Avifaunal Impact Assessment for the proposed Harvard to Noordstad power line at Bloemfontein, Free State Province

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DRAFT

9 May 2017

Consultant background and declaration of independence in accordance with the National Environmental Management Act (107 of 1998): Environmental Impact Assessment Regulations (2014):

I, Johan van Niekerk (PhD Zoology), am an ornithologist with 13 years of experience as an independent environmental consultant specialising in birds. During this period I successfully completed a number of environmental impact assessments, bird monitoring and risk assessment studies. My curriculum vitae is included in Appendix A on page 72.

Enviroworks CC appointed me as an independent specialist to conduct the Avifaunal Impact Assessment for the proposed power line project. This document represents the Avifaunal aspect of the Basic Assessment.
I declare:

- I act/acted as the independent specialist in this application;
- I will perform/preformed the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- There are no circumstances that compromised my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Johan van Niekerk
9 January 2017

Contents

Executive summary

Centlec SOC Limited proposes to develop a 132 kV power line from the existing Harvard-Cecilia power line to the existing Noordstad power line on the outskirts of Bloemfontein. The focus of this draft report is on the avifaunal component of the Impact Assessment study of the project. The study was based on a review of the relevant literature and site surveys.

The proposed development will consist of an approximately 33 km long main overhead power line, a 3.5 km long underground power line, six new substations, and an additional overhead power line of approximately 2.4 or 5.6 km long (two alternatives) which will connect one of the substations not on the main line to the electricity grid.

The habitat along the proposed Havard-Noordstad power line consists of agricultural fields & small holdings, open grassland, woodland and scrubland. There is a distinct contrast between the relatively flat west with no prominent drainage systems and the more undulating/hilly eastern area which falls in the catchment of the Stinkhoutspruit, a multi-branched, well-defined drainage system.

The impact of each of the six new substations will be similar to one another. During the construction phase the breeding activity of a few bird species could potentially be disrupted. However, the impacted area is relatively small and if the footprint of all construction related activities are restricted to designated areas and minimized wherever practically possible, the probability of negative impact would be very low. The non-threatened status of the taxa involved does not warrant any other mandatory mitigation measures. Factors potentially contributing to the risk of bird fatalities at the substations are also considered and recommendations for mitigation are made.

With regards to the overhead power lines, construction activities could potentially cause temporary disturbance. Apart from minimising the footprint of construction activities, the non-threatened status of the taxa involved does not warrant any other mandatory mitigation measures. During their operational phase, the overhead power lines pose a notable collision risk to two Red Data species (Secretarybird *Sagittarius serpentarius* and Lanner Falcon R172) and 18 non-threatened taxa. Mitigation options are considered.

The installation and operation of the section of underground power line is unlikely to pose a measurable negative impact on birds.

It is concluded that there are no fatal flaws with the proposed Havard-Noordstad power line project. However, it is recommended that the mitigation strategies considered in Section 6 should be implemented. Once the route is finalised and the exact position of the towers have been surveyed and pegged, the input of an avifauna specialist must be obtained in order to determine where anti-collision devices such as bird flight diverters must be installed as per the recommendations herein.

Abbreviations, acronyms & definitions

Cumulative impact: The impact of an activity that in itself may not be significant, but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area (National Environmental Management Act (Act No. 107 of 1998), Environmental Impact Assessment Regulations 2014).

EIA Environmental Impact Assessment

ELP Ecological light pollution (see Section 2.6 on page 10)

ha Hectare

kV Kilovolt = 1 000 volts

MAMSL Metres above mean sea level

Pentad A 5' latitude by 5' longitude block

QDGC Quarter degree grid cell. A 15' latitude by 15' longitude block

Resident: Any bird species, including migrant and nomadic taxa, utilising the indicated area at least once a week for an extended period of time (a month or more)

SABAP1 The first Southern African Bird Atlas Project (1987–1991; Harrison *et al.* 1997a,b)

SABAP12 Data from SABAP1 and SABAP2 combined

SABAP2 The second Southern African Bird Atlas Project (2007 to present; `http://sabap2.adu.org.za`)

SAC9Q-block Study area centred 9-QDGC block (see page 12)

Wetland: "land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil." (National Water Act (No. 36 of 1998)); "Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt. ... Also land where the water table is, at least periodically, at or above the land surface for long enough to promote the formation of hydric (waterlogged) soils and the growth of aquatic plants" (Mucina & Rutherford 2006).

Wetland complex: Standing open water features such as dams and pans which are less than 250 m apart.

1. Introduction

Centlec SOC Limited, hereinafter referred to as “Centlec”, proposes to develop a power line from the existing Harvard-Cecilia power line to the existing Noordstad power line/substation on the outskirts of Bloemfontein, Free State Province (Fig. 1, page 58). Centlec initially proposed two route alternatives which were subjected to a Preliminary Environmental Sensitivity assessment, including a desktop study on their potential impact on birds (Van Niekerk 2015). Subsequently, modified versions of the resulting preferred route option were sequentially selected for further assessment, with the latest version being illustrated in Figure 2 (page 59). This report concerns the avifaunal aspect of this latest version.

1.1. Planned power line infrastructure

Located west of the N1 bypass, Langenhovenpark represents Bloemfontein’s western suburb. From the corner of Bankovs Boulevard and Du Plessis Avenue, Koppie road leads one to the west and out of Langenhovenpark into farmland. The proposed new 132 kV power line will connect to the recently constructed Harvard-Cecilia power line — which is running south of, and parallel to, Koppie road — approximately 1.4 km west along Koppie Road. The route to the Noordstad substation is conveniently divided into five sections. Except for the terminal points, each section starts and ends at a planned substation (Fig. 2). The five sections are the following (follow the green line in Figure 2):

Havard-Outspan: The proposed new power line will originate at an existing gantry on the recently erected Harvard to Cicilia power line. From there it will head northwards for 4.0 km, mostly across agricultural land and parallel to the existing 1HAR/MER power line, to the site of the proposed Outspan substation (Fig. 2).

Outspan-Rooidam: The 3.6 km long power line between the proposed Outspan and Rooidam substations will be passing over agricultural fields, again running parallel to the existing 1HAR/MER power line (Fig. 2; Fig. 3, page 60).

Rooidam-Tevrede: From the proposed Rooidam substation site, the route of the power line will lead it around (west and parallel to the existing 1HAR/MER power line and then alone north) of the New Tempe Airport (FATP) to the site of the proposed Tevrede substation, covering a distance of 5.2 km and passing mostly over agricultural land (Fig. 2).

Tevrede-Mimosa: The proposed power line between the proposed Tevrede and Mimosa substations will follow an 11.6 km long northern detour, mostly along the existing 1HAR/MER power line. The route transverse Bloemfontein Dry Grassland (Gh 5) in the west, and predominantly Highveld Alluvial Vegetation (AZa 5) in the east (Fig. 2; Fig. 4, page 61; Fig. 5, page 62).

Mimosa-Noordstad: From the proposed Mimosa substation, the power line will keep to the north/east of the S1066 gravel road for the first 2.9 km after which it will work its way through the hilly terrain of the upper catchment of Stinkhoutspruit (Fig. 6, page 63) before crossing over into the upper catchment of a tributary of the Renosterspruit (Fig. 7, page 64) were it will connect to the Hillside substation, which is located approximately 2.8 km south-east of the Noordstad substation.

In addition to the above, a new, 3.5 km long, **underground power line** will be installed between the proposed **Tevrede and Olivier** substations (Fig. 2, orange line). There are also two alternative routes proposed for supplying power to the proposed Hillandale substation (Fig. 2, red & yellow lines respectively):

Northern Alternative: A long loop-in loop-out power line (5.6 km) originating from the Mimosa substation and crossing Bloemfontein Dry Grassland (Gh 5) over the first part of its route and later Windburg Grassy Shrubland (Gh 7) (Fig. 2, red line; Fig. 8, page 65).

Southern Alternative: A loop-in loop-out power line (2.4 km) originating from the Noordstad substation from where it will be heading north-west to the proposed Hillandale substation (Fig. 2, yellow line).

1.2. Terms of reference

The terms of reference for the Avifaunal Impact Assessment were as follow:

- Desktop Study;
- Walk-through Survey;
- Review of literature;
- Compilation of a Draft Report;
- Review of Draft Report by Enviroworks and Client;
- Comments on Draft Report from Enviroworks and Client;
- Compilation of Final Report by Specialist (incorporation of comments received);
- Description of the receiving environment (habitat) from an avifaunal perspective;
- Identification of high risk species, particularly Red listed and other priority species that might be impacted by the proposed facility;
- Description and assessment of potential impacts on priority avifauna;
- Provision of mitigation measures to reduce the envisaged impacts.

1.3. Assumptions, uncertainties and gaps in knowledge

Assumptions, uncertainties and gaps in knowledge applicable to this investigation appear as underlined text throughout this report. The following is a summary of the main issues:

- This assessment is based on the supplied power line routes as reflected in Figure 2. Deviation from this route could potentially render the conclusions of this report invalid.

- Knowledge on bird distribution and movement patterns along and around the route of the proposed power line is incomplete and it is difficult to assess if, when and how these patterns will change over time.

- It is assumed that this report will be distributed and consulted in its entirety. The specialist who compiled this report does not accept any responsibility for subsequent amendments effected without his specific and written consent. In case of any uncertainty, please direct your enquiries to djvnemail@gmail.com.

2. The impact of power line infrastructure on birds

2.1. Bird collision risk

In principle, any bird capable of flight, including small species, are at risk of colliding with power lines (Bevanger 1998; Haas *et al*. 2005; Hunting 2002; Janss 2000; Jenkins *et al*. 2010). Factors contributing to this risk are considered in the paragraphs below.

The proximity to locations where birds tend to congregate and / or flight paths is an important factor to take into account when planning the route of a new power line as this is often where most collision incidents occur (Avian Power Line Interaction Committee (APLIC) 2012; Brown *et al*. 1987; Faanes 1987; Henderson *et al*. 1996; Prinsen *et al*. 2011).

Earth wires on top of electricity infrastructure, which is supposed to protect the phase conductors from lightning strikes (Avian Power Line Interaction Committee (APLIC) 2012; Hunting 2002), are often the primary cause of avian collision incidents (*e.g.* Brown *et al*. 1987; Faanes 1987; Jenkins *et al*. 2010; Savereno *et al*. 1996; Scott *et al*. 1972; Van Rooyen 2003). Observations of collision incidents suggests that birds often see the conductors but not the earth wires (Bevanger 1994; Faanes 1987; Savereno *et al*. 1996; Scott *et al*. 1972; Thompson 1978), which is typically thinner and less obvious than the conductors. However, mortalities also occur in the absence of earth wires (Bevanger 1994).

It has been suggested that power lines running parallel and in the same right-of-way could help to reduce collision risk (Thompson 1978). The reasoning behind it is twofold: 1) It would tend to make the lines more visible; 2) A bird would only require a single ascent and descent to cross the lines instead of more than one avoidance manoeuvre (Thompson 1978). Although this suggestion has been around for nearly four decades, and in spite of the fact that Thompson (1978) himself noted that the "relative effect on mortality rates of separate versus clustered lines depends on many site-specific factors and deserves further study", there appears to be no such studies as reviews touching on the subject (*e.g.* Avian Power Line Interaction Committee (APLIC) 2012; Bevanger 1994) all refer back to Thompson's (1978) original suggestion. Thompson (1978) also noted that birds flying "during periods of decreased visibility" may actually be at a greater risk of colliding with clustered lines (Thompson 1978).

2.2. Bird electrocution risk

A bird may be electrocuted by power line infrastructure when it causes an electrical short circuit by physically bridging the air gap between live components and/or other live and grounded components (Bevanger 1998; Van Rooyen 2003). The resulting flow of current through the body of the bird is lethal (Van Rooyen 2003). These type of incidents occur especially when the feathers of the bird is wet (Bevanger 1998).

In cases where the long ejected excreta (called a streamer) of a bird bridge the air insulation between a live conductor and the power line tower structure, it could cause a flash-over and on rare occasions the death of the bird (Van Rooyen 2003).

2.3. Birds nesting on power line towers

In addition to providing perching sites, power line towers associated with power lines are frequently used by birds for breeding purposes as well (Anderson 2013; Boshoff *et al*. 1990; Dean 1975; Machange 2003). Nesting material, including wires and plant material, can result in flash-overs, and possibly fire, when it comes into simultaneous contact with two conductors, particularly during wet conditions (Anderson 2013; Van Rooyen 2003; Vosloo & Van Rooyen 2009a). Flash-overs can also be caused by the excreta of nest occupants (Vosloo & Van Rooyen 2009a).

2.4. Habitat alteration

The vegetation underneath power lines need to be managed to ensure safe clearance space under and around the power lines, adequate access for inspection, maintenance and repair activities, and to reduce fuels for fire under power lines that cause flashovers (Vosloo 2009). Consider, for example, that in South Africa vegetation fires cause approximately 20% of line faults on high-voltage transmission lines ($\geq 132\,\mathrm{kV}$), amounting to an estimated annual financial impact of approximately R80 000 0000 (Vosloo *et al*. 2008). Vegetation management entails alteration of habitat along power lines (*e.g.* Fig. 5; Vosloo 2009). These habitat changes could potentially have a negative impact on resident species, particularly if the vegetation management activities coincide with breeding activity.

2.5. Roads

Depending on the circumstances roads can have a range of negative impact on the environment (for reviews, see Forman & Alexander 1998; Trombulak & Frissell 2000). For example, the construction of a road can have a negative impact on the breeding success of local birds through disturbance and or destruction of active nesting sites. Roads can also change the habitat in ways that could render the habitat unsuitable for resident species. Once established, a road can change the routing of shallow groundwater and surface flow in ways that may trigger erosion (Forman & Alexander 1998; Trombulak & Frissell 2000). Roads can also provide optimal habitat for invasive/exotic plant species (Forman & Alexander 1998; Kuvlesky *et al*. 2007; Trombulak & Frissell 2000). Chemical control of these plants and other pests can have a negative impact on birds and other animals if food that was in contact with these herbicides or pesticides are ingested. Moisture and sediment deposits from road drainage may also benefit patches of local plants (Forman & Alexander 1998) and may lead to the establishment of habitats where insects flourish. This, in turn, could attract insect eating birds to the area. Furthermore, dust mobilised and spread by road traffic could potentially have a negative impact on nearby plants (Trombulak & Frissell 2000).

2.6. Lighting (at substations)

Ecological light pollution (ELP) "includes chronic or periodically increased illumination, unexpected changes in illumination, and direct glare" (Longcore & Rich 2004). The impact of ELP on birds and other animals has been reviewed in recent years (Bruce-White & Shardlow 2011; Longcore & Rich 2004; Navara & Nelson 2007). Among its many impacts on birds and other animals (see Bruce-White & Shardlow 2011; Longcore & Rich 2004; Navara & Nelson 2007; Perry *et al*. 2008) two aspects will be considered. Firstly, security lighting often attracts insects, which can easily serve as food for birds and other predators (Frank 1988). This may become an attractant for birds and may possibly lead to collisions with project infrastructure. Secondly, nocturnal migrating birds can get entrapped by artificial light and may then collide with structures close to the light source, die of exhaustion, or be exposed to an increased risk of predation (Ogden 1996). It is agreed with The Royal Commission on Environmental Pollution (2009) that, while further research is evidently needed, the information at hand justify concern regarding the potential adverse ecological impact of ELP.

2.7. Fencing

While fencing could present a collision risk for some birds (Baines & Andrew 2003; Baines & Summers 1997; Cornwell & Hochbaum 1971; DJvN pers. obs.), others may find it suitable for perching or breeding.

3. General description of the receiving environment

Bloemfontein is situated in the Dry Highveld Grassland Bioregion (Mucina & Rutherford 2006; Fig. 1). The mean annual precipitation of the Bloemfontein area is approximately 480 mm with most rain falling from October to April (Mucina & Rutherford 2006). The proposed new power lines will be passing across the following vegetation units (Fig. 1; Mucina & Rutherford 2006):

- *Bloemfontein Dry Grassland* (Gh 5): This type of grassland consists of slightly undulating bottomland landscape covered with tall, dense grassland alternating with patches of karroid scrub occurring especially over calcrete (Mucina & Rutherford 2006). It is an endangered vegetation unit with more than 40% already transformed for crop production, urban development, *etc.* (Mucina & Rutherford 2006; *e.g.* Fig. 3). The western and northern sections (Fig. 4; Fig. 8) of the proposed new power line crosses this vegetation unit (Fig. 1), but much of the habitat in the west and north-west have been converted for crop production and urban development (Fig. 3).

- *Winburg Grassy Shrubland* (Gh 7): A mosaic of habitats ranging from open grassland to shrubland created of solitary hills, slopes and escarpments of mesas (Mucina & Rutherford 2006). Tall shrubs and trees occur in places sheltered against frost during winter and veld fires (Mucina & Rutherford 2006). This vegetation unit is least threatened (Mucina & Rutherford 2006). The easterly parts of the proposed power lines, including part of the Mimosa-Noordstad power line (Fig. 6) and the area around the proposed Hillandale substation (Fig. 8), will be running across this vegetation unit (Fig. 1).

- *Bloemfontein Karroid Shrubland* (Gh 8): Plateaus or slightly sloping flanks of dolerite outcrops supporting low shrubland dominated by dwarf small-leaved karroid and succulent shrubs (Mucina & Rutherford 2006). This vegetation unit is classified as least threatened (Mucina & Rutherford 2006). Along the proposed power line, this vegetation unit occurs at an isolated patch near the proposed Rooidam substation (Fig. 3), as well as at the area around the Noordstad substation (Fig. 1).
- *Highveld Alluvial Vegetation* (AZa 5): Flat topography supporting riparian thickets mostly dominated by *Vachellia karroo* accompanied by seasonally flooded grasslands and disturbed herblands, often dominated by alien plants (Mucina & Rutherford 2006). This vegetation unit is least threatened (Mucina & Rutherford 2006). The north-eastern part of the proposed power line cross this vegetation unit (Fig. 1; Fig. 5).

In the project area, there is a distinct contrast between the relative flat west with no prominent drainage systems — approximately from the proposed Tevrede substation westwards — and the more undulating/hilly eastern area which falls mostly in the catchment of the Stinkhoutspruit, a multi-branched, well-defined drainage system which empties into the Modder River approximately 15 km north of the proposed Mimosa substation (Fig. 1). There are many dams in the Stinkhoutspruit system, most of which are less than 2 km from the proposed power lines, e.g. those in the Seven Dams Conservancy, the Free State National Botanical Garden and Woodland Hills Wildlife Estate (Fig. 2). The south-eastern end of the proposed power line runs across the upper catchment of a tributary of the Renosterspruit, where there are also several dams (Fig. 2; Fig. 7).

There are only a few areas with some form of conservation status within 50 km from the proposed power line (Table 2, page 34). Formally protected areas includes the Soetdoring Nature Reserve (which is also a Important Bird Area, Marnewich *et al*. 2015; Table 2 B), located approximately 21 km to the north-west, and the Rustfontein Nature Reserve approximately 47 km to the south-east (Table 2 A).

4. Methods

For ease of reference the so-called Roberts number as per Maclean (1985) is included together with the name of bird species whenever they are mentioned, *e.g.* Cape Turtle-Dove R354. Thus given it is easy to locate the species in Table 3 (page 35) where the birds within each group (see below) are sorted by their Roberts number. In cases where changes in taxonomy subsequent to Maclean (1985) resulted in a taxon being split into more than one species (*e.g.* Eastern Clapper Lark R495a), or when new species were admitted to the southern African list (*e.g.* Mallard R104n), a number was improvised. In cases were a species is mentioned which does not occur in the SAC9Q-block, and hence in Table 3, its English named is followed by its scientific name. Taxonomy follows BirdLife South Africa (2015).

4.1. Study approach

The occurrence and behaviour of bird species in any given area are influenced by internal (*e.g.* internal circadian and circannual clocks) and external (*e.g.* amount and timing of rainfall) factors (Van Niekerk 2009). While factors such as day-length changes predictably throughout the year — day-length is the environmental factor showing the most consistent seasonal change from year to year (Berthold 1996; Brandstätter 2003) — the temporal occurrence of other factors such as rainfall are less predictable, for example a specific wetland may be inundated in December of one year, but dry the next. Consequently, within EIA time-frames it will never be possible to cover all possible environmental conditions during fieldwork. Therefore, decisions made within these time-frames are necessarily based on incomplete data, regardless of the thoroughness of any fieldwork on which these decisions are based. Supplementary information from other sources such as literature and past experience could help to fill in some of the knowledge gaps.

In addition to earlier bird surveys conducted in the area of the proposed Havard to Noordstad power line, including fieldwork for the recently constructed Cecilia power line and substation (Van Niekerk 2013a), the author conducted site surveys focused on the proposed power line from the first half of January 2017 to the first half of May 2017.

4.2. Bird species occurrence

At the core of any avifaunal impact assessment is a list of bird species likely to be found in the proposed development site and environs. Because the proposed Havard to Noordstad power line will be in operation for a few decades, it would be ideal to consider all species which would occur in the area over that period. However, as illustrated in Section 5 below (see from page 15), two factors make this difficult: 1) Current knowledge on the distribution and movement patterns of birds in and around the proposed development area is incomplete; 2) The distribution of species may change over time and for any given species it is difficult to predict if, when and how this will happen. The approach followed included all species recorded in 2926AA, *i.e.* the quarter degree grid cell (QDGC) in which most of the project site is located in (Fig. 9, page 66), as well as those recorded in the eight surrounding QDGCs during the first Southern African Bird Atlas Project (SABAP1; 1987-1991; Harrison *et al*. 1997a,b; Minimum spatial resolution: QDGC, *i.e.* a 15' latitude by 15' longitude block), and second Southern African Bird Atlas Project (SABAP2, 2007-present; `sabap2.adu.org.za`; Minimum spatial resolution: pentad, *i.e.* a 5' latitude by 5' longitude block). These nine QDGCs will be referred to as the Study Area Centred 9-QDGC block, or simply the SAC9Q-block (Fig. 9). SABAP2's coverage of the SAC9Q-block, specifically the number of 'full protocol' checklists per pentad, is illustrated in Figure 9. The analysis of SABAP2 data reflects the state of their database as on 5 December 2016.

4.2.1. Field observations

Data from the two bird atlas projects referred to above were supplemented by other observations made by the author in the area. The aim of the field observations was to develop an understanding of the composition and movement pattens of avifaunal community components utilising the proposed project site and environs. The observations were conducted while travelling on foot and by vehicle.

4.3. Habitat preference

Although birds are highly mobile, many species utilise only specific habitats, with habitat diversity playing an important role in determining avifaunal diversity (Cody 1985). The hierarchical habitat classification system of Harrison *et al*. (1994) was used to characterise the habitat preferences of each species. Only primary habitat levels were used, which include marine (MA), aquatic (AQ), montane/rocky (RC), grassland (GR), scrub (SC), woodland (WO) and forest (FR) habitats. In addition, "habitat-unspecific" species were placed into a 'habitat generalist' (HG) category. In the few cases where Harrison *et al*. (1994) did not assess the habitat preferences of a species, or where taxonomic changes occurred subsequent to the publication of Harrison *et al*. (1994), or where new species were admitted to the Southern African list, appropriate habitat associations were assigned based on information in Hockey *et al*. (2005), or personal experience. For the purposes of this assessment, the term 'waterbird' refers to all species associated with aquatic habitats according to the system of Harrison *et al*. (1994). The habitat preferences of all species is shown in Table 3 and summarised in Figures 10 (page 67) and 11 (page 68).

4.4. Species of special concern

Particular emphasis is placed on species appearing on the Red Data list (Taylor *et al*. 2015), species endemic or at least near-endemic to South Africa, Lesotho and Swaziland (all will be referred to as 'endemic' in the text), range restricted species (Marnewich *et al*. 2015), and species which may potentially interact with, or be affected by, the proposed power lines. All of this information is summarise in Table 3 for each species. Waterbirds are highlighted in Table 3 by printing their risk assessment in blue, except in cases where the risk is high in which case it appears in red print.

A distinction is made between the risk of disturbance and the risk of accidents. **Disturbance** refers to any action by humans which deprives a bird species of its habitat. This includes the physical destruction or alteration of habitat in a way that causes displacement, as well as disturbance which have a negative impact on breeding success. In general this type of disturbance is primarily associated with the construction phase of the project. **Accidents** refer to incidents involving the project infrastructure which could lead to the injury or death of birds once the facility is completed and operational.

The term 'resident' is used here to mean species present at (or at least regularly visiting) the indicated area for an extended period of time (a month or more) and include migrating species. The risk categories distinguished below refer to the situation before consideration of mitigation measures.

4.4.1. Power Line Infrastructure Risk

The following *negative* disturbance risk categories are distinguished:

- **Unlikely**: The species is either unlikely to occur in the area of the proposed power lines, a possible transient visitor to the area, and/or otherwise unlikely to be disturbed;
- **Low**: The species is a resident or have another status in the area of the proposed power lines, but the risk of disturbance is likely to be minimal (*e.g.* species with large territories and species which utilise the area mainly for activities other than breeding);
- **Moderate** (**Mod.**): The species is a resident in the area of the proposed new power lines and the risk of disturbance is likely to be moderate (*e.g.* species which may potentially breed in the affected area);
- **High**: The species is a resident in area of the proposed power lines and the risk of disturbance is likely to be high (*e.g.* species which probably breed in the affected area).

When disturbance of species are predicted, the only viable mitigation option may be to schedule the development's activities which would cause these disturbances to occur outside the breeding season. However, the more species that are involved the less likely it would become to find a period outside the breeding season of all of them. This is the case in the present study. In order to determine the time of the year when the least number of species would be impacted, the Median Breeding Index method of Van Niekerk (2013b). For each species, the number of breeding records for each month was converted into an index value by dividing the value of each month by the value of the month with the highest count. A median index value was then calculated for each month with the results graphically presented in Figure 12 (page 69). Theoretically speaking, the predicted disturbances would affect the least number of species during the months with the lowest Breeding Index.

Information on confirmed collision (c) and electrocution (e) accidents involving power lines and associated infrastructure were obtained for species occurring in South Africa, Lesotho and or Swaziland from published sources referring to incidents recorded in southern Africa (Anderson 2000; Anonymous 2008; Diamond 2008; Diamond *et al*. 2010; Jenkins 2008; Krüger *et al*. 2015; Prinsen *et al*. 2011; Shaw *et al*. 2010; Van Niekerk 2013a; Van Rooyen & Ledger 1999; Vosloo & Van Rooyen 2009b) and elsewhere in the African-Eurasian region (Barrientos *et al*. 2012; Ferrer 2012; Janss & Ferrer 1998; Prinsen *et al*. 2011; Scott *et al*. 1972; Shobrak 2012). There are probably more species involved as it is likely that a large number of incidents go unreported (Shaw *et al*. 2010; Vosloo & Van Rooyen 2009b). For example, the carcasses of smaller species may be easily overlooked, and carcasses of dead birds are removed by scavengers at a relatively rapid rate (Drewitt & Langston 2006; Flint *et al*. 2010; Hunting 2002; Johnson *et al*. 2000; Ponce *et al*. 2010; Scott *et al*. 1972; Smallwood 2007; Van Niekerk 2012). Incidents recorded outside southern Africa are indicated with an asterisk (*). An "x" indicates cases where the type of incident (either collision or electrocution, but probably the former in most cases) was not specified. A question mark (?) indicates cases with no confirmed incidents, but where it may possibly occur based on incidents involving similar species and other information. The following risk levels were used (levels above the 'low' category are applicable to collision risk only):

- **Unlikely**: There is no known collision or electrocution cases involving this species on record;
- **Low**: Collision incidents involving electricity infrastructure have been recorded in this species. However, the species is probably a transient visitor to the affected area or are otherwise unlikely to be affected;
- **Moderate**: Collision incidents involving electricity infrastructure have been recorded in this species. In addition, the species is expected to occur regularly in the area of the proposed development, which could potentially render it vulnerable to accidents under certain circumstances.
- **High**: Power lines often cause injury or death in the species through collisions and local conditions is likely to lead to these type of incidents.

The impact rating system used in this assessment is explained in Appendix B on page 78.

5. The avifauna

The 357 birds listed in Table 3 include the following species recorded during SABAP1 and/or SABAP2: 307 species recorded in 2926AA (see Fig. 9) and 47 species not recorded in 2926AA but in one or more of the eight adjacent QDGCs (Table 4, 8QDGC, page 53). An additional three species have been recorded by the author.

The reason for the inclusion of birds recorded outside 2926AA was to help compensate for the two factors mentioned on page 12. The first factor, *i.e.* the incompleteness of current knowledge on bird distribution in and around the proposed development area, is readily illustrated. In spite of receiving apparent reasonable attention from SABAP2 bird atlasers (Fig. 9), the SABAP2 bird species lists for each of the three pentads in which proposed development area is to be located in is clearly incomplete with 9, 11 and 22 'new' species being recorded by the author in the respective pentads (Table 5 A, page 53). When the data for the three pentads are combined, there is 18 'new' species relative to SABAP2 data, and 9 'new' species when the entire 2926AA QDGC is considered (Table 5 A). Even when considering the data of both SABAP1 & SABAP2, the bird species recorded in the three pentads by the author added 7 'new' species to 2926AA (Table 5 B).

Many of the 'new' species highlighted above are probably (temporary) residents within 2926AA but have been overlooked during the respective atlas projects. The same probably also applies to many of the species indicated in Table 4 which have been recorded exclusively during either SABAP1 or SABAP2, although in many cases 2926AA is located at or near the edge of their distribution (Table 4).

Collectively the aforementioned data clearly demonstrates the incompleteness of the SABAP12 dataset. Nevertheless, the dataset also illustrates the dynamic nature of bird distributions. For example, examination of SABAP12 data suggests that approximately 40 species expanded their ranges towards 2926AA since SABAP1 and they already have been recorded in one or more of the eight surrounding QDGCs. As such 2926AA is close to the edge of their respective present distribution ranges. Most of these species have not been recorded close to 2926AA during SABAP1, and as far as could be determined their range expansions were not predicted. Because of the difficulty in predicting which of the species not yet recorded within the SAC9Q-block will be recorded there in the future, no predictions were made for the present analysis.

5.1. Priority species

Three groups of priority species can be described, namely Red Data species, the resident avifaunal community, and waterbirds. No range restricted species are known to occur in the vicinity of the project site.

5.1.1. Red Data species

The 37 Red Data species recorded in the SAC9Q-block during SABAP1 and SABAP2 are listed in Table 3 A. They include one Critically Endangered species, nine Endangered species, ten Vulnerable species and 17 Near-Threatened species (Table 3 A). Species most likely to be encountered in the immediate vicinity of the proposed power line include the Secretarybird R118, Lanner Falcon R172, and European Roller R446. The African Rock Pipit R721 is a localised resident associated with the mountainous terrain and is known to occur at two localities, each c. 1.9 km from the proposed power line. The rest of the species is at best transient visitors to the area.

5.1.2. Resident avifaunal community

The habitat along the proposed power line route include cultivated fields, grassland, scrub/woodland and hilly terrain. The power line will also cross a number of drainage lines (Fig. 2). Construction activities could lead to the disturbance of several resident species (no Red Data species) associated with these habitats, but in all cases the risk is considered to be low, except for the Greater Kestrel R182 which may breed on a close-by pylons (Table 3 B1). The impact would be most severe if the construction phase overlaps with the breeding season of these birds. During its operational phase, the power line will pose a permanent collision treat to many species with the risk considered to be high for ten non-threatened species and moderate for two Red Data species and eight others (Table 3 A, B).

5.1.3. Waterbirds

Wetlands typically represent discrete habitats within landscapes, *e.g.* rivers, dams and pans. When they have water they attract a variety of animals, leading to a concentration of biota. Most prominent among these are birds, in particular waterbirds, many of which are also known to colonise ephemeral wetlands soon after they received water. Because of its potential of attracting birds to a specific location, a wetland in an area often implies increased bird movements there. Therefore, in cases where man-made structures pose some form of danger to birds, the presence of a wetland in the same area can greatly increase the potential for undesirable incidents, particularly since many waterbird species are flying around between dusk and dawn (Avian Power Line Interaction Committee (APLIC) 2012). Power lines near wetlands are known to cause high mortalities in waterbirds (*e.g.* Faanes 1987). All waterbirds are highlighted in Table 3 by printing their risk assessment in blue, except in cases where the risk is high in which case it is typed in red.

There are numerous open water wetlands in and around the proposed project site. Most of them represent ephemeral systems which are temporarily inundated by rain (*e.g.* Fig. 13, page 70). The eastern and western branches of the Stinkhoutspruit, which drains the eastern half of the project site (Fig. 2), represent movement corridors for waterbirds and other species associated with the trees and bushes found along it.

Waterbirds constitute more than a quarter (28.6%) of all bird species recorded to date in the SAC9Q-block (Fig. 10). Disturbance of waterbirds are foreseen for only two species during the construction phase (Table 3 B1). However, during its operational phase the proposed power line will pose a permanent threat to several waterbirds with the risk for collisions in most cases considered to be low (Table 3 A, B2). Exceptions involve five of the more common species where the risk is considered to be high (Table 3 B).

Along the northern section of the proposed Tevrede-Mimosa power line section there are two wetlands which each appear capable of holding water for an extended period of time and which lies directly in the proposed path of the power line (Fig. 4; Fig. 5). This poses a severe threat not only for the species which utilise these wetlands directly, but also for their predators.

5.2. Receiving environment from an avifaunal perspective

In this section, consideration is given to each habitat occurring in the project site and environs and the bird species associated with each. Habitat Generalists are considered separately at the end.

5.2.1. Woodland

Woodland habitats are mostly associated with the small holdings in the west (Fig. 3), and the Stinkhoutspruit in the east (Fig. 5) (Fig. 2). Almost a third of the species recorded in the SAC9Q-block (32.2%) are associate with woodland habitats (Fig. 10). Nearly one third (32.8%) of these species also shows a preference for other habitats, particularly grassland, scrub and forest habitats (Fig. 11).

Eight of the 37 Red Data species are associated with woodland habitats, but none of them are likely to experience disturbance during the construction phase (Table 3 A). During the operational phase the proposed power lines will pose a permanent collision/electrocution risk to six of these species (Table 3 A), of which the European Roller R446 is most likely to be encountered in the area.

There are 17 non-threatened species associated with woodland habitats which could experience a low risk of disturbance during the construction phase, none of which are known to have been involved in accidents with power lines (Table 3 B1). Collision incidents are known for an additional ten non-threatened species, with the risk considered to low in all species except the Southern Pale Chanting Goshawk R162 where the risk is considered to be moderate, and the Red-eyed Dove R352 where the risk is considered to be high (Table 3 B2).

5.2.2. Aquatic

Aquatic habitats and the birds associated with it were already considered in Section 5.1.3.

5.2.3. Grassland

A sizeable proportion of the route of the proposed power line will be crossing over open grassland (Fig. 2; *e.g.* Fig. 4). 17.5% of the species recorded in the SAC9Q-block are associated with grassland habitats (Fig. 10). A large proportion of these species (60.3%) are also associated with other habitats (Fig. 11). A fifth of the grassland species are endemics (Fig. 10).

None of the nine Red Data species associated with grassland are likely to experience disturbance (Table 3 A). Fatal incidents involving power line infrastructure are known for three of these species, but all three are presently infrequent visitors to the project site (Table 3 A).

Of the non-threatened species associated with grassland, 19 are residents with a low risk that they could experience disturbance during construction, especially if construction coincides with their breeding season (Table 3 B1). In one species, the Egyptian Goose R102, the risk is considered to be moderate as a pair is possibly breeding on an existing pylon close to the proposed new power line. For two of the three species which are known to collide with power lines the risk of this happening is considered to be moderate (Table 3 B1). An additional five other grassland species recorded in the SAC9Q-block are also known to collide with power lines (Table 3 B2). In all cases except the Northern Black Korhaan R239a (moderate) the risk is considered to be low.

5.2.4. Scrub

In the study area scrubland is associated with the Bloemfontein Karroid Shrubland found in the vicinity of the proposed Rooidam substation in the west (Fig. 3), and along an hilly eastern section of the proposed power line (Fig. 6) (Fig. 1; Fig. 2). Although only 13.9% of the species recorded in the SACQ9-block are associated with scrub habitats, more than a quarter (26.0%) of them are endemics (Fig. 10). Two-thirds of these species are also associated with other habitat, mainly grassland or woodland (Fig. 11).

None of the six Red Data species associated with scrubland are likely to experience disturbance (Table 3 A). Fatal incidents involving power line infrastructure are known for three of these species, but all three are presently infrequent visitors to the project site (Table 3 A).

Thirteen non-threatened species associated with shrubland are residents with a low risk that they could experience disturbance during construction, especially if construction coincides with their breeding season (Table 3 B1). Only the Greater Kestrel R182 is expected to be exposed to a moderate risk of disturbance (Table 3 B1). Except for the Greater Kestrel R182 and Red-capped Lark R507, none of the rest are known to collide with power lines (Table 3 B1). Fatal interactions with power line infrastructure are known for an additional three species associated with scrub (Table 3 B2). In all these cases the risk for collisions are considered to be low, except for the Southern Pale Chanting Goshawk R162 (moderate risk) which is relatively common in the north-eastern aspect of the project site.

5.2.5. Montane/Rocky

In the project site this type of habitat is closely associated with Bloemfontein Karroid Shrubland and is confined to an isolated outcrop near the proposed Rooidam substation, and the mountain area in the east (Fig. 2; Fig. 3; Fig. 6). Only 4.2% of the species known to occur in the SAC9Q-block are associated with this type of habitat with approximately a quarter of them being endemics (Fig. 10).

The Verreauxs' Eagle R131 and African Rock Pipit R721 are the only Red Data species in this group (Table 3 A), but neither presently occur in the footprint area.

Three non-threatened species associated with montane habitats are relatively common in the eastern aspect of the study area and could potentially experience disturbance during the constriction phase (Table 3 B1). For an additional two species, collision (and electrocution) incidents are known. In the case of the Peregrine Falcon R171, an individual was observed to hunt at a wetland which is in the path of the proposed new power line (Fig. 4). Consequently the proposed power line may pose a moderate risk to these birds (Table 3 B2).

5.2.6. Other habitats

Neither forest nor marine habitats occur in the immediate vicinity of the proposed development. All 15 species associated with forest habitats are also associated with woodland, and four of them are additionally associated with scrub (Fig. 11). Thirteen of the 18 species associated with marine habitats are also associated with freshwater systems (Fig. 11). Although the remaining five species are primarily associated with marine habitats, they also frequents inland aquatic systems.

5.2.7. Habitat generalists

Habitat generalists constitute 17.8% of the species occurring in the SAC9Q-block (Fig. 10). This includes seven Red Data species (Table 3 A) of which only the Secretarybird R118 and Lanner Falcon R172 are presently resident in the area. Neither of the latter two species is likely to experience disturbance during construction, however both species will be exposed to a moderate risk of collisions with the proposed new power line.

Six non-threatened species are resident habitat generalists which may experience disturbance during the construction phase, but in all cases the risk is considered to be low (Table 3 B1). For the three species for which fatal incidents with power line infrastructure are known, the risk is considered to be moderate (Helmeted Guineafowl R203) or high (xdfvr;

Laughing Dove R355) (Table 3 B1). Fatal power line related incidents are known for an additional 27 habitat generalists, but for most of them the risk is considered to be low (Table 3 B2). The exceptions are the Rock Dove R348 and Speckled Pigeon R349 which commutes daily between the city and the surrounding agricultural fields, the Cattle Egret R071 and Hadeda Ibis R094 which are relatively common in the area, and the African Sacred Ibis R091 which is expected to move daily across the proposed new power line at the Noordstad dumping site (Fig. 7).

6. Assessment of potential impacts and mitigation measures

6.1. Substations

There are a total of six new substations planed along the route of the proposed power line (Fig. 2). The avifaunal impact of these substations will be similar to one other.

6.1.1. Construction phase

Construction of the proposed substations will entail land levelling and complete destruction of the existing habitat. During the process it is possible that active nests could be destroyed or that birds breeding in the area could experience disturbance. However, the impacted area is relatively small and if the footprint of all construction related activities are restricted to designated areas and minimized wherever practically possible, the probability of negative impact would be very low. The non-threatened status of the taxa involved does not warrant any other mandatory mitigation measures. At present the habitat at the sites of the proposed substations includes woodland (Outspan), agricultural fields (Tevrede) and grassland (Rooidam, Olivier, Mimosa and Hillandale).

Change in impact significance:
Without mitigation **Low**→**Low** with mitigation
(See Table 6 on page 54)

6.1.2. Operational phase

Construction of each substation will entail the permanent transformation of existing habitat — which include woodland, grassland or agricultural fields — into a relative sterile habitat consisting of fences, buildings, steel structures, *etc*., and the consequent permanent displacement of species which currently utilise the impacted area. Factors potentially contributing to the risk of bird fatalities at the substations include the following (see also Section 2 on page 8):

- Fences may pose a collision risk to birds.
- As indicate earlier (see Section 2.6 on page 10) insects attracted by security lighting, which is a source of ELP, could attract birds, and this could lead to collisions with project infrastructure. Gaston *et al*. (2012) recently investigated options for reducing the ecological consequences of ELP. They concluded that the most effective option would

probably be to maintain and increase natural unlit areas. Relevant mitigation options in this regard include the following (see Gaston *et al*. (2012) for more information):

  - Maintain and increase natural unlit areas;
  - Security lighting should be installed only where it is absolutely essential;
  - Avoid direct illumination of any substation structures;
  - Reduce the trespass of lighting by using luminaires that prevents light from shining beyond the intended area and eliminates light directed upwards or at the horizontal;
  - Decreasing light intensity will reduce energy consumption and limit both skyglow and the area impacted by high-intensity direct light;
  - Lighting technologies emitting a narrow spectrum of light are likely to have less ecological impact compared to broader spectrum light sources.

- The construction of the access roads could also have a negative impact on birds. Dust suppressants other than pure water should be used only as a last resort, and then only after very careful research were conducted as it could potentially have adverse environmental impacts (Lovich & Ennen 2011; Piechota *et al*. 2002). The access road should also be carefully designed in order to avoid erosion over the long term and minimise the occurrence of areas where water could collect to create pools.
- Wherever possible, grazing or mechanical methods should be used instead of chemical alternatives to keep the vegetation in check where necessary. In this way the possible poisoning of birds and other animals will be avoided.

Change in impact significance:
Without mitigation **Low**→**Low** with mitigation
(See Table 7 on page 55)

6.1.2.1. Cumulative impacts Given the low probability of negative impact of the proposed substations, no cumulative impacts are foreseen.

6.1.2.2. Positive impacts The new substation habitat will not be suitable for most of the species which utilise the present habitats in the respective footprint areas. The following species occurring in the area are known to build their nests on/in man-made structures and they may attempt to do so at the new substations: Speckled Pigeon R349, White-rumped Swift R415, Little Swift R417, White-throated Swallow R520, Pearl-breasted Swallow R523,Greater Striped Swallow R526, South African Cliff-Swallow R528, Rock Martin R529, Common Myna R758, Cape Glossy Starling R764, House Sparrow R801, and Cape Sparrow R803. While the swallows and martin use mud to construct their nests underneath horizontal/vertical surfaces, others use grass and other material to construct their nest. In certain cases this may interfere with the normal functioning of the used structures or create a fire risk. The Common

Myna R758 and House Sparrow R801 are both Category 3 introduced invasive species (National Environmental Management: Biodiversity Act (10 of 2004): Alien and Invasive Species List (2014)). Mitigation strategies include the following:

- Avoid the use of lattice-type structures in order to minimize perching and nesting opportunities;
- Minimize standing water. This will make it more difficult for the swallow species to obtain mud for their nests. It will also help to minimize the risk of large congregations of birds near the substation.
- It is recommended that the new substations should be inspected for nesting activity at least once a month. This can be accomplished during routine maintenance activities. Observations at substations suggest that the only effective counter measure against small birds nesting in equipment is to remove the nesting material when it appears (Van Rooyen & Ledger 1999). The same strategy is recommended for the new substation, but only if the nest belongs to one of the species indicated above, and if it interfere with the substation's operation and/or creates a fire risk. In cases where a species other than those indicated above are involved, permission should first be obtained from the local nature conservation authorities. If the surveys for nests are done regularly as recommended above (at least once a month), then it would help minimize the risk of eggs or nestlings being involved.

6.2. Overhead power lines

The main power line will include approximately 33 km of overhead power lines of 3.5 km of underground power lines (Fig. 2). There is also an additional overhead power line (with two alternative options) of 2.4/5.6 km which will connect the Hillandale substation to the gird (Fig. 2).

6.2.1. Construction phase

During construction there will be movement of personnel and vehicles along the route of the proposed overhead power lines. Building materials and other building equipment will also be stored temporarily on the ground along this route. These activities will lead to local habitat transformation and disturbance, including disruption of breeding activity, of bird species present. While none of the Red Data species are expected to be impacted by this (Table 3 A), many non-threatened taxa are (Table 3 B1). These disturbances would be most likely when construction coincides with breeding activity. Apart from minimising the footprint of construction activities, the non-threatened status of the taxa involved does not warrant any other mandatory mitigation measures. However, the impact could be minimised by scheduling construction to occur during the non-breeding season of most of the species involved. Examination of the Median Breeding Index indicates that the best period for construction would be between April and July (inclusive) and the worst period from October to January (Fig. 12).

Change in impact significance:
Main power line: Without mitigation **Moderate**→**Moderate** with mitigation

Northern Alternative: Without mitigation **Low**→**Low** with mitigation
Southern Alternative: Without mitigation **Low**→**Low** with mitigation
(See Table 8 on page 56)

6.2.2. Operational phase

Power lines represent a permanent collision hazard to birds. Cases of collisions with electrical infrastructure are known for 20 of the 37 Red Data species occurring in the SAC9Q-block (Table 3 A). Most of these species are presently at best transient visitors to the project site and or their risk of colliding with new power lines at the site is considered to be low (Table 3 A). The risk is considered to be moderate for the following two species (Table 3 A):

- Secretarybird R118 (Vulnerable): Breeding resident. There is at least one breeding pair which utilise the area of the proposed power line. Fatal collision incidents involving power lines have been recorded for this species (Brown & Lawson 1989; Diamond 2008; Diamond *et al*. 2010; Prinsen *et al*. 2011; Van Niekerk 2013a; Van Rooyen & Ledger 1999; Vosloo & Van Rooyen 2009b).

- Lanner Falcon R172 (Vulnerable): Breeding resident. This species possibly breed in the study area. They forage over a wide area. Fatal collision and electrocution incidents are known for this species (Anderson 2000; Prinsen *et al*. 2011; Shaw *et al*. 2010).

In addition to the above, there are 18 non-threatened species which have a moderate or high risk of colliding with the new power lines (Table 3 B). On a daily basis hundreds of doves and pigeons will fly across the lines as they move between urban areas and agricultural land further afield. These movements are expected to occur over most of the length of the power line.

Ducks and geese is another group of birds which is likely to collide with the proposed power line infrastructure, in part because they frequently move about between dusk and dawn. The major drainage lines represent linear movement corridors for these and other species. Where a power line transverses such a feature it represents a collision risk zone. Risk level is a function of site specific characteristics, such as the location of the crossing area relative to feeding and resting areas of these waterbirds. A relatively high collision risk is predicted for the following areas**:**

- Wetlands WL1 and WL2 are isolated wetlands which would retain water for an extended period of time. The current route places the proposed new line dangerously close (Fig. 4; Fig. 5);

- Where the proposed power line will cross tributaries of the Stinkhoutspruit (*e.g.* Fig. 5);

- Where the line transverse the upper catchment of the Renosterspruit tributary at the Noordstad dumping site (Fig. 7).

- The area around the proposed Hillandale substation (Northern & Southern Alternatives; Fig. 8);
- Southern Alternative: The area south of the Shell Ultra City.

In addition, frequent waterbird movement is expected across the development zone when ephemeral wetlands in the area are inundated (*e.g.* Fig. 13).

Mitigation options considered include the following:

- The surest way of preventing birds from colliding with power lines is to place the lines underground (Hunting 2002). Technical feasibility of undergrounding have been demonstrated for power lines up to 500 kV (Elinfrastrukturudvalget (Denmark) 2008; Rosa 2010; Umeda *et al*. 2007). For example, a Danish study concluded that undergrounding of 132 kV power lines can be done without any significant technological problems (Elinfrastrukturudvalget (Denmark) 2008). In fact, a 24.6 km long, 132 kV underground power line was installed in Botswana already in 2000-2001 using cross-linked polyethylene (XLPE; also called solid dielectric) cables (ABB 2006). The use of underground cables is gaining momentum in Europe (Energinet DK 2009) and the USA (Hall 2012) and installation guides are available (*e.g.* Williams 2013). However, for financial, technical and / or environmental reasons, overhead power lines is typically preferred over undergrounding, if the latter is considered feasible at all (*e.g.* Zitholele Consulting 2014).
- There is general agreement amongst researchers that "vertically separated arrays of lines should be avoided as much as possible" (Jenkins *et al*. 2010). Horizontal designs where conductors are all on the same height is regarded to be saver as it presents a smaller vertical collision zone (Bevanger 1994; Drewitt & Langston 2008).
- The removal of earth wires has been shown to reduce collision incidents substantially (Bevanger 1994; Bevanger & Brøseth 2001; Brown *et al*. 1987). However, Bloemfontein is located in a "severe" lightning strike risk zone (Gijben 2012), which would necessitate the use of earth wires.
- Another strategy would be the use of thicker cabling (Jenkins *et al*. 2010), the idea being that it would make it easier for birds to see the wires (Avian Power Line Interaction Committee (APLIC) 2012). However, in one study this was found to be not nearly as effective as removing the earth wires (Brown *et al*. 1987), while a few other studies have shown that heavy mortalities can occur on transmission and distribution lines without earth wires (Bevanger 1994; Janss & Ferrer 1998). Although there are anecdotal reports which suggest that larger diameter earth wires is effective, studies of its effectiveness are needed before it can be recommended for reducing collision risk (Avian Power Line Interaction Committee (APLIC) 2012).
- Another option is to mark earth wires and/or conductors in order to make them more visible to birds, *e.g.* by using bird flight diverters (Fig. 14, page 71). This strategy has been used with some success in the past, particularly when a sufficiently large marker

— *i.e.* those which thickens the appearance of the line at that point by at least 20 cm over a length of at least 10 cm — spaced at regular intervals no greater than 10 m apart was used (Jenkins *et al*. 2010). This refers to static devices with no moving parts (*e.g.* pigtails/spirals; Fig. 14). Dynamic (including most "suspended") devices ("bird flappers") have moving parts and is more visible to birds, but unfortunately they are also less durable than static devices and may damage the power line to which it is attached (Vosloo & Van Rooyen 2009b). Birds differ in ways which seem to demand the need for various types of visual and non-visual devices to safeguard them all against the risk of colliding with power lines. For example, standard markers may not reduce the number of collisions involving crepuscular or nocturnal species (Barrientos *et al*. 2011) and research on the development of alternative markers is lacking (Jenkins *et al*. 2010). A further complication is that for diurnal species with narrow visual fields (*e.g.* bustards and cranes), visual markers may have limited success as these birds can render themselves blind in the direction of travel when they pitch their heads downward in flight (Martin & Shaw 2010).

- In terms of the two Hillandale alternatives, the Southern Alternative is preferred as it is much shorter than the Northern Alternative (2.4 km vs. 5.6 km).
- The only way to mitigate the situation at wetlands WL1 and WL2 (Fig. 4; Fig. 5) is to reroute the power line in such a way that it will be at least 100 m from these isolated wetlands;

The following mitigation strategies seem most appropriate for the proposed power lines:

- **Overhead power lines** will be required for the main line and the connection to the Hillandale substation. This will pose a collision risk to birds;
- The proposed new power line should be of a **horizontal design** where conductors are all on the same height;
- In addition, **bird flight diverters** (see Figure 14) or other suitable devices should be fitted to the earth wires of power line sections crossing major drainage lines following the guidelines provided by Jenkins *et al*. (2010);
- The **Southern Alternative** is preferred to the Northern Alternative;
- With regards to wetlands **WL1 and WL2**, reroute the proposed power line in a way that it does not approach them closer than 100 m;
- It is acknowledged that *no* combination of the mitigation strategies considered above is likely to completely eliminate the collision risk.

Of the species occurring in the SAC9Q-block, cases of electrocution involving electrical infrastructure are known for 13 Red Data species and many non-threatened species (Table 1<U+2009>A & B). Electrocution risk is primarily a function of power line tower design and bird body size and behaviour (Guil *et al*. 2011; Lehman *et al*. 2007; Van Rooyen 2003). Since the best strategy for avoiding bird electrocution is to use low risk power line tower designs (Van Rooyen 2003), it is recommended that such designs must be used for the proposed project following available guidelines (e.g. Ferrer 2012; Guil *et al*. 2011; Van Rooyen 2003).

Change in impact significance:
Main power line: Without mitigation **Moderate**→**Moderate** with mitigation

Northern Alternative: Without mitigation **Moderate**→**Moderate** with mitigation
Southern Alternative: Without mitigation **Moderate**→**Moderate** with mitigation
(See Table 9 on page 57)

6.2.2.1. Cumulative impacts There are several existing power lines in the area of the proposed development. Earlier surveys for dead birds under an 132 kV power line running parallel to the Havard-Cecilia power line revealed the carcasses of several species, including Red Data taxa (Van Niekerk 2013a). It is likely that the proposed new power line would increase the potential for collision incidents.

6.2.2.2. Positive impacts of power lines At least 19 of the species occurring in the SACQ9-block are known to breed on power line pylons and wires (Table 1). As discussed earlier (see Section 2.3 on page 9) nesting activity on pylons can potentially cause flash-overs. Removal of nests is only recommended as a last resort because the nest owners will frequently return and rebuild the nest (Anderson 2013). Alternative mitigation strategies include trimming of excessive nesting material, insulation of conductors, and the provision of an artificial nest platform (Anderson 2013).

6.3. Underground power lines

Due to its proximity to the New Tempe Airport, the 3.5 km power line between the proposed Rooidam and Olivier substations will be placed underground (Fig. 2). It is unlikely that the installation process will have a measurable negative impact on birds, and during the operational phase the impact of the underground lines will be zero.

7. Conclusions & Recommendations

It is highly likely that the proposed new power line — representing a permanent collision hazard as it does — will cause the death of many birds over the course of its lifespan, regardless of the mitigation strategy followed. Most of the victims will likely include pigeons, doves, ducks or other species which are not currently of any particular conservation concern. However, two Red Data species are relatively common in the area and could potentially collide with the proposed power lines.

It is concluded that there are no fatal flaws with the proposed Havard-Noordstad power line project. However, it is recommended that the mitigation strategies considered in Section 6 should be implemented. Once the route is finalised and the exact position of the towers have been surveyed and pegged, the input of an avifauna specialist must be obtained in order to determine where anti-collision devices such as bird flight diverters must be installed as per the recommendations herein.

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Table 1: Species occurring in the SACQ9-block and which are known to breed on power line pylons and wires (Anderson 2000, 2013; Anderson & Hohne 2007; Boshoff & Fabricius 1986; Brown & Lawson 1989; Dean 1975; Kemp 1972; Ledger & Hobbs 1985; Machange 2003; Van Rooyen & Ledger 1999; Vosloo & Van Rooyen 2009a).

Species	**Species**
R094 Hadeda Ibis	R152 Jackal Buzzard
R102 Egyptian Goose	R162 Pale Chanting Goshawk
R123 White-backed Vulture	R171 Peregrine Falcon
R127 Black-shouldered Kite	R172 Lanner Falcon
R131 Verreauxs' Eagle	R181 Rock Kestrel
R132 Tawny Eagle	R182 Greater Kestrel
R140 Martial Eagle	R547 Cape Crow
R142 Brown Snake Eagle	R548 Pied Crow
R143 Black-chested Snake Eagle	R800 Sociable Weaver
R148 African Fish Eagle	

Table 2: Summary of areas with some form of conservation status within 50 km from the proposed Harvard to Noordstad power line.

Name	**Distance (km)**	**Direction**
	A) Formally protected areas	
Soetdoring Nature Reserve	21 km	North-west
Rustfontein Nature Reserve	47 km	South-east
	B) Important Bird Areas	
Soetdoring Nature Reserve	20 km	North-west

Table 3: Bird species expected to occur in the study area and environs (see Methods section on page 11). Each species is included in only one of five groups (A–D) with the groups arranged in descending ordered of priority. Name: Roberts' number (Maclean 1985) followed by English and scientific name based on BirdLife South Africa (2015) (E, endemic; n-E, near-endemic; RR, range restricted); Red Data status is based on Taylor *et al*. (2015); Habitat: Habitat preferences according to Harrison *et al*. (1994): AQ, Aquatic; FR, Forest; GR, Grassland; HG, Generalist; MR, Marine; RC, Montane\Rocky; SC, Scrub; WO, Woodland; REFrisk: Risk associated with the primary renewable energy structures (wind turbines/heliostats/PV panels) (see page **??**); PLIrisk: Risk associated with power line infrastructure (see page 14).

Name	**Cl**	**Red Data**	**Habitat**	**PLIrisk**	
				Disturb.	**Accident**
		A. 37 RED DATA BOOK SPECIES:			
R123 White-backed Vulture (*Gyps africanus*)		Critically Endangered	WO	unlikely	low (c, e)
R090 Yellow-billed Stork (*Mycteria ibis*)		Endangered	AQ	**unlikely**	**unlikely**
R122 Cape Vulture (*Gyps coprotheres*) n-E		Endangered	HG	unlikely	low (c, e)
R132 Tawny Eagle (*Aquila rapax*)		Endangered	HG	unlikely	low (c, e)
R140 Martial Eagle (*Polemaetus bellicosus*)		Endangered	HG	unlikely	low (c, e)
R165 African Marsh Harrier (*Circus ranivorus*)		Endangered	AQ	**unlikely**	**unlikely**
R168 Black Harrier (*Circus maurus*) n-E		Endangered	GR, SC	unlikely	unlikely
R209 Grey Crowned Crane (*Balearica regulorum*)		Endangered	AQ, GR	**unlikely**	**low (c, e)**
R232 Ludwig's Bustard (*Neotis ludwigii*)		Endangered	SC	unlikely	low (c)
R463 Southern Ground-Hornbill (*Bucorvus leadbeateri*)		Endangered	HG	unlikely	unlikely
R050 Pink-backed Pelican (*Pelecanus rufescens*)		Vulnerable	AQ	**unlikely**	**unlikely**
R084 Black Stork (*Ciconia nigra*)		Vulnerable	AQ	**unlikely**	**low (c*, e*)**
R118 Secretarybird (*Sagittarius serpentarius*)		Vulnerable	HG	unlikely	**Moderate (c)**
R131 Verreauxs' Eagle (*Aquila verreauxii*)		Vulnerable	RC	unlikely	low (c, e)
R141 Crowned Eagle (*Stephanoaetus coronatus*)		Vulnerable	FR, WO	unlikely	low (e)

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. . . Table 3 continued.

Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	Accident
R172 Lanner Falcon (*Falco biarmicus*)		Vulnerable	HG	unlikely	**Moderate (c, e)**
R239b Southern Black Korhaan (*Afrotis afra*) n-E		Vulnerable	SC	unlikely	low (c)
R299 Burchell's Courser (*Cursorius rufus*)		Vulnerable	GR, SC	unlikely	unlikely
R322 Caspian Tern (*Sterna caspia*)		Vulnerable	AQ, MR	**unlikely**	**unlikely**
R393 African Grass Owl (*Tyto capensis*)		Vulnerable	AQ, GR	**unlikely**	**unlikely**
R085 Abdim's Stork (*Ciconia abdimii*)		Near-Threatened	HG	unlikely	low (c)
R089 Marabou Stork (*Leptoptilos crumeniferus*)		Near-Threatened	WO	unlikely	low (c*, e)
R096 Greater Flamingo (*Phoenicopterus roseus*)		Near-Threatened	AQ	**unlikely**	**low (c)**
R097 Lesser Flamingo (*Phoeniconaias minor*)		Near-Threatened	AQ	**unlikely**	**low (c)**
R117 Maccoa Duck (*Oxyura maccoa*)		Near-Threatened	AQ	**unlikely**	**unlikely**
R167 Pallid Harrier (*Circus macrourus*)		Near-Threatened	GR, WO	unlikely	unlikely
R179 Red-footed Falcon (*Falco vespertinus*)		Near-Threatened	GR, WO	unlikely	low (c*, e*)
R208 Blue Crane (*Anthropoides paradiseus*) n-E		Near-Threatened	GR	unlikely	low (c)
R230 Kori Bustard (*Ardeotis kori*)		Near-Threatened	SC, WO	unlikely	low (c)
R235 Karoo Korhaan (*Eupodotis vigorsii*) n-E		Near-Threatened	GR, SC	unlikely	unlikely
R242 Greater Painted-snipe (*Rostratula benghalensis*)		Near-Threatened	AQ	**unlikely**	**unlikely**
R247 Chestnut-banded Plover (*Charadrius pallidus*)		Near-Threatened	AQ, MR	**unlikely**	**unlikely**
R289 Eurasian Curlew (*Numenius arquata*)		Near-Threatened	MR	**unlikely**	**low (c*, e*)**
R305 Black-winged Pratincole (*Glareola nordmanni*)		Near-Threatened	GR	unlikely	unlikely
R446 European Roller (*Coracias garrulus*)		Near-Threatened	WO	unlikely	low (c*, e*)
R501 Short-clawed Lark (*Certhilauda chuana*)		Near-Threatened	WO	unlikely	unlikely
R721 African Rock Pipit (*Anthus crenatus*) E		Near-Threatened	RC	unlikely	unlikely

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. . . Table 3 continued.

Name	**Cl**	**Red Data**	**Habitat**	**PLIrisk**	
				Disturb.	**Accident**
B. 113 ADDITIONAL SPECIES POTENTIALLY NEGATIVE IMPACTED BY POWER LINES					
B1. 47 SPECIES WITH LOW, MODERATE OR HIGH POTENTIAL EESRISK DISTURBANCE IMPACT:					
R182 Greater Kestrel (*Falco rupicoloides*)		Not listed	GR, SC	**Moderate**	**Moderate (c, e)**
R193 Orange River Francolin (*Scleroptila gutturalis*)		Not listed	GR, WO	low	unlikely
R199 Swainson's Spurfowl (*Pternistis swainsonii*)		Not listed	GR, WO	low	unlikely
R200 Common Quail (*Coturnix coturnix*)		Not listed	GR	low	low (c*)
R203 Helmeted Guineafowl (*Numida meleagris*)		Not listed	HG	low	**Moderate (c, e)**
R239a Northern Black Korhaan (*Afrotis afraoides*)		Not listed	GR	low	**Moderate (c)**
R255 Crowned Lapwing (*Vanellus coronatus*)		Not listed	GR	low	unlikely
R258 Blacksmith Lapwing (*Vanellus armatus*)		Not listed	AQ	**low**	**HIGH (c)**
R354 Cape Turtle Dove (*Streptopelia capicola*)		Not listed	HG	low	**HIGH (c)**
R355 Laughing Dove (*Streptopelia senegalensis*)		Not listed	HG	low	**HIGH (c)**
R425 White-backed Mousebird (*Colius colius*)		Not listed	WO	low	unlikely
R426 Red-faced Mousebird (*Urocolius indicus*)		Not listed	WO	low	unlikely
R465 Acacia Pied Barbet (*Tricholaema leucomelas*)		Not listed	WO	low	unlikely
R492 Melodious Lark (*Mirafra cheniana*) n-E		Not listed	GR	low	unlikely
R494 Rufous-naped Lark (*Mirafra africana*)		Not listed	GR, WO	low	unlikely
R495a Eastern Clapper Lark (*Mirafra fasciolata*)		Not listed	GR	low	unlikely
R506 Spike-heeled Lark (*Chersomanes albofasciata*)		Not listed	GR, SC	low	unlikely
R507 Red-capped Lark (*Calandrella cinerea*)		Not listed	GR, SC	low	low (c)

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. . . Table 3 continued.

Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	Accident
R557 Cape Penduline-Tit (*Anthoscopus minutus*)		Not listed	SC, WO	low	unlikely
R567 African Red-eyed Bulbul (*Pycnonotus nigricans*)		Not listed	WO	low	unlikely
R577a Karoo Thrush (*Turdus smithi*) n-E		Not listed	WO	low	unlikely
R595 Ant-eating Chat (*Myrmecocichla formicivora*)		Not listed	GR, SC	low	unlikely
R601 Cape Robin-Chat (*Cossypha caffra*)		Not listed	FR, SC, WO	low	unlikely
R614 Karoo Scrub Robin (*Erythropygia coryphoeus*) n-E		Not listed	SC	low	unlikely
R615 Kalahari Scrub Robin (*Erythropygia paena*)		Not listed	WO	low	unlikely
R621 Chestnut-vented Tit-Babbler (*Sylvia subcaerulea*)		Not listed	SC, WO	low	unlikely
R664 Zitting Cisticola (*Cisticola juncidis*)		Not listed	GR	low	unlikely
R665 Desert Cisticola (*Cisticola aridulus*)		Not listed	GR	low	unlikely
R666 Cloud Cisticola (*Cisticola textrix*) n-E		Not listed	GR	low	unlikely
R669 Grey-backed Cisticola (*Cisticola subruficapilla*)		Not listed	SC	low	unlikely
R681 Neddicky (*Cisticola fulvicapilla*)		Not listed	SC	low	unlikely
R685 Black-chested Prinia (*Prinia flavicans*)		Not listed	SC, WO	low	unlikely
R698 Fiscal Flycatcher (*Sigelus silens*) n-E		Not listed	WO	low	unlikely
R716 African Pipit (*Anthus cinnamomeus*)		Not listed	GR	low	unlikely
R717 Long-billed Pipit (*Anthus similis*)		Not listed	RC	low	unlikely
R727 Cape Longclaw (*Macronyx capensis*)		Not listed	GR	low	unlikely
R732 Southern (Common) Fiscal (*Lanius collaris*)		Not listed	HG	low	unlikely
R746 Bokmakierie (*Telophorus zeylonus*)		Not listed	SC	low	unlikely
R796a Orange River White-eye (*Zosterops pallidus*)		Not listed	WO	low	unlikely
R803 Cape Sparrow (*Passer melanurus*)		Not listed	HG	low	unlikely

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. . . Table 3 continued.

Name	**Cl**	**Red Data**	**Habitat**	**PLIrisk**	
				Disturb.	**Accident**
R806 Scaly-feathered Finch (*Sporopipes squamifrons*)		Not listed	WO	low	unlikely
R814 Southern Masked Weaver (*Ploceus velatus*)		Not listed	HG	low	unlikely
R826 Yellow-crowned Bishop (*Euplectes afer*)		Not listed	AQ, GR	**low**	**unlikely**
R870 Black-throated Canary (*Crithagra atrogularis*)		Not listed	WO	low	unlikely
R878 Yellow Canary (*Crithagra flaviventris*)		Not listed	GR, SC	low	unlikely
R885 Cape Bunting (*Emberiza capensis*)		Not listed	GR, RC, SC	low	unlikely
R886 Cinnamon-breasted Bunting (*Emberiza tahapisi*)		Not listed	RC	low	unlikely

B2. 66 SPECIES UNLIKELY TO EXPERIENCE EESRISK DISTURBANCE IMPACT:

Name	**Cl**	**Red Data**	**Habitat**	**Disturb.**	**Accident**
R006 Great Crested Grebe (*Podiceps cristatus*)		Not listed	AQ	**unlikely**	**low (x*)**
R008 Little Grebe (*Tachybaptus ruficollis*)		Not listed	AQ	**unlikely**	**low (x*)**
R055 White-breasted Cormorant (*Phalacrocorax lucidus*)		Not listed	AQ, MR	**unlikely**	**low (c)**
R062 Grey Heron (*Ardea cinerea*)		Not listed	AQ, MR	**unlikely**	**low (c, e)**
R063 Black-headed Heron (*Ardea melanocephala*)		Not listed	HG	unlikely	low (c, e)
R064 Goliath Heron (*Ardea goliath*)		Not listed	AQ	**unlikely**	**low (c)**
R065 Purple Heron (*Ardea purpurea*)		Not listed	AQ	**unlikely**	**low (c*, e*)**
R071 Western Cattle Egret (*Bubulcus ibis*)		Not listed	HG	unlikely	**Moderate (c, e)**
R072 Squacco Heron (*Ardeola ralloides*)		Not listed	AQ	**unlikely**	**low (x*)**
R083 White Stork (*Ciconia ciconia*)		Not listed	HG	unlikely	low (c, e)
R091 African Sacred Ibis (*Threskiornis aethiopicus*)		Not listed	HG	unlikely	**HIGH (c, e)**
R094 Hadeda Ibis (*Bostrychia hagedash*)		Not listed	HG	unlikely	**Moderate (c, e)**

CONTINUED ON NEXT PAGE . . .

. . . Table 3 continued.

Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	Accident
R099 White-faced Whistling Duck (*Dendrocygna viduata*)		Not listed	AQ	**unlikely**	**HIGH (c)**
R102 Egyptian Goose (*Alopochen aegyptiaca*)		Not listed	AQ	**unlikely**	**HIGH (c, e)**
R103 South African Shelduck (*Tadorna cana*)		Not listed	AQ	**unlikely**	**HIGH (c)**
R104 Yellow-billed Duck (*Anas undulata*)		Not listed	AQ	**unlikely**	**HIGH (c)**
R104n Mallard (*Anas platyrhynchos*)		Not listed	AQ	**unlikely**	**low (c*)**
R108 Red-billed Teal (*Anas erythrorhyncha*)		Not listed	AQ	**unlikely**	**low (c)**
R116 Spur-winged Goose (*Plectropterus gambensis*)		Not listed	AQ	**unlikely**	**low (c, e)**
R126b Black Kite (*Milvus migrans*)		Not listed	HG	unlikely	low (c*, e*)
R127 Black-shouldered Kite (*Elanus caeruleus*)		Not listed	HG	unlikely	low (c, e)
R136 Booted Eagle (*Hieraaetus pennatus*)		Not listed	HG	unlikely	low (c*, e*)
R139 Long-crested Eagle (*Lophaetus occipitalis*)		Not listed	HG	unlikely	low (e)
R142 Brown Snake Eagle (*Circaetus cinereus*)		Not listed	WO	unlikely	low (e)
R143 Black-chested Snake Eagle (*Circaetus pectoralis*)		Not listed	HG	unlikely	low (c, e)
R148 African Fish Eagle (*Haliaeetus vocifer*)		Not listed	AQ	**unlikely**	**low (c, e)**
R149 Common (Steppe) Buzzard (*Buteo buteo*)		Not listed	HG	unlikely	low (c, e)
R152 Jackal Buzzard (*Buteo rufofuscus*) n-E		Not listed	HG	unlikely	low (c, e)
R162 Pale Chanting Goshawk (*Melierax canorus*)		Not listed	FR, SC, WO	unlikely	**Moderate (c, e)**
R166 Montagu's Harrier (*Circus pygargus*)		Not listed	GR, WO	unlikely	low (c*, e*)
R169 African Harrier-Hawk (*Polyboroides typus*)		Not listed	HG	unlikely	low (e)
R170 Western Osprey (*Pandion haliaetus*)		Not listed	AQ	**unlikely**	**low (c*, e*)**
R171 Peregrine Falcon (*Falco peregrinus*)		Not listed	RC	unlikely	**Moderate (c*, e*)**
R173 Eurasian Hobby (*Falco subbuteo*)		Not listed	HG	unlikely	low (c*, e*)

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...Table 3 continued.

Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	**Accident**
R181 Rock Kestrel (*Falco rupicolus*)		Not listed	HG	unlikely	low (c*, e*)
R183 Lesser Kestrel (*Falco naumanni*)		Not listed	GR	unlikely	low (c, e*)
R190 Grey-winged Francolin (*Scleroptila afra*) E		Not listed	GR, SC	unlikely	low (c)
R202x Indian Peafowl (*Pavo cristatus*)		Not listed	HG	unlikely	low (x)
R226 Common Moorhen (*Gallinula chloropus*)		Not listed	AQ	**unlikely**	**low (c*)**
R228 Red-knobbed Coot (*Fulica cristata*)		Not listed	AQ	**unlikely**	**low (c*)**
R234 Blue Korhaan (*Eupodotis caerulescens*) E		Not listed	GR	unlikely	low (c)
R284 Ruff (*Philomachus pugnax*)		Not listed	AQ	**unlikely**	**low (c*, e*)**
R290 Common Whimbrel (*Numenius phaeopus*)		Not listed	MR	**unlikely**	**low (c*, e*)**
R313 Lesser Black-backed Gull (*Larus fuscus*)		Not listed	AQ	**unlikely**	**low (x*, e*)**
R348 Rock Dove (*Columba livia*)		Not listed	HG	unlikely	**Moderate (c)**
R349 Speckled Pigeon (*Columba guinea*)		Not listed	HG	unlikely	**HIGH (c, e)**
R352 Red-eyed Dove (*Streptopelia semitorquata*)		Not listed	WO	unlikely	**HIGH**
R356 Namaqua Dove (*Oena capensis*)		Not listed	HG	unlikely	low (c*)
R374 Common Cuckoo (*Cuculus canorus*)		Not listed	WO	unlikely	low (x*)
R392 Western Barn Owl (*Tyto alba*)		Not listed	HG	unlikely	low (c, e)
R401 Spotted Eagle-Owl (*Bubo africanus*)		Not listed	HG	unlikely	low (c, e)
R411 Common Swift (*Apus apus*)		Not listed	HG	unlikely	low (c*)
R480 Ground Woodpecker (*Geocolaptes olivaceus*) E		Not listed	RC	unlikely	low (c)
R518 Barn Swallow (*Hirundo rustica*)		Not listed	HG	unlikely	low (c*)
R547 Cape Crow (*Corvus capensis*)		Not listed	HG	unlikely	low (e)
R548 Pied Crow (*Corvus albus*)		Not listed	HG	unlikely	low (e)

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. . . Table 3 continued.

Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	**Accident**
R587 Capped Wheatear (*Oenanthe pileata*)		Not listed	GR, SC	unlikely	low (c)
R619 Garden Warbler (*Sylvia borin*)		Not listed	WO	unlikely	low (c*)
R620 Common Whitethroat (*Sylvia communis*)		Not listed	WO	unlikely	low (c*)
R628 Great Reed Warbler (*Acrocephalus arundinaceus*)		Not listed	AQ	**unlikely**	**low (c*)**
R634 Sedge Warbler (*Acrocephalus schoenobaenus*)		Not listed	AQ	**unlikely**	**low (x*)**
R643 Willow Warbler (*Phylloscopus trochilus*)		Not listed	WO	unlikely	low (c*)
R689 Spotted Flycatcher (*Muscicapa striata*)		Not listed	WO	unlikely	low (x*)
R733 Red-backed Shrike (*Lanius collurio*)		Not listed	WO	unlikely	low (c*)
R757 Common Starling (*Sturnus vulgaris*)		Not listed	HG	unlikely	low (c*)
R801 House Sparrow (*Passer domesticus*)		Not listed	HG	unlikely	low (c*)

C. 68 ADDITIONAL WATERBIRDS:

R007 Black-necked Grebe (*Podiceps nigricollis*)		Not listed	AQ, MR	**unlikely**	**unlikely**
R058 Reed Cormorant (*Phalacrocorax africanus*)		Not listed	AQ	**unlikely**	**unlikely**
R060 African Darter (*Anhinga rufa*)		Not listed	AQ	**unlikely**	**unlikely**
R066 Great Egret (*Egretta alba*)		Not listed	AQ	**unlikely**	**unlikely**
R067 Little Egret (*Egretta garzetta*)		Not listed	AQ, MR	**unlikely**	**unlikely**
R068 Yellow-billed Egret (*Egretta intermedia*)		Not listed	AQ	**unlikely**	**unlikely**
R069 Black Heron (*Egretta ardesiaca*)		Not listed	AQ	**unlikely**	**unlikely**
R074 Green-backed Heron (*Butorides striata*)		Not listed	AQ	**unlikely**	**unlikely**
R075 Rufous-bellied Heron (*Ardeola rufiventris*)		Not listed	AQ	**unlikely**	**unlikely**

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. . . Table 3 continued.

Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	Accident
R076 Black-crowned Night Heron (*Nycticorax nycticorax*)		Not listed	AQ, MR	unlikely	unlikely
R078 Little Bittern (*Ixobrychus minutus*)		Not listed	AQ	unlikely	unlikely
R079 Dwarf Bittern (*Ixobrychus sturmii*)		Not listed	AQ	unlikely	unlikely
R081 Hamerkop (*Scopus umbretta*)		Not listed	AQ	unlikely	unlikely
R093 Glossy Ibis (*Plegadis falcinellus*)		Not listed	AQ	unlikely	unlikely
R095 African Spoonbill (*Platalea alba*)		Not listed	AQ	unlikely	unlikely
R100 Fulvous Whistling Duck (*Dendrocygna bicolor*)		Not listed	AQ	unlikely	unlikely
R101 White-backed Duck (*Thalassornis leuconotus*)		Not listed	AQ	unlikely	unlikely
R105 African Black Duck (*Anas sparsa*)		Not listed	AQ	unlikely	unlikely
R106 Cape Teal (*Anas capensis*)		Not listed	AQ	unlikely	unlikely
R107 Hottentot Teal (*Anas hottentota*)		Not listed	AQ	unlikely	unlikely
R112 Cape Shoveler (*Anas smithii*)		Not listed	AQ	unlikely	unlikely
R113 Southern Pochard (*Netta erythrophthalma*)		Not listed	AQ	unlikely	unlikely
R115 Knob-billed Duck (*Sarkidiornis melanotos*)		Not listed	AQ	unlikely	unlikely
R210 African Rail (*Rallus caerulescens*)		Not listed	AQ	unlikely	unlikely
R212 African Crake (*Crecopsis egregia*)		Not listed	AQ, GR	unlikely	unlikely
R213 Black Crake (*Amaurornis flavirostra*)		Not listed	AQ	unlikely	unlikely
R215 Baillon's Crake (*Porzana pusilla*)		Not listed	AQ	unlikely	unlikely
R223 African (Purple) Swamphen (*Porphyrio madagascariensis*)		Not listed	AQ	unlikely	unlikely
R240 African Jacana (*Actophilornis africanus*)		Not listed	AQ	unlikely	unlikely
R245 Common Ringed Plover (*Charadrius hiaticula*)		Not listed	AQ, MR	unlikely	unlikely
R248 Kittlitz's Plover (*Charadrius pecuarius*)		Not listed	AQ	unlikely	unlikely

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. . . Table 3 continued.

Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	Accident
R249 Three-banded Plover (*Charadrius tricollaris*)		Not listed	AQ	**unlikely**	**unlikely**
R254 Grey Plover (*Pluvialis squatarola*)		Not listed	MR	**unlikely**	**unlikely**
R262 Ruddy Turnstone (*Arenaria interpres*)		Not listed	MR	**unlikely**	**unlikely**
R264 Common Sandpiper (*Actitis hypoleucos*)		Not listed	AQ, MR	**unlikely**	**unlikely**
R266 Wood Sandpiper (*Tringa glareola*)		Not listed	AQ	**unlikely**	**unlikely**
R269 Marsh Sandpiper (*Tringa stagnatilis*)		Not listed	AQ	**unlikely**	**unlikely**
R270 Common Greenshank (*Tringa nebularia*)		Not listed	AQ, MR	**unlikely**	**unlikely**
R272 Curlew Sandpiper (*Calidris ferruginea*)		Not listed	AQ, MR	**unlikely**	**unlikely**
R274 Little Stint (*Calidris minuta*)		Not listed	AQ, MR	**unlikely**	**unlikely**
R279 Pectoral Sandpiper (*Calidris melanotos*)		Not listed	AQ	**unlikely**	**unlikely**
R281 Sanderling (*Calidris alba*)		Not listed	MR	**unlikely**	**unlikely**
R286 African Snipe (*Gallinago nigripennis*)		Not listed	AQ	**unlikely**	**unlikely**
R294 Pied Avocet (*Recurvirostra avosetta*)		Not listed	AQ	**unlikely**	**unlikely**
R295 Black-winged Stilt (*Himantopus himantopus*)		Not listed	AQ	**unlikely**	**unlikely**
R315 Grey-headed Gull (*Chroicocephalus cirrocephalus*)		Not listed	AQ, MR	**unlikely**	**unlikely**
R338 Whiskered Tern (*Chlidonias hybrida*)		Not listed	AQ	**unlikely**	**unlikely**
R339 White-winged Tern (*Chlidonias leucopterus*)		Not listed	AQ, GR	**unlikely**	**unlikely**
R395 Marsh Owl (*Asio capensis*)		Not listed	AQ, GR	**unlikely**	**unlikely**
R428 Pied Kingfisher (*Ceryle rudis*)		Not listed	AQ	**unlikely**	**unlikely**
R429 Giant Kingfisher (*Megaceryle maxima*)		Not listed	AQ	**unlikely**	**unlikely**
R431 Malachite Kingfisher (*Alcedo cristata*)		Not listed	AQ	**unlikely**	**unlikely**
R440 Blue-cheeked Bee-eater (*Merops persicus*)		Not listed	AQ	**unlikely**	**unlikely**

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. . . Table 3 continued.

Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	Accident
R520 White-throated Swallow (*Hirundo albigularis*)		Not listed	AQ	**unlikely**	**unlikely**
R532 Sand Martin (*Riparia riparia*)		Not listed	AQ, GR	**unlikely**	**unlikely**
R533 Brown-throated Martin (*Riparia paludicola*)		Not listed	AQ	**unlikely**	**unlikely**
R631 African Reed Warbler (*Acrocephalus baeticatus*)		Not listed	AQ	**unlikely**	**unlikely**
R633 Marsh Warbler (*Acrocephalus palustris*)		Not listed	AQ, WO	**unlikely**	**unlikely**
R635 Lesser Swamp Warbler (*Acrocephalus gracilirostris*)		Not listed	AQ	**unlikely**	**unlikely**
R638 Little Rush Warbler (*Bradypterus baboecala*)		Not listed	AQ	**unlikely**	**unlikely**
R677 Levaillant's Cisticola (*Cisticola tinniens*)		Not listed	AQ, GR	**unlikely**	**unlikely**
R687 Namaqua Warbler (*Phragmacia substriata*) n-E		Not listed	AQ	**unlikely**	**unlikely**
R711 African Pied Wagtail (*Motacilla aguimp*)		Not listed	AQ	**unlikely**	**unlikely**
R713 Cape Wagtail (*Motacilla capensis*)		Not listed	AQ	**unlikely**	**unlikely**
R714 Western Yellow Wagtail (*Motacilla flava*)		Not listed	AQ	**unlikely**	**unlikely**
R824 Southern Red Bishop (*Euplectes orix*)		Not listed	AQ	**unlikely**	**unlikely**
R846 Common Waxbill (*Estrilda astrild*)		Not listed	AQ	**unlikely**	**unlikely**
R854 Orange-breasted Waxbill (*Amandava subflava*)		Not listed	AQ	**unlikely**	**unlikely**

D. 139 ADDITIONAL SPECIES:

R001 Common Ostrich (*Struthio camelus*)		Not listed	HG	unlikely	unlikely
R126y Yellow-billed Kite (*Milvus aegyptius*)		Not listed	HG	unlikely	unlikely
R130 European Honey Buzzard (*Pernis apivorus*)		Not listed	WO	unlikely	unlikely
R155 Rufous-breasted Sparrowhawk (*Accipiter rufiventris*)		Not listed	HG	unlikely	unlikely

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. . . Table 3 continued.

Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	Accident
R158 Black Sparrowhawk (*Accipiter melanoleucus*)		Not listed	FR, WO	unlikely	unlikely
R161 Gabar Goshawk (*Melierax gabar*)		Not listed	WO	unlikely	unlikely
R180 Amur Falcon (*Falco amurensis*)		Not listed	GR, WO	unlikely	unlikely
R196 Natal Spurfowl (*Pternistis natalensis*)		Not listed	WO	unlikely	unlikely
R205 Common (Kurrichane) Buttonquail (*Turnix sylvaticus*)		Not listed	GR	unlikely	unlikely
R297 Spotted Thick-knee (*Burhinus capensis*)		Not listed	HG	unlikely	unlikely
R300 Temminck's Courser (*Cursorius temminckii*)		Not listed	GR	unlikely	unlikely
R301 Double-banded Courser (*Rhinoptilus africanus*)		Not listed	GR, SC	unlikely	unlikely
R303 Bronze-winged Courser (*Rhinoptilus chalcopterus*)		Not listed	WO	unlikely	unlikely
R344 Namaqua Sandgrouse (*Pterocles namaqua*)		Not listed	SC	unlikely	unlikely
R366 Rose-ringed Parakeet (*Psittacula krameri*)		Not listed	HG	unlikely	unlikely
R367 Rosy-faced Lovebird (*Agapornis roseicollis*)		Not listed	SC	unlikely	unlikely
R377 Red-chested Cuckoo (*Cuculus solitarius*)		Not listed	FR, WO	unlikely	unlikely
R378 Black Cuckoo (*Cuculus clamosus*)		Not listed	FR, WO	unlikely	unlikely
R380 Great Spotted Cuckoo (*Clamator glandarius*)		Not listed	WO	unlikely	unlikely
R382 Jacobin Cuckoo (*Clamator jacobinus*)		Not listed	WO	unlikely	unlikely
R385 Klaas's Cuckoo (*Chrysococcyx klaas*)		Not listed	WO	unlikely	unlikely
R386 Diederik Cuckoo (*Chrysococcyx caprius*)		Not listed	GR, WO	unlikely	unlikely
R391a Burchell's Coucal (*Centropus burchellii*)		Not listed	WO	unlikely	unlikely
R404 European Nightjar (*Caprimulgus europaeus*)		Not listed	HG	unlikely	unlikely
R405 Fiery-necked Nightjar (*Caprimulgus pectoralis*)		Not listed	WO	unlikely	unlikely
R406 Rufous-cheeked Nightjar (*Caprimulgus rufigena*)		Not listed	WO	unlikely	unlikely

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. . . Table 3 continued.

Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	Accident
R408 Freckled Nightjar (*Caprimulgus tristigma*)		Not listed	RC	unlikely	unlikely
R412 African Black Swift (*Apus barbatus*)		Not listed	HG	unlikely	unlikely
R413 Bradfield's Swift (*Apus bradfieldi*)		Not listed	HG	unlikely	unlikely
R415 White-rumped Swift (*Apus caffer*)		Not listed	HG	unlikely	unlikely
R416 Horus Swift (*Apus horus*)		Not listed	HG	unlikely	unlikely
R417 Little Swift (*Apus affinis*)		Not listed	HG	unlikely	unlikely
R418 Alpine Swift (*Tachymarptis melba*)		Not listed	HG	unlikely	unlikely
R421 African Palm Swift (*Cypsiurus parvus*)		Not listed	HG	unlikely	unlikely
R424 Speckled Mousebird (*Colius striatus*)		Not listed	WO	unlikely	unlikely
R435 Brown-hooded Kingfisher (*Halcyon albiventris*)		Not listed	WO	unlikely	unlikely
R438 European Bee-eater (*Merops apiaster*)		Not listed	HG	unlikely	unlikely
R443 White-fronted Bee-eater (*Merops bullockoides*)		Not listed	WO	unlikely	unlikely
R445 Swallow-tailed Bee-eater (*Merops hirundineus*)		Not listed	WO	unlikely	unlikely
R447 Lilac-breasted Roller (*Coracias caudatus*)		Not listed	WO	unlikely	unlikely
R451 African Hoopoe (*Upupa africana*)		Not listed	WO	unlikely	unlikely
R452 Green Wood-hoopoe (*Phoeniculus purpureus*)		Not listed	FR, WO	unlikely	unlikely
R454 Common Scimitarbill (*Rhinopomastus cyanomelas*)		Not listed	WO	unlikely	unlikely
R457 African Grey Hornbill (*Tockus nasutus*)		Not listed	WO	unlikely	unlikely
R464 Black-collared Barbet (*Lybius torquatus*)		Not listed	WO	unlikely	unlikely
R473 Crested Barbet (*Trachyphonus vaillantii*)		Not listed	WO	unlikely	unlikely
R474 Greater Honeyguide (*Indicator indicator*)		Not listed	WO	unlikely	unlikely
R476 Lesser Honeyguide (*Indicator minor*)		Not listed	WO	unlikely	unlikely

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. . . Table 3 continued.

Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	Accident
R478 Brown-backed Honeybird (*Prodotiscus regulus*)		Not listed	WO	unlikely	unlikely
R483 Golden-tailed Woodpecker (*Campethera abingoni*)		Not listed	WO	unlikely	unlikely
R486 Cardinal Woodpecker (*Dendropicos fuscescens*)		Not listed	WO	unlikely	unlikely
R489 Red-throated Wryneck (*Jynx ruficollis*)		Not listed	WO	unlikely	unlikely
R495b Cape Clapper Lark (*Mirafra apiata*)		Not listed	SC	unlikely	unlikely
R497 Fawn-coloured Lark (*Calendulauda africanoides*)		Not listed	WO	unlikely	unlikely
R498 Sabota Lark (*Calendulauda sabota*)		Not listed	WO	unlikely	unlikely
R500c Eastern Long-billed Lark (*Certhilauda semitorquata*) E		Not listed	GR	unlikely	unlikely
R508 Pink-billed Lark (*Spizocorys conirostris*)		Not listed	GR	unlikely	unlikely
R512 Large-billed Lark (*Galerida magnirostris*) E		Not listed	GR, SC	unlikely	unlikely
R515 Chestnut-backed Sparrow-lark (*Eremopterix leucotis*)		Not listed	GR, WO	unlikely	unlikely
R516 Grey-backed Sparrow-lark (*Eremopterix verticalis*)		Not listed	GR, SC	unlikely	unlikely
R523 Pearl-breasted Swallow (*Hirundo dimidiata*)		Not listed	HG	unlikely	unlikely
R524 Red-breasted Swallow (*Cecropis semirufa*)		Not listed	GR, WO	unlikely	unlikely
R526 Greater Striped Swallow (*Cecropis cucullata*)		Not listed	GR, SC	unlikely	unlikely
R528 South African Cliff Swallow (*Petrochelidon spilodera*) b-E		Not listed	GR	unlikely	unlikely
R529 Rock Martin (*Hirundo fuligula*)		Not listed	RC	unlikely	unlikely
R530 Common House Martin (*Delichon urbicum*)		Not listed	HG	unlikely	unlikely
R534 Banded Martin (*Riparia cincta*)		Not listed	GR	unlikely	unlikely
R541 Fork-tailed Drongo (*Dicrurus adsimilis*)		Not listed	FR, WO	unlikely	unlikely
R543 Eurasian Golden Oriole (*Oriolus oriolus*)		Not listed	WO	unlikely	unlikely
R545 Black-headed Oriole (*Oriolus larvatus*)		Not listed	FR, WO	unlikely	unlikely

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Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	Accident
R551 Grey Tit (*Parus afer*) n-E		Not listed	SC	unlikely	unlikely
R552 Ashy Tit (*Parus cinerascens*)		Not listed	WO	unlikely	unlikely
R577b Olive Thrush (*Turdus olivaceus*)		Not listed	FR, WO	unlikely	unlikely
R581 Cape Rock Thrush (*Monticola rupestris*) n-E		Not listed	RC	unlikely	unlikely
R582 Sentinel Rock Thrush (*Monticola explorator*) E		Not listed	GR, RC, SC	unlikely	unlikely
R583 Short-toed Rock Thrush (*Monticola brevipes*)		Not listed	RC	unlikely	unlikely
R586 Mountain Wheatear (*Oenanthe monticola*)		Not listed	RC	unlikely	unlikely
R589 Familiar Chat (*Cercomela familiaris*)		Not listed	HG	unlikely	unlikely
R591 Sickle-winged Chat (*Cercomela sinuata*) n-E		Not listed	GR, SC	unlikely	unlikely
R592 Karoo Chat (*Cercomela schlegelii*)		Not listed	SC	unlikely	unlikely
R593 Mocking Cliff Chat (*Thamnolaea cinnamomeiventris*)		Not listed	RC	unlikely	unlikely
R596 African StoneChat (*Saxicola torquatus*)		Not listed	GR, SC	unlikely	unlikely
R622 Layard's Tit-Babbler (*Sylvia layardi*)		Not listed	SC	unlikely	unlikely
R625 Icterine Warbler (*Hippolais icterina*)		Not listed	WO	unlikely	unlikely
R645 Bar-throated Apalis (*Apalis thoracica*)		Not listed	FR, SC, WO	unlikely	unlikely
R651 Long-billed Crombec (*Sylvietta rufescens*)		Not listed	SC, WO	unlikely	unlikely
R653 Yellow-bellied Eremomela (*Eremomela icteropygialis*)		Not listed	SC, WO	unlikely	unlikely
R667 Wing-snapping Cisticola (*Cisticola ayresii*)		Not listed	GR	unlikely	unlikely
R672 Rattling Cisticola (*Cisticola chiniana*)		Not listed	WO	unlikely	unlikely
R686a Karoo Prinia (*Prinia maculosa*) n-E		Not listed	SC	unlikely	unlikely
R688 Rufous-eared Warbler (*Malcorus pectoralis*)		Not listed	SC	unlikely	unlikely
R695 Marico flycatcher (*Bradornis mariquensis*)		Not listed	WO	unlikely	unlikely

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. . . Table 3 continued.

Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	Accident
R697 Chat Flycatcher (*Bradornis infuscatus*)		Not listed	SC, WO	unlikely	unlikely
R703 Pririt Batis (*Batis pririt*)		Not listed	WO	unlikely	unlikely
R706 Fairy Flycatcher (*Stenostira scita*) n-E		Not listed	SC, WO	unlikely	unlikely
R710 African Paradise Flycatcher (*Terpsiphone viridis*)		Not listed	FR, WO	unlikely	unlikely
R718 Plain-backed Pipit (*Anthus leucophrys*)		Not listed	GR	unlikely	unlikely
R719 Buffy Pipit (*Anthus vaalensis*)		Not listed	GR	unlikely	unlikely
R731 Lesser Grey Shrike (*Lanius minor*)		Not listed	WO	unlikely	unlikely
R739 Crimson-breasted Shrike (*Laniarius atrococcineus*)		Not listed	WO	unlikely	unlikely
R741 Brubru (*Nilaus afer*)		Not listed	WO	unlikely	unlikely
R743 Brown-crowned Tchagra (*Tchagra australis*)		Not listed	WO	unlikely	unlikely
R758 Common Myna (*Acridotheres tristis*)		Not listed	HG	unlikely	unlikely
R759 Pied Starling (*Lamprotornis bicolor*) E		Not listed	HG	unlikely	unlikely
R760 Wattled Starling (*Creatophora cinerea*)		Not listed	HG	unlikely	unlikely
R764 Cape Glossy Starling (*Lamprotornis nitens*)		Not listed	WO	unlikely	unlikely
R769 Red-winged Starling (*Onychognathus morio*)		Not listed	RC	unlikely	unlikely
R772 Red-billed Oxpecker (*Buphagus erythrorynchus*)		Not listed	WO	unlikely	unlikely
R775 Malachite Sunbird (*Nectarinia famosa*)		Not listed	SC	unlikely	unlikely
R787 White-bellied Sunbird (*Cinnyris talatala*)		Not listed	WO	unlikely	unlikely
R788 Dusky Sunbird (*Cinnyris fuscus*)		Not listed	SC, WO	unlikely	unlikely
R792 Amethyst Sunbird (*Chalcomitra amethystina*)		Not listed	FR, WO	unlikely	unlikely
R796b Cape White-eye (*Zosterops virens*) n-E		Not listed	FR, SC, WO	unlikely	unlikely
R799 White-browed Sparrow-Weaver (*Plocepasser mahali*)		Not listed	WO	unlikely	unlikely

CONTINUED ON NEXT PAGE . . .

. . . Table 3 continued.

Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	Accident
R800 Sociable Weaver (*Philetairus socius*)		Not listed	WO	unlikely	unlikely
R802 Great Sparrow (*Passer motitensis*)		Not listed	WO	unlikely	unlikely
R804a Southern Grey-headed Sparrow (*Passer diffusus*)		Not listed	WO	unlikely	unlikely
R813 Cape Weaver (*Ploceus capensis*) n-E		Not listed	GR, WO	unlikely	unlikely
R821 Red-billed Quelea (*Quelea quelea*)		Not listed	HG	unlikely	unlikely
R829 White-winged Widowbird (*Euplectes albonotatus*)		Not listed	WO	unlikely	unlikely
R832 Long-tailed Widowbird (*Euplectes progne*)		Not listed	GR	unlikely	unlikely
R834 Green-winged Pytilia (*Pytilia melba*)		Not listed	WO	unlikely	unlikely
R840 African Firefinch (*Lagonosticta rubricata*)		Not listed	FR, WO	unlikely	unlikely
R841 Jameson's Firefinch (*Lagonosticta rhodopareia*)		Not listed	WO	unlikely	unlikely
R842 Red-billed Firefinch (*Lagonosticta senegala*)		Not listed	WO	unlikely	unlikely
R844 Blue Waxbill (*Uraeginthus angolensis*)		Not listed	WO	unlikely	unlikely
R845 Violet-eared Waxbill (*Uraeginthus granatinus*)		Not listed	WO	unlikely	unlikely
R847 Black-faced Waxbill (*Estrilda erythronotos*)		Not listed	WO	unlikely	unlikely
R852 African Quail-finch (*Ortygospiza fuscocrissa*)		Not listed	GR	unlikely	unlikely
R856 Red-headed Finch (*Amadina erythrocephala*)		Not listed	GR, SC, WO	unlikely	unlikely
R860 Pin-tailed Whydah (*Vidua macroura*)		Not listed	HG	unlikely	unlikely
R861 Shaft-tailed Whydah (*Vidua regia*)		Not listed	WO	unlikely	unlikely
R862 Long-tailed Paradise Whydah (*Vidua paradisaea*)		Not listed	WO	unlikely	unlikely
R867 Village Indigobird (*Vidua chalybeata*)		Not listed	WO	unlikely	unlikely
R872 Cape Canary (*Serinus canicollis*)		Not listed	HG	unlikely	unlikely
R876 Black-headed Canary (*Serinus alario*) n-E		Not listed	SC	unlikely	unlikely

Continued on next page . . .

. . . Table 3 continued.

Name	Cl	Red Data	Habitat	PLIrisk	
				Disturb.	Accident
R879 White-throated Canary (*Crithagra albogularis*)		Not listed	SC	unlikely	unlikely
R884 Golden-breasted Bunting (*Emberiza flaviventris*)		Not listed	WO	unlikely	unlikely
R887 Lark-like Bunting (*Emberiza impetuani*)		Not listed	SC, WO	unlikely	unlikely

Table 4: Total number of bird species recorded in 2926AA and in the eight surrounding QDGCs but not in 2926AA (8QDGC). Percentages in brackets indicate the proportion of species where 2926AA is on, or close to, the edge of species distribution.

Location	SABAP1&2	SABAP2 only	SABAP1 only	TOTAL
2926AA	216 (17.1%)	83 (83.1%)	8 (87.5%)	307 (36.8%)
8QDGC	16 (93.8%)	20 (100.0%)	11 (100.0%)	47 (97.9%)
SEC9Q	232 (22.4%)	103 (86.4%)	19 (94.7%)	354 (44.9%)

Table 5: Relative completeness of the SABAP12 dataset. Numbers represent the number of bird species recorded. The 'Shared' column indicates the number of species recorded during the December 2016 to March 2017 fieldwork and which have also been recorded earlier during SABAP1/2.

Pentad/QDGC	Fieldwork		SABAP2	Total
	Unique	Shared	Unique	
		A) SABAP 2		
2900_2605	9	99	47	155
2900_2610	11	201	46	258
2905_2605	22	161	43	226
All	18	220	43	281
2926AA	9	229	63	301
		B) SABAP12		
2926AA	7	231	69	307

Table 6: Impact table assessing the significance of the construction phase impact of the six proposed substations on birds. The impact will be similar for all substations.

Project alternative: All six substations.
Potential environmental impact / nature of impact:
Construction of the proposed substations will entail land levelling and complete destruction of the existing habitat. During the process it is possible that active nests could be destroyed or that birds breeding in the area could experience disturbance. However, the impacted area is relatively small.

	Without mitigation	**With mitigation**
Duration	Permanent (5)	Permanent (5)
Extent	Site-specific (1)	Site-specific (1)
Irreplaceable loss of resources?	Very low potential (1)	Very low potential (1)
Reversibility	Not reversible (5)	Not reversible (5)
Magnitude of negative impact	Low (4)	Very low (2)
Magnitude of positive impact	Very low (2)	Very low (2)
Probability	Low (2)	Low (2)
Cumulative impacts	Low	Low
Significance points	Low (32)	Low (28)

Mitigation:
- The footprint of all construction related activities should be restricted to designated areas and minimized wherever practically possible.

Table 7: Impact table assessing the significance of the operational phase impact of the six proposed substations on birds. The impact will be similar for all substations.

Project alternative: All six substations.
Potential environmental impact / nature of impact:
Construction of each substation will entail the permanent transformation of the existing habitat — which include woodland, grassland or agricultural fields — into a relative sterile habitat consisting of fences, buildings, steel structures, *etc*., and the consequent permanent displacement of species which currently utilise the impacted area. Factors potentially contributing to the risk of bird fatalities at the substations include collision with fences and other infrastructure (potentially aggravated by security lighting), and the use of chemicals to control vegetation.

	Without mitigation	With mitigation
Duration	Permanent (5)	Permanent (5)
Extent	Site-specific (1)	Site-specific (1)
Irreplaceable loss of resources?	Very low potential (1)	Very low potential (1)
Reversibility	Not reversible (5)	Not reversible (5)
Magnitude of negative impact	Low (4)	Very low (2)
Magnitude of positive impact	Very low (2)	Very low (2)
Probability	Low (2)	Low (2)
Cumulative impacts	Low	Low
Significance points	Low (32)	Low (28)

Mitigation:

- Maintain and increase natural unlit areas following the guidelines provided by Gaston *et al*. (2012);
- Wherever possible, grazing or mechanical methods should be used instead of chemical alternatives to keep the vegetation in check where necessary.

Table 8: Impact table assessing the significance of the construction phase impact of the proposed overhead power lines on birds.

Project alternative: There is no alternative for the main power line. Two power line alternatives (2.4/5.6 km long; Northern Alternative & Southern Alternative) is proposed for connecting the proposed Hillandale substation to the electricity grid.

Potential environmental impact / nature of impact:

During construction there will be movement of personnel and vehicles along the route of the proposed power line. Building materials and other building equipment will also be placed on the ground along this route. These activities will lead to local habitat transformation and disturbance, including disruption of breeding activity, of bird species present. While none of the Red Data species are expected to be impacted by this (Table 3 A), many non-threatened taxa are (Table 3 B1). These disturbances would be most likely when construction coincides with breeding activity.

	Without mitigation			With mitigation		
	Main	**Northern Alt.**	**Southern Alt.**	**Main**	**Northern Alt.**	**Southern Alt.**
Duration	Short term (2)	Short term (2)	Short term (2)	Short term (2)	Short term (2)	Short term (2)
Extent	Local (2)	Local (2)	Local (2)	Local (2)	Local (2)	Local (2)
Irreplaceable loss of resources?	Low (2)	Low (2)	Low (2)	Low (2)	Low (2)	Low (2)
Reversibility	High potential (2)	High potential (2)	High potential (2)	High potential (2)	High potential (2)	High potential (2)
Magnitude of negative impact	Low (4)	Low (4)	Low (4)	Low (4)	Low (4)	Low (4)
Magnitude of positive impact	Very low (2)	Very low (2)	Very low (2)	Very low (2)	Very low (2)	Very low (2)
Probability	Medium (3)	Low (2)	Low (2)	Medium (3)	Low (2)	Low (2)
Cumulative impacts	Low	Low	Low	Low	Low	Low
Significance points	Low (36)	Low (24)	Low (24)	Low (36)	Low (24)	Low (24)

Mitigation:

- The footprint of all construction related activities should be restricted to designated areas and minimized wherever practically possible.

Table 9: Impact table assessing the significance of the operational phase impact of the proposed overhead power lines on birds.

Project alternative: There is no alternative for the main power line. Two power line alternatives (*c*. 3 km long; ; Northern Alternative & Southern Alternative) is proposed for connecting the proposed Hillandale substation to the electricity grid.

Potential environmental impact / nature of impact:

Power lines represent a permanent collision hazard to birds. Cases of collisions with electrical infrastructure are known for 20 of the 37 Red Data species occurring in the SAC9Q-block (Table 3 A). Most of these species are presently at best transient visitors to the project site and or their risk of colliding with new power lines at the site is considered to be low (Table 3 A). The risk is considered to be moderate for the Secretarybird R118 and Lanner Falcon R172 (Table 3 A). In addition, there are 14 non-threatened species which have a moderate of high risk of colliding with the proposed power lines (Table 3 on page 35 B).

	Without mitigation			With mitigation		
	Main	**Northern Alt.**	**Southern Alt.**	**Main**	**Northern Alt.**	**Southern Alt.**
Duration	Permanent (5)	Permanent (5)	Permanent (5)	Permanent (5)	Permanent (5)	Permanent (5)
Extent	Local (2)	Local (2)	Local (2)	Local (2)	Local (2)	Local (2)
Irreplaceable loss of resources?	Low (2)	Low (2)	Low (2)	Low (2)	Low (2)	Low (2)
Reversibility	Low (4)	Low (4)	Low (4)	Low (4)	Low (4)	Low (4)
Magnitude of negative impact	Low (4)	Low (4)	Low (4)	Low (4)	Low (4)	Low (4)
Magnitude of positive impact	Very low (2)	Very low (2)	Very low (2)	Very low (2)	Very low (2)	Very low (2)
Probability	Very High (5)	High (4)	High (4)	High (4)	Medium (3)	Medium (3)
Cumulative impacts	Low	Low	Low	Low	Low	Low
Significance points	Moderate (85)	Moderate (68)	Moderate (68)	Moderate (68)	Moderate (51)	Moderate (51)

Mitigation:

The proposed new power line should be of a horizontal design where conductors are all on the same height. In addition, bird flight diverters (see Figure 14) should be fitted to the earth wires of power line sections crossing major drainage lines following the guidelines provided by Jenkins *et al*. (2010).

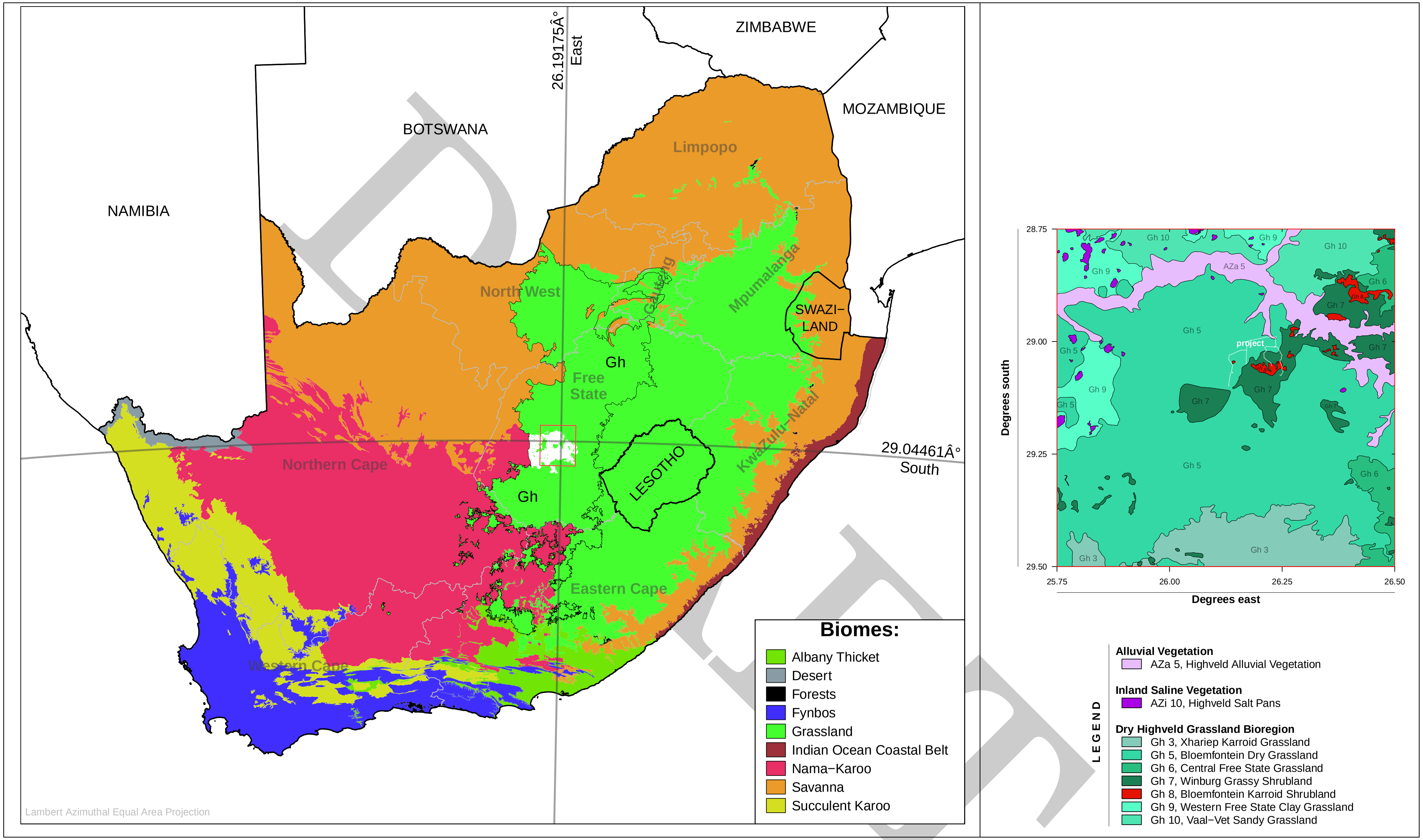

Figure 1: Location of the proposed Harvard to Noordstad power line in Bloemfontein, Free State Province, in relation to the South African biomes and vegetation units. LEFT: White areas within the Dry Highveld Grassland Bioregion (Gh; Delineated) represent the distribution of the Bloemfontein Dry Grassland (Gh 5) vegetation unit. The intersection of the pair of latitudinal and longitudinal lines indicates the average location of the project site with the surrounding red block indicating the extent of the SAC9Q-block. RIGHT: Vegetation units within the SAC9Q-block (see also Figure 9) with the white lines representing the proposed new power lines (see Figure 2 for details). Vegetation data from Mucina & Rutherford (2006).

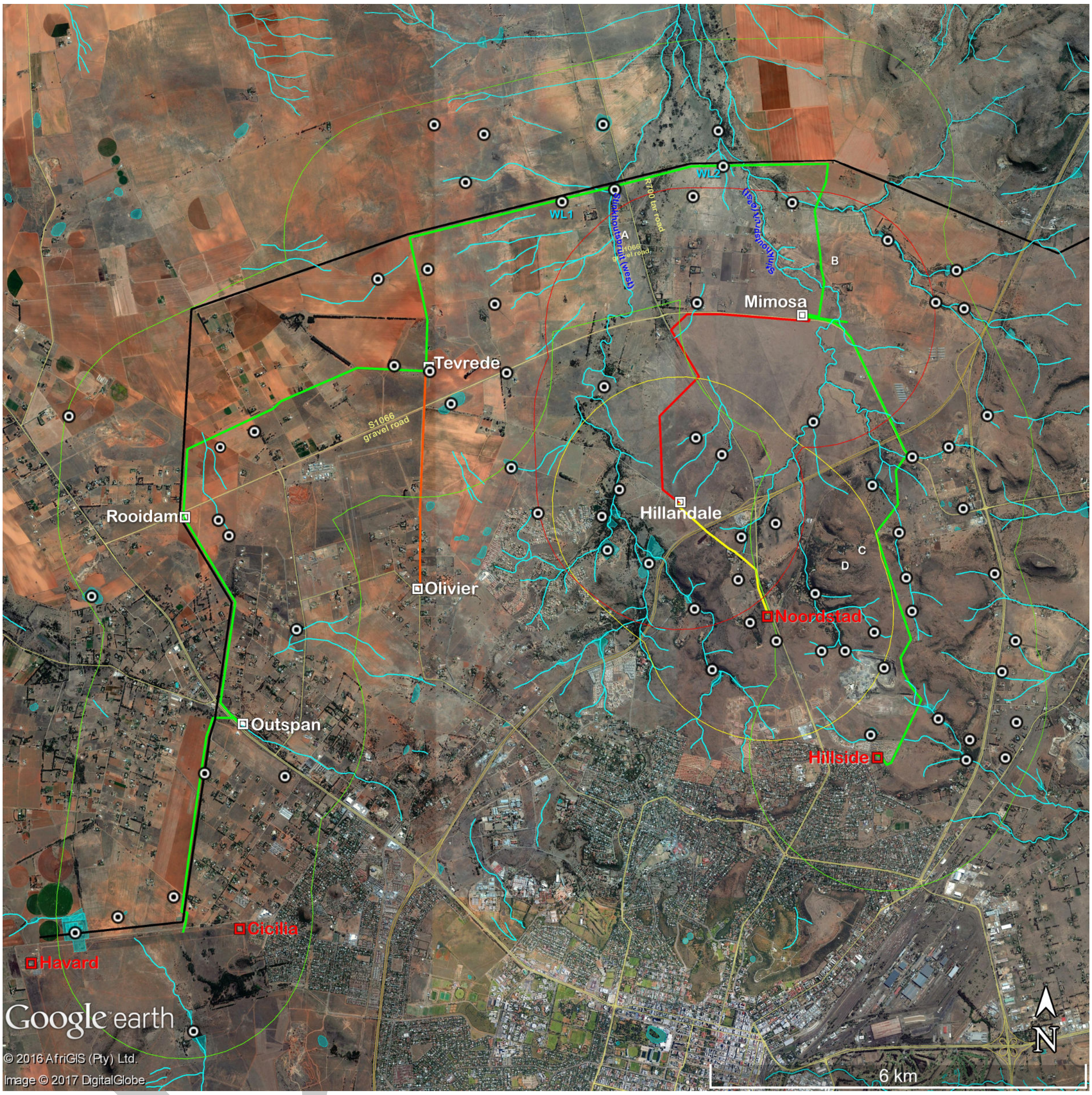

Figure 2: Environs of the proposed Harvard to Noordstad 132 kV power line at Bloemfontein, Free State Province. Black line: existing 1HAR/MER power line; Green lines: main power line; Orange line (Tevrede-Olivier), underground power line; Red lines (Mimosa-Hillandale), Northern Alternative for connection of the Hillandale substation; Yellow lines (Noordstad-Hillandale), Southern Alternative for connection of the Hillandale substation. Thinner lines represent a 2 km zone around the respective power lines. Named red squares, existing substations; Named white squares, proposed substations; White circles with dots, and blue lines: Wetland systems based on data from PlanetGIS SA-topo50 map (version 19 September 2014; `www.planetgis.net`), supplemented by field observations. Wetlands in the north-eastern quarter mostly represent the upper catchment of the Stinkhoutspruit which drains northwards into the Modder River.

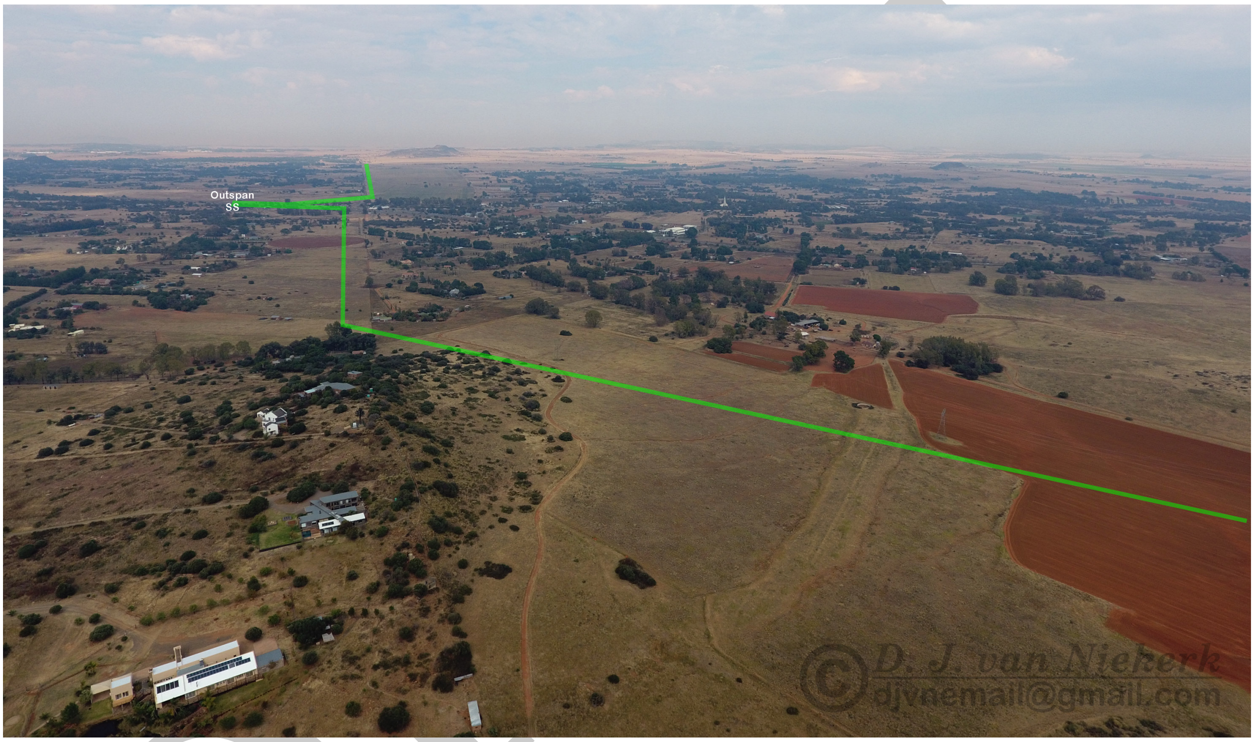

Figure 3: The first part of the proposed power line route (green line) between the proposed Outspan and Rooidam substations illustrating the transformation of Bloemfontein Dry Grassland (Gh 5) into agricultural land and smallholdings. The hill in the foreground-left represents a largely intact isolated patch of Bloemfontein Karroid Shrubland (Gh 7) (Fig. 1).

Figure 4: Bloemfontein Dry Grassland (Gh 5) along the northern part of the Tevrede-Mimosa section of the proposed main power line (green line) looking eastwards. Note how close the proposed new line will pass to the wetland in the foreground (see WL1 in Figure 2). Waterbirds such as the Blacksmith Lapwing R258 which frequents this wetland is highly likely to collide with the new power line, for example when harassed by the Peregrine Falcon R171 (illustrated) which was seen hunting in the vicinity of this wetland. The trees in the distance represent Highveld Alluvial Vegetation (AZa 5) riparian thickets associated with the Stinkhoutspruit (see Figure 5).

Figure 5: The north-eastern aspect of the proposed main power line (green) where it crosses the eastern branch of Stinkhoutspruit. In its current alignment it goes straight over a prominent wetland (WL2; see Figure 2). Up to the north-eastern (upper left) corner, the line will run parallel to the existing 1HAR/MER power line which runs north (left) of the proposed line. Note the strip of cleared habitat along this existing power line.

Figure 6: Part of the route of the proposed power line (green line) south of the N1 national road. All of this still forms part of the Stinkhoutspruit catchment and include Winburg Grassy Shrubland (Gh 7) in the bottom part and Bloemfontein Karroid Shrubland at the top (Fig. 1). Beyond the upper-left the power line will cross over into the upper catchment of a tributary of the Renosterspruit (Fig. 7).

Figure 7: South-eastern end of the proposed main power line (green line) looking south-westwards towards the Noordstad dumping site. This represents the upper catchment of a tributary of the Renosterspruit. Three wetlands (WL) is visible. It is expected that waterbirds such as the African Sacred Ibis R091 will need to cross the proposed power line daily as they move around from one wetland to the next.

Figure 8: The northern alternative (red line) for connection of the Hillandale substation. Top, as seen from the south-west. The habitat east (on the other side) of the R700 tar road represents Bloemfontein Dry Grassland (Gh 5) while the habitat to the west (foreground) represents Windburg Grassy Shrubland (Gh 7).

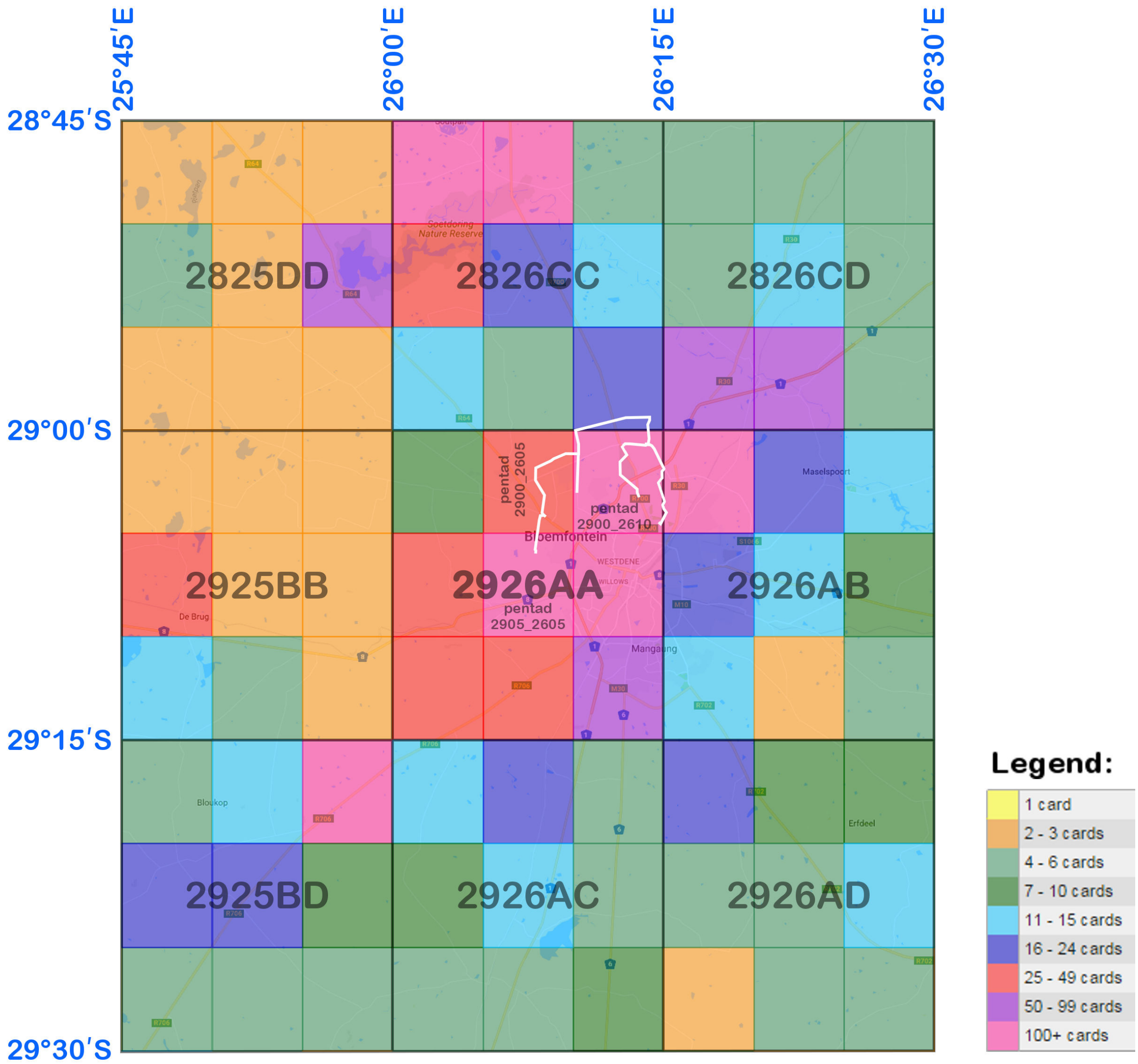

Figure 9: SABAP2 coverage of the nine quarter degree grid cells (SAC9Q-block) centred on 2926AA as on 5 December 2016 (`http://sabap2.adu.org.za/coverage.php`). Each coloured block represents a pentad, *i.e.* a 5' latitude by 5' longitude block, with the colours of each indicating the number full protocol cards submitted for it to date (see legend bottom-right). The white lines indicate the alignment of the proposed new power line.

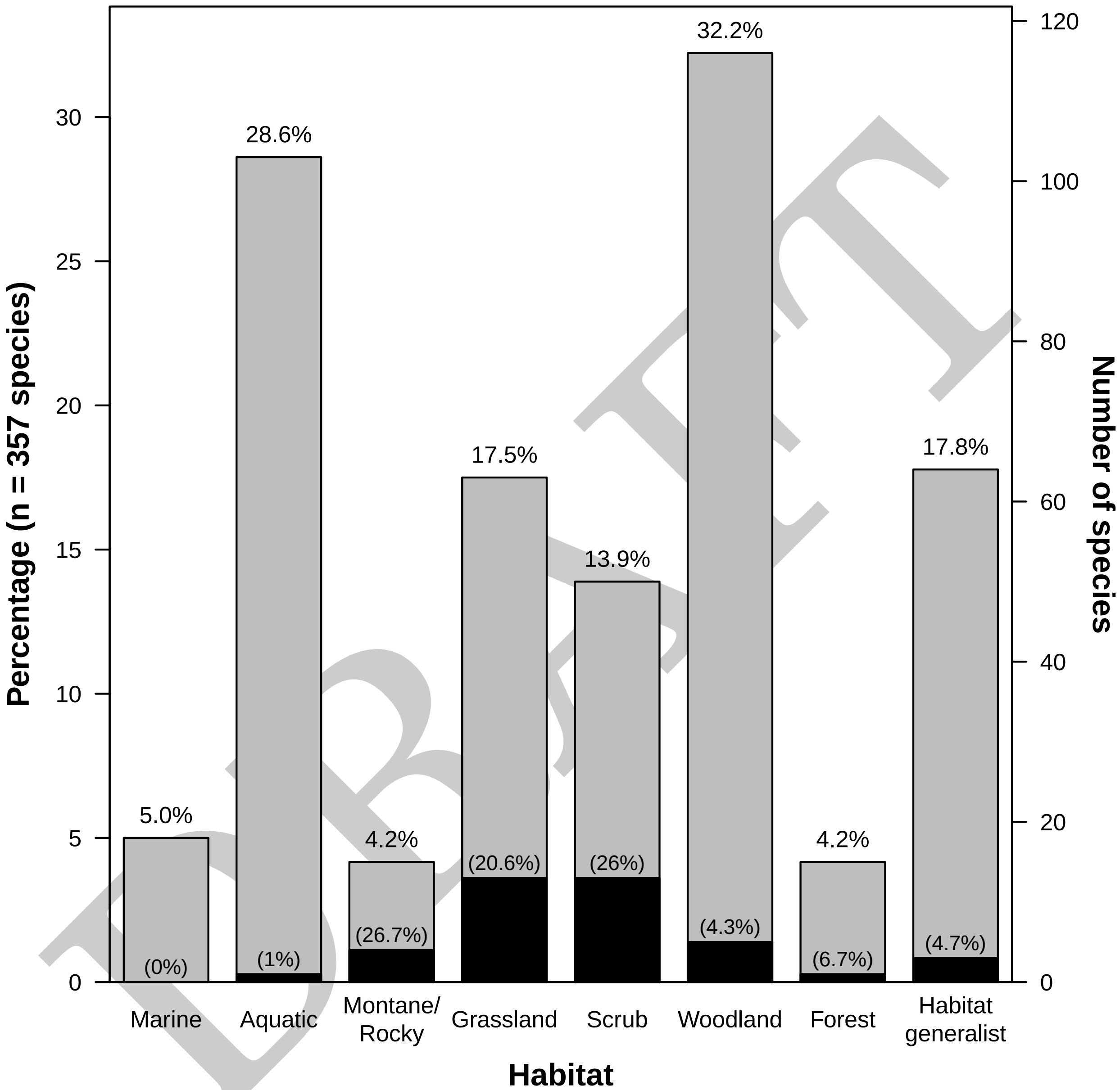

Figure 10: Habitat preferences of bird species occurring in the SAC9Q-block. The black bottom part of each bar represents species which are endemic or near-endemic with the percentage that they constitute of the respective habitats indicated in brackets. Note that species may be associated with more than one habitat type, hence the percentages do not add up to 100%. Data from Table 3 on page 35.

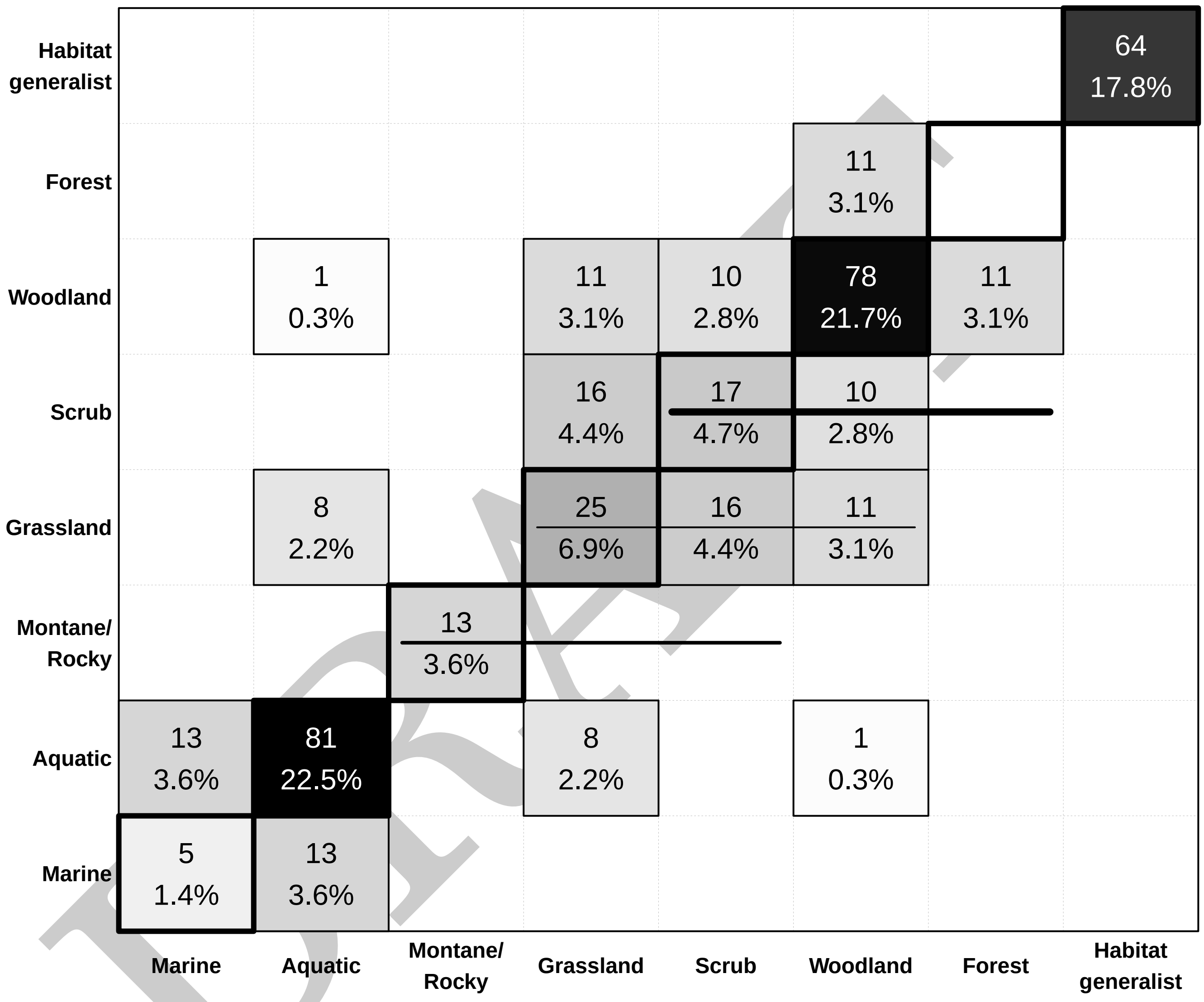

Figure 11: Habitat preference combinations of all species recorded in the SAC9Q-block. Numbers represent species totals while percentages indicate the proportion of all species (n = 260). The three horizontal lines represent from top to bottom four, one and two species associated with three habitats. Shading of each block is relative to the combination with the highest proportion (Aquatic).

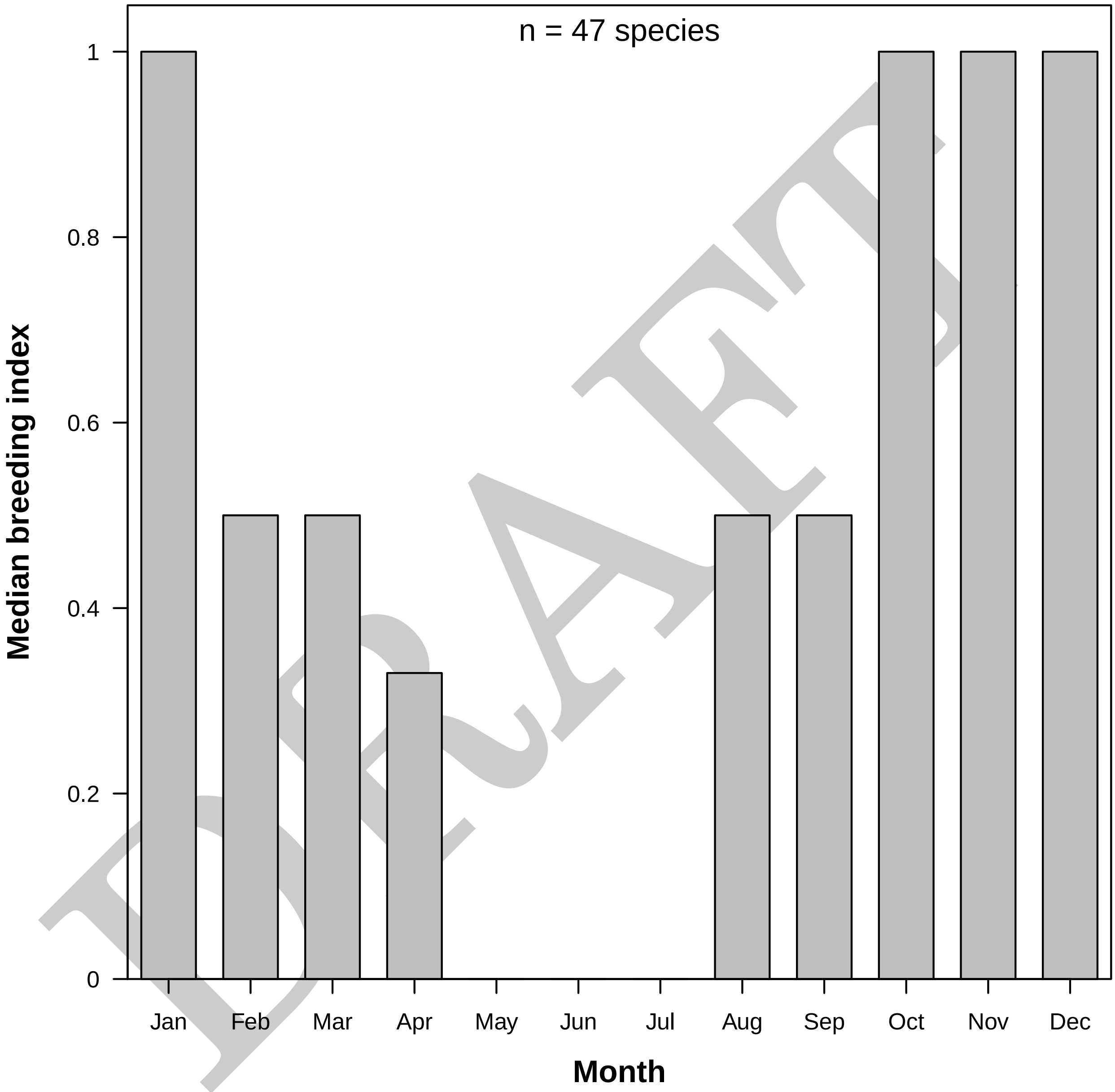

Figure 12: The monthly median breeding index for species (excluding Red Data taxa) projected to be negatively impacted by construction activities related to the power line between Newgate and Noupoort substations. See Section 4.4.1 on page 14.

A) Part of a roadside pool along the S1066 gravel road, approximately 600 m north of the N1. This pool was used by Yellow-billed Duck R104. The proposed overhead power line will run (from left to right) only a few meters from this pool.

B) A wetland located in a field just south of the S1066 gravel road and 600 m south-east of the site of the proposed Tevrede substation. This wetland is visited by a variety of waterbirds including Egyptian Goose R102 and Spur-winged Goose R116.

Figure 13: Examples of ephemeral pools which formed after rain.

Figure 14: Example of bird flight diverters employed on the earth wires of a power line.

Appendices

Appendix A Curriculum Vitae: Dr. D. J. van Niekerk

CURRICULUM VITAE

(Abridged)

Dr. D. Johan van Niekerk

Ornithologist & Independent Environmental Consultant

March 2017

1 General

Name: Daniël Johan van Niekerk

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2 Tertiary qualifications

- B. Sc. (Biochemistry and Zoology). University of the Free State (1994)
- B. Sc. Honours in Zoology. University of the Free State (1995)
- M. Sc. in Zoology with distinction. University of the Free State (2000)
- Ph. D. in Zoology. University of the Free State (2009)

Additional courses

- Taxidermy course. National Museum, Bloemfontein. June 1988.
- EIA, Centre for Environmental Management, University of the Free State, January 2006

3 Work experience

Savannah Environmental	Avifaunal specialist for impact assessments	Since 2015
Environamics Environmental Consultants	Avifaunal specialist for impact assessments	2015
Tlokoeng Valley Biodiversity Conservation Project (Lesotho)	Project manager for the faunal component	Since 2012
Nare Sereto CC	Avifaunal specialist for impact assessments	Since 2012
Enviroworks	Avifaunal specialist for impact assessments	Since 2009
Gold Fields Limited (Beatrix mine)	Avifaunal specialist for International Cyanide Management Code	2008
Syngenta	Trainer of personnel in Brazil for conducting risk assessment studies Project manager for risk assessment studies	2010 2006–2007; 2010–2011
Conserving Mountain Biodiversity in Southern Lesotho (UNDP Project)	Project manager for bird component	2003-2004
Lesotho Highlands Development Authority	Project manager for bird component of monitoring and faunal rescue at Mohale Dam	2002–2003
University of the Free State	Research associate Temporary lecturer Laboratory assistant	2010–2012 2006-2007 1995-2005 & 2008-2009

Specialist reports:

- Van Niekerk, D. J. 2002. Birds. In: Biological Resource Monitoring Contract LHDA 1053: Annual Report 2001/2002 (ed. C. Mokuku). NUL-CONSULS, Maseru, Lesotho.
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- Van Niekerk, D. J. 2013. Potential impact of the proposed 75 MW First Solar CdTe photovoltaics development near Prieska, Northern Cape, on birds. Report to Nare Sereto CC.
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- Van Niekerk, D. J. 2015. The status of birds in Tlokoeng Valley, northern Lesotho: July 2012 – June 2014. A report to the Environmental & Sustainability Education Network of Lesotho.
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- Van Niekerk, D. J. 2016. Feasibility study for the proposed construction of the Semonkong Wind Farm in Lesotho: Avifauna. Report to Savannah Environmental.

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Appendix B Criteria for assessing impacts as provided by Enviroworks

For each potential impact, the DURATION (time scale), EXTENT (spatial scale), IRREPLACEABLE loss of resources, REVERSIBILITY of the potential impacts, MAGNITUDE of negative or positive impacts, and the PROBABILITY of occurrence of potential impacts must be assessed. The assessment of the above criteria will be used to determine the significance of each impact, with and without the implementation of the proposed mitigation measures. The scales to be used to assess these variables and to define the rating categories are tabulated in Table 1 and Table 2 below.

TABLE 1: EVALUATION COMPONENTS, RANKING SCALES AND DESCRIPTIONS (CRITERIA).

Evaluation component	Ranking scale and description (criteria)
DURATION	**5 - Permanent** **4 - Long term**: Impact ceases after operational phase/life of the activity (> 20 years). **3 - Medium term**: Impact might occur during the operational phase/life of the activity (5 to 20 years). **2 - Short term**: Impact might occur during the construction phase (< 5 years). **1 - Immediate**
EXTENT (or spatial scale/influence of impact)	**5 - International**: Beyond National boundaries. **4 - National**: Beyond Provincial boundaries and within National boundaries. **3 - Regional**: Beyond 5 km of the proposed development, within Provincial boundaries. **2 - Local**: Within 5 km of the proposed development. **1 - Site-specific**: On site or within 100 m of the site boundary. **0 -** None
IRREPLACEABLE loss of resources	**5 – Definite** loss of irreplaceable resources. **4 – High** potential for loss of irreplaceable resources. **3 – Moderate** potential for loss of irreplaceable resources. **2 – Low** potential for loss of irreplaceable resources. **1 – Very low** potential for loss of irreplaceable resources. **0 - None**
REVERSIBILITY of impact	**5 –** Impact **cannot** be reversed. **4 – Low** potential that impact might be reversed. **3 – Moderate** potential that impact might be reversed. **2 – High** potential that impact will be reversed. **1 –** Impact **will** be reversible. **0 –** No impact.
MAGNITUDE of <u>NEGATIVE</u> IMPACT (at the indicated spatial scale)	**10 - Very high**: Bio-physical and/or social functions and/or processes might be *severely* altered. **8 - High**: Bio-physical and/or social functions and/or processes might be *considerably* altered. **6 - Medium**: Bio-physical and/or social functions and/or processes might be *notably* altered. **4 - Low**: Bio-physical and/or social functions and/or processes might be *slightly* altered. **2 - Very Low**: Bio-physical and/or social functions and/or processes might be *negligibly* altered. **0 - Zero**: Bio-physical and/or social functions and/or processes will remain *unaltered.*
MAGNITUDE of <u>POSITIVE</u> IMPACT (at the indicated spatial scale)	**10 - Very high (positive)**: Bio-physical and/or social functions and/or processes might be *substantially* enhanced. **8 - High (positive)**: Bio-physical and/or social functions and/or processes might be *considerably* enhanced. **6 - Medium (positive)**: Bio-physical and/or social functions and/or processes might be *notably* enhanced. **4 - Low (positive)**: Bio-physical and/or social functions and/or processes might be *slightly* enhanced. **2 - Very Low (positive)**: Bio-physical and/or social functions and/or processes might be *negligibly* enhanced. **0 - Zero (positive)**: Bio-physical and/or social functions and/or processes will remain *unaltered.*
PROBABILITY (of occurrence)	**5 - Definite**: >95% chance of the potential impact occurring. **4 - High probability**: 75% - 95% chance of the potential impact occurring.

	3 - Medium probability: 25% - 75% chance of the potential impact occurring **2 - Low probability**: 5% - 25% chance of the potential impact occurring. **1 - Improbable**: <5% chance of the potential impact occurring.
CUMULATIVE impacts	**High**: The activity is one of several similar past, present or future activities in the same geographical area, and might contribute to a very significant combined impact on the natural, cultural, and/or socio-economic resources of local, regional or national concern. **Medium**: The activity is one of a few similar past, present or future activities in the same geographical area, and might have a combined impact of moderate significance on the natural, cultural, and/or socio-economic resources of local, regional or national concern. **Low**: The activity is localised and might have a negligible cumulative impact. **None**: No cumulative impact on the environment.

Once the evaluation components have been ranked for each potential impact, the significance of each potential impact will be assessed (or calculated) using the following formula:

SP (significance points) = (duration + extent + irreplaceability + reversibility + magnitude) x probability

The maximum value is 150 SP (significance points). The unmitigated and mitigated scenarios for each potential environmental impact should be rated as per **Table 2** below.

Significance Points	Environmental Significance	Description
100 – 150	**High (H)**	An impact of high significance which could influence a decision about whether or not to proceed with the proposed project, regardless of available mitigation options.
40 – 99	**Moderate (M)**	If left unmanaged, an impact of moderate significance could influence a decision about whether or not to proceed with a proposed project.
<40	**Low (L)**	An impact of low is likely to contribute to positive decisions about whether or not to proceed with the project. It will have little real effect and is unlikely to have an influence on project design or alternative motivation.
+	**Positive impact (+)**	A positive impact is likely to result in a positive consequence/effect, and is likely to contribute to positive decisions about whether or not to proceed with the project.

TABLE 2: DEFINITION OF SIGNIFICANCE RATINGS (POSITIVE AND NEGATIVE).

(a) Impacts that may result from the planning, design and Construction Phase (briefly describe and compare the potential impacts (as appropriate), significance rating of impacts, proposed mitigation and significance rating of impacts after mitigation that are likely to occur as a result of the planning, design and Construction Phase.

(**Note:** Evaluation components: M – Magnitude; D – Duration; E – Extent; R - Reversibility; I - Irreplaceable; P – Probability; S - Significance)

Refer to **Section G**, **Table 1:** Evaluation components, ranking scales and descriptions (criteria) and to **Table 2:** Definition of Significance Ratings.

Example of impact assessment table to be used in all specialist reports.

PROJECT ALTERNATIVE	POTENTIAL ENVIRONMENTAL IMPACT / NATURE OF IMPACT	ENVIRONMENTAL SIGNIFICANCE																		MITIGATION
		BEFORE MITIGATION									AFTER MITIGATION									
		Magnitude	Duration	Extent	Irreplaceable	Reversibility	Probability	TOTAL (SP)	Significance	CUMULATIVE	Magnitude	Duration	Extent	Irreplaceable	Reversibility	Probability	TOTAL (SP)	Significance	CUMULATIVE	
Potential Impacts on geographical and physical aspects																				
Project activity:	**Planning and design**																			
Preferred Alternative and Layout Alternative 2	**E.g.** The change of land use from vacant to General Industrial purposes.	-	-	[illegible]	-	-	[illegible]	[illegible]	[illegible]	-	10+	5	3	1	1	5	100	H (+)	H (+)	**E.g.** Optimise the urban design of Erf 113223, to create as many development opportunities as possible to alleviate the shortage of zoned general industrial land in proximity to the Cape Town Metropole.

PROJECT ALTERNATIVE	POTENTIAL ENVIRONMENTAL IMPACT / NATURE OF IMPACT	ENVIRONMENTAL SIGNIFICANCE																		MITIGATION
		BEFORE MITIGATION									AFTER MITIGATION									
		Magnitude	Duration	Extent	Irreplaceable	Reversibility	Probability	TOTAL (SP)	Significance	CUMULATIVE	Magnitude	Duration	Extent	Irreplaceable	Reversibility	Probability	TOTAL (SP)	Significance	CUMULATIVE	
"No-go" alternative	**E.g.** The land use will not change and the site will remain unchanged, i.e. vacant and under-utilized. No general industrial development and job opportunities in the area.	0	5	2	1	1	5	45	M	M	2	5	[illegible]	1	1	3	33	L	L	**E.g.** The only mitigation to be applied will be the eradication of alien vegetation.

It is requested that all specialists strictly adhere to the above table and significance ratings.