narrow linear ecosystems like rivers and wetlands.
-
- **Loss of conservation-significant taxa and/or changes in community structure** – The small footprint of lines on the landscape is unlikely to cause direct and widespread loss of threatened taxa or change in community structure, except for species prone to collision due to their biology (e.g. poor anterior and/or peripheral vision, occupation of open habitats, tendency to fly long distances, poor aerial manoeuvrability due to large size - such as cranes, bustards, vultures). Positive effects, for the species concerned, may arise from the provision of new perch/roost/nest sites. None of these factors is expected to arise on site unless very large high structures are to be installed, since the various existing lines across the general area seem not to have created any problems.

- **Increased habitat fragmentation & loss of connectivity** – Lines and their poles/pylons are unlikely to cause habitat fragmentation and or connectivity loss, except where they are so numerous and/or prominent that they deflect birds from their normal flight paths. The access track along the servitude may affect habitat connectivity, such as across rivers/wetlands, but the track does not normally require any special construction and sensitive habitats can be avoided.
-
- **Increased anthropogenic encroachment** – Lines and their poles/pylons do extend anthropogenic effects, often over long distances and across otherwise pristine habitats. Particularly sensitive habitats can usually be avoided, but the power they conduct has extensive anthropogenic effects at source (power and distribution sub-/stations) and termination (industrial, residential and urban developments).

  These effects for the Hekpoort-Cashan line are likely to be beneficial to human resident in the area, with no new, obvious or significant threats likely to the birds.

8. RECOMMENDED MITIGATION MEASURES

Presumably alternative structures, routes and placement have been considered by the designers/developers but rejected for various financial and practical reasons. The proposal considered for this assessment has therefore been the only one considered.

It must also be reiterated that the exact voltage, pole/pylon type and average line height for the proposed power line was not available to us at the time of this survey, so our observations focussed mainly on the types of habitats to be crossed and the avifauna expected therein.

The following mitigation measures (M1-M7) proposed are derived from personal experience of birds and transmission lines, and from the comprehensive set of guidelines developed by the Gauteng authorities (GDACE 2009) Although these measure are of a general nature, they are mostly applicable to all newly proposed power lines and associated substations:

M1: Loss of habitat

- Minimize area cleared for construction activities. This includes the areas used by staff during construction.
- Building material to be located in a secure site.

M2: Disturbance

- Limit construction activities to daytime.
- Minimize the use of earthmoving equipment that results in noise generation.
- Construction staff must be restricted to an allocated area and should not gain access to sensitive habitat types.
- Provide adequate ablution facilities to avoid using natural (sensitive) areas as toilets.
- Minimise the number of vehicles using access roads.
- Physical barriers must be constructed around fuel depots and generators to prevent spilled fuel from spreading or coming into contact with surface or ground water.
- Chemicals and equipment for the treatment of fuel spillages must be available on site at all times.
- Degraded sites should be rehabilitated using indigenous species only, especially using species from the naturally occurring vegetation of the area.
- All disturbed areas during construction and operation, including discard dumps, should be levelled to prevent run-off.

M3: Protection of natural resources

- Harvesting of firewood or any plant material is strictly prohibited. Staff shall only assist with the (necessary) removal of important plant species if requested to do so, under supervision.
- All staff should be advised by means of environmental awareness training on the significant importance of the area and its conservation importance.
- Intentional killing of any faunal species should be avoided. The labour force should be made aware of the conservation issues pertaining to the fauna and flora taxa occurring on the study site. Any person found deliberately harassing any animal in any way should face disciplinary measures.

M4: Lighting and the attraction of invertebrates

- Light pollution around the substation(s) should be avoided/minimised so as not to

impact on activities of nocturnal species, since invertebrates flying at night are attracted to lights, also attract predators, and so should be kept to a minimum.

- Outside lighting should be designed to minimize impacts on fauna. All outside lighting should be directed away from sensitive areas. Fluorescent and mercury vapour lighting should be avoided and sodium vapour (yellow) lights should be used wherever possible.

M5: Storm water control

- Design storm water collection and runoff to prevent erosion

M6: Control of invasive species

- Prevent introduction of alien plant species. Indigenous species already present in the area should be used during the rehabilitation phase.
- It is recommended that a monitoring programme be implemented to enforce continual eradication of alien and invasive species, especially on wetland and open space systems.

M7: Reduction in pole/line bird mortality

- Where overhead lines are to be constructed within/adjacent to open space systems, the Eskom-EWT strategic partnership should advise on appropriate mitigation measures.
- The design (including mitigation measures) and location of any proposed power lines should be endorsed by the bird conservation experts of the Eskom-EWT strategic partnership. Anti-collision devices, such as bird flappers, should be installed where power lines cross flight corridors, as along watercourses and around wetlands.

10. GENERAL CONCLUSIONS

The main conservation objectives for birds along this proposed power line near Hekpoort are to retain as much as possible of the natural bush- and grassveld, together with what little drainage, watercourse and wetland habitats might be affected by the development. The main concern is for any birds that make use of the ranges in the Magaliesberg and Witwatersberg Important Bird Area, which may visit the study area and be at risk from the power line development. No threatened species expected for the area seem likely to

be negatively affected by the proposed power line, with the caveat that the exact design and height of the line was not available during the compilation of this report. Wherever necessary, Eskom should apply their normal expertise is designing support poles that minimise electrocution risk and suitably mark lines where avian collisions are most likely, as indicated in this report.

11 LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

The primary data for this assessment came from the distribution and status information collected for southern African birds during the SABAP1 atlas project, comparison with the incoming data for the on-going SABAP2 atlas project, and is therefore only as accurate and reliable as the limitations and assumptions described for those exercises (Harrison *et al*. 1997; www.sabap2.org.za; Bonnevie 2011), augmented with information from earlier atlas studies of the old Transvaal (Tarboton *et al*. 1987). I also had access to suitable databases, information and identification resources, and did not consider that the present assignment warranted a more detailed (and expensive) survey. My personal field experience includes community surveys across a wide range of southern African habitats and particular work with birds on power lines.

Environmental Impact Assessments (EIAs) attempt to provide an accurate but subjective study of the main environmental factors and possible mitigation measures that might apply to a given development proposal. EIAs are limited in scope, time and budget, even though every care is taken to ensure their accuracy. Even a more objective and factual report, based on field sampling and observation over several years and seasons to account for fluctuating environmental conditions, nomadism and migrations, may be insufficient, since one deals with dynamic natural systems, especially for birds that have such a mobile response to changing conditions. I offer this EIA in good faith, based on the information available to me at the time, but cannot accept responsibility for subsequent changes in knowledge or conditions.

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APPENDICES

Appendix 1: Images of the habitats at important points (with coordinates) along the proposed power line from SW (Hekpoort village) to NE (Hekpoort substation; cf. Fig. 4 & Table 1). Views south have the Witwatersberg in the background and views north the Magaliesberg.

New substation	**25 52 56.5**	**27 37 09.5**

Photo 1: Left, view southeast along the R560 road at the entrance to the proposed new substation on right (south) at Transformer pole SAA 117/27, and right, view northwest within the substation site, both showing the transformed and degraded habitat, the latter with part of an informal settlement on the edge of Hekpoort village. Note the existing power lines nearby.

Corner 1 S-E	**25 53 08.0**	**27 37 20.5**

Photo 2: View west from the start of road crossing 1, looking between the water tank and trees towards the location of Corner 1, across old fallow land with small *Acacia*

karroo establishing and the R560 to the left (north). Note the density of alien trees around a farmstead in the centre and the existing power lines nearby.

Road crossing 1 S-N	**25 52 52.5**	**27 37 40.0**

Photo 3: View ENE from the same position as Photo 2, with chicken sheds to the right (south) and irrigated lucerne fields to the north (left) along which side the power line will proceed. Note the scattered tall alien eucalypt and palm trees, and the existing power lines nearby.

River crossing 1	**25 52 38.0**	**27 38 07.0**

Photo 4: Above, view north where the power line will cross the bulrush-covered headwaters of an artificial dam within transformed and mown grazing land and, below, the view south on the opposite side of the road where the watercourse originates from

the distant Witwatersberg and forms a small bulrush-rimmed pool above the under-road drainage culvert. Note the lack of existing power lines nearby.

Road crossing 2 N-S	**25 52 33.5**	**27 38 14.0**

Photo 5: Above, view northeast from about where the power line will cross the R560 for the second time, with cultivated grazing land and tree row to the left (west) and one of the few blocks of natural habitat to the right (east). Below, the opposite view south, into heavily grazed natural and fallow areas with an extensive farmyard further from the road. Note the existing power lines nearby.

Road crossing 3 S-N	**25 52 18.0**	**27 38 39.5**

Photo 6: Above, view south from about where the power line will cross the R560 for the third time, from an area of short fallow heavily grazed grassland. Below, the view north into older fallow land with scattered thorn bushes. Note the existing power lines nearby.

River crossing 2	**25 52 04.5**	**27 39 04.0**

Photo 7: Above, view north and downstream of where the power line will cross the river and, below, the view south and upstream. Note the existing power lines nearby. The high-level bridge and deep dry seasonal river bed is evident, along with the alien-infested riparian vegetation flanked by degraded grassland and bushveld.

Road crossing 4 N-S	**25 51 44.5**	**27 39 38.5**

Photo 8: Above, view north of where the power line will make its fourth and final crossing of the R560 road, from the best patch of natural bushveld encountered along the study site to, below, the view south where it will enter similar habitat. Note the existing power lines nearby.

Corner 2 E-S	**25 51 11.5**	**27 40 34.5**

Photo 9: Above, view southeast at about where the power line will turn south away from the R560 road towards the Hekpoort substation, across degraded and heavily grazed bushveld and near an extensive farmyard and hospitality facility. Note the existing power lines nearby. Below, View north showing less degraded bushveld on the opposite side of the road.

Corner 3 S-SE	**25 51 24.5**	**51 40 47.0**

Photo 10: Above, view northwest from the gravel access road off the R560 to the Hekpoort substation and adjacent sandpits, looking back across fallow grassland towards the farm/hospitality facility, south of which the power line will bend towards the substation. Below, view south from the same position towards where the power line will cross the gravel road, with the substation in the distance just left (east) of the road.

River crossing 3	25 51 28.0	27 40 55.0

Photo 11: Above, view west, and below, view east, of about where the power line will cross the gravel road and a depression draining west-east, lined with sedges, bulrushes and in places reeds, and formed from seepage and runoff from the extensive open sandpits along the northern base of the Witwatersberg.

Hekpoort substation	25 51 33.5	27 41 02.0

Photo 12: View south along the gravel road leading to the Hekpoort substation to the left (east). Note the existing power lines nearby, especially the higher voltage lines and their taller HMC pylons that run along the left (east) side of the gravel road.

Appendix 2: Abridged Curriculum Vitae: Alan Charles Kemp

Born: 7 May 1944 in Gweru, Zimbabwe
Citizenship: South African, British
Marital status: Married, 1 daughter, 1 son

Present work address:

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Tel: (+27)(12)804-7637 Fax: (+27)(12)804-7637
E-Mail: leadbeateri@gmail.com
or
Naturalists & Nomads, Postnet Suite #38, Private Bag X19, Menlo Park, 0102, South Africa

Qualifications:

1965 B.Sc. Rhodes University, Zoology and Entomology majors
1966 B.Sc. Hons. Rhodes University, Zoology
1973 Ph.D. Rhodes University, Zoology

Thesis: (Ph.D.) The ecology, behaviour and systematics of *Tockus* hornbills (Aves: Bucerotidae), conducted mainly in the Kruger National Park

Professional titles:

• Pr.Sci.Nat. South African Council for Natural Scientific Professions Registration Number 400059/09, Zoological and Ecological Sciences.

Professional career:

- Field Research Assistant to Prof. Tom J. Cade, Section of Ecology and Systematics, Cornell University, in Kruger National Park, South Africa, Nov 1966 - Apr 1969.
- Department of Birds, Transvaal Museum, Pretoria, June 1969 – August 1999, Head of Department from 1971, rising to Senior Scientist and then Head Curator by 1974.
- Elected Manager, Transvaal Museum, September 1999 – July 2001, until voluntary early retirement.

- Edward Grey Institute of Ornithology, Oxford, December 2001 – April 2002, drafting specialist bird texts for Gale Publishing, USA and Andromeda Press, Oxford, UK.
- Berg 'n Dal & Pretoria, April 2002 - February 2003, presenting paper and later editorial assistant for book from the Mammal Research Institute, University of Pretoria, *The Kruger Experience: ecology and management of savanna heterogeneity.*
- Bangkok, March – June 2003, drafting research papers for colleague at Mahidol University; touring Laos.
- Pretoria, August-December 2003, editorial assistant for book from the Mammal Research Institute, University of Pretoria, a revision of *The Mammals of Southern Africa.*
- Hala-Bala Wildlife Reserve, January – December 2004, a one-year rainforest study of hornbills, raptors and owls in southern Thailand for their National Center for Genetic Engineering and Biotechnology (BIOTEC).
- Pretoria, January 2005 – July 2007, organizing 4th International Hornbill Conference at Mabula Game Lodge and editing and publishing CD-ROM proceedings, and consulting on ground hornbills to Mabula, University of Cape Town and Endangered Wildlife Trust.
- Bangkok, India, Singapore, Sarawak, September 2006 – April 2007. assisted colleagues at Mahidol University, Bangkok, with compilation of research paper on molecular systematics of hornbills, and travelled to see other Asian habitats and meet with other colleagues.
- Singapore, March 2009, present opening address, paper and poster at 5th International Ornithological Conference

Academic career:

• Students:

- Supervise completed post graduate students: M.Sc. 14; Ph.D. 5.

• Author of:

- 104 scientific papers or notes in refereed journals
- 48 papers at national and international congresses
- 6 scientific (unpublished) reports on environment and natural resources
- 73 popular scientific papers.

- 15 contributions in or as books

• Editorial Roles

- Ostrich, African Journal of Ornithology (editor 1973-75).
- Bird Conservation (International (editorial committee 1995-present)

• FRD evaluation category: C2 (Avian Biology and Systematics)

● Associate positions:

- University of the Witwatersrand, Honourary lecturer, Department of Zoology (1988-2001)
- Percy FitzPatrick Institute of African Ornithology, University of Cape Town, research associate (2001 – present).
- Ditsong National Museum of Natural History (ex Transvaal Museum), Honorary curator (2004-present)
- Wildlife Conservation Society, New York, wildlife conservation associate (1996-present).

Membership:

- American Ornithologist's Union, Corresponding Fellow (1986- present)
- Birdlife South Africa (South African Ornithological Society), Ordinary Member (1969-present), President (1975-1993) of Northern Transvaal (Pretoria) Branch, Honourary Life Member of North Gauteng (Pretoria) Bird Club (2000 – present).

Special committees:

- International Ornithological Committee of 100, elected member (1989-present).
- Raptor Research Foundation, Grants assessor, Leslie Brown Memorial Fund (1985-present).

Merit awards and research grants:

- 1969-86. Annual research grants from South African Council for Scientific and Industrial Research (CSIR).
- 1974. Chapman Fund Award, American Museum of Natural History, for field research in

Borneo and India.

- 1986-98. Annual research award from South African Foundation for Research Development (FRD) as "C"-graded national scientist.
- 1989-95. Team member of FRD Special Programme in Conservation Biology.
- 1989-95. Team member of FRD Special Programme in Molecular Systematics.
- 1991-95. Various private sector sponsorships.
- 1992, 1994. FRD merit award to museum scientists.
- 2000. Special NRF Science Liaison award to attend 10th Pan-African Ornithological Congress, Kampala, Uganda.
- 2001. Special NRF Science Liaison award to attend 3rd International Hornbill Workshop, Phuket, Thailand.
- 2004. One year's support from Thailand's National Center for Genetic Engineering and Biotechnology (BIOTEC) for rainforest survey research.
- 2007-2008. Six month's funding to enable specialist assistance at Department of Microbiology, Mahidol University, Thailand.
- 2010. Gill Memorial Medal of Birdlife South Africa

Consultant

- Sept-Oct 1994 – Kruger National Park, specialist consultant on ground hornbills to BBC Natural History Unit for filming of Wildife on One programme, 10 weeks.
- Oct-Nov 1996. Kruger National Park, specialist consultant on various birds to David Attenborough for BBC series Life of Birds, 3 weeks.
- Sep-Oct 1998. Kruger National Park, specialist hornbill consultant to National Geographic magazine team, 4 weeks
- October 2001 – Mala Mala, specialist consulting on ground hornbills for National Geographic film unit, 1 week.
- 2004-present - >15 specialist birding and nature tours as a National South African Tourist Guide, registration number GP0770.

  2005-present – >20 Biodiversity assessments for a Ramsar wetland proposal, Important Bird Area proposal, and general scoping, G20 and specialist avifaunal EIAs.