PRE- AND POST- CONSTRUCTION AVIFAUNAL MONITORING PLAN FOR KLOOFSIG 1, 2 & 3 DEVELOPMENTS

Commissioned by:

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1. INTRODUCTION

This monitoring plan has been developed for the proposed Kloofsig Solar PV Energy Facility on the Farm Kalk Poort RE/18, Hopetown, Northern Cape Province, and takes into account **Birdlife South Africa's (BLSA's) most recent "Birds and Solar Energy Best Practice Guidelines"** (Jenkins *et al.* 2016).

The development is planned as three successive and adjacent phases, Kloofsig 1, 2 & 3 (Fig. 1). The area of photovoltaic (PV) arrays for each phase is considered large (>150 ha) by BLSA's standards (with potentially a very large total of 970 ha if all three phases are completed). In addition, the avifauna expected on site is considered to be of medium sensitivity, while the site falls within the northern end of the Platberg-Karoo Important Bird and Biodiversity Area (IBBA SA037; see Fig. 2). On these criteria, each phase of the development qualifies for BLSA's monitoring Regime 3. Regime 3, which recommends monitoring to be **both pre- and post-construction, with a minimum of 4-5 surveys spread over 12 months, each of 4-8 days and including a carcass search** (Jenkins *et al.* 2016). Based on previous assessments of each phase (Kemp 2016 a,b,c), BLSA's Regime 3 guidelines are adapted to suit the topography, extent, habitats and avifauna expected over all three site phases and infrastructure. The monitoring plans proposed should be read in conjunction with the references cited, in particular BLSA's guidelines (Jenkins *et al.* 2016), but additional references are provided to assist with development and modification of the on-site monitoring.

2. MONITORING PRIORITIES AND PROPOSALS

The threatened bird species expected on the sites are described in the site assessments for each phase (Kemp 2016 a,b,c), with bustards and raptors apparently of most immediate concern.

The monitoring proposals are for compilation of information that can be used to reduce any negative effects of the arrays and associated powerline structures on birds, and of the birds on operation of the arrays. Two primary approaches are considered necessary, each with two principal objectives **1)** To compile sufficiently rigorous information on the diversity, composition and abundance of bird species that visit/occupy the site so as to detect changes resulting from the development, and **2)** To compile site-specific information on interactions of birds with the developments as the basis for their mitigation and management. Given the inadequate database for planning the monitoring (see section 3 below), any plans must be considered as preliminary and subject to adaptive development and management as more on-site experience and information is acquired.

2.1.) Establish pre-construction and seasonal post-construction baselines

An initial survey must be initiated prior to development, so that a baseline of current composition and density of the on-site avifauna can be estimated for the undisturbed vegetation and habitats prior to commencement of construction. Then post-construction, a further year of monitoring is necessary so that a baseline for seasonal changes can be

estimated. The experimental design of the surveys for accumulation of these baseline data includes identical control studies in adjacent habitats, which will subsequently provide comparative information for distinguishing on-site from merely seasonal changes. Monitoring for the initial Kloofsig 1 phase is proposed as two line-transects, N-S and W-E, which extend from the site into neighbouring habitats as controls (Fig. 1). The control extensions of the N-S transect for Kloofsig 1 will cross the adjacent sites proposed for Kloofsig 2 & 3, where they can subsequently serve as pre-construction baselines for each of these phases once their own W-E control transects are added across them (Fig. 1).

- **Timing of surveys:** The pre-construction survey should be conducted in mid-summer (around 21 December). The four post-construction surveys should be conducted quarterly for one year, starting around the mid-summer and mid-winter solstices and intervening equinoxes (around 21 December, March, June & September, respectively).
- **Transects per surveys:** During each of the five site visits, at least four surveys of each line transect should be conducted, if possible six or even eight.
- **Timing of transects:** Each line transect should be done during the cooler least-disturbed periods, alternating between a start 30 min after sunrise or ending 30 min before sunset. Exact start, finish and duration times for each transect should be recorded.
- **Starting points of transects:** Each successive round of line-transects should commence at the opposite end and sequence to the previous one (i.e. S-W, N-E, S-E and N-W).
- **Recording of sightings during transects:** Each line transects should first record the time and GPS location of the observer on the line for each sighting, including for flying birds, to provide a count of each species and its individuals seen from the line. This takes into account the open habitat and diversity in size of species likely to be encountered. Secondly, the distance and direction of each individual/flock from the initial sighting point should also be estimated (ideally using a range-finder and compass), to allow subsequent analysis and estimation of density for each species based on perpendicular distance from the line.
- **Documentation of structural habitat changes:** Once on each visit, at 50-m intervals and for each direction/time of transect (i.e. N or S, W or E, dawn or dusk) to include different views and lighting, take geo-referenced fixed-point images facing forward along the transect to document changes in habitat structure and composition, both within and outside areas covered by the arrays.
- **Documentation of climate:** Establish an on-site weather station at the centre of Kloofsig 1, ideally automated, to daily record at least rainfall, temperature, wind direction/speed and cloud cover, and to convey the results directly to the monitoring avian biologist. These data will inform the seasonal conditions for each monitoring visit and line-transect, and variance in the seasonal conditions for each monitoring visit, line-transect or opportunistic report/recording (see section 3 below). They will also provide alerts of any extreme weather events and their effects, so that they can decide if a special additional monitoring visit is necessary and what it might entail (section 3).
- **Analysis of surveys:** After each monitoring visit, the data collected should be analysed to guide how best subsequent line-transects can be optimised. By the end of the first year of post-construction transects, transects should be analysed to

document changes in avian species composition on the sites, both pre- and post-construction and in relation to seasonal changes in climate and habitat, and also in changes in densities of some of the species encountered. At the end of a year of post-construction monitoring, the transect design and results should be reviewed to decide what subsequent monitoring is required.

2.2.) Monitor bird movements and interactions relative to arrays, powerlines and extreme local climatic events

These types of movements and interactions cannot all be monitored in such a repeatable and structured way as the line-transects, especially for the Karoo where local climatic events and their effects on avifaunal are so unpredictable.

2.2.1. Structured monitoring:

- **Point counts from lookouts:** During each monitoring visits, conduct as many 1-hour point-counts as possible from elevated lookouts, such as on-site windmills/sub-stations or adjacent hilltops/slopes. Make as wide a spread of locations and daylight hours as possible.
    - **Choose a fixed geo-referenced lookout point**; use a compass to decide the arc over and around the arrays within which counts and observations will be confined, and take location-specific habitat images within that arc from the lookout point on each visit.
    - **Record the times when birds are detected and under observation** within that arc and estimate their distance away, using a range-finder where possible, and their altitude and direction if flying, all of which will differ for each species according to size and habits. The period that the bird is under observation and any relevant activities, such as movements or behaviours, and how they are affected by the arrays or pylons, should be recorded.
    - **Along powerlines, detect any regular flight paths,** or long-distance movements and their directions and altitudes, since this is especially relevant for large birds, such as threatened raptors, storks and cranes, and especially bustards, three of which were seen on or over the property on the initial site visit.

2.2.2. Opportunistic monitoring:

- **Use the weather station results to detect any extreme events** (i.e. outside the normal range of any parameter for that season) and their effects (e.g. flooding, desiccation, wind damage), so that they can decide if a special additional monitoring visit is necessary and what it might entail.
- **Record whenever and wherever any birds are encountered among the arrays**, alongside the arrays, above the arrays and/or along the pylons during each monitoring visits, and with the assistance between visits of on-site staff during maintenance.
    - **Note as accurately as possible** the location, date, description and duration of behaviours.
    - **Randomly observe bird species and activities**, where possible, from a vehicle or other lookout. Check that the edges and undersides of panels (poles/legs, frames, wiring), and pylons of powerlines, do not provide

unsuitable perch/roost/nest sites for birds or other animals. Note any other uses by birds of the structures, such as for shade, resting or nesting, or where unnaturally high input of nutrients or seeds/fruits may have altered vegetation structure, composition and/or attractiveness. Take geo-referenced images of any particular avian interactions and effects.

- **Report any bird remains found,** during all activities and with the help of on-site staff.
    - **Note the location and take an image/sample** of each set of remains to enable identification of high-risk sections and the bird species involved.
    - **Searches for carcasses during each monitoring visit**, along each transect, array and new power lines, and the around sub-station structures and fences associated with each development phase. Also search along existing powerlines that cross or come within 500 m of the developments for possible influence from the presence of or reflections off the arrays.
- **Consult data from both structured and opportunistic monitoring on acquisition**, so as to plan and guide any adaptive management and remedial mitigatory actions considered necessary. These also expand databases of little-studied effects of the technology on semi-arid habitats and avifaunas, with relevance to development to both subsequent phases and new projects.

3. INITIAL LIMITATIONS TO COMPILING THIS MONITORING PLAN

There are four immediate challenges that affect the compilation of a monitoring plan for the site and to what extent BLSA's guidelines in this regard can be implemented.

1) The knowledge base for the avifauna of the area is sparse

Documentation for the avifauna of the three development sites and their surrounding areas by the Southern African Bird Atlas Projects (SABAP 1 & 2; Harrison *et al.* 1997, www.sabap2.org.za) is insufficient to provide a baseline for monitoring. This is particularly relevant to the sites themselves, where the most recent, relevant and ongoing SABAP 2 project (2007-present; Fig. 3) has no cards yet submitted for the sites' pentad grid cell, only 3 for its quarter-degree grid cell and only 1 and 19 respectively for the adjacent northern grid cells covering the other half of the property. Furthermore, no cards have been submitted for most pentads south of the sites, which cover the same Northern Upper Karoo vegetation unit as on the sites, despite being part of the northern end of the Platberg-Karoo IBBA).

2) The initial site visit was too brief to develop a population baseline

The visit to the property on 18-19 April 2015 was used as a basis for compilation of site-specific avian Environmental Impact Assessments (EIAs) for each of the three proposed phases (Kemp 2016 a, b, c). These initial assessments, based on the best available data, are admissible due to the aerial vagility expected of most bird species, but they do not constitute a sufficient baseline survey to initiate a monitoring plan for avian communities or individual populations and species.

3) Avian-Karoo-PV array interactions are poorly studied (Jenkins at al. 2016)

For birds, the interactions may be negative (such as collisions or entanglement) or positive (such as provision of perch/roost/nest sites), but interactions may also be negative for the developer (such as soiling/shorting/breaking components), and so both parties would benefit from effective monitoring. For example, PV arrays are predicted to have a significant effect on patterns of shading and runoff on the normally-exposed 2-dimensional vegetation of the Karoo, and they also introduce a novel third dimension to the Karoo, with their tree-like 'stems', 'branches' and 'canopies', which is expected to attract additional numbers, species and the seeds/fruits and nutrients that they introduce from surrounding habitats. This may alter vegetation structure/composition and pose novel management risks at the arrays, while avian collisions with PV-array, powerline and fencing structures also require monitoring to identify the bird species and high-risk sections of infrastructure involved, and to devise mitigation measures.

4) Bird species, populations and interactions may peak unpredictably

The climatic factors in the Nama-Karoo exhibit notably high variance and are therefore unpredictable in extent, intensity, space and time (Harrison *et al.* 1997, Mucina & Rutherford 2006), ranging locally from prolonged droughts to sudden downpours and local floods. This results in the conditions of avian habitats experiencing abrupt and patchy changes, which may attract a significant component of vagile and/or nomadic avian species, such as larks/buntings to abundant seeds/insects, predators to locust/bird/rodent outbreaks or waterfowl to temporary wetlands. Such sudden influxes may also lead to significant negative avian interactions with arrays and powerlines, even unpredictable and only temporary.

4. REFERENCES CITED AND ADDITIONAL LITERATURE

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5. FIGURES

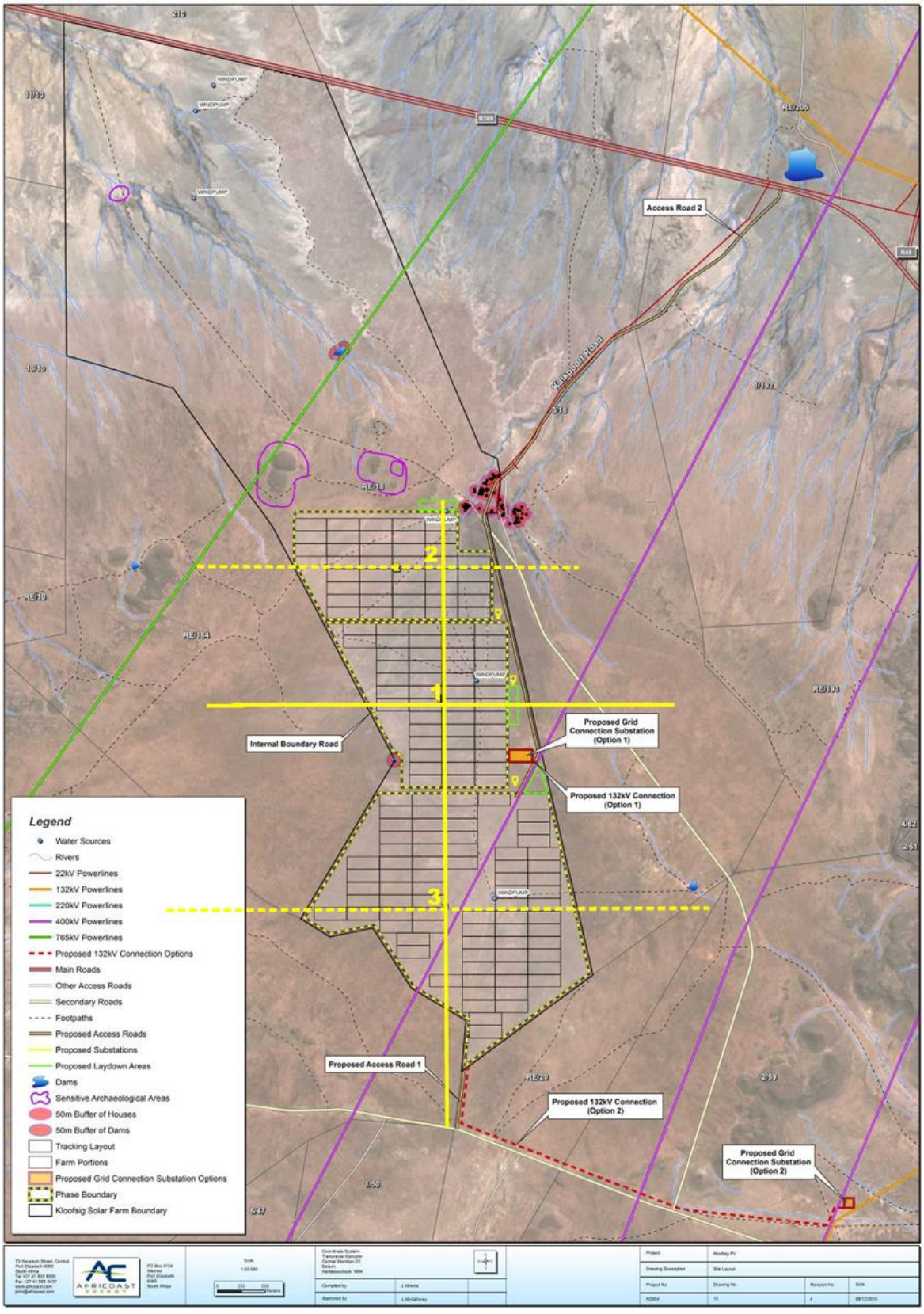

Figure 1: Close-up satellite image of Kalk Poort RE/18 property (black polygon), showing the three locations selected as positions for the solar arrays, and associated developments and infrastructure, of the Kloofsig 1, 2 & 3 development phases. The solid yellow N-S and W-E lines suggest the transect sections for Kloofsig 1, with the dotted lines indicating the additional sections to be added to the baselines prior to the start of Kloofsig 2 and then Kloofsig 3 phases. The transect sections that extend outside the array areas for each phase provide controls for the sections within the arrays. The exact lengths of the transects need to be decided on site, to cover similar habitat to that at the arrays, but from the centre point of Kloofsig 1 the W, N and E sections are intended as half the length (~440 m) of the S section.

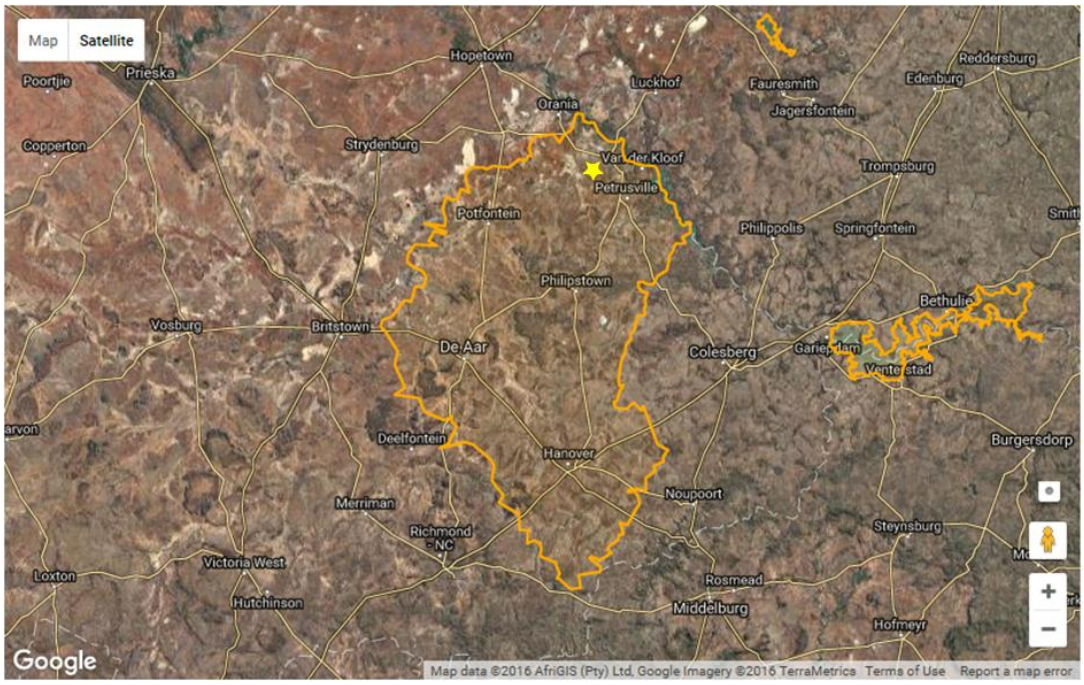

Figure 2: Boundaries of the Platberg-Karoo and Upper Orange River IBBA, grabbed from the IBBA on-line description, with the approximate location of the Kloofsig 1-3 sites indicates as a yellow star.

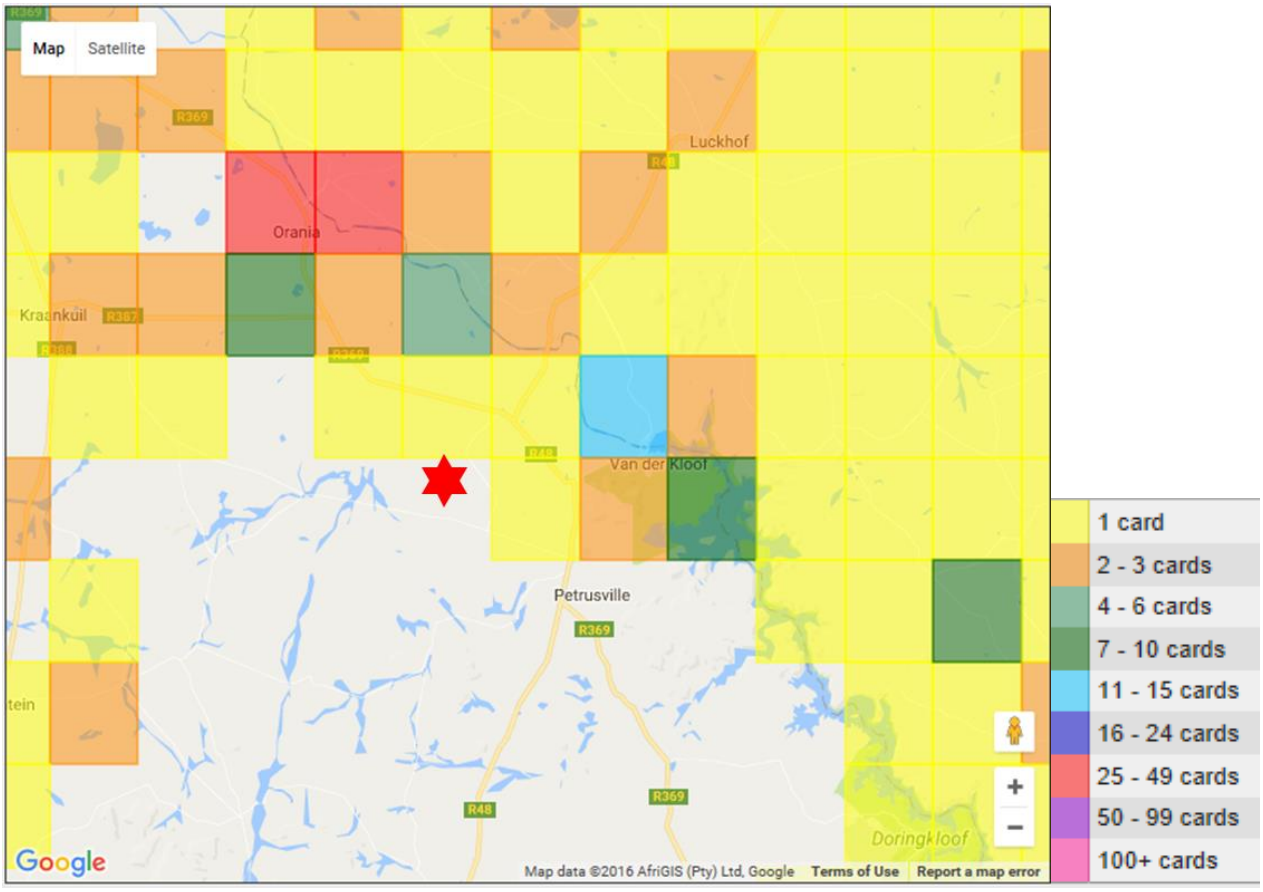

Figure 3: November 2016 coverage of pentad grids (5' lat x 5' long) used to plot avian diversity as the distribution and relative frequency-of-encounter for individual species, based on number of record cards submitted. Pentad 2955_2430, with one card, covers the northern half of the Kalk Poort RE/18 property, while pentad 3000_2924 (red star) covering the Kloofsig 1-3 sites has no cards, as do most surrounding pentads to the south across similar Northern Upper Karoo habitat to the sites,. Almost all of the better covered pentads in surrounding areas to the north and east include or comprise different vegetation units and topographies associated with the Vaal River and its dams and tributaries. Note the widespread seasonal water bodies indicated south of the site, where erratic water bird invasions can be expected.