An avifaunal assessment for the Kloofsig 1 phase of the proposed Kloofsig Solar PV Energy Facility on the Farm Kalk Poort RE/18, Hopetown, Northern Cape Province

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EXECUTIVE SUMMARY

Kloofsig 1, the first phase of the proposed development for the 970 ha Kloofsig Solar PV Energy Facility, intended ultimately to produce 225 MW of electricity for the national grid, is the secondmost extensive at 270 ha of solar PV arrays and associated infrastructure required, but it also includes construction of two grid-substations and their powerline connections of ~9.0 km to the nearest existing 400 kW and 132 kW powerlines.

The site occupies the dominant Northern Upper Karoo vegetation unit and, for birds, its ecology exemplifies the challenges to birds and their assessment in relation to such a development within this habitat. This vegetation unit is mostly on rocky or sandy semi-arid flatlands, with low, well-spaced plants, many of them woody or succulent and, together with their substrate, sensitive to utilisation. Rainfall as thunderstorms is the main local driver of ecological productivity, but is notably patchy, with high variance from long droughts to heavy falls and flooding. Many bird species use their aerial mobility to be nomadic in this habitat, making optimum spatio-temporal use of such resources but leading to high inter-annual and inter–seasonal fluctuations in avifaunal composition and population densities.

The habitat on and around the development site is expected to support 158 species of birds, of which 18 are listed as nationally threatened in South Africa. The Kloofsig 1 site lies at the northwest edge of the extensive Platberg-Karoo Conservancy, classified as a national Important Bird Area (SA037). Of most concern is the globally Endangered and near-endemic Ludwig's Bustard, which was seen on site and seemed relatively common in surrounding areas. This species, together with five others (Vulnerable Secretarybird and Lanner Falcon, and Near Threatened Kori Bustard, Karoo Korhaan and Double-banded Courser) are expected as regular residents or frequent visitors, while the remaining 12 threatened species are only expected as erratic to infrequent visitors. Eleven of the 18 species are large cumbersome species (3 vultures, 2 korhaans, 2 bustards, 2 storks, Blue Crane and

Secretarybird), known for their propensity to collide with high-tension powerlines, two of which already cross Portion RE/18 of Kalk Poort farm and a further three pass nearby. The global and national decline in Ludwig's Bustard populations is attributed primarily to utility line collisions, exacerbated by hunting, poisoning and disturbance.

The construction and extent of arrays required will have unavoidable impacts on the substrate and the Northern Upper Karoo vegetation unit that it supports, disturbing the shallow soil layer and selectively excluding previously direct sunlight and rainfall patterns. It is also expected to affect bird species differentially, driving some away but offering novel shade and shelter to others. The exact outcomes of these effects on the vegetation and avifauna are poorly understood, but suggestions are provided for further investigation and monitoring that might inform avenues for mitigation. The arrays will be either fixed or tracking, relative to the sun's position, the former preferred from an avian perspective. Management of water runoff from and water use on the arrays also requires judicious management, due to its various influences on plants, birds and substrates in this predominantly arid environment.

The arrays are to be interconnected with each other by underground cables leading to an adjacent Kloofsig 1 step-up substation (DC to 33 kV), and this connected to the national grid via various sections of powerline that link it to two grid-connection substations, a 400 kV and a 132 kV connection. Those powerline linkages associated with the step-up substation and 400-kV grid-connection are only short, but a longer ~8.5 km section is required to link the Kloofsig 1 arrays to the nearest 132 kV line to the southeast. Powerlines are better understood than PV arrays with respect to bird and habitat interactions, and Eskom, through its affiliation with the Endangered Wildlife Trust (EWT), apply comprehensive guidelines for their design and mitigation. From an avian perspective, erection of 132 kV lines on monopoles rather than lattice pylons is preferred, because monopoles offer fewer rest, roost and nest sites compared to lattices, which reduces risks of negative interactions.

The area selected for development of Kloofsig 1 is at the northern edge of what is an extensive and Least Threatened national vegetation unit, its local variations considered of Low to Medium-Low sensitivity. Within that context, development of

Kloofsig 1 will degrade a relatively small area of habitat and will only minimally impact the conservation prospects of the avifauna, including the threatened species. The property and surrounding areas already support five major and other minor power and utility lines, so the additional powerline infrastructure required is relatively insignificant. Application of the proposed mitigations during construction and operation, especially keeping the development footprint as small as possible and monitoring avian interactions with the facility, followed by careful decommissioning of the facility and rehabilitation of the habitat on termination will reduce the long term impacts even further.

1. DEVELOPMENT PROPOSAL FOR ASSESSMENT

1.1. General Property and Regional Development

The property where it is proposed to erect the Kloofsig Solar PV Energy Facility with a capacity to produce about 225 MW of electricity for the national grid is on the 3000 ha of the remaining extent of Portion RE/18 (or Portion 0 of Farm 18) of Kalk Poort. It lies just south of the Gariep (Orange) River, between the villages of Orania and Hopetown to the west and Van Der Kloof and Petrusville to the east, within Pixley ka Seme District and Rhenosterberg Local Municipalities, Northern Cape Province (Figures 1 & 2). The property was selected for the extensive flat areas available on the farm, which is owned by the Havenga family and currently managed for livestock (mainly sheep, and cattle) and game (mainly springbok, and gemsbok).

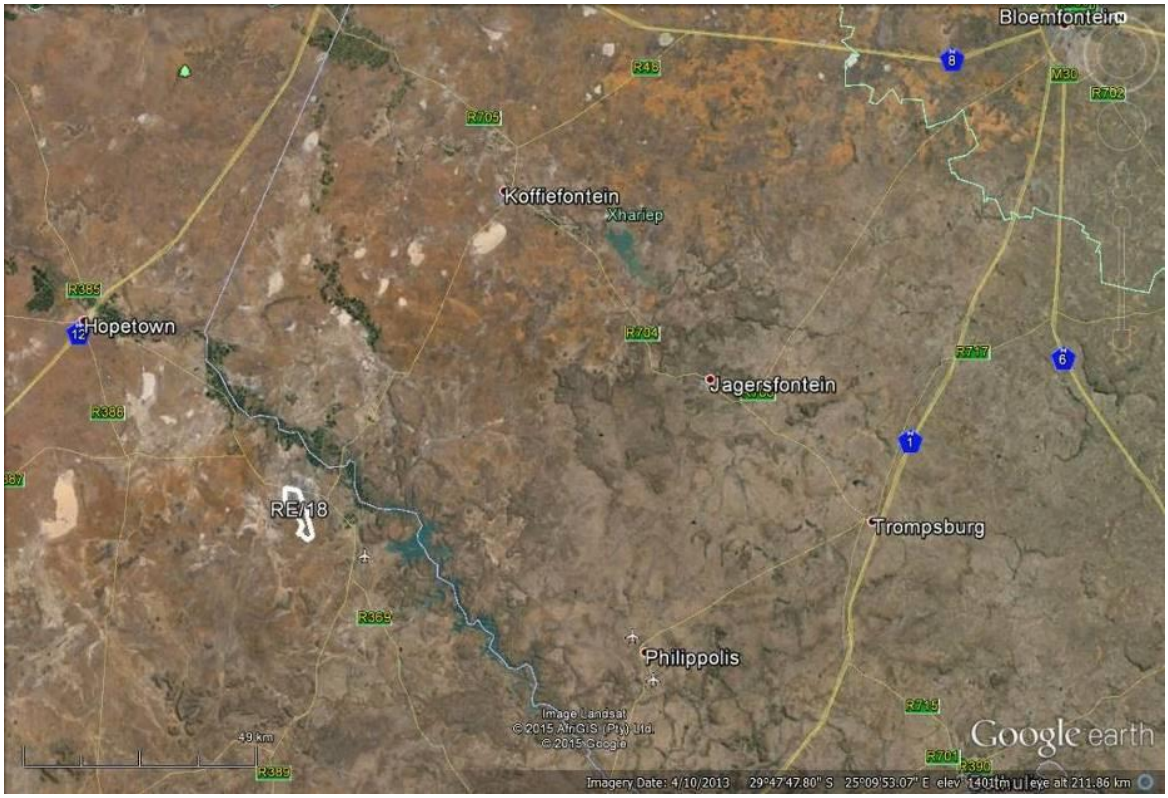

Figure 1: Satellite image to show the location of the farm Kalk Poort RE/18 (white polygon) in relation to the main surrounding towns, borders, roads and features.

The property is already crossed by two Eskom high-voltage power lines, of 765 kV and 400 kV respectively, with two more 400 kV lines and a 132 kV line just to the east, some of which emanate from the hydroelectric power station below the wall of the Vanderkloof

(previously P. K. le Roux) Dam, and offer ideal on-site opportunities for connection to the national grid (Figures 3 & 4). An initial basic assessment and sensitivity screening was done of the whole property, which then served in determining the three locations now selected for successive development within the southern half of the property (Figure 4). A full environmental assessment is now applied separately to each of these three successive phases of development, Kloofsig 1-3, each proposed for the construction of separate 75-MW solar-array units and their connections to the national electricity grid which, combined, will occupy 970 ha (32%) of the Kalk Poort RE/18 property.

Figure 2: Satellite image of the farm Kalk Poort RE/18 (white polygon) in relation to the Gariep River, Vanderkloof Dam, nearby villages and local access routes. Note especially the R369 forming the northern border of the property and the small secondary road from Petrusville that passes just south of the property.

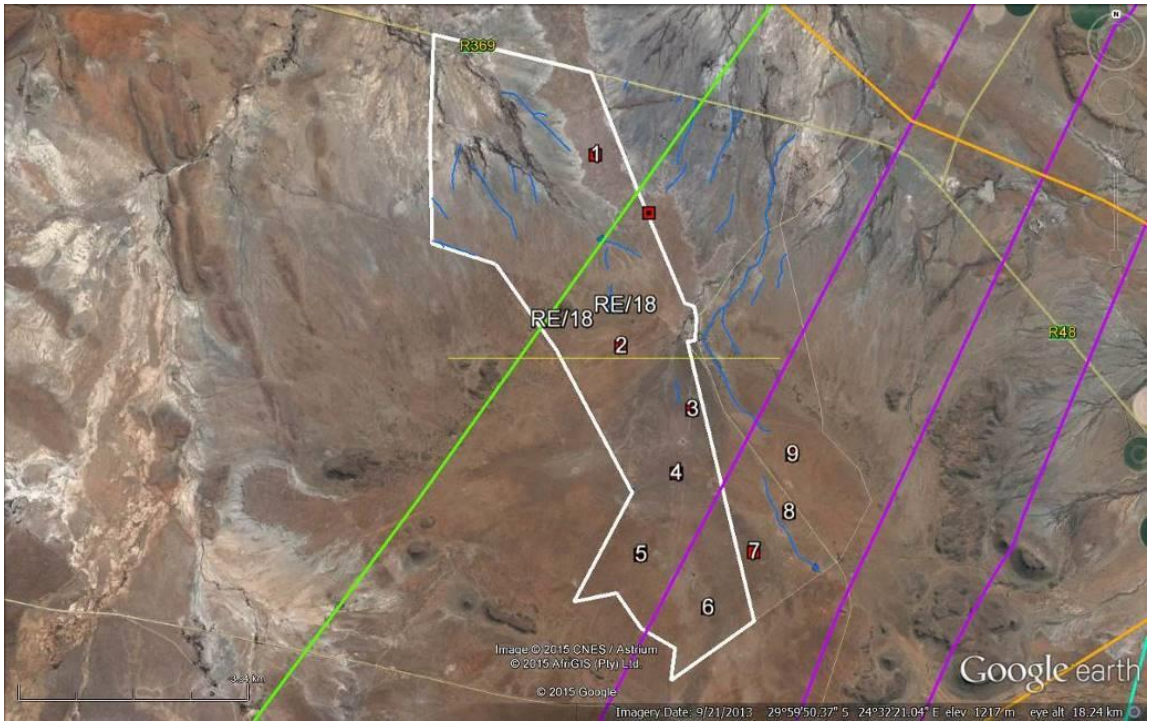

Figure 3: Close-up satellite image of Kalk Poort RE/18 (white polygon), showing locations 1-6 within the property that were initially selected as positions for the arrays during an aerial survey, the roads passing at either end, and the Eskom high-voltage transmission lines crossing the area (765 kV green, 400 kV purple). (Locations 7-9 are not relevant for this study.)

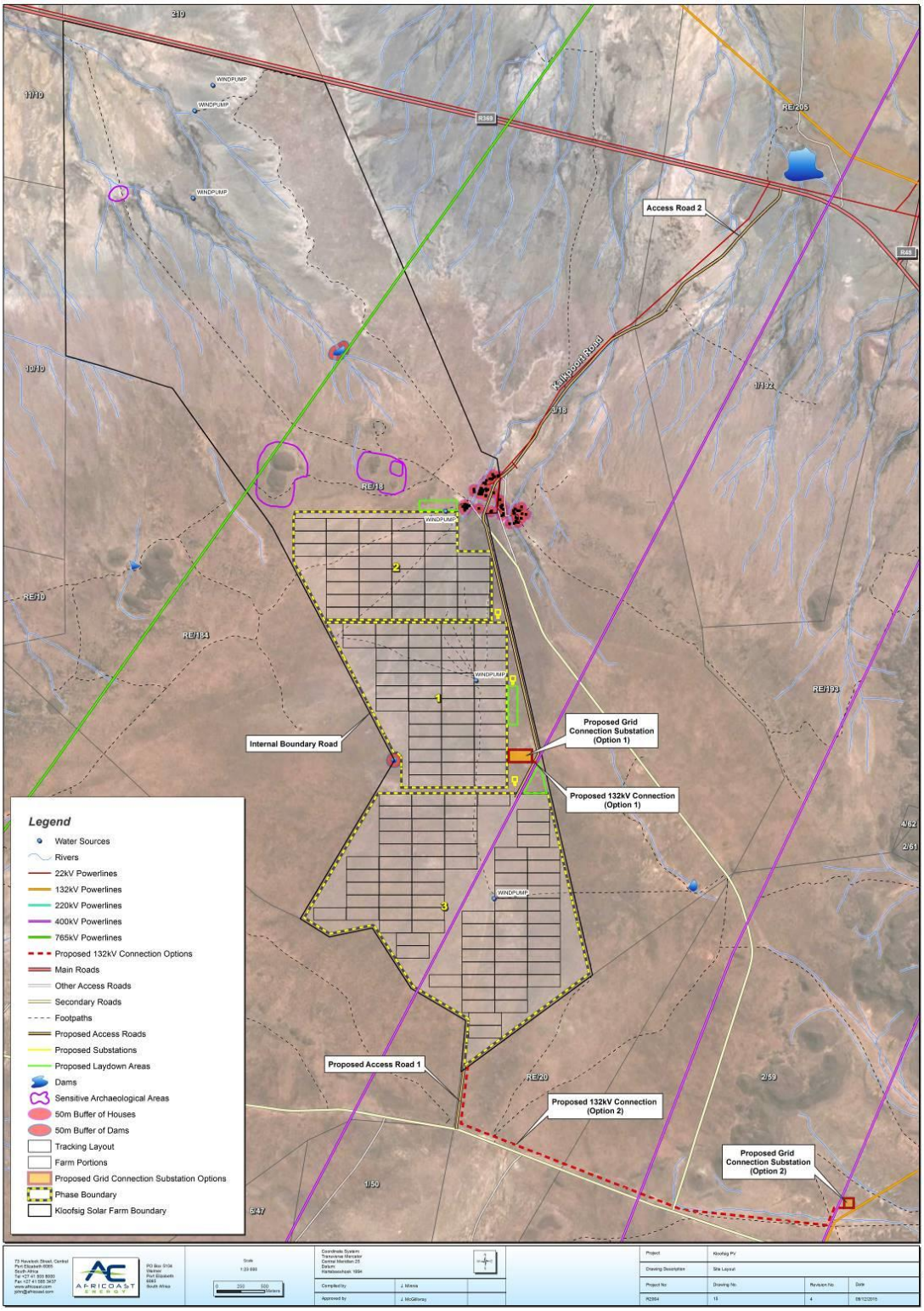

Figure 4: Close-up satellite image of Kalk Poort RE/18 (black polygon), showing the final three locations selected as positions for the solar arrays and associated developments and infrastructure for the Phases 1-3 of the final proposal for development.

1.2. Particular Kloofsig 1 Development

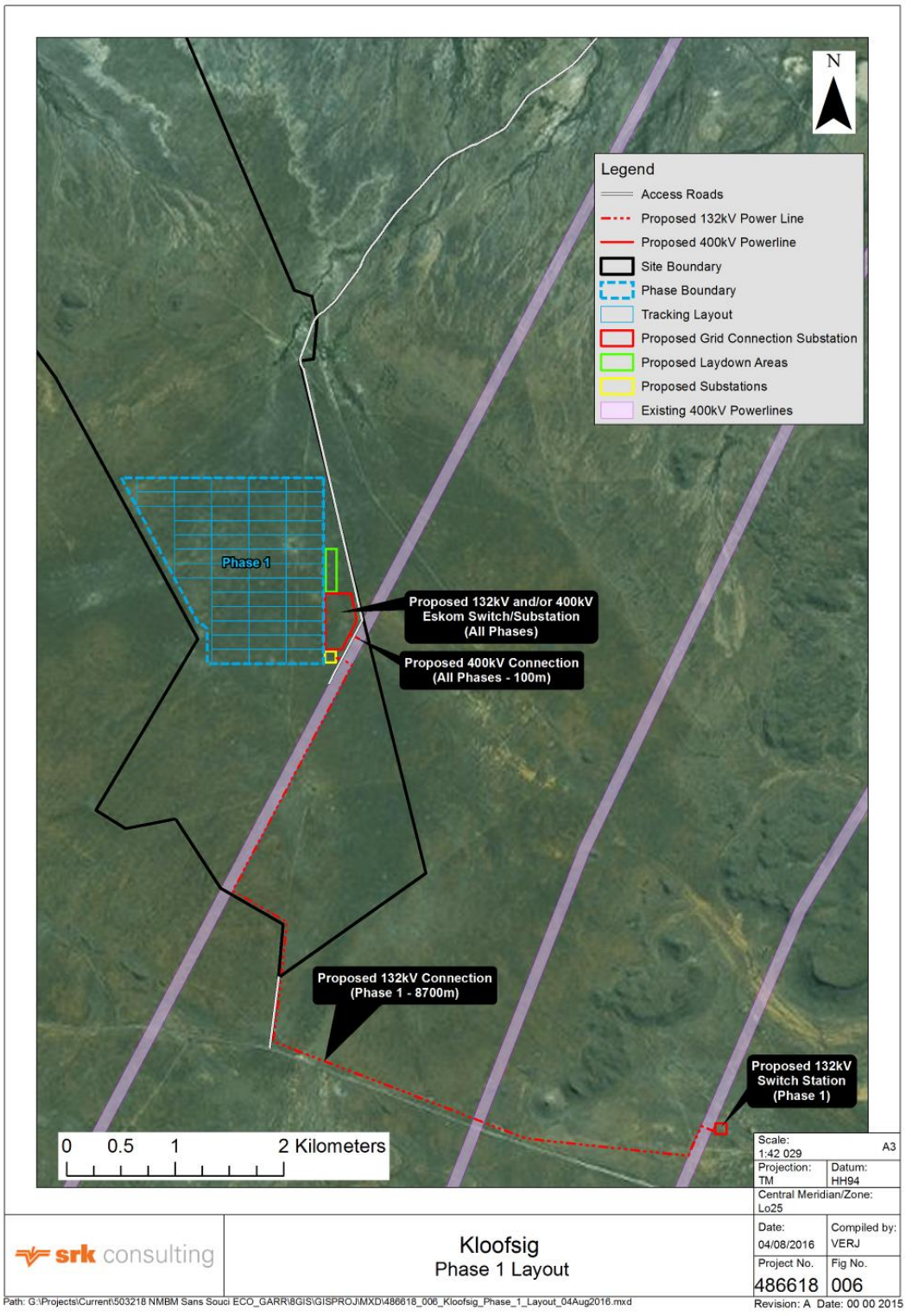

Figure 5: Details of the developments proposed for the Kloofsig 1 phase on Portion RE/18 on the Farm Kalk Poort.

Kloofsig 1 (Figure 5): This initial phase is the middle one of the three areas finally proposed for successive development of solar arrays (Figure 4). It will cover a total area of 270 ha, or 28% of the projected total of 970 ha. Most of this area would comprise separate fixed or tracking solar arrays, mounted as modules and linked in clusters. The arrays and modules would be interconnected via medium-voltage underground cables (along with a cable or fibre-optic Supervisory Control and Acquisition System (SCAS)) to inverters (DC to 33 kV AC). The inverters would then be connected to a single Kloofsig 1 step-up substation just east of the arrays, for conversion of 33 kV to 132 kV. This substation would have an extent of 1 ha, and include such maintenance structures as offices and stores. A rectangular laydown area to be used during construction/maintenance, east of the arrays and just south of the Kloofsig 1 step-up substation, is also designated.

The Kloofsig 1 step-up substation will then be connected by a short overhead 132 kV powerline to the Option 1 grid-connection substation (12.4 ha), which is to be constructed alongside the existing 400 kV powerline that passes just east of Kloofsig 1 and linked to it by another short 132 kV powerline. At the same time, a new 132 kV powerline of ~8.5 km (including its 31-m servitude) will be constructed south and east of Portion RE/18, to link the Kloofsig 1 step-up substation with the nearest existing 132 kV powerline. At that junction, an Option 2 grid-connection substation (1 ha, with its short 132 kV powerline link to the existing grid) will also be constructed. The route for the 132 kV overhead powerline from the Kloofsig 1 step-up substation will follow the servitude of the nearest 400 kW line, then cross to beside the servitude of the southern access road and thereafter follow the secondary Petrusville road and latterly powerline servitudes leading to the 132 kV grid-connection substation site (Figures 2, 4 & 5). Much of the new southern 132 kV powerline linkage falls outside the initial avain assessment of Portion RE/18 of Kloof Poort, and so deserves special attention during subsequent monitoring of the development.

1.3. Subsequent Development Phases

Kloofsig 2: This second phase of development will fall immediately north of the already completed Kloofsig 1 (Figure 4). It will cover a total area of 200 ha. Most of this area will

comprise separate fixed or tracking solar arrays, mounted as modules and linked in clusters. The arrays and modules would be interconnected via medium-voltage underground cables (along with a cable or fibre-optic Supervisory Control and Acquisition System (SCAS)) to inverters (DC to 33 kV AC), and from these to a single Kloofsig 2 step-up substation at the southeast corner of the arrays for conversion of 33 kV to 132 kV. This substation would have an extent of 1 ha, and include such maintenance structures as offices and stores. A rectangular laydown area to be used during construction/maintenance, northeast of the arrays and just west of the Kloofsig 2 step-up substation, is also designated. Overhead 132 kV powerline will then link the Kloofsig 2 step-up substation to the existing Option 1 grid-connection substation and from there to the adjacent 400 kV existing powerline.

Kloofsig 3: This third and final phase of development will fall immediately south of the original Kloofsig 1 arrays (Figure 4). It will cover a total area of 500 ha, occupying the largest array extent of the phases because it has to be divided on either side of the 400 kV powerline and its servitude across Portion RE/18. Most of this area would comprise separate fixed or tracking solar arrays, mounted as modules and linked in clusters. The arrays and modules would be interconnected via medium-voltage underground cables (with a cable or fibre-optic Supervisory Control and Acquisition System (SCAS)) to inverters (DC to 33 kV AC), and from these to a single Kloofsig 3 step-up substation northeast of the arrays, for conversion of 33 kV to 132 kV. This substation will have an extent of 1 ha extent, and include such maintenance structures as offices and stores. A triangular laydown area to be used during construction/maintenance, northeast of the arrays and just east of the Kloofsig 3 substation, is also designated. A short 132 kV powerline will then link the Kloofsig 3 step-up substation to the on-site grid-connection substation.

2. ASSIGNMENT

2.1. General Protocol

I was appointed by EcoAgent CC for SRK Consulting to conduct a basic assessment of the avifaunal habitats and bird diversity for the proposed development sites and their immediate surroundings, and thereafter an environmental impact assessment (EIA) of the first Kloofsig 1 phase of the proposed development (hereafter “the site”). The

purpose of the bio-survey was to estimate the bird species expected for the area and the likelihood of their interactions with the proposed development and, with the EIA, to propose possible mitigations should the development proceed. The purposes of the survey and assessment is to provide background information, augment any existing Environmental Impact Assessments (EIAs) or Environmental Management Plans (EMPs), and recommend priorities with respect to the on-going management of any priority and/or sensitive areas or species. This assignment is conducted in accordance with the 2014 Environmental Impact Assessment (EIA) Regulations (No. R. 982, DEAT, Department of Environmental Affairs, 4 December 2014) and their latest guidelines (Notice 891 of 2014) that emanate from Chapter 5 of NEMA, the National Environmental Management Act, 1998 (Act No. 107 of 1998), as well as the National Water Act 1998 (Act 36 of 1998) and the Mineral and Petroleum Resources Development Act (MPRDA, Act No. of 2002).

In accordance with The Natural Scientific Professions Act (Act 27 of 2003), only persons registered with the South African Council for Natural Scientific Professions may practice in a consulting capacity.

This report assessment includes the results of a property visit on 17-19 April 2015 with the EcoAgent team (Prof GJ Bredenkamp, botanist; Dr IL Rautenbach, mammalogist; and Mr JCP van Wyk, herpetologist), and their resulting specialist reports were consoltued in assessing the vegetation and vertebrate fauna relative to possible avian impacts of the development.

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

2.2. Initial preparations:

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

2.3. Habitat survey:

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

2.4. Avifaunal assessment

- Obtain lists of the general avifauna and especially any Red Data bird species that can be expected in the area.
- Assess the quantitative and qualitative condition of suitable habitats for the Red-listed bird species that may occur in the area.
- Assess the possibility and probability of Red-listed avifauna being present on the study site.
- Compile a list of occurrences.
- Recommend aspects that should be monitored before, during and/or after development.
- Assess potential impacts of the proposed development on avifauna, together with possible mitigations that may be applied.

2.5. General

- Identify and describe natural areas of particular ecological sensitivity, e.g. wetlands, pans, rivers, forest and ridges.

Possible localities that could be developed and others that should be conserved and not be developed were identified, and any feasible options for mitigation were described. The results of these other specialist studies were also used to further inform this separate avifaunal assessment.

3. RATIONALE

It is widely recognised that the natural resources on Earth are essential in providing the ecological processes and life support systems that maintain healthy and viable populations of plants and animals, including humans. Therefore, for any sustainable development to take place, all possible impacts of such development on the environment must be considered before it can be approved by the relevant authorities. This has led to various and increasing legislation that protects the natural environment in South Africa. In 1992, the Convention of Biological Diversity (CBD), a landmark international convention, was signed by >90 % of members of the United Nations. In South Africa, the Environmental Conservation Act (ECA, Act 73 of 1989), the National Environmental Management Act (NEMA, Act 107 of 1998) and the National Environmental Management Biodiversity Act (NEMBA, Act 10 0f 2004) ensure the protection of ecological processes, natural systems and natural beauty, as well as the preservation of biotic diversity within the natural environment. They also ensure the protection of the environment against disturbance, deterioration, defacement or destruction as a result of man-made structures, installations, processes, products or activities. In support of these Acts, a draft list of Threatened Ecosystems was published (Government Gazette 2009), as part of the NEMBA (Act 10 of 2004). Details of these Threatened Ecosystems have been described by SANBI & DEAT (2009) and a list of Threatened or Protected Species (ToPS) regulations is also available (NEMBA Notice 388 of 2013). International and national Red Data lists have also been produced for various threatened plant and animal taxa.

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

This makes it necessary to make a thorough inventory of the biodiversity on the site, and to evaluate the ecosystems, habitats and possibility of threatened species. This inventory should then serve as a scientific and ecological basis for planning, initiating, managing and, where necessary, terminating the development. Birds, being among the

most visible and best studied group of animals, are an ideal group of so-called 'indicator' species that might signal the health and importance of any terrestrial and/or aquatic habitats.

4. SCOPE AND OBJECTIVES OF THE ASSESSMENT

- To comment on avian connectivity with natural vegetation and habitats on adjacent sites and in relevant surrounding areas.
- To recommend suitable buffer zones, if relevant.
- To provide a list of bird species which occur or might occur on site and that may be affected by the development, and to identify species of conservation concern.
- To highlight potential impacts of the proposed development on the bird species of the study site.
- To provide management recommendations that might mitigate negative and enhance positive impacts, should the proposed development be approved.

5. STUDY AREA

5.1. Regional setting

The study property and its surroundings lie within natural vegetation on the southern rim of the Gariep River valley and drain down into the river below (Figure 2). The most prominent mountains in the area are the Rhenosterberg to the east, within which the 100-km-long Vanderkloof (previously P. K. le Roux) Dam was constructed, the second-largest in South Africa by capacity (Figures 1-4). The R369 road forms the northern boundary of the property, while a minor secondary road that passes just south of the property provides the shortest route between Petrusville and Kraankuil station, and is relevant for transporting materials on the Cape Town-Kimberley railway line. Further details are available in other specialist reports.

5.2. Physical Environment

Summary based on Mucina & Rutherford (2006), with further details in other specialist assessments, and only avian-relevant details presented.

5.2.1. Regional Climate

Temperature on the property ranges from as low as -11^{o}C in the austral winter to over 40^{o}C in summer, and this Northern Upper Karoo habitat expects only 275 mm of rain annually, but with annual variance of 36%. This results on site in near drought or occasional widespread flooding, with rainfall mainly as orographic thundershowers in the summer and autumn, but more regular frontal rain in recent years (John Havenga, pers. comm.).

5.2.2. Geology and soils

The site is almost flat, with shallow wind-blown soils over a hard calcrete base, only slightly eroded by flows of rainwater to the north. Deeper soils accumulate below protruding hills and calcrete shelves, locally hills west of and a ridge across the centre of the site, and more pronounced as the Rhenosterberg further east and other scattered buttes across the western flats. The calcrete base is penetrated at scattered spots by burrows of fossorial mammals and the whole area supports high densities of termite mounds.

5.2.3. Topography and drainage

The average elevation of the general area is about 1100-1400 meters above sea level (m a.s.l.), with some of the hills and mountains rising 200-300 m above the surrounding plains. All drainage in the area is northwards into the Gariep River, the largest watercourse in the area, reaching it well before its confluence with the Vaal River. The generally flat to undulating terrain often produces long and meandering watercourses, with small pools, earth-wall dams and endorheic pans, and artificial watering points, scattered through the area.

The southern third of the property slopes only slightly to the north (1243-1204 m a.s.l.), but sufficiently for any southern flows to converge and cut through the calcrete near the farm houses (Figures 4 & 5). The cut drops at about 2.8 m/100-m (1204-1187 m a.s.l. or about 1 7 m over 600 m), forming the 4-5-m-deep Kalk Poort just north of the farmhouses. The dolerite hills and ridge pass more or less across the centre of the property, with their broader influence indicated by the deeper red wind-blown soils built up around them. The highest point on the ridge on the western boundary (1220 m a.s.l.) is notably higher than the slopes on either side, forming a sort of watershed, as do the

red soils around the southwest and south edges of the site. The original calcrete substrate continues as a plateau along the northeast side of the property, only sloping slightly northwest (1196-1167-1143 m a.s.l.). Its sides have been cut away to form a mini-escarpment on either side, deeper to the east than to the west. The long flows west of the plateau drain across a wide area before they converge on the main northern drainage lines as they exit from the northwest corner of the property.

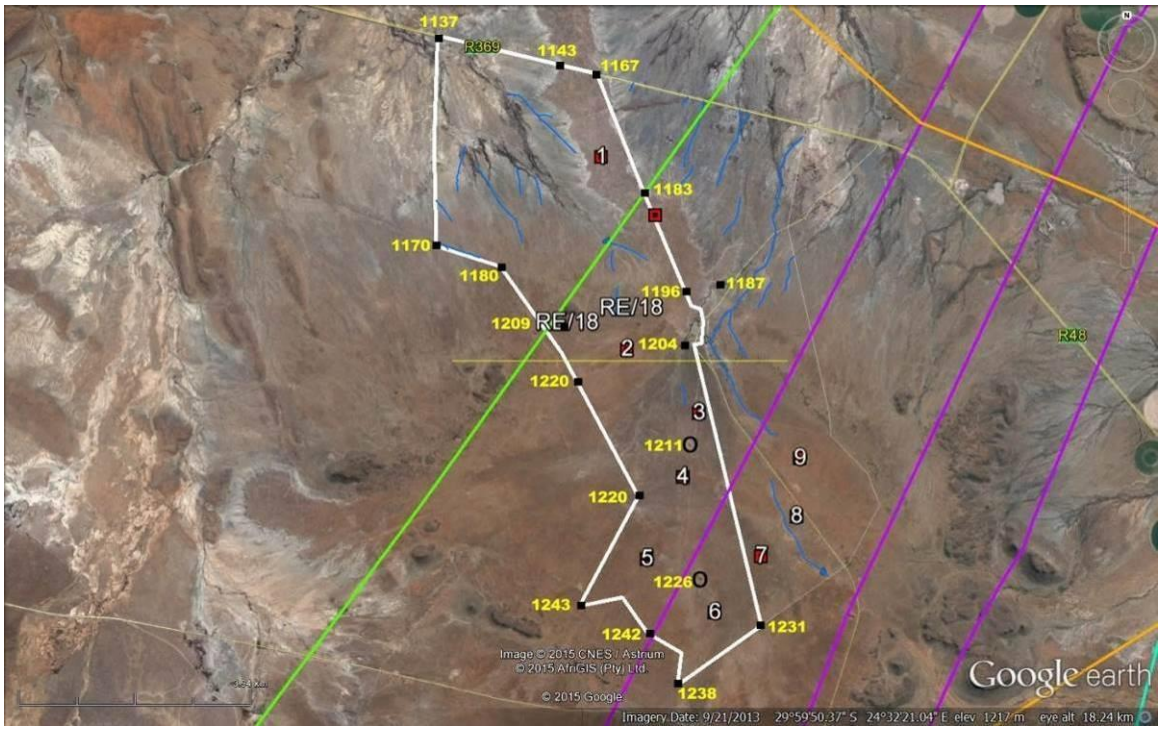

Figure 6: Close-up satellite image showing the altitudes in m a.s.l. of selected points across the property (yellow numbers by black squares) in relation to the original array sites 1-6 proposed. See Figures 1-5 for other details.

5.2.4. Land Use

Most of the farms in the area, as for the property, conduct extensive livestock and game management on natural rangelands. Closer to the river are farms with more intensive agriculture, based on crops irrigated by centre-point pivots with water from the river and a canal from the dam. Apparently, the property was suffering from the worst drought in 50 years when assessed; only slightly alleviated by modest recent rains.

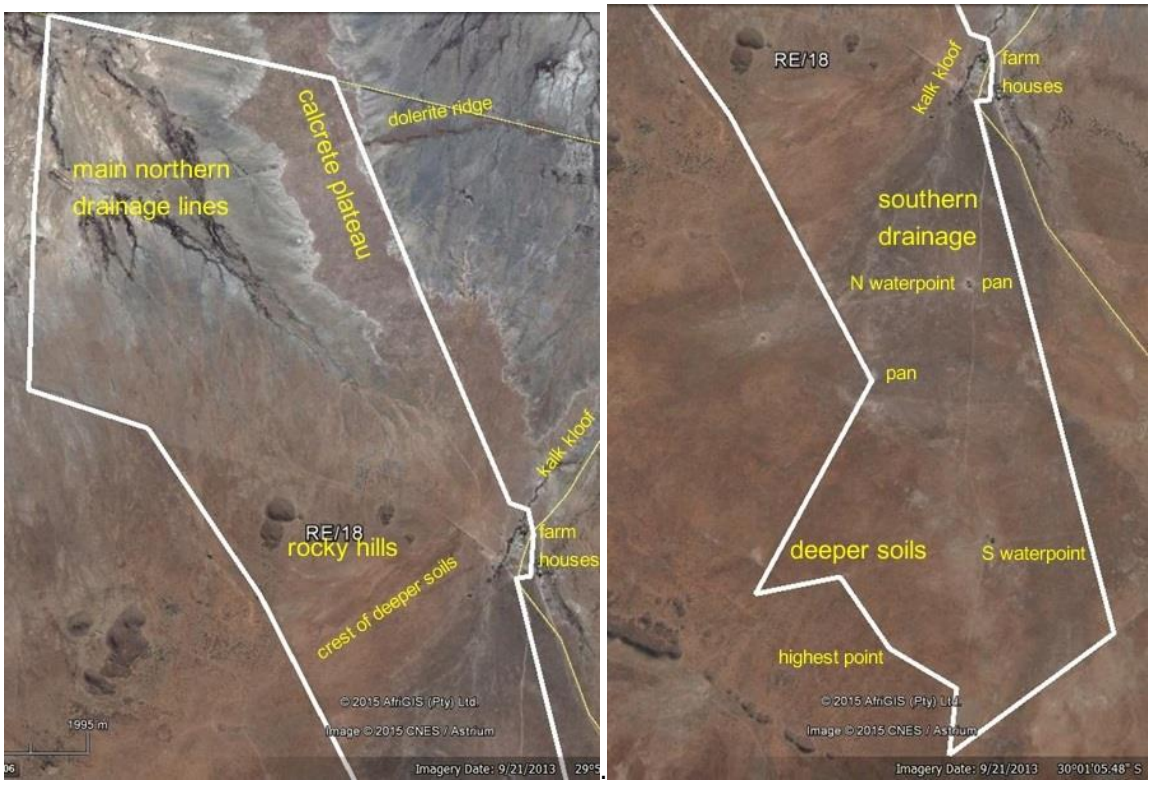

Figure 7: Close-up satellite images for the habitats in the northern (left) half of Kalk Poort RE/18, which will not be developed, and southern (right) half where development of Kloofsig phases 1-3 are proposed, each annotated with the main ecological features of the property mentioned in the text.

5.2.6. Vegetation Types

The area falls at the junction of the Nama-Karoo, Grassland and Savanna Biomes, with the site itself in only the Northern Upper Karoo vegetation unit (NKu 3 of Mucina & Rutherford 2006). Adjacent vegetation units just to the north of the site comprise Besemkaree Koppies Shrubland (Gh 4) and the southwest limits of Kimberley Thornveld (SVk 4). Overall, the study site is dominated by small shrubs and succulents, most below 50 cm, with signs that sparse grass cover fills the bare areas between after sufficient rain. Small trees and more grass occur at the northern rocky outcrops and drainage lines, with taller alien trees planted around farmyards, homesteads and watering points. Other vegetation units occur beyond the property, but easily within the range of most bird species expected on the Kloofsig 1 site (Figure 8).

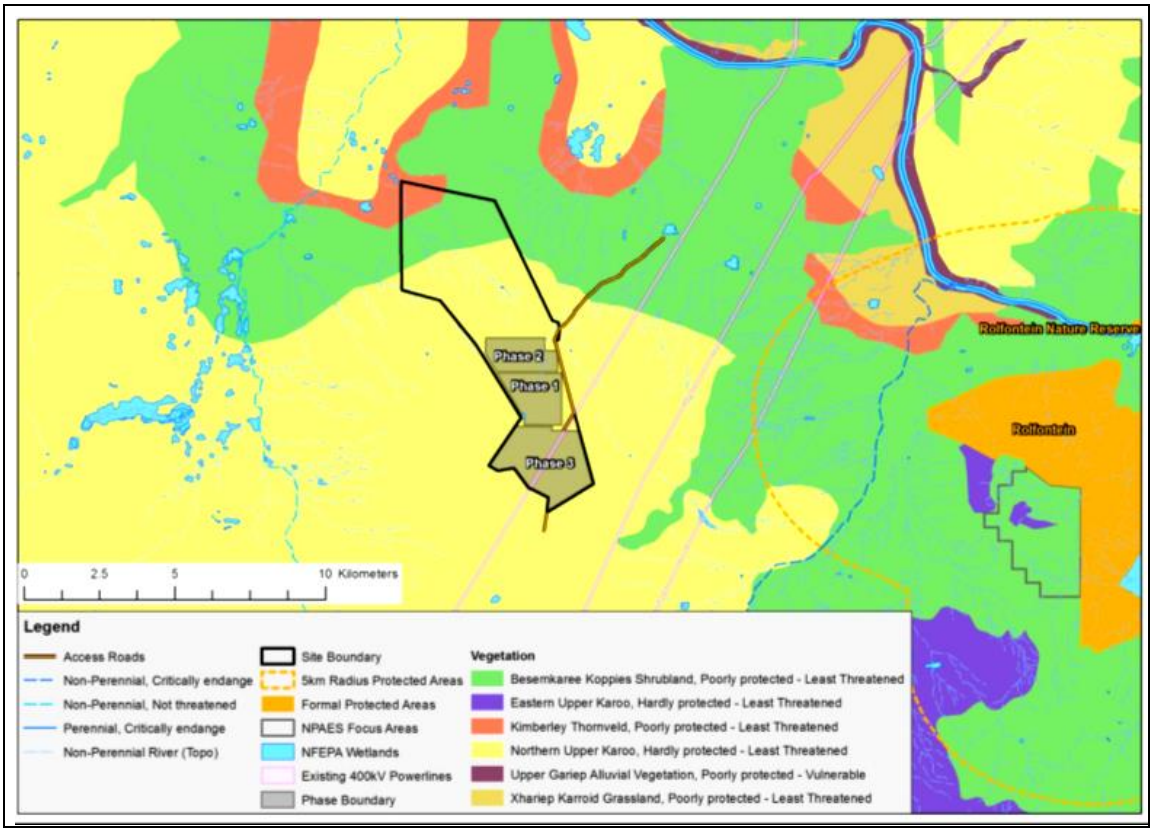

Figure 8: Main vegetation units, hydrological features and areas of conservation concern on and around Kalk Poort RE/18 and the sites for the proposed Kloofsig 1-3 developments, at about the scale that covers the sources of local birds that might visit the property and site.

5.2.7. Conservation status of habitats

All three vegetation units on and around the site are classified as Least Threatened, mainly because they fall within areas that have substrates unsuitable for and therefore not transformed by tilling, but also because they fall in drier areas of the country with low productivity, population densities and urbanisation. Other vegetation units occur on and around the property, within flying distance of most bird species expected on and around the site, some of which are more sensitive to and/or included in surrounding conservation areas (Figure 8). To the east, two provincial nature reserves (NRs), Rolfontein (80 km^2) and Doornkloof,(94 km^2, on the south bank of the Vanderkloof Dam, and the riverine and riparian corridor of the Gariep River, are important nearby potential sources for dispersal of birds onto the property. These protected NRs, and the river, form part of the extensive 12 463 km^2 Platberg-Karoo Conservancy IBA (Figure 9) that is

equally important as a source. Further afield, the Mokala National Park, 70 km west-southwest of Kimberley, and the Upper Orange River IBA (SA051), together with various smaller and more widely scattered IBAs and private or local reserves around game farms and/or dams, are also within range of a variety of bird species.

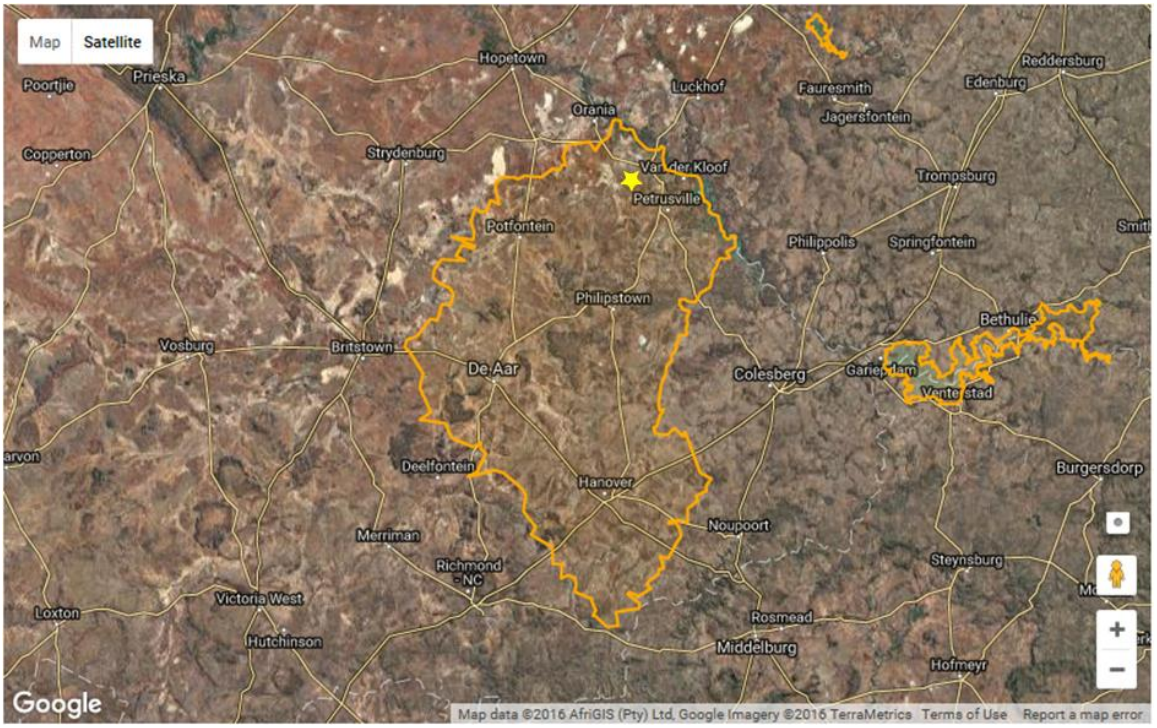

Figure 9: Boundaries of the Platberg-Karoo and Upper Orange River IBAs, grabbed from the IBA descriptions, with the approximate location of the Kloofsig 1-3 sites marked as a yellow star.

The Platberg–Karoo Conservancy (established in July 1990) is not formally protected, but various research and environmental awareness projects were initiated, including a Karoo Large Terrestrial Bird Survey, Blue Crane Awareness Project and an Eskom/EWT partnership investigation of the major threat of bird-power-line collisions. At the time of the IBA's latest assessment, a total of 289 bird species are known to occur here, obviously contributing significantly to the conservation of large terrestrial birds and raptors, even if its 214 pentads had been only poorly atlassed so far for the ongoing second Southern African Bird Atlas Project (SABAP2; Platberg-Karoo Conservancy 2015).

6. METHODS

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

6.1.1. Bird Habitats

While bird distributions have been related to broad vegetation communities, there is a general consensus internationally that vegetation structure, rather than floral composition, is the most critical parameter in most bird-habitat preferences (Allan *et al*. in Harrison *et al*. 1997). The principal vegetation units identified for birds in South Africa, based primarily on similarity in vegetation structure, are divided into four major groups **Karoo** (subdivided into Succulent, Nama and Grassy), **Grassland** (Sweet, Mixed, Sour and Alpine), **Kalahari** (South and Central), **Woodland** (Arid, Moist and Mopane), plus the discrete and smaller areas of **Fynbos**, **Valley Bushveld**, **East Coast Littoral** and **Afromontane Forest** habitat (Allan *et al*. in Harrison *et al*. 1997).

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

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

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

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

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

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

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

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

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

High: High and Medium-High conservation priority categories mentioned above are considered to have a High sensitivity and development

should not be supported. These include sensitive ecosystems with low inherent resistance and/or resilience to disturbance factors, or highly dynamic systems important for maintenance of ecosystem integrity. Most such systems represent ecosystems with high connectivity to other important ecological systems or support high species diversity and provide suitable habitat for a number of threatened or rare species.

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

6.1.2. Bird Species

On the property visit, the presence of bird species was recorded, or assessed for the probability of their occurrence based on the habitat types recognized on and around the study property. This was done with due regard to the well-recorded general distributions of southern African birds at the quarter-degree grid cell (QDGC) scale (SABAP 1, Harrison *et al*. 1997) or the smaller pentad (5' lat. x 5' long) scale (SABAP 2, on-going, Animal Demography Unit website www.adu.org.za), coupled to experience with the qualitative and quantitative nature of the habitats recognized on site. Due to the mobility of most birds, at least 500 m of adjoining properties for important faunal habitats and avian species were scanned, and note was taken of the extent and proximity of other major areas of natural habitat and conservation potential within the normal flying distance of birds expected. The assessment of the extent, qualities, and limits of the various habitat types, both on site and on adjacent properties, were extended by study of satellite images from Google Earth. While the QDGC mapping of South African bird species provides the best current information of what birds to expect where, the roughly

26-23 km (north-south) x 27.3 km (west-east) grid area usually far exceeds the area of most assessment sites and can only be expected to support regularly a subset of the QDGC species recorded, depending on the subset of possible QDGC habitats actually available on site. Furthermore, the bird species listed for each QDGC are only those recorded during the atlas survey period and not necessarily as comprehensive as they may appear, with biases neglecting cryptic and/or low-density species, and less accessible grids. The SABAP 2 distribution data offers a 9-times higher resolution than the SABAP 1 data, useful for smaller sites when the relevant pentad has been repeatedly and adequately surveyed, but still ongoing and only comparable historically to SABAP 1 when reduced back to the QDGC resolution.

6.1.3. Field Survey

Birds are a relatively visible and audible group of homoeothermic vertebrates, active throughout the day/night and year, and with habitat preferences that we can evaluate both by reference to the comprehensive literature available and by the subset of species detected during a field survey done at a particular season and time of day/night. Such information and personal experience also informs searches for particular species of conservation concern.

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

6.1.4. Desktop Survey

Three criteria were used to gauge the probability of occurrence of bird species on the study site: their known distribution range, their habitat preference(s) and the quality and extent of suitable habitat(s) on site. Initially, I derived and compared lists of bird species expected to occur on site from the QDGC records presented in atlases of southern African birds (Harrison et al. 1997; www.sabap2.org.za). Based on an assessment of the habitats present on site, and on the most recent regional field and sound guides for the area (Gibbon 2011, Sinclair *et al*. 2011), the list was then reduced to those species

recorded on site during this study, or expected subjectively to occur within those habitats as either resident species or regular visitors.

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

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

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

No objective assessment was made of the avian community structure or the carrying capacity of any habitat for any species, since this varies through time, birds being particularly capable of arriving or departing as conditions change, and our ability to

detect them also varying seasonally. These limitations are especially relevant to short-term assessment of the Karoo avifauna at a particular site, given the unpredictable, erratic and stochastic nature of the spatio-temporal changes in temperature and rainfall events, which so influence the regional and local fluctuations in Karoo habitat conditions and faunal dispersion and density (e.g. Dean 2004, Esler *et al.* 2006, Dean *et al.* 2009, Dean & Milton 2009). However, special attention was paid to species considered as threatened internationally or nationally, so-called Red Data or Red-listed species (Birdlife International website www.birdlife.org; DEAT 2007; Taylor *et al*. 2015), and so for any threatened species expected even to visit the area the status category assigned to them was elevated based on the Precautionary Principle.

7. RESULTS

The property visit on 17-19 April 2015 was made in late summer after most Palaearctic and intra-African migrant bird species had departed. The weather during the visit was mild and clear for most of the time, with only a slight breeze. The visit addressed the whole of the Kalk Poort RE/18 property, and at least 500 m of its immediate surroundings, rather than just the final development sites selected for each phase of Kloofsig 1-3. The aerial mobility of birds requires assessment of not just what birds are recorded on site, but also those that might at times be expected to visit from surrounding habitats within their flight range: quite different from the residence and/or dispersal of most earth-bound plants and other faunal groups.

7.1. Regional Bird Habitats

Details of the vegetation communities and flora, mammals and herpetofauna form a separate specialist biodiversity report for the property and site, which should be consulted for further details. For connectivity of avian populations, their aerial mobility demands attention to the principal habitats surrounding the study property and their conservation status, not just those along the immediate borders, but also more distant habitats that might provide sources for species visiting the site and sinks for those breeding on site, as addressed in Section 5.2.7 above.

7.2. On-property Bird Habitat Assessment

The broader habitats adjacent to the study sites are mainly extensions of those present on the property, or mentioned specifically in the habitat types described below. It was

notable that in general the neighbouring properties appeared less heavily browsed/grazed and therefore as good sources of local species. I did not assign aerial-feeding species, such as swifts, martins and swallows, to a specific habitat on site, except for those habitats that offered potential nesting habitats, since they feed wherever aerial wind-borne plankton is available. Four principal avian habitat types were distinguished on and/or adjacent to the Kloofsig 1 site, and considered most relevant to its avian ecology, community structure and connectivity. Their approximate extent relative to the developments and surrounding areas can be visualized from satellite images (Figures 3-7 & 9) and a map (Figure 8).

- **Shrubland on calcrete and sand** (Figures: 10, 11, 13). This typical Karoo *bossiesveld* habitat was the most extensive on the Kloofsig 1 site. It consisted of a mosaic of different plant species, densities and heights, even though most were less than 50 cm high. Grass cover was sparse between the woody shrubs, except in patches where the recent light rains had penetrated sufficiently, but more grass cover is expected during periods of high rainfall. Further north, shrubs were significantly smaller and sparser on the northern plateau, and taller in deeper sandy soils around the base of steep slopes around the hills and below the calcrete 'escarpment' where *Rhigozum* was dominant.
- **Thornveld and drainage lines** (Figure: 14). This obviously taller and woodier habitat was most widely represented to the north of the Kloofsig 1 site, along the northwest and lower southeast drainage lines, with *Vachellia karroo* predominant. Included in this habitat, mainly for their woody and structural similarity plus distinctiveness within the area, were the trees along and above the moister Kalk Poort drainage itself, and around the moister farmyard developments together with various taller alien trees (eucalypts, poplars, mesquites), but with significant *Ziziphus* and *Searsia* numbers, a few just extending south into the northeast corner of Kloofsig 1. On Kloofsig 1 itself, only the northern watering point had a few larger indigenous and alien trees although, in an avifaunal sense, these, and the line of pylons passing near the site add a 3-dimensional structural options on the scrublands, offering hunting and roost perches, even nest sites to some species.
- **Rocky outcrops**. The calcrete base to the scrublands on Kloofsig 1 has none of the rocky hills and ridges to the north of the property. These examples are small relative to others in the general area, but larger rocky dolerite outcrops and hills

occur just north of the Kloofsig 1 132kV servitude that will extend southeast from the Kalk Poort RE/18 property. These outcrops constitute the most significant landmarks and stepping 'stones' for connectivity of rupicolous species, among the bare dolerite boulders, more trees (especially *Searsia*) and taller, and the denser grasses on the deeper soils between them and around their bases. Because of the hard, sheltered substrates they provide, buildings and other manmade structures were also included with this habitat type.

- **Water bodies** (Figure: 12, 14). Any water bodies in an area of such sparse rainfall are ephemeral, except for tanks and troughs that artificially provide water for human and livestock consumption. Two small dry endorheic pans were noted on the site visit, which both fall on the Kloofsig 1 site. Further north, and some of the small earth-wall dams, across drainage lines and/or fed by drainage channels, also held water, the results after an extend period of drought followed by recent light rains. However, the infrequent heavy rains sometimes experienced offer a completely different picture, of 'lakes' formed in the southern drainage area that would include much of Kloofsig 1 (cf. Figure 7), while in the northern drainage areas streams flow, pans and dams fill and even support significant marginal vegetation (John Havenga, pes. comm.). Whatever the rainfall, water bodies on site will always be temporary, so the list of aquatic species regularly expected for the site is reduced accordingly, but with the caution that extreme rainfall events may briefly attract unexpected numbers and species of water birds, and provide useful stopover sites, depending on the extent of simultaneous rainfall in surrounding areas.

Table 1: Rating of recognised on-property avian habitats (site + 500 m buffer) on and around the proposed Kloofsig solar PV facility on the farm Kalk Poort RE/18, Petrusville, Northern Cape.

Avian Habitats	Conservation Priority					Sensitivity	
	High	Medium -high	Medium	Medium -low	Low	High	Low
1. Shrubland on calcrete			X				X
2. Thornveld			X				X
3. Rocky outcrops		X				X	
4. Water bodies				X			X

Images of habitats relevant to the Kloofsig 1 development

Figure 10: View northeast from the southern point of Kalk Poort RE/18 where the proposed Kloofsig 1, 132kV powerline will exit the Kalk Poort RE/18 property, showing the flat open scrubland, the substrate green after light recent rains and the site more grazed/browsed than the neighbouring property. Note the Rhenosterberg, just visible in the distance, the smaller eastern ridges the proposed powerline will reach and the numerous termite mounds.

Figure 11: View north from the same point as Figure 10. The proposed Kloofsig 1, 132 kV powerline will arrive at this point, just inside (right of) the fence (cf. Figure 5), having followed the servitude of the existing 400kV pylons visible on the northwest (left) horizon. The track alongside the fence will become an extension of the proposed southern access road.

Figure 12: View west over the ephemeral small endorheic pan within the calcrete, showing the shallow soils at this southern indent of the site boundary and fence, which will be at the southwest corner of the proposed Kloofsig 1 development (cf. Figures 4, 5 & 7). A Ludwig's Bustard was seen where the image was taken.

Figure 13: View south from the northeast corner of the Kloofsig 1 site taken in October 2016, showing the scrub vegetation on a calcrete base and with the tree clump around the northern water point (cf. Figure 7) in the distance.

Figure 14: View east at the northern water point (cf. Figure 7) on the east side of the Kloofsig 1 site, about opposite the northern end of the laydown area (cf. Figure 5). The windmill and a small pan just behind the trees both stand on the calcrete floor of the main part of the southern drainage system (cf. Figure 7).

7.3. Expected and Observed Bird Species Diversity

The property falls just west of the junction of two QDGCs (2924DC HAVENGABRUG and 3024BA PETRUSVILLE), in pentad 2955_2430. Out of the 139-147 species expected for the property during 1987-1991, based on the two QDGCs (SABAP 1), and including the few species so far reported on a single card for the pentad since 2009 (SABAP2), and a few other species expected based on a desktop study, it was assessed that 158 bird species have a **high**, **medium** or **low probability** to occur on site, based on the habitats available. Of these, the presence of 57 species (36%, 9 of them reported by the landowners) was confirmed, which offers a good sample in support of general species:habitat correlations (Table 2). The number would surely have been higher if we had spent more days/seasons in search of species, if the surveys had started earlier and extended later in the day/night, if the full range of seasons and conditions was included, and if we had covered every sector in more detail. I assessed 77 species (49%) as having a high probability of occurrence, 43 species (27%) a medium probability and 38 species (24%) a low probability, and of these the presence of 43, 9 and 5 species, respectively, was confirmed. The total number of species expected

would also be much larger if other **unlikely** species, which are only recorded as rare vagrants to the area, were not excluded from this analysis due to inadequate availability of their preferred habitat(s).

Table 2: Bird species diversity observed and expected on and around the proposed Kloofsig solar PV facility on the farm Kalk Poort RE/18, Petrusville, Northern Cape (2924DC). Based on the national list and annotations of Birdlife South Africa (2014), sorted in the order of 'Roberts VII' (Hockey *et al*. 2005), with probability of occurrence and habitat preferences assessed after a property visit on 18-19 April 2015 and comparison with lists from SABAP 1 & 2 (Harrison *et al*., 1997; www.sabap2.org). Species in bold font were detected on the site visit, and those reported by the landowners asterisked.

Common English Name	Scientific Name	Status Codes (see below)			Probability of occurrence (see 5.1 above)			Preferred Habitats (see 7.2 above)
		RD	S	E	High	Medium	Low	
***Orange River francolin**	***Scleroptila levaillantoides***					**M**		**1**
***Swainson's Spurfowl**	***Pternistis swainsonii***						**L**	**2**
***Common Quail**	***Coturnix coturnix***		**NBM**			**M**		**1**
Helmeted Guineafowl	***Numida meleagris***				**H**			**1,2**
Lesser Honeyguide	*Indicator minor*						L	2
Cardinal Woodpecker	*Dendropicos fuscescens*						L	2
Acacia Pied Barbet	*Tricholaema leucomelas*						L	2
African Hoopoe	*Upupa africana*				H			1,2,3
Common Scimitarbill	*Rhinopomastus cyanomelas*						L	2
Swallow-tailed Bee-eater	*Merops hirundineus*					M		1,2
European Bee-eater	*Merops apiaster*		**B/NBM**			M		1,2
White-backed Mousebird	*Colius colius*				H			2
Red-faced Mousebird	***Urocolius indicus***				**H**			**2**
Diderick Cuckoo	*Chrysococcyx caprius*		**BM**		H			2
Alpine Swift	*Tachymarptis melba*		**BM**		H			Aerial
Common Swift	*Apus apus*					M		Aerial
Bradfield's Swift	*Apus bradfieldi*					M		Aerial
Little Swift	*Apus affinis*				H			Aerial,3
White-rumped Swift	*Apus caffer*		**BM**		H			Aerial,3
Barn Owl	*Tyto alba*				H			2,3
Spotted Eagle-Owl	***Bubo africanus***				**H**			**1,2,3**
Rufous-cheeked Nightjar	*Caprimulgus rufigena*		**BM**		H			1,2,3
Rock Dove	***Columba livia***				**H**			**3**
Speckled Pigeon	***Columba guinea***				**H**			**2,3**
Laughing Dove	***Streptopelia senegalensis***				**H**			**1,2,3**

Common English Name	Scientific Name	Status Codes (see below)			Probability of occurrence (see 5.1 above)			Preferred Habitats (see 7.2 above)
		RD	S	E	High	Medium	Low	
Cape Turtle-Dove	***Streptopelia capicola***				**H**			**1,2,3**
Red-eyed Dove	***Streptopelia semitorquata***						**L**	**2**
Namaqua Dove	***Oena capensis***				**H**			**1,2**
Ludwig's Bustard	***Neotis ludwigii***	**EN,EN**			**H**			**1**
***Kori Bustard**	***Ardeotis kori***	**NT,NT**			**H**			**1**
Northern Black Korhaan	***Afrotis afraoides***				**H**			**1**
Karoo Korhaan	*Eupodotis vigorsii*	**NT,LC**				M		1
Blue Korhaan	*Eupodotis caerulescens*	**LC,NT**					L	1
***Blue Crane**	***Anthropoides paradiseus***	**NT,VU**					**L**	**1,2,4**
Namaqua Sandgrouse	***Pterocles namaqua***				**H**			**1,4**
Marsh Sandpiper	*Tringa stagnatilis*		NBM				L	4
Common Greenshank	*Tringa nebularia*		NBM				L	4
Wood Sandpiper	*Tringa glareola*		NBM				L	4
Common Sandpiper	*Actitis hypoleucos*		NBM				L	4
Ruff	*Philomachus pugnax*		NBM				L	4
Spotted Thick-knee	*Burhinus capensis*				H			1,2,3
Black-winged Stilt	*Himantopus himantopus*						L	4
Pied Avocet	*Recurvirostra avosetta*						L	4
Kittlitz's Plover	*Charadrius pecuarius*						L	4
Three-banded Plover	*Charadrius tricollaris*					M		4
Blacksmith Lapwing	*Vanellus armatus*						L	4
Crowned Lapwing	***Vanellus coronatus***				**H**			**1,2**
Double-banded Courser	*Rhinoptilus africanus*	**NT,LC**			H			1
Burchell's Courser	*Cursorius rufus*	**VU,LC**				M		1
Black-shouldered Kite	*Elanus caeruleus*				H			1,2,3
Yellow-billed Kite	*Milvus aegyptius*					M		1,2,3
White-backed Vulture	*Gyps africanus*	**EN,EN**					L	1,2,3
Cape Vulture	*Gyps coprotheres*	**EN,VU**					L	1,2,3
Lappet-faced Vulture	*Aegypius tracheliotos*	**EN,VU**					L	1,2,3
Black-chested Snake-Eagle	*Circaetus pectoralis*					M		1,2,3
Black Harrier	*Circus maurus*	**EN,VU**		**(*)**			L	1
Southern Pale Chanting Goshawk	***Melierax canorus***				**H**			**1,2,3**
Gabar Goshawk	*Melierax gabar*				H			2,3
Steppe Buzzard	*Buteo buteo*		**NBM**		H			1,2,3
Jackal Buzzard	***Buteo rufofuscus***			**(*)**	**H**			**2,3**
Tawny Eagle	*Aquila rapax*	**EN,LC**					L	1,2,3
Verreaux's Eagle	*Aquila verreauxii*	**VU,LC**				M		3

Common English Name	Scientific Name	Status Codes (see below)			Probability of occurrence (see 5.1 above)			Preferred Habitats (see 7.2 above)
		RD	S	E	High	Medium	Low	
Martial Eagle	*Polemaetus bellicosus*	EN,VU					L	1,2,3
***Secretarybird**	***Sagittarius serpentarius***	VU,VU			**H**			**1,2**
Lesser Kestrel	*Falco naumanni*		NBM			M		1,2
Rock Kestrel	*Falco rupicolus*					M		1,2,3
Greater Kestrel	***Falco rupicoloides***				**H**			**2,3**
Lanner Falcon	*Falco biarmicus*	VU,LC			H			1,2,3,4
Black-headed Heron	***Ardea melanocephala***						**L**	**1,2**
Cattle Egret	*Bubulcus ibis*					M		1,2
***Hadeda Ibis**	***Bostrychia hagedash***					**M**		**2**
***African Sacred Ibis**	***Threskiornis aethiopicus***						**L**	**4**
African Spoonbill	*Platalea alba*						L	4
Black Stork	*Ciconia nigra*	VU,LC					L	4
Abdim's Stork	*Ciconia abdimii*	NT,LC	NBM				L	1,2,4
***White Stork**	***Ciconia ciconia***		NBM			**M**		**1,2,4**
Fork-tailed Drongo	*Dicrurus adsimilis*						L	2
Crimson-breasted Shrike	***Laniarius atrococcineus***				**H**			**2**
Bokmakierie	*Telophorus zeylonus*				H			1,2,3
Pririt Batis	*Batis pririt*				H			2
Cape Crow	*Corvus capensis*					M		1,2
Pied crow	***Corvus albus***				**H**			**1,2,3,4**
Red-backed Shrike	*Lanius collurio*		NBM		H			1,2
Lesser Grey Shrike	*Lanius minor*		NBM			M		1,2
Common Fiscal	***Lanius collaris***				**H**			**1,2,3**
Cape Penduline-Tit	*Anthoscopus minutus*				H			2
Ashy Tit	***Parus cinerascens***				**H**			**2**
Barn Swallow	*Hirundo rustica*		NBM		H			Aerial
Greater Striped Swallow	*Cecropis cucullata*		BM		H			Aerial,3
South African cliff-Swallow	*Petrochelidon spilodera*			B(*)	H			Aerial
Rock Martin	*Hirundo fuligula*					M		Aerial,3
African Red-eyed Bulbul	***Pycnonotus nigricans***				**H**			**2**
Fairy Flycatcher	*Stenostira scita*			(*)		M		2
Long-billed crombec	*Sylvietta rufescens*					M		2
Yellow-bellied Eremomela	***Eremomela icteropygialis***				**H**			**2**
Karoo Eremomela	*Eremomela gregalis*			(*)		M		1,2
Layard's Tit-Babbler	***Sylvia layardi***			(*)		**M**		**1,2**
Chestnut-vented Tit-Babbler	***Sylvia subcaerulea***					**M**		**2**
Orange River White-eye	*Zosterops pallidus*					M		2,3

Common English Name	Scientific Name	Status Codes (see below)			Probability of occurrence (see 5.1 above)			Preferred Habitats (see 7.2 above)
		RD	S	E	High	Medium	Low	
Grey-backed Cisticola	*Cisticola subruficapilla*					M		3
Desert Cisticola	*Cisticola aridulus*				H			1,2
Black-chested Prinia	*Prinia flavicans*				H			2,3
Karoo Prinia	*Prinia maculosa*					M		1
Rufous-eared Warbler	***Malcorus pectoralis***				**H**			**1**
Cinnamon-breasted Warbler	*Euryptila subcinnamomea*			**(*)**		M		3
Eastern clapper Lark	***Mirafra fasciolata***				**H**			**1**
Sabota Lark	***Calendulauda sabota***				**H**			**2**
Spike-heeled Lark	***Chersomanes albofasciata***				**H**			**1**
Karoo Long-billed Lark	*Certhilauda subcoronata*						L	3
Grey-backed Sparrowlark	*Eremopterix verticalis*				H			1,2
Red-capped Lark	***Calandrella cinerea***				**H**			**1,2**
Stark's Lark	*Spizocorys starki*						L	1
Pink-billed Lark	*Spizocorys conirostris*						L	1
Large-billed Lark	***Galerida magnirostris***			**(*)**		**M**		**1**
Short-toed Rock-Thrush	*Monticola brevipes*					M		3
Karoo Thrush	***Turdus smithi***			**(*)**			**L**	**2**
Chat Flycatcher	*Bradornis infuscatus*					M		2
Fiscal Flycatcher	*Sigelus silens*			**(*)**		M		2
Spotted flycatcher	*Muscicapa striata*		**NBM**				L	2
Cape Robin-Chat	*Cossypha caffra*						L	2
Kalahari Scrub-Robin	***Erythropygia paena***				**H**			**2**
Karoo Scrub-Robin	***Erythropygia coryphoeus***				**H**			**1,3**
African StoneChat	*Saxicola torquatus*						L	4
Mountain Wheatear	***Oenanthe monticola***					**M**		**3**
Capped Wheatear	***Oenanthe pileata***				**H**			**1**
Sickle-winged Chat	***Cercomela sinuata***			**(*)**	**H**			**1**
Familiar Chat	***Cercomela familiaris***				**H**			**1,2,3**
Ant-eating Chat	***Myrmecocichla formicivora***				**H**			**1**
Pale-winged Starling	***Onychognathus nabouroup***					**M**		**2**
Cape Glossy Starling	***Lamprotornis nitens***				**H**			**2**
Pied Starling	*Lamprotornis bicolor*			**(*)**		M		1,2
Wattled Starling	*Creatophora cinerea*				H			1,2,3
Malachite Sunbird	*Nectarinia famosa*						L	2
Dusky Sunbird	***Cinnyris fuscus***				**H**			**2,3**
Scaly-feathered Finch	*Sporopipes squamifrons*					M		2
White-browed Sparrow-Weaver	***Plocepasser mahali***				**H**			**2**

Common English Name	Scientific Name	Status Codes (see below)			Probability of occurrence (see 5.1 above)			Preferred Habitats (see 7.2 above)
		RD	S	E	High	Medium	Low	
Southern Masked-Weaver	***Ploceus velatus***				**H**			**2**
Red-billed Quelea	*Quelea Quelea*				H			1,2
Southern Red Bishop	***Euplectes orix***				**H**			**1,2**
African Quailfinch	*Ortygospiza fuscocrissa*						L	1
Red-headed Finch	*Amadina erythrocephala*					M		2
Common Waxbill	*Estrilda astrild*				H			2,4
Red-billed Firefinch	*Lagonosticta senegala*					M		2,3
Pin-tailed Whydah	*Vidua macroura*					M		1,2,3,4
House Sparrow	*Passer domesticus*		I		H			3
Cape Sparrow	***Passer melanurus***				**H**			**2,3**
Southern Grey-headed Sparrow	*Passer diffuses*				H			2
Cape Wagtail	***Motacilla capensis***				**H**			**4**
African Pipit	***Anthus cinnamomeus***				**H**			**1**
Buffy Pipit	***Anthus vaalensis***				**H**			**1**
Cape Canary	*Serinus canicollis*					M		2
Black-headed Canary	*Serinus alario*			**(*)**		M		1
Black-throated Canary	*Crithagra atrogularis*				H			2
Yellow Canary	***Crithagra flaviventris***				**H**			**1,2,3**
White-throated Canary	*Crithagra albogularis*				H			1,2
Lark-like Bunting	***Emberiza impetuani***				**H**			**1**
Cinnamon-breasted Bunting	*Emberiza tahapisi*				H			2,3
Cape Bunting	*Emberiza capensis*					M		3

Red Status	Status in south Africa (S)	Endemism in South Africa (E)
T = Threatened	BM = breeding migrant	Endemism in South Africa (E) (not southern Africa as in field guides)
NT = Near-Threatened	NBM = non-breeding migrant	
Vul = Vulnerable	V = vagrant	* = endemic
E = Endangered	I = introduced	
CE = Critically Endangered	R = rare	(*) = near endemic (i.e. ~70% or more of population in RSA)
RE = Regionally Extinct	PRB = probable rare breeder	B* = breeding endemic
§ = Refer to footnote	RB = rare breeder	B(*) = breeding near endemic
	RV = rare visitor	W* = winter endemic
Red Status is from *The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland, Taylor* et al. *(2015).*		

The four different habitat types that were distinguished either support or are expected to support somewhat different species of birds (Table 2). Only 3 generalist species (2%) are expected to use all four habitat-types, excluding the 9 species (6%) classed as aerial feeders and expected to range across all habitats when feeding. For the 148 non-aerial species expected, while only 3 species (2%) preferred four habitats, 25 (17%) preferred three, 35 (24%) two, and 86 (57%), the majority, only a single habitat type. Based on a total of 277 assessments of predicted habitat preference, wooded thornveld thickets and scrubland are potentially the two richest and most distinctive habitat, predicted to be used by 107 (39%) and 84 (30%) respectively of the expected species' choices. Rocky outcrops are preferred by an estimated 58 species (21%), with 29 species (10%) regularly at water bodies. The nine aerial-feeding species are included within the above analysis, not only for all the habitats they range across when feeding, but also if there are terrestrial habitats that some might use for breeding. Overall, thornveld thickets are expected to support a high diversity relative to their limited extent, scrublands a significant diversity despite their large extent, but rocky outcrops and water bodies lower diversities of rupicolous and aquatic species.

On the particular Kloofsig 1 site, due to its proximity to other neighbouring habitats (Besemkaree Koppies Shrubland, Kimberley Thornveld and the Gariep River), visitation by a wider range of bird species is expected than if the site was only surrounded by Nama-Karoo ecosystems. For this reason, the probability of species on the site is taken to be the same as for the whole Kalk Poort RE/18 property (Table 2), but with the species that prefer avian habitat-type 1 (Shrubland on calcrete and sand; see 7.2) those more likely to be resident (see 6.1.4).

7.4. Threatened and Red-Listed Bird Species

By the Scientific Community

Based on the most recent assessment of the threatened status of South Africa's avifauna (Taylor *et al.* 2015), a total of 16 Red Data avifaunal species are expected possibly to use the property and its surroundings, given the quantity and quality of the habitats available (Table 1). One of these species (**Ludwig's Bustard**) has already been reported for the pentad within which the property falls, and others within the surrounding

pentads of the two QDGCs, 10 up to 1998 (SABAP1) but only eight so far during the period of the ongoing Southern African bird atlas project that started in 2009 (SABAP2).

Most of these threatened species fall into a few obvious categories by habitat preference (Table 3) and their likelihood of occurrence on site by habitat extent and quality (Table 4); especially once one appreciates what use the habitats on site are to their basic diurnal and annual requirements (Table 5).

Table 3: List of threatened species that will possibly make use of the habitats on and around the proposed site for the Kloofsig solar PV facility on the farm Kalk Poort RE/18, Petrusville, Northern Cape (2924DC). Note one species may have more than one habitat preference. * indicates species recorded for the site's pentads, + from other pentads within the QDGCs since 2009, or - from QDGCs prior to 1997 (sabap2.org.za).

Threatened Status	Species	Preferred Habitat Type(s)			
		Scrubland	Thornveld	Rocky outcrops	Water bodies
Least Concern	-Blue Korhaan	X			
Near Threatened	Kori Bustard+	X			
	-Karoo Korhaan+	X			
	-Blue Crane+	X			X
	-Double-banded Courser+	X			
	Abdim's Stork	X	X		
Vulnerable	-Burchell's Courser	X			
	-Verreauxs' Eagle++			X	
	-Secretarybird+	X	X		
	-Lanner Falcon+	X	X	X	X
	Black Stork				X
Endangered	Ludwig's Bustard*+	X			
	White-backed Vulture	X	X		
	-Cape Vulture	X	X		
	Lappet-faced Vulture	X	X		
	Black Harrier	X			
	-Tawny Eagle	X	X	X	X
	Martial Eagle	X	X	X	X
TOTALS	**18**	**16**	**8**	**4**	**5**

Table 4: The expected frequency of occurrence of threatened bird species on and around the proposed site for the Kloofsig solar PV facility on the farm Kalk Poort RE/18, Petrusville, Northern Cape (2924DC), based on the quantity and quality of habitats available. * indicates species recorded for the site's pentads, + from other pentads within the QDGCs since 2009, or - from QDGCs prior to 1997 (sabap2.org.za).

Threatened Status	Species	Expected frequency of occurrence on site			
		Regular resident	Frequent visitor	Erratic visitor	Infrequent vagrant
Least Concern	-Blue Korhaan				X
Near Threatened	Kori Bustard+		X		
	-Karoo Korhaan+	X			
	-Blue Crane+			X	
	-Double-banded Courser+		X		
	Abdim's Stork				X
Vulnerable	-Burchell's Courser			X	
	-Verreauxs' Eagle++			X	
	-Secretarybird+		X		
	-Lanner Falcon+		X		
	Black Stork				X
Endangered	Ludwig's Bustard*+	X			
	White-backed Vulture				X
	-Cape Vulture				X
	Lappet-faced Vulture				X
	Black Harrier				X
	-Tawny Eagle				X
	Martial Eagle				X
TOTALS	**18**	**2**	**4**	**3**	**9**

The majority of threatened species (16/18) are expected to make use primarily of the scrubland on calcrete and sand (Table 3). Generalist predators (**Lanner Falcon, Tawny** and **Martial Eagles**) are expected to seek faunivorous prey over all habitats, while scavengers (**White-backed, Cape** and **Lappet-faced Vultures**) and terrestrial hunters (**Abdim's Stork, Secretarybird)** are also likely to locate food in the thornveld. The specialist **Verreauxs' Eagle** is expected only to visit for hunting hyrax on the rocky

outcrops and the **Black Stork** aquatic prey in the ephemeral water bodies. The **Blue Crane** is expected only water bodies are available to roost in.

Table 5: Estimated suitability of favoured habitats to support requirements of threatened bird species on and around the proposed site for the Kloofsig solar PV facility on the farm Kalk Poort RE/RE/18, Petrusville, Northern Cape (2924DC), based on the quantity and quality of habitats available and scored as Good (G), Mediocre (M), Poor (P), Absent (A) or Not Applicable (N/A). * indicates species recorded for the site's pentads, + from other pentads within the QDGCs since 2009, or - from QDGCs prior to 1997 (sabap2.org.za).

Threatened Status	Species	Potential support for:			
		Movement	Feeding	Roosting	Breeding
Least Concern	-Blue Korhaan	M	P	G	P
Near Threatened	Kori Bustard+	G	M	G	P
	-Karoo Korhaan+	G	M	G	M
	-Blue Crane+	M	P	P	P
	-Double-banded Courser+	G	M	G	M
	Abdim's Stork	P	P	P	NA
Vulnerable	-Burchell's Courser	M	M	G	M
	-Verreauxs' Eagle++	G	G	P	A
	-Secretarybird+	G	G	P	A
	-Lanner Falcon+	G	G	M	P
	Black Stork	P	P	A	A
Endangered	Ludwig's Bustard*+	G	G	G	M
	White-backed Vulture	M	P	P	A
	-Cape Vulture	M	P	P	A
	Lappet-faced Vulture	M	P	P	A
	Black Harrier	M	M	A	NA
	-Tawny Eagle	P	P	P	A
	Martial Eagle	P	P	P	P
TOTALS	**18**	**G7;M7,P4**	**G4;M5;P9**	**G5;M1,P9;A2**	**M4;P5;A7;NA2**

Only two species can be expected as regular residents, both of them bustards near-endemic to the Karoo habitats (**Karoo Korhaan, Ludwig's Bustard**), the former sedentary, and the latter nomadic, seen on feeding site and at least three more passing over (Table 4). Four more species are expected as frequent visitors (**Kori Bustard, Double-banded Courser, Secretarybird, Lanner Falcon**), the former two possibly breeding there during ideal conditions, the latter two less likely due to a virtual lack of

suitable nest sites. Three species are expected only as erratic visitors (**Blue Crane, Burchell's Courser, Verreauxs' Eagle**) because their habitats are only erratically suitable and ecologically restricted in time (crane, courser) or space (eagle). The other nine species are expected only as infrequent vagrants, passing through en route to and from more favourable habitats elsewhere.

The habitats on the property are considered good to adequate in support of the movements of most species, but less attractive if they need to stop to feed on passage through the site (Table 5). The property provides good to reasonable roost sites for only six species, low quality roosts for 10 species and a lack of preferred roost sites for two species. Because the habitat on the property seems more heavily utilized and disturbed than several neighbouring areas, the opportunities for breeding on site are expected to be only mediocre to poor for most species, even for ground-nesters. Two species are non-breeding visitors and no good-quality nest sites are available on site for seven species. Of the poor-quality nesting opportunities on site, hopefully some occasionally become more suitable, or else the species nests elsewhere in similar habitat nearby (e.g. Martial Eagle and Lanner Falcon on pylons).

Under the pre-2015 Red Data listings (Barnes 2000), 11 of the expected species were reported as threatened for the 2924DC and 3024BA QDGCs under SABAP 1, with no additional species more recently reported under SABAP 2. In addition to the species already listed as possible to occur on site above, Lesser Kestrel from previous listings has been omitted because it is no longer classified as threatened.

By the Biodiversity Act No 10 of 2004

The following species expected on Kalk Poort RE/18 are listed under Government Notice 2007 of the NEMBA 2004 Act:

Endangered: Blue Crane, White-backed Vulture, Cape Vulture, Lappet-faced Vulture.
Vulnerable: Tawny Eagle, Kori Bustard, Black Stork, Blue Korhaan, Lesser Kestrel, Ludwig's Bustard, Martial Eagle.

These species were presumably selected from the 2000 Red Data book for South African birds (Barnes 2000), but have been superseded by the latest revision (Taylor *et al*. 2015).

By the Northern Cape Conservation Act, 2009

All indigenous species 'protected' but those in Schedules 1 'specially protected', and unprotected only three 'common' indigenous species and six 'invasive' species.), which include none of the threatened species expected on site.

Within the Platberg-Karoo Conservancy IBA

Although this IBA is not a legally protected conservation entity, it is selected and recognised as globally and nationally important area for birds, based on specific criteria developed by BirdLife International and applied globally (Platberg-Karoo Conservancy 2015). The threatened species with significant populations that triggered its declaration as an IBA (with those expected on the site in bold) are:

Globally threatened species: **Blue Crane**, **Ludwig's Bustard**, **Kori Bustard**, **Secretarybird**, **Martial Eagle**, **Blue Korhaan**, **Black Harrier**, Denham's Bustard.

Regionally threatened species: **Black Stork**, **Lanner Falcon**, **Tawny Eagle**, **Karoo Korhaan**, **Verreauxs' Eagle**.

The formation of the conservancy and IBA is based partly on its significant contribution to the conservation of large terrestrial birds and raptors. In addition, it supports Biome-restricted species that include on the property Karoo Long-billed Lark, Layard's Tit-Babbler, Pale-winged Starling and Black-headed Canary, and the congregatory Lesser Kestrel.

8. KLOOFSIG 1 ENVIRONMENTAL IMPACT ASSESSMENT

So little is known about ecological effects of solar PV arrays on birds and their habitats, worldwide, but particularly in South Africa and especially in the Karoo, that it makes this section more a summary of predicted environmental impacts on and by birds, some with no obvious mitigation (Visser 2016). Much more is known about ecological effects of powerlines on birds and their habitats, and attempts to mitigate their impacts (e.g. Smit 2013; Jenkins *et al*. 2016), although possible further effects of bird-powerline interactions

on avian habitats are also proposed in this section for consideration. For these reasons, monitoring of bird interactions with arrays and powerlines is proposed as a management option, to enable adaptive management of any operational or ecological problems that may arise from these interactions.

These deficiencies in knowledge also limit significant proposals of mitigation measures for all of the issues addressed, but formal ratings of known impacts expected for the Kloofsig 1 site and their possible mitigation are detailed in Section 9.

8.1. General Avifaunal Impacts

Regional threats that might be expected to affect the avifauna on site, as part of the Platberg-Karoo Conservancy IBA, can best be summarised in statements from its establishment (Platberg-Karoo Conservancy 2015 and references therein). "This IBA contributes significantly to the conservation of large terrestrial birds and raptors." "Renewable energy developments are a new threat" and "[a]ll the trigger species are predicted to be moderately susceptible to the various impacts of solar-energy facilities". "Numerous existing and new power lines are significant threats to trigger species", because they "kill substantial numbers of all large terrestrial bird species in the Karoo, including threatened species". In addition, the "planned Eskom central corridor for future power-line developments includes the northern half of this IBA", as witnessed by the number of powerlines crossing over or near the site. "There is currently no completely effective mitigation method to prevent collisions", despite research that "covered the impact of power lines on populations of large terrestrial bird species and evaluated the effectiveness of earth-wire marking devices" (Eskom/EWT Strategic Partnership, Anderson 2000, Jenkins et al. 2010 & 2011, Shaw 2013). Other important regional threats identified, which may also need consideration during planning and operation of new developments, are from drowning of raptors in open water reservoirs, and use of toxic chemicals in control of brown locusts while, over the life expectancy of the project, "[c]limate change scenarios for the region predict slightly higher summer rainfall by 2050", "increased rainfall variability" and droughts "expected to become more severe".

Local concerns over avifaunal impacts of the proposed developments for the Kloofsig 1 site fall in to two main categories: 1) reduction in availability of pristine habitat, and 2)

alterations in bird populations due to interactions with PV-array and transmission-line infrastructure. Smit (2013) offers broad "Guidelines to minimise the impact on birds of solar facilities and associated Infrastructure in South Africa", with a more detailed revision in 2016 (Jenkins *et al.* 2016)

8.2. General Ecological Impacts

Even though the site consists mostly of Northern Upper Karoo shrubland, which is a nationally extensive and Least Threatened vegetation unit, it does support a significant degree of avian endemicity that includes biome-restricted and congregatory species, with 18 threated bird species expected (Table 2; Section 7.4). Of the latter, the large bustards and Blue Crane are of most obvious concern, especially the endemic and Endangered Ludwig's Bustard (Jenkins *et al.* 2011, Shaw 2013), since they are so sensitive to the transformation and disturbance expected from development and operation of such an extensive solar array and the associated powerlines, which might eventually cover an estimated 970 ha of the best shrubland and 32% of the Kalk Poort RE/18 property. For most other threatened species expected, the habitat is considered marginal, or they are expected only as infrequent visitors, but even so they will be even more deterred from the area by the developments, while the commoner and smaller scrubland birds and other small animals (Section 8), which serve as food for most of the threatened species, are also expected to be displaced in numbers. Details of the specific subsets of vegetation of be affected on the Kloofsig 1 site, and their sensitivity, are the subject of a separate biodiversity specialist report.

PV arrays affect the avian habitats in four main ways. **1) Initially**, through the transformation caused by placement and insertion of the supports for the arrays, and by trenches for the interconnection of arrays and control devices, and for supply and drainage of water. **2) Intermittently**, during operation, through access requirements to deliver, store, construct and maintain the arrays. **3) Indirectly**, during operation, by the effects of shading and altered water distribution on the soil and plants below, and the veld-management techniques applied. **4) Finally**, by decommissioning of infrastructure and rehabilitation of habitat.

Standard procedures and mitigations can be applied to habit effects 1, 2 & 4. As of 2010, for indirect effect 3, “The shade effects of solar photovoltaic on plants are still uncertain.” (www.renewablepowernews.com/archives/1049, in Arsenault 2010), and no published research on this factor for Karoo flora was located (Visser 2016). This makes assessment difficult and suggests that monitoring of avian-array interactions and habitat changes, to inform adaptive management of the operation are necessary. At present, regardless of how and where they are placed, large areas of the ground under the solar arrays will now be subjected to partial or total shelter from sunlight, introducing a foreign impact on the substrate and vegetation in such a treeless and sunny habitat, poorly studied and therefore their effects difficult to predict. In addition, most rainfall on the arrays will be received on the ground as a stream from the lower or drip from the upper edges of the panels, rather than as evenly dispersed drops with a maximum possibility of absorption, and so these new patterns of rainfall and dispersal of runoff become important considerations for both the flora and the substrate (Esler *et al.* 2006). The responses to these foreign changes by the habitats, and probably their resident avifauna, positive and/or negative, are also little known and therefore unpredictable. Furthermore, the additional powerline requirements linking the arrays to the grid will add to the already high density of lines in the area, with their well-known avifauna-associated risks of collisions (see 8.2.3 below).

Overall, the impact of the development on the avifauna is expected to be of only local significance within the predominant and extensive Nama Upper Karoo habitats on and around the site, and of only low additive effect on the already significant local and regional threats to and declines of populations of such large threatened species as bustards, cranes, eagles and storks.

The vegetation types on the Kloofsig 1 site fall on flat areas and within some of the better-quality shrubland for the typical Karoo avifauna, and presumably other small vertebrates and invertebrates that serve as prey to many bird species. Much of the arrays will occupy the floor of the southern drainage basin, and so the development should investigate the conditions that develop in the southern drainage area after exceptional rains, heeding reports that apparently the area forms an extensive temporary wetland, expected to attract large numbers of water birds, which only drains slowly away through the northern constriction of the Kalk Poort itself (John Havenga,

pers. comm.). In these senses, the areas to be developed are of local importance to the existing bird communities, although the total area to be affected is small relative to the large extent of similar surrounding vegetation and habitat.

8.2.1. Avian Impacts associated with PV Arrays

With so little research on the effect of arrays on birds and their habitats, especially in South Africa and specifically in the Karoo, it is difficult to propose mitigation for suspected effects and suggests that monitoring of array-bird interactions to inform adaptive management might be the best current mitigation option. As of 2010, the "literature appears void of any directly applicable citations that would attribute vegetation success to the size and shape of the solar panels or the shade cast by such photovoltaic (PV) structures", the "majority of the knowledge associated with open field solar collection for electricity is less than 50 years old" and these studies "are silent on the impacts associated with grasses or wildlife" (Arsenault 2010) , while studies in South Africa have only just started (Visser 2016). Given the known influence of water and shade regimes on the germination, seed/fruit production and survival of some Karoo plants (Esler *et al.* 2006), changes in vegetation structure and composition under and around arrays can be expected. The effects proposed and discussed below should therefore be seen as primarily for consideration during monitoring, rather than proven changes to which known mitigation can be applied.

On the particular Kloofsig 1 site, due to its proximity to other neighbouring habitats (Besemkaree Koppies Shrubland, Kimberley Thornveld and the Gariep River), visitation by a wider range of bird species is expected than if the site was only surrounded by Nama-Karoo ecosystems. For this reason, the probability of species on the site is taken to be the same as for the whole Kalk Poort RE/18 property (Table 2), but with the species that prefer avian habitat-type 1 (Shrubland on calcrete and sand; see 7.2) those are more likely to be resident (see 6.1.4).

- **Effects of PV arrays and associated structures** – For birds, solar PV arrays create tree-like structures that will be especially novel in the flat, shrubby vegetation of the Karoo. The formation of artificial 'trunks', 'branches' and 'canopies' may attract some bird species normally found in more wooded habitats such as the Kimberley Thornveld at the northern end of the property. They also offer potential perch, roost

and even nest sites for any birds passing through the area, which will introduce additional nutrient loads with their droppings and exotic seed rain to the habitat. More particularly, the tops of the PV arrays form a smooth sloping surface that should constitute neither a reflective or collision risk (e.g. due to shiny and/or polarised reflection). Birds are unlikely to try and land on the slippery sloping structure, except along the top ridge, and maybe on any water drainage channel along the base, unless these are specially designed to avoid the associated soiling and scratching/pecking risks. The three main effects of the PV arrays will be underneath them where 1) they will cast shade on what is naturally a virtually unshaded flora and fauna, 2) their 'feet' on concrete slabs resting on or buried in the ground will resemble loose rocks, and 3) any exposed legs, struts, wiring and boxes will provide possible roost and/or nest sites for some bird species (e.g. Cape Sparrow).

While the effect of shading is difficult to predict, many bird species seek shade in the Karoo during extreme heat and may be expected to concentrate under the arrays, at least around the edges of the layout and these may then attract predators not normally present on the site. An important effect may arise from effects of shading on the vegetation, altering plant community composition, survivorship and/or structure, and hence use by and effects on birds, but this remains unstudied.

The effect of foot slabs or embedded legs is unlikely to differ from that of naturally occurring structures, locally eliminating plant cover but providing some shelter for small animals. However, if excavation is necessary, to level the ground or embed the feet, and so alters its soil structure, a risk of permanent degradation is expected in the long term. This also applies to burying any cables or water provision/drainage pipelines. Natural disturbance of the soil surface under strong winds and/or heavy rains, and the ability of the vegetation to adapt to this instability, suggests that the effects of development disturbances may be temporary or at least capable of rehabilitation. The effect of the exposed legs, struts and wiring will depend on how well the design discourages birds, such as having only vertical and sloping surfaces, and concealing wiring/boxes, to prevent perching and/or nest attachment. Obviously, for operations and safety, care must be taken to ensure that no living organisms can come into contact with or be entangled by any electrical wiring that might cause short circuits, injury or death. This also applies if livestock and/or game is to graze in and around the PV arrays. If the arrays are to pivot and tilt to track the sun, any moving parts must be shielded from access by small animals that may

become trapped between or entangled in slow-moving parts, making fixed arrays preferable, at least for birds with their flight feathers protruding and insensitive to contact.

- **Effect on use and management of water** – Besides runoff, water is used in any washing system to periodically clean the upper surfaces of the solar panels on the PV arrays. Water is a scarce and valuable commodity in this arid landscape and so needs to be managed wisely. Collection, storage and use of rain and washing water that runs off the base of the panel arrays should be considered. The only effect on birds would be if residual water gathers on the arrays and attracts birds to drink, assuming that the water does not contain any potentially toxic ingredients used to clean the panel surfaces. A regular supply is required to initiate and replenish the required volumes for washing, especially given the high evaporation rates in the area, and how this is supplied or stored is not specified, but should avoid open reservoirs in which large birds sometimes drown. Access, maintenance and timing of the supply has to be built into the overall design, to avoid unseasonal runoff that might inappropriately germinate seeds or stimulate new plant growth, and so negatively alter bird movement, feeding and breeding activities.
- **Loss of conservation-significant taxa and/or changes in community structure** – The relatively small footprint of the total solar array on the greater landscape is unlikely to cause direct and widespread loss of threatened taxa or change in community structure. The development is placed in good Nama Karoo habitat, but the actual surface footprint of the arrays themselves and their cabling/piping is limited, expected to be temporary in the longer term and capable of rehabilitation.
- **Increased habitat fragmentation & loss of connectivity** – The scope of the solar panel array within the greater area is unlikely to have any significant effect on habitat fragmentation or connectivity, especially for birds that can move over, under and around the development. The affected habitat is widespread all around the development and does not include restricted or sensitive movement corridors.
- **Increased anthropogenic encroachment** – The solar panel arrays do markedly extend the normal anthropogenic effects for this arid and sparsely populated farming region, but on a relatively small spatial (<1000 ha) and short temporal (<40 year) scale. **N.B**. It should be noted that logistical details for construction, decommissioning and rehabilitation have not been explicitly presented/defined, even though they may increase the final footprint and impact of the development if

provisions made for rehabilitation on completion of these phases are neglected. In addition, no mention has been proposed for security provisions, such as lighting and fencing, which could also create significant impacts for birds. Construction and post-development activities have the potential to be more damaging to the delicate substrate and habitat than operational activities, although at least access to the site for deliveries and staff is already facilitated by the network of gravel roads in the area, even if some need to be widened and upgraded with their own consequences.

- **Loss and degradation of natural habitat** – The general effect of the construction and maintenance of the solar array will inevitably lead to some immediate loss and alteration of the natural habitats on site. These effects can be mitigated to some extent, especially bearing in mind what needs to remain after decommissioning, but the impact is likely to be evident for a long time, especially on such a dry and sensitive substrate with slow wind and water erosion.
- **Loss of conservation-significant taxa and/or changes in community structure** – The relatively small footprint of the solar array on the landscape is unlikely to cause direct and widespread loss of any threatened bird taxa, but it is likely to cause some site-specific changes in community structure while in operation. Species that dislike living under solid cover might decrease while others that welcome the shade and protection might increase, or species that nest in shrubs or on the ground might decrease while those that can make use of man-made lattice structures might prosper.

8.2.2. Avian Impacts associated with Transmission Lines

Portion RE/18 already has four high-voltage powerlines passing over or near the site, which are known hazards for collisions by large flying birds, especially bustards, cranes vultures and storks, so the relatively minor addition of connecting lines for the Kloofsig 1 development is expected to be of low additive impact provided it is planned and executed efficiently, with adequate warning devices attached where appropriate. Of these additions, the ~8.5 km of 132kV lines and pylons proposed to extend south and then east from the Option 1 400-kW grid-connection substation are of most concern, because, to the east, they run more-or-less perpendicular to the existing lines, so forming a new orientation of the hazard for any birds habituated to flying along and not across the existing lines.

Given the variance expected in bird species and numbers, resulting from the highly unpredictable and erratic fluctuations in climate and habitat responses for the Karoo, it is impossible, on a 2-day site visit, to document the range of climatic and habitat conditions, and avian responses that might affect the development, or to propose a sufficient range of mitigations. Once again, monitoring of changes, to inform ongoing adaptive management of the habitat and associated structures seems most appropriate. Furthermore, designs and interventions by Eskom, such as for pylon structures or markers on earth lines, can only be afforded at identified sections, based on monitoring results and protocols and devices established by the Eskom-EWT Strategic Partnership. (http://www.eskom.co.za/AboutElectricity/FactsFigures/Documents/Partnerships).

- **Effects of lines and associated structures** – Lines and their supporting pylons intrude into previously open space. This has two new consequences for birds along their route. First it increases the risk of aerial collisions, and second provides potential perch/roost/nest sites. The collision risks depend on a variety of factors, the biology and density of bird species in the area, the location of the lines in relation to bird flight paths, and the prominence and visibility by day/night of the structures relative to their surroundings. Effects from the proposed powerline are of most concern for the relatively large number of threatened species that are large, and therefore less manoeuvrable in flight to avoid collisions (e.g. bustards, cranes, eagles, storks) and more voluminous in moist droppings to risk electrocution (e.g. eagles, vultures). Use of the structures by birds has the potential for positive and negative ecological consequences, positive in providing new perch/roost/nest sites safe from human and other disturbance, such as hunting perches for raptors or roost/nest sites inaccessible to predators, or negative in increasing the predation pressure on bird (and other animal) prey species living below. There is also a risk to birds of electrocution if they land/perch/take-off in such a way that they touch live and earth lines, or their moist droppings compromise insulator efficiency. This risk exists regardless of the voltage of the lines, but many/most modern line and pole/pylon designs by Eskom have reduced this risk to a minimum, since short circuits not only kill birds but also cause expensive power breaks/outages. New perches can also have secondary effects on the vegetation below, by nutrient enrichment from bird droppings and concentration of seed rain from fruits/seeds eaten elsewhere. All these effects are most intense for the novelty they introduce into flat open treeless

habitats, such this Karoo site. The site already has a range of powerline and other utility line structures and routes across and alongside it, but the addition of 132 kV pylons (lattice or monopole <24 m high) still requires optimal siting and design. Monopoles are preferred, as lattices provide birds with more opportunities for roosting and nest construction.

- **Loss and degradation of natural habitat** – The general effect of the construction of transmission lines on the habitats they traverse is low due to the small areas involved, basically the footprint at the base of each support pylon. However, for safety purposes, such lines require a wide servitude (15.5 m on each side for these 132 kV lines). An access track normally runs along this servitude, for construction and subsequent maintenance, and vegetation has to be kept short (grazed, mown, cut and/or sprayed) to avoid damage from fires. These disturbances usually only occur at intervals during the year. Negative effects of electromagnetic radiation immediately around the lines on flora and fauna have also been proposed, but are considered unlikely. Effects of lines on habitats are mainly due to their prominence as perches and/or obstructions above sensitive habitats, or where high densities and/or diversities of birds concentrate, such as along updrafts on ridgelines or across narrow linear ecosystems like rivers or ponds. The effect of these 132 kV servitudes have been minimised by directing the Kloofsig 1 routes alongside areas already cleared and/or otherwise transformed, such as road/utility-line servitudes, and avoiding crossing ridges and watercourses.
- **Loss of conservation-significant taxa and/or changes in community structure** – The small footprint of lines on the landscape is unlikely to cause direct and widespread loss of threatened taxa or change in community structure, except for species prone to collision due to their biology (e.g. poor anterior and/or peripheral vision, occupation of open habitats, tendency to fly long distances and poor aerial manoeuvrability due to large size - such as cranes, bustards, vultures and storks). Positive effects, for some of the species of concern, may arise from the provision of new perch/roost/nest sites. This is especially significant for the proposed 132 kV (and existing) powerline routes, and line patrols need to report any incidences of interactions with birds (negative or positive) for attention.
- **Increased habitat fragmentation & loss of connectivity** – Lines and their pylons are unlikely to cause habitat fragmentation and or connectivity loss, except where they are so numerous and/or prominent that they deflect birds from their normal flight

paths. The access tracks do not normally require any special construction and sensitive habitats can be avoided. Give the new line routes, mainly alongside the solar arrays, existing powerlines and/or roads, no significant fragmentation effects are expected.

- **Increased anthropogenic encroachment** – Lines and their pylons do extend anthropogenic effects, often over long distances and across otherwise pristine habitats. Particularly sensitive habitats can usually be avoided, but the power they conduct has more extensive anthropogenic effects at source (power and distribution sub/stations) and termination (industrial, residential and urban developments). The proposed powerlines will not obviously increase the local anthropogenic effects at and around Kalk Poort, nor through the sparsely inhabited areas that it will traverse.

8.3. SRK Impact- and Mitigation-Rating Methodology

The assessment of impacts will be based on the professional judgement of specialists, fieldwork, and desk-top analysis. The significance of potential impacts that may result from the proposed development will be determined in order to assist DEA in making a decision.

The significance of an impact is defined as a combination of the consequence of the impact occurring and the probability that the impact will occur. The criteria that are used to determine impact consequences are presented in Table 6.

Table 6: Criteria used to determine the Consequence of the Impact

Rating	Definition of Rating	Score
A. Extent– the area over which the impact will be experienced		
None		0
Local	Confined to project or study area or part thereof (e.g. site)	1
Regional	The region, which may be defined in various ways, e.g. cadastral, catchment, topographic	2
(Inter)	Nationally or beyond	3

national		
B. Intensity– the magnitude of the impact in relation to the sensitivity of the receiving environment		
None		0
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. Duration– the time frame for which the impact will be experienced		
None		0
Short-term	Up to 2 years	1
Medium-term	2 to 15 years	2
Long-term	More than 15 years	3

The combined score of these three criteria corresponds to a Consequence Rating, as in Table 7.

Table 7: Method used to determine the Consequence Score

Combined Score (A+B+C)	0 – 2	3 – 4	5	6	7	8 – 9
Consequence Rating	Not significant	Very low	Low	Medium	High	Very high

Once the consequence has been derived, the probability of the impact occurring will be considered using the probability classifications presented in

Table **8**.

Table 8: Probability Classification

Probability– the likelihood of the impact occurring	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

The overall significance of impacts will be determined by considering consequence and probability using the rating system prescribed in Table 9.

Table 9: Impact Significance Ratings

Significance Rating	**Possible Impact Combinations**		
	Consequence		**Probability**
Insignificant	Very Low	&	Improbable
	Very Low	&	Possible
Very Low	Very Low	&	Probable
	Very Low	&	Definite
	Low	&	Improbable
	Low	&	Possible
Low	Low	&	Probable
	Low	&	Definite
	Medium	&	Improbable
	Medium	&	Possible
Medium	Medium	&	Probable
	Medium	&	Definite
	High	&	Improbable
	High	&	Possible

Significance Rating	Possible Impact Combinations		
	Consequence		**Probability**
High	High	&	Probable
	High	&	Definite
	Very High	&	Improbable
	Very High	&	Possible
Very High	Very High	&	Probable
	Very High	&	Definite

Finally, the impacts will also be considered in terms of their status (positive or negative impact) and the confidence in the ascribed impact significance rating. The system for considering impact status and confidence (in assessment) is laid out in Table 10.

Table 10: Impact status and confidence classification

Status of impact	
Indication whether the impact is adverse (negative) or beneficial (positive).	+ ve (positive – a 'benefit')
	– ve (negative – a 'cost')
Confidence of assessment	
The degree of confidence in predictions based on available information, SRK's judgment and/or specialist knowledge.	Low
	Medium
	High

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

Insignificant: the potential impact is negligible and will not have an influence on the decision regarding the proposed activity/development.

Very Low: the potential impact is very small and should not have any meaningful influence on the decision regarding the proposed activity/development.

Low: the potential impact may not have any meaningful influence on the decision regarding the proposed activity/development.

Medium: the potential impact should influence the decision regarding the proposed activity/development.

High: the potential impact will affect the decision regarding the proposed activity/development.

Very High: The proposed activity should only be approved under special circumstances.

Practicable mitigation measures will be recommended and impacts will be rated in the prescribed way both with and without the assumed effective implementation of mitigation measures. Mitigation measures will be classified as either:

Essential: must be implemented and are non-negotiable; or

Optional: must be shown to have been considered, with sound reasons provided by the proponent if not implemented.

9. KLOOFSIG 1 AVIFAUNAL IMPACT AND MITIGATION RATINGS

No alternative routes or placements were presented. The proposal for this assessment is therefore the only one considered for acceptance, subject to any proposed alterations and/or mitigations, or else a no-go option adopted.

Impacts from the development can therefore be divided into three categories:

1) Impacts that are unstudied, suspected or unavoidable and that cannot be significantly mitigated at present, given the nature of the proposed development, and must therefore be permitted for its acceptance (proposed in Section 8),

2) Impacts that can be reduced by suggested adjustments or alterations to the design and operation of the proposed development (proposed in Section 8.2 and included below where mitigation is known), and

3) Impacts for which recognised mitigations are available and should be considered as conditions for its acceptance (rated below).

9.1. Effects of development on avian habitat under Solar PV arrays

The introduction of PV arrays and associated infrastructure into such flat and open Nama-Karoo habitat provides a novel third dimension due to the tree-like effect of the 'trunks', 'branches' and 'canopies' formed by the arrays. The effect this will have on the

avifauna is undocumented, but is expected to be used by some resident and attract other arboreal species (for shade and perch/roost/nest), with concomitant concentration of nutrient and seed/fruit loads below.

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+ -	Confidence
Before Management	Local, 1	Low, 1	Long-term, 3	Low, 5	Probable	Low	-	Medium
Management Measures								
Monitor bird-array-habitat interactions: • Monitor, report and respond to any bird/animal interactions with all aspects of the array, to allow adaptive management and remedial action, and also to compile databases relevant to the further phases and developments of these little-studied effects of the technology in semi-arid habitats. • Ensure that the edges and undersides of panels (poles/legs, frames, wiring) do not provide unnatural and potentially problematic perch/roost/nest sites for birds or other animals. • Monitor other bird uses of the structures, such as use of shade for resting, or where unnaturally high input of nutrients or seeds may alter vegetation structure, composition and/or attractiveness.								
After Management	Local, 1	Low, 1	Long-term, 3	Low, 5	Possible	Low	-	Medium

9.2. Disturbance of birds during construction and operation

Vehicles and people moving about and building infrastructure in such open Nama-Karoo habitat are obvious and disturbing to birds, especially to larger and more sensitive species. Open habitat also tends to induce long flights to safety by disturbed birds, which increases the effort of return and/or recovery, especially if they are nesting.

	Spatial Extent	Intensity	Duration	Consequence	Probability	Significance	+ -	Confidence
Before Management	Local, 1	Low, 1	Long-term, 3	Low, 5	Definite	Low	-	High
Management Measures								
To reduce disturbance:								

- Limit construction activities to daytime.
- Minimize the use of equipment that results in noise generation.
- Restrict construction staff to an allocated area and avoid access to surrounding or sensitive habitats.
- Provide adequate ablution facilities to avoid use of natural (sensitive) areas as toilets.
- Minimise the number of vehicles using access and maintenance roads.

After Management	Local, 1	Low, 1	Long-term, 3	Low, 5	Definite	Low	-	High

9.3. Negative bird-powerline interactions

A variety of bird species collide with and/or are electrocuted by powerline structures but, given the lengths involved, mitigation can only be applied where high risk or hot-spot areas are identified by regular monitoring. Therefore, the development should monitor its own lengths of powerline that connect to the national grid, and any parts of the national grid that pass through and might be affected by the arrays. Installing anti-collision devices is expensive, and only justified where problems are obvious, which is impossible to determine during a brief site visit, especially for so many nomadic and uncommon threatened species that characterise the Karoo avifauna.

	Spatial Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**+ -**	**Confidence**
Before Management	Regional, 2	Medium, 2	Long-term, 3	High, 7	Possible	Medium	-	Medium
Management Measures								
Reducing bird collisions, electrocutions and impacts: • The design (including mitigation measures) and location of any proposed power lines should be endorsed by the bird conservation experts of the Eskom-EWT Strategic Partnership and note taken of the guidelines issued by Birdlife South Africa (Smit 2013; Jenkins *et al.* 2016). Ideally, the new 132 kV powerline route should be assessed for potential bird-powerline interactions before construction commences. • Bird anti-collision devices for diurnal, nocturnal and/or auditory warning should be installed where power lines cross movement corridors, the exact locations for these interventions to be guided by								

regular search, location, identification and reporting of interactions or casualties (see 9.1 above).								
After Management	Regional, 2	Low, 1	Long-term, 3	Medium, 6	Possible	Low	-	Medium

9.4. Degradation of habitat during and after development

Despite the extensive areas of surrounding Nama-Karoo habitat, the patch(es) of habitat affected by the development need to be disturbed as little as possible during development and operation, so that birds can continue to use them as much as possible. Even such relatively small patches as the development may have high temporary and local importance given the localised rainfall events that can attract large numbers of nomadic species. Minimal disturbance of the substrate will also enable more effective rehabilitation after decommissioning, especially given the slow recovery of the woody plants that constitute a significant proportion of Karoo ground cover.

	Spatial Extent	**Intensity**	**Duration**	**Consequence**	**Probability**	**Significance**	**+ -**	**Confidence**
Before Management	Local, 1	Medium, 2	Short-term, 2	Low, 5	Possible	Very low	-	Medium
Management Measures								
Unnecessary degradation of habitat: • Minimize the areas cleared for construction activities by remaining within the terrestrial footprint of each particular development. This includes the areas excavated for array supports, cabling/piping and used by staff during construction. • Locate materials in an ecologically secure site, ideally within habitat that is or will be transformed by the development rather than on additional natural habitat nearby. If feasible, make the laydown areas within the last-to-be-developed array areas, so as to avoid unnecessary clearing of areas that will require early rehabilitation. • Remove any waste or rubble from the site as soon as possible, especially on decommissioning. **Chemical spills:** All building materials, mixes and chemicals should be held within impervious rims to prevent seepage/spillage.								

Physical barriers must be constructed around fuel depots and generators to prevent spilled fuel from spreading or coming into contact with surface or ground water. Chemicals and equipment for the treatment of fuel spillages must be available on site at all times. **Minimise lighting:** Invertebrates flying at night are attracted to lights and these should be kept to a minimum so as not to impact on activities of nocturnal predatory or avian prey species. All outside lighting should be directed to the minimal area necessary and away from sensitive areas. Fluorescent and mercury-vapour lighting should be avoided and sodium vapour (yellow) lights used wherever possible.								
After Management	Local, 1	Low, 1	Short-term, 2	Very Low, 4	Possible	Insignificant	-	Medium

10. LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

The primary data for this assessment came from the distribution and status information collected for southern African birds during the SABAP1 atlas project, comparison with the incoming data for the on-going SABAP2 atlas project, and is therefore only as accurate and reliable as the limitations and assumptions described for those exercises (Harrison *et al*. 1997; www.sabap2.org.za; Bonnevie 2011, Retief 2013), and an earlier atlas for the adjacent Free State (Earlé & Grobler 1987). I also had access to suitable databases, information and identification resources, and did not consider that the present assignment warranted a more detailed (and expensive) survey, even though summer migrants were absent, and given the nomadic or sporadic nature of most of the threatened species expected. My personal field experience includes avian community surveys across a wide range of southern African habitats, including 15 years of field work particularly with birds on power lines. Environmental Impact Assessments (EIAs) attempt to provide an accurate but subjective study of the main environmental factors and possible mitigation measures that might apply to a given development proposal. EIAs are limited in scope, time and budget, even though every care is taken to ensure their accuracy. Even a report based on field sampling and observation over several years and seasons, to account for fluctuating environmental conditions, nomadism and migrations may be insufficient, since one is dealing with dynamic natural systems, especially in the Karoo and for birds that have such a mobile response to changing

conditions. I offer this avifaunal assessment in good faith, based on the information available to me at the time, but cannot accept responsibility for subsequent changes in knowledge or conditions.

11. REFERENCES

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12. APPENDICES

12.1. Checklist of Specialist Report

EIA REGULATIONS 2014 GNR 982 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	Required at Scoping/Desk-top Phase	Required at BA/EIA Phase	Cross-reference in this scoping report
(a) details of— the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	**X**	**X**	Appendix 12,2
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	**X**	**X**	Appendix 12.3,
(c) an indication of the scope of, and the purpose for which, the report was prepared	**X**	**X**	Secrtion 4, p.19
(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	**X**	**X**	Section 7, p.30
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	**X**	**X**	Section 6, p. 25
(f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	**X**	**X**	Section 8.1 p.74
(g) an identification of any areas to be avoided, including buffers;	**X**	**X**	Section 7.1, p. 75
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	**X**	**X**	None
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	**X**	**X**	Section 10, p.63

EIA REGULATIONS 2014 GNR 982 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	Required at Scoping/Desk-top Phase	Required at BA/EIA Phase	Cross-reference in this scoping report
(j) *a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	**X**	**X**	Section 8, p. 46
(k) any mitigation measures for inclusion in the EMPr		**X**	Section 9, p. 60
(l) any conditions for inclusion in the environmental authorisation;		**X**	None
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;		**X**	Table 9.1, p 60
(n) a reasoned opinion— i. as to whether the proposed activity or portions thereof should be authorised; and ii. if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;		**X**	Exexutive Summary, p7
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	**X**	**X**	N/A
(p) any other information requested by the competent authority	**X**	**X**	None

12.2. Abridged Curriculum Vitae: Alan Charles Kemp

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

Present work address:

Naturalists & Nomads, 8 Boekenhout Street, Navors, Pretoria, 0184, South Africa
Tel: (+27)(12)804-7637 Fax: (+27)(12)804-7637
E-Mail: leadbeateri@gmail.com
or
Naturalists & Nomads, Postnet Suite #38, Private Bag X19, Menlo Park, 0102, South Africa

Qualifications:

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

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

Professional titles:

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

Professional career:

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

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

Academic career:

• Students:

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

• Author of:

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

- 15 contributions in or as books

• Editorial Roles

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

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

● Associate positions:

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

Membership:

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

Special committees:

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

Merit awards and research grants:

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

Borneo and India.

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

Consultant

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

  2005-present – >64 Biodiversity assessments for a Ramsar wetland proposal, Important Bird Area proposal, and general scoping, G20 and specialist avifaunal EIAs.

12.3. DEA Declaration of interest

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20 or 12/9/11/I
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

PROJECT TITLE

An avifaunal assessment for the Kloofsig 1 phase of the proposed Kloofsig Solar PV Energy Facility on the Farm Kalk Poort RE/18, Hopetown, Northern Cape Province

Specialist:	Alan C. Kemp		
Contact person:	A.C. Kemp		
Postal address:	Postnet Suite #38, Private Bag X19, Menlo Park		
Postal code:	0102		
Telephone:	0128047637		0713875170
E-mail:	leadbeateri@gmail.com		

Professional affiliation(s) (if any)	

Project Consultant:	SRK Consulting (South Africa) (Pty) Ltd		
Contact person:	Karien Killian		
Postal address:	Ground Floor, Bay Suites, 1a Humewood Road, Port Elizabeth, 6001 P O Box 214842, Port Elizabeth, 6000		
Postal code:	6000		
Telephone:	0861626222		
E-mail:	kkillian@srk.co.za		

4.2 The specialist appointed in terms of the Regulations_

I, Alan Chalres Kemp declare that --

General declaration:

- I act as the independent specialist in this application
- I will perform 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
- I declare that there are no circumstances that may compromise 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 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Name of company (if applicable):

Date: 28 October 2016