REF: GROOTPOORTFINAL

AVIFAUNAL REPORT

FOR THE PROPOSED

GROOTPOORT SOLAR ARRAY

Figure 1. View to the north from the eastern edge of the SPP area. Note the sparse vegetation and the extent of similar vegetation across the wider region

Prepared for: **Pele Green Energy (Pty) Ltd**

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Pele Green Energy (Pty) Ltd proposes to develop a 115MW photovoltaic Solar Power Plant (hereafter SPP) which, with associated infrastructure, will occupy ca. 250 hectares on the farm Grootpoort 168 located 13 km south-west of the town Luckhoff, in the Letsemeng Local Municipality of South Africa's Free State Province. This scoping report concerns the potential impacts the development may have on birds of the directly affected, and immediately surrounding, areas.

This report is based on a desk-top review of documented information as well as on field observations during two surveys, totalling six days, one in the dry, and the other in the late "wet" season. The broader area is likely to have populations of some 200 species of birds. Only one red data species was observed**.**

The site proposed for the SPP is flat to gently sloping. The vegetation is low and sparse karooid scrub which is the primary regional vegetation. This scrub provides few resources for birds and the numbers and diversity of birds are naturally low. The situation during the two survey periods was of extremely dry conditions following three years of below average rainfall. As a result, both the number and diversity of birds was lower than usual and declined even further between the first and second surveys.

The main effect of an SPP development is destruction of habitat and consequent displacement of birds. The resident, and so primarily affected, bird species all have wide ranges. None are considered threatened. There are extensive areas of similar habitat in areas adjacent to the proposed SPP into which the displaced birds can move. Due to the low productivity of the affected habitats the number of individuals per concerned species is small and the overall effect of bird displacement is considered negligible.

It is likely that threatened (red listed) species may sometimes occur on or over the site in its current natural condition. In the absence of any particular feature to attract them, these species will be, at most, only transient users of the area to be developed. Thus the development of the proposed SPP will have no marked effect on red-listed species. The species most likely to be negatively impacted is the Northern Black Korhaan. These korhaans are ground foragers and both feed and breed in local habitat, including that to be developed. The population that may be displaced is minimal, 2-3 pairs at most. Disturbance during construction may deter birds from breeding in adjacent habitat.

A feature of potential concern is the possibility that polarized light from the PV panels, which at night gives the impression that there is a waterbody, may cause night-flying waterbirds to descend and die from collision with the structures. It is recommended that bird monitoring is carried out through the first year of the post-construction phase.

Development of the SPP is likely to produce a range of short-term and acute impacts on birds during construction as well as longer-term, chronic, impacts in the operational period. These impacts are mainly features that will also, to varying extent, degrade habitats adjacent to the developed area. A number of mitigation measures are suggested that will serve to reduce the effects of these impacts.

The conclusion of this scoping report is that, provided the indicated mitigations are followed, the impacts of the proposed development on local bird populations are of an acceptable level.

1. INTRODUCTION

1.1 Proposed Development

The firm Pele Green Energy (Pty) Ltd (a wholly owned subsidiary of Pele Renewable Energies (Pty) Ltd) proposes to develop a photovoltaic (hereafter PV) solar power plant on the farm Grootpoort 15 km southwest of the town Luckhoff in the Letsemeng Local Municipality of the Free State Province.

At application phase, the development footprint (construction and operation) is envisaged to cover a core area of approximately 250 ha. Vegetation will be cleared from the core area. The construction will include:

- PV panel arrays on mounting structures
- Underground cabling between panel structures;
- Internal unpaved roads
- Central inverters to convert DC current to AC
- A new, step-up, substation of 1 ha that will link to an existing powerline
- An above-ground power line to link the new substation to a 132 kV substation that is off-site
- Subcontractor site camps, workshops and offices
- Storage and lay-down areas, water storage tanks, waste recycling area

Potential impacts

A typical SPP is expected to impact birds through: disturbance, habitat destruction, and, in particular, mortality of birds through collision with PV panels or project associated powerlines (Smit 2012, Kagen *et al*. 2014). The purpose of this study was to assess the impacts the proposed development may have on the local avifauna, including appraisal of any cumulative impacts that may accrue as a result of other developments in the region.

1.2 Terms of reference

African Insights was appointed to conduct the avifaunal scoping study for the Environmental Impact Assessment. The terms of reference were to:

1.2.1 Conduct a desk-top review of existing literature relevant to the potential impacts of the development in general and on the local avifauna, as well as the status of bird groups likely to be affected.

1.2.2 Survey bird occurrence on, and adjacent to, the site where the SPP is proposed, with especial attention to habitats that may favour the occurrence of bird species of particular conservation concern.

1.2.3 Assess the significance and acceptability of the likely impacts of the proposed development on birds during the construction and operational phases.

1.2.4 Suggest optional or essential ways in which to mitigate negative impacts and enhance positive impacts;

1.2.5 Consider the cumulative effects associated with this and other projects which are either developed, or in the process of being developed, in the local area;

1.2.6 Rate the development in terms of its potential impacts on birds taking into consideration baseline data, survey information and likely cumulative situation

Note that the latest version of the BLSA guidelines (Jenkins *et al*. 2015) was not available or ratified at the time this study was initiated, and budgeted This study was conducted in compliance with the earlier BLSA guidelines (Smit 2012). Any additional requirements of the 2015 draft guidelines cannot be expected to apply.

Not included in the terms were nocturnal observations, or the de-commissioning phase. No indication was given of associated infrastructure – construction camps etc. - and specifically no indication of powerline routes from the SPP to where they will connect with the Eskom grid.

The specialist reserves the right to amend this report, recommendations and conclusions at any stage, if extra information becomes available.

This report may not be altered without the specific and written consent of the specialist who authored it.

2 AFFECTED ENVIRONMENT

2.1 Climate

The region lies within the predominantly summer rainfall region of South Africa. Rainfall is variable and the region is considered semi-arid.

Climatic conditions are especially important for appreciation of the findings in this report. Mr Otto, who farms the property, stated that rainfall had been below average for the three years preceding the first survey visit which took place during the peak El Nino induced drought. The second visit was scheduled to experience conditions following the local "wet" season. However, except for a thundershower three days before the second survey, there had been no rainfall in the intervening period so conditions remained extremely dry. Temperatures during both surveys were high, in December $>40^0$ in the shade. The prolonged drought had depressed the local vegetation with its associated resources and the high temperatures led to birds limiting their activity between about 09.00 and 15.00 on all six survey days.

2.2 Terrain

The footprint area of the proposed Grootpoort SPP is a small section of an extensive plain of low relief (Figure 1). Other than trees along stream lines, the only "topographic" features on the site are un-natural. Specifically, there are neither cliffs, nor any natural standing water wetlands, on or within 5 km of the property. The ephemeral stream Lemoenspruit with associated thick riparian thorn bush is 2 km north of the SEF area. A few small feeder streamlets arise closer to, or within, the SEF area but these are only likely to flow during particularly wet conditions.

2.3 Vegetation (Figures 2 & 3)

Grootpoort is in the ecotonal zone between the Nama-Karoo and Grassland biomes. The vegetation is scrub dominated. Scrub is here considered simply as woody bushes that grow to less than knee, and shrubs to waist, height of an average human. In years of good rainfall there is growth of grasses between the scrubby bushlets. There are a few bushes along the southern boundary of the property and there are small patches of taller shrubs within the matrix of dwarf scrub (Figure 2). The density of scrub variation across the property but at Grootpoort the individual bushes are generally well separated. During the

survey periods the ground between the scrub bushes was largely bare. In wet years the intervening ground supports grasses and forbs. The property has for a long time been used for grazing by sheep, goats, and small herds of game. It is unclear to what extent this may have degraded the native vegetation on the property.

Figure 2. View eastwards across the property. Note the evenness of the low scrub vegetation and the high proportion of bare ground. The low scrub bushes offer little by way of shade and birds' nests in the scrub will be readily accessible to any terrestrial predator.

2.4 **Animals other than birds**

A range of mammals occur. Those observed in the surveys were Springbok, Steenbok, Gemsbok, Wildebeest, Scrub Hare, and Ground Squirrel. In this area, where sheep and goat grazing has long been the prevailing economy, mammalian predators have been controlled for a long period. The only reptile seen was an unidentified snake. Invertebrates were the most available animal food resource for birds and, due to the prolonged extremely dry conditions, they cannot have been abundant.

2.5 **Human developments**

The proposed SEF area is, apart from fence lines and a few farm tracks, almost entirely under degraded natural vegetation. The farmstead is situated 1.5 km from the proposed SEF area. A public road runs along the southern boundary of the proposed SEF area. An Eskom powerline runs from south-west to north-east across the immediately adjacent farms and at one point crosses the north-western corner of Grootpoort.

The properties immediately adjacent to the SEF area mostly support the same vegetation as in Grootpoort. Canalized water from the Vanderkloof dam is used for central pivot irrigation of maize on croplands in the vicinity.

METHODS

3: STUDY APPROACH

3.1 Desk-top assessments

A desk-top review was conducted. This considered two aspects: 1) the conservation status of bird species known or likely to occur in the Grootpoort area; and 2) the global literature concerning the impacts of equivalent developments on birds.

Following the BirdLife South Africa best practise guidelines (Smit 2012, Jenkins *et al*. 2015) the following data banks, held at the Animal Demography Unit, University of Cape Town, were consulted: CAR (Co-ordinated Avian Roadcounts), CWAC (Co-ordinated Waterbird Counts) and SABAP (South African Bird Atlas Project) phases 1 and 2.

This region of the Free State Province has been subject to relatively little documentation of bird status. Neither CAR nor CWAC surveys have been conducted in the Quarter degree square (QDS) 2924DC in which the Grootpoort property is located. Only a single SABAP 2 report is available for the pentad that includes Grootpoort and this listed only 25 species. The QDS which includes the pentad also includes areas with radically different habitats to that across the Grootpoort property – trees along watercourses, and numerous areas converted from natural vegetation for central pivot irrigation of cereals. Previous observations, almost certainly, occurred in far wetter conditions - so that the SABAP list is too biased to allow appropriate insight into bird occurrence at the Grootpoort SEF site.

3.2 Field study

The occurrence of birds in the Grootpoort area was assessed in 2015-2016 during two surveys each conducted over 2.5 consecutive days. The survey periods were: 1) 14-24 April 2015 i.e.before any summer rainfall; and 2) 9-11 March 2016 in the late summer when, under average conditions, seasonal rainfall should have left the area in its best condition and prior to the departure of any summer visiting migrants.

In each survey, observations of birds were made on: two days in the early morning from first light until, between 09.00 and 10.00, the heat drove most birds into shade; and on three afternoons from 15.00-dusk.

Monitoring in each survey was undertaken by Dr A.J. Williams, a professional ornithologist for 43 years and with prior experience of avifaunal assessments for eight SEFs.

4 BIRD SURVEY RESULTS

4.1 Species recorded

A total of 40 bird species were recorded during observations on the 6 calendar days (Appendix 10). This is relative to a total of ca. 200 bird species that are likely to regularly occur in the far larger, and more habitat diverse, area of the quarter degree square in which Grootpoort lies. The small species total reflects the evenness of the habitat on the property, and the paucity of resources for birds in the dwarf shrub lands, a situation exacerbated by the extreme drought conditions.

4.2 Priority species

No red-listed bird species were recorded on the Grootpoort property during the six calendar days of observation. Nor are there any particular features that would be of importance to any red-listed species for breeding or roosting. Nevertheless, it is likely that a range of red-listed species may occur. The key issues are: 1) whether they do so regularly; and especially 2) the degree to which the SEF area is essential habitat for them. Most of the priority species that are likely to occur are relatively large sized and require far larger areas of suitable habitat than occurs on the Grootpoort site. Thus they are only likely to be transients that at most make occasional, usually very brief use of the SEF area - hours in the case of raptors or, in wet years, potentially a few days in the case of ground-foraging species. The species most likely to be affected are those that are, or may be, resident in the immediate vicinity.

Threatened species that could occur on the Grootpoort property are here considered (with their 2016 conservation status: as per Birdlife South Africa 2016).

During the December survey a single Kori Bustard *Ardeotis kori* (Near-threatened) was seen in flight over an adjacent property. Mr Otto, the local farmer, stated that as many as 15 Ludwig's Bustards *Neotis ludwigii* (Endangered) sometimes occur locally in wet years (though not necessarily on the Grootpoort site).

The Platberg-Karoo Consultancy IBA (globally Important Bird Area), whose north-eastern border is 5 km south of Grootpoort, supports a range of threatened bird species which might be expected to rarely, or very occasionally, occur on the proposed SEF area. In addition to the Kori and Ludwig's Bustards these include: Blue Crane *Anthropoides paradiseus (*Near-threatened), Black Stork *Ciconia nigra (*Vulnerable*)*, Secretarybird *Sagittariusserpentarius* (Vulnerable), Martial Eagle *Polemaetus bellicosus* (Endangered), Verreaux's Eagle *Aquila verreauxii*(Vulnerable), and Tawny Eagle *Aquila rapax* (Endangered) (Marnewick *et al*. 2015). The IBA has an area of ca. 1,250,000 ha with very extensive areas of un-fragmented native scrub and grass vegetation subject to a low degree of human disturbance, as well as sections with trees, and rocky hills. In comparison the 250 ha Grootpoort property lies within an area which has been fragmented by the creation of irrigated croplands with an associated increase in human disturbance, and the property lacks both trees and rocky hills, though there are trees within 2-5 km and an extensive area of rocky hills 10 km to the east. The threatened species of the IBA are large, prefer extensive undisturbed areas of native vegetation, and or are associated either trees or rocky outcrops for roosting and breeding. Conditions on and immediately around the Grootpoort property are less suited to these species hence the presumption that, although they may visit the property, none of these species can be considered dependent upon it and are likely to occur rarely if at all.

4.3 Other bird species

Most of the bird species recorded during the two surveys are dependent upon invertebrate animals for their survival. It was notable that the number of individuals of the commoner species (e.g. Ant-eating Chat *Myrmecocichla formicivora,* Familiar Chat *Cercomela familiaris)* was lower in the March than in the December survey and the Rufous-eared Warbler *Malcorus pectoralis* was not recorded in the second survey. This is attributed to a progressive decrease in invertebrate prey on the property across the intervening drought period.

The number of granivorous-feeding bird species was considerably less in the March, than in the December, survey. This reflects the lack of seeding grasses and, after three years of low rainfall, the severely decreased local seed bank.

Detailed counts of the resident bird species were not feasible during the brief survey periods as the majority of smaller species were furtive and generally kept to the shade unless flushed. However, the strong impression was gained that populations of all species were low and for many species there were probably fewer than 20 individuals on the entire property. Most of the species recorded are insectivorous. Such birds are more dispersed and, during average climatic conditions, naturally occur in smaller numbers than seed-eaters which are less territorial. The populations of insectivores are low especially in areas of low vegetation structure. Seed-eaters are probably more numerous at Grootpoort during wet years when grasses grow and seed but, probably because due to the extreme drought there was no new seed production, seed-eating birds became noticeably less common between the first and second surveys.

No waterbirds were recorded on or over the SEF area. A pair of Egyptian Geese were seen flying between the Lemoenspruit and the irrigation canal some 2 km north of the property, and a few Hadeda Ibises flew across an adjacent property early one morning.

Many waterbirds disperse between wetlands at night and, though not detected during the diurnal surveys, some may occur over the property. No attempt was made to assess such occurrence during the two surveys because, as a result of the prolonged drought, waterbird numbers in the area were presumed to be very low and concentrated around such wetlands as retained water and so not close to Grootpoort.

No birds of prey were recorded during the December survey. In March single Rock Kestrels (seen on two days) and a juvenile Pale Chanting Goshawk were seen on Eskom pylons close to Grootpoort. The only raptor seen on the actual property was an adult Black-breasted Snake Eagle, accompanied by a juvenile, which caught a snake in the extreme southern section of the Grootpoort site. None of these species are red-listed. The snake eagle is a wide ranging species. The goshawk and kestrel are more localized. It is not clear why there was an apparent absence of raptors during the December survey. Nor, because there is no suitable habitat, would any have bred, or been bred, on the property.

The Grootpoort property lies near the crest of a rise with ground falling away in three directions – east, north and west. Visibility was excellent on all survey days and in the absence of any trees and topographic obstructions it was possible to readily detect any large birds, of Speckled Pigeon size or larger, flying across the property and for some distance (1-2 km) across adjacent areas. Thus across the two surveys there was visual coverage of large birds on, over, or adjacent to the Grootpoort property for a total of 15 hours and all sightings have already been mentioned in this report.

It is important to appreciate the extent to which the prolonged, 3-year, dry period preceding the surveys and the intense, El Nino induced drought of 2015-2016 with associated high temperatures, is likely to have depressed the numbers and diversity of bird species on the Grootpoort property relative to the situation which may apply during periods of above-average rainfall. However, because of the dwarf structure of the prevailing native vegetation, the property is never likely to sustain bird populations that are significant in even sub-regional terms

4.4 Programme for further monitoring

The bird faunas of this part of South Africa are poorly known and especially for the area that includes the Grootpoort property. It is unwise to base decisions solely on the six days of bird observations all made following an unusually hot, dry period.

It should be a requirement for development of the Grootpoort SEF that impacts on birds be appraised by regular monitoring. This monitoring should be continued over at least two years of operation as time is needed for plant life to re-develop and bird use of the area will increase as the plants grow. Surveys of bird presence, especially for collision victims, should be conducted over a few days in at least each summer and winter period. These surveys should be performed according to a protocol drawn up by a supervising bird specialist who should write annual reports. These reports will provide information for any further development at this proposed site and usefully provide information for the appraisal of the anticipated other solar array proposals in southern Africa.

4.4 Cumulative impacts

There is potential for cumulative impacts on bird populations as a result of other renewable energy developments in the region. There is the even greater potential impact in situations where farmers convert areas of natural vegetation into cropland.

According to the Energy Blog's database seven solar PV SEFs are currently fully operational in the region around Grootpoort (Figure 3). These are six in the Northern Cape Province:

Four near De Aar:De Aar Solar Power with a capacity of 50MW;

de Kalkbult with a capacity of 72.5MW;

- Mulilo Renewable Energy Solar PV De Aar with a capacity of 9.7MW; Solar Capital De Aar 3 with a capacity of 75MW near De Aar;

  Two near Douglas:

- Herbert Solar Park with a capacity of 19.9MW
- Greefspan Solar Park with a capacity of 10MW
- In the Free State Province the Pulida Solar Park with a capacity of 75MW near Jakobsdal,

  It is probable that other SEFs will be proposed in the region

Two Wind Energy projects, both near De Aar, are also located within the region

- Longyuan Mulilo North Wind Energy Facility with a capacity of 139MW (construction); and
- Maanhaarberg Wind Energy Facility with a capacity of 96MW (awaiting construction – approved and financed).
  As can be seen none of these projects are close to the Grootpoort site

According to the (CSIR/ DEA) database on Wind and Solar Energy in South Africa, 28 applications have been submitted for renewable energy projects within the geographical area of investigation. The majority (18) of these projects are located in close to De Aar, which is more than 70km from the Grootpoort site. It is quite possible that future solar farm development may take place within the region.

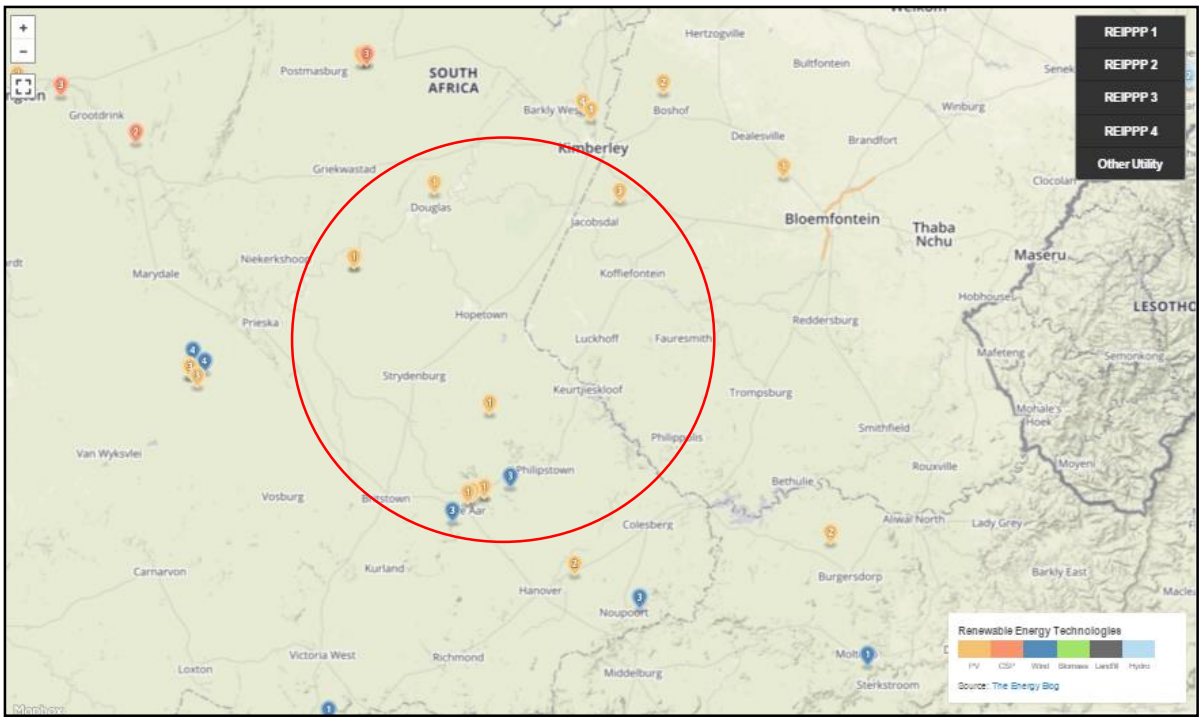

Figure 3: Regional utility-scale Renewable Energy Generation Sites. The distance from Grootpoort to De Aar is ca. 70 km

Probably more pertinent in terms of cumulative impact, would be any substantial changes in agricultural use, from the current retention of native vegetation for grazing, to transformation of this vegetation into croplands.

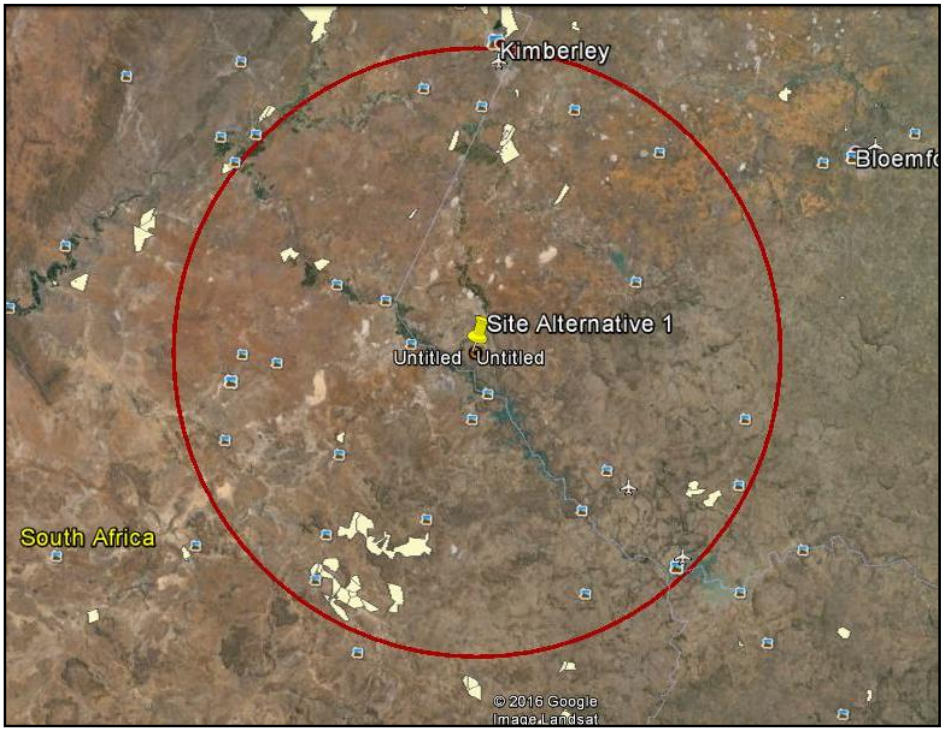

Figure 4. National Wind and Solar PV SEA: Renewable Energy EIA Application Received before Dec. 2012

All that can be said at this stage is that, if the other proposed SEFs go ahead, there will inevitably be increased loss, and fragmentation, of habitat for those bird species dependent on the habitats transformed. No species were recorded at Grootpoort that do not have extensive distributions, and so populations, in the wider region. Thus, whilst there will be a regional reduction in species populations, there is no reason to predict that, as a result of the SEF projects, any species will be threatened in terms of gross reduction in either its regional or global populations.

5. IMPACT ASSESSMENTS

5.1 Introduction

The key issue for this faunal report is the potential for impacts associated with the development of the SEF to affect the populations of local birds and especially those of conservation priority species. These impacts on birds may be either direct i.e. through loss of habitat, as well as collision mortality; or indirect through effects on other elements of the environment which then affect the birds.

A photovoltaic solar energy facility has three life-phases: 1) construction; 2) operation; and 3) de-commissioning. These three phases differ in their environmental impacts. Construction and de-commissioning are short-term periods of dramatic and acute environmental disturbance whereas in the operational phase impacts are steady, long-term – over 20-30 years - and so of chronic impact.

The Grootpoort SEF is to be located in an environment which is semi-arid. This environment is one of low productivity. The pace of soil development, of plant growth, ecological succession, and hence any ecological recovery, is slow. Indeed, environmental restoration may be unfeasible. The impacts of the SEF are likely to continue to affect the local environment, and so the local bird fauna, for decades after de-commissioning. However, it is likely that as the proposed PV panels reach the end of their operational life they will be replaced so, in terms of the time envisaged in this report, the development situation is permanent. In the event that panel renewal does not happen legislation requires that a de-commissioning EIA be conducted. Consequently, de-commissioning is not further considered in this report.

Accessible information on the environmental impacts of SEFs is severely limited. This is due, in part, to the relatively recent development of SEFs and the normal lag time before impacts are realised, quantified by researchers, and the results published. Most information is in environmental compliance documents and other, non-peer reviewed, grey literature of limited distribution and accessibility. Two recent over-views of the environmental impacts of renewable energy facilities have stressed that, on an international basis, information on the effects of solar energy developments is particularly limited (Hotker*et al*. 2005, Lovich & Ennen 2011). Nevertheless, a range of known, or potential, environmental impacts as a result of SEFs have been identified (Lovich & Ennen 2011, Kagan *et al*. 2014). As these might directly or indirectly affect birds at Grootpoort all the identified impacts on the local fauna and are considered here.

The development will have impacts on two broadly defined areas: 1) the "core" of the SEF where existing terrain will be covered by structures or converted into roads and other infrastructure; and 2) the "surrounds" where the terrain will be not be developed but where

there will be indirect effects emanating from the core. It is impossible to precisely define the outer periphery of the surrounds as the distance over which impacts have effect will vary with weather, especially wind, as well as moonlight etc. conditions.

5.2 Construction period

This is the period of most dramatic and acute potential impacts on local fauna. It is not feasible at this pre-approval stage to indicate the time frame and seasonality of construction although both factors will potentially affect the scale of impacts. The key impacts in this period, in diminishing order of importance, are the destruction of habitats, disturbance, and dust emission.

5.2.4 Habitat destruction and fragmentation

The final footprint of the proposed SEF is small. However, during construction, there will be fairly extensive habitat destruction, alteration and fragmentation. Some of this may be temporary, e.g., lay-down areas for machinery and materials, but in some cases it may be permanent e.g. workshops, substations, roads and power line servitudes. This will result in localised destruction of food resources and prey species, with low magnitude of impact, but the duration of the effect will be long-term, extending beyond the lifetime of the SEF.

The SEF and its associated environmental changes may fragment the habitat for non-volant, and especially small, animals but is unlikely to have substantial impact on birds which can quickly fly across the area.

5.2.1 Disturbance

Construction period disturbance will be greatest in the core area. This will cause the displacement of birds and most other larger vertebrates (antelopes, zebras, ground squirrels etc.) and the likely death of animals that do not leave (e.g. lizards and rodents). Disturbance during this period will also have potentially considerable impact on the surrounds. It will suppress bird activities and may lead to temporary displacement from affected areas i.e. those closest to lay-down areas or where buildings are constructed. Changes in sound volume of only a few decibels can lead to substantial animal responses and cause them to move aware from the source. Noise will especially be generated during construction

5.2.2 General pollution

During construction, the use of heavy machinery and vehicles, and the mixing and use of cement, will inevitably lead to some chemical pollution of soil and ground water. Waste water, fuel spills and other pollutants such as herbicides and pesticides will contaminate the environment and may poison insects which birds prey upon. Pollution of soil can be especially damaging if it occurs in areas that are intended for later rehabilitation to a natural state. Nutrient-rich effluents, such as sewage, can cause water pollution.

5.2.3 Dust

Development of the SEF involves clearance of existing vegetation from the core and some grading of the soil surface. The soils of the core area are formed of poorly consolidated Kalahari sand i.e. with a high proportion of fine material which if disturbed will create dust.

Clearance of the stabilizing vegetation, and especially grading, will expose the sand surface to wind and, unless this is suppressed, will create large quantities of dust through the construction period and until a stable condition is re-established.

Depending upon wind conditions dust can carry over large distances. Dust can have dramatic effects on ecological processes at all scales (reviewed by Field *et al*. 2010). Dust adheres to plants downwind of a source. This affects the gas exchange, photosynthesis, and water use of the dusted plants and together these affects reduce the plants' primary production. Wind driven dust also abrades soft plant materials. In these ways dust can, indirectly, affect agricultural food crops and wildlife food plants (Farmer 1993; Greening 2011). Dusted plants are less palatable to animals, especially insects, and so this will affect local food resources for birds. However, dust deposited down-wind, whilst having a temporary negative impact, should have a mild fertilizing effect after the silt is washed off plants by rain and deposited on the ground.

The removal of finer soil materials as dust has long-term local effects as these materials contain most of the cation-exchange capacity, water holding capacity, and fertility of soil. In particular, the loss of fine materials from soil reduces the ability of plants to re-establish since germinants rely on soil resources and water held in the uppermost soil layers. The loss of dust will affect any re-growth under the panels and along internal dirt service roads. Again, these changes have the potential to impact bird use of the area.

5.3 Operational period

A number of factors will create potentially negative impacts on birds through the predicted 25-30-year operational life of the PV panels. These relatively long-term and chronic impacts are: continued disturbances; light pollution – both ecological and polarizing; electromagnetic radiation; and dust.

5.3.1 Light pollution

Photovoltaic solar energy facilities cause two types of light pollution. These are ecological light pollution (ELP), which has different impacts by day and at night, and polarizing light pollution (PLP). The Grootpoort area has low levels of existing light pollution so the localized effects of nocturnal light pollution are likely to be greater than in areas where there are already higher levels of existing light pollution.

5.3.2 Ecological light pollution (ELP)

Daylight reflected from the PV panels can adversely affect animal physiology, behaviour, and population ecology potentially through alteration of predation, competition and reproduction (Longcore & Rich 2004). Animals may experience increased orientation or disorientation, and are attracted to or repulsed by glare. This can affect their foraging, reproduction, communication and other critical behaviours.

It is unclear to what extent there may be night illumination associated with the SEF. Outdoor lighting of the short-wavelength type (white and blue lights) attracts night-flying insects from considerable distances. This can lead to high levels of mortality of insects, many of which are critically important to normal ecosystem functioning and form an important part of the diets of bats (Frank 1988) and some nocturnal birds.

5.3.3 Polarized Light Pollution (PLP)

Many kinds of animals, especially those that are night active, are well tuned to polarized light and use it as a source of information. Horvath *et al*. (2009) have reviewed the effects of polarized light. Polarizing light (PL) is more effectively reflected from smooth dark surfaces. In nature water surfaces are the primary source of horizontal polarization by reflection. Many aquatic insects and night dispersing waterbirds use PL to find suitable water bodies for feeding and breeding habitat. Glass, or similar smooth surfaces, share important physical characteristics with the surface of dark water and polarize light strongly. SEFs with their extensive banks of light polarizing panels may form supernormal optical stimuli and appear as exaggerated water surfaces. This can impact the animals' ability to judge safe and suitable habitats. This is especially important for insects with limited flight duration.

Shallow waterbodies, where dabbling ducks can readily feed from the benthos are a scarce and limiting resource in semi-arid areas such as the region around Grootpoort. These, and several other groups of waterbirds –grebes, gallinulids, flamingoes, -regularly reconnoitre at night to see where alternative waterbodies exist. This is especially the case in the late dry season when most waterbodies in a region have dried down and birds are forced to locate alternative wetlands. When they fly at night waterbirds apparently use moon and star polarized light reflected off water to indicate the presence of a waterbody. PV arrays also reflect moon and star light. If birds fly down to land at what they assume is a waterbody they may collide with the panels and deaths from such collisions have been recorded at a PV solar energy facility in North America (Kagan *et al*. 2014). In the USA a study of birds recorded dead at a PV SEFfound that the most frequently recorded group was of waterbirds (Kagan *et al*. 2014). Examined carcasses indicated three sources of mortality: 1) outright deaths through "blunt force trauma" i.e. by collision with panels; 2) starvation; and 3) predation. Many waterbirds have difficulty in taking off into flight if they are not on a water surface. Flying waterbirds attracted by the panels' impression of water may land among panels and, without water, are unable to take-off. Isolated from suitable habitat they either starve to death or, weakened, are caught and killed by predators (Kagan *et al*. 2014).

In the absence of adequate published information on mortality of birds at photo voltaic arrays, and specifically of such potential impacts on African bird species, it is impossible to predict the potential scale of such mortality. However, international experience is that at least small numbers of a range of bird species will die as a result of collision with the panels (McCrary *et al*. 1986, Kagan *et al*. 2014).

5.3.4 Electromagnetic Radiation (EMR)

When electricity is passed through cables it generates electric and magnetic fields. To transmit energy internally within SEFs a distribution system of buried electricity cables is used. These can lead to chronic, but localized, electromagnetic radiation (EMR). Balmori (2009) has reviewed the impacts of increased local EMR on animals. These impacts include: reduced male fertility; embryonic deformities; weakened immune systems and so susceptibility to infectious diseases, bacteria, viruses and parasites. Insects are especially impacted and their local populations decline. Bird navigation abilities may also be impacted by EMR.

EMR at the Grootpoort SEF could have both positive and negative impacts. The positive impact is that if EMR leads to a major local reduction of insects this will decrease the attraction of the SEF to birds and so reduce the impact of other potential negative impacts. However, on the negative side, a lack of insects may then reduce the breeding success, and numbers, of birds in the adjoining areas. Reduced insect availability will, through lack of food, especially increase infant mortality in birds.

5.3.5 Power line strikes and electrocution

Power lines pose a collision risk to some bird species particularly larger birds (Jenkins *et al.* 2010). Collision risk is largely influenced by the situation of power lines, but also by their visibility (especially of the earth wire) to birds. Animals will be electrocuted if, when attempting to perch on an electrical structure, they succeed in bridging the air gap between live and earthed components. The risk of electrocution is highest on low voltage infrastructure with relatively small air gaps.

No powerline layout was available at the time of report writing. Bird collision mortality with powerlines is usually only considered important where lines pass close to waterbodies or cross funnelled flight-paths. Neither case applies relative to the proposed Grootpoort SEF.

6 SUGGESTED MITIGATIONS

Unlike the situation in windfarms where bird observations may suggest relocation of structures, there is no reason from a bird perspective why the proposed layout should be subject to any change. The mitigations recommended here are for smaller scale features and actions.

6.1 Minimize the direct impact area:

Wherever possible, natural vegetation should be left intact. Corridors of natural vegetation should be maintained between developed areas on site (e.g. lay-down areas and PV panel field). Construction and final footprints should be kept to an absolute minimum. During construction, the footprint area of each construction site must be demarcated with stakes and hazard tape (or some equivalent method) prior to site clearance, and should remain marked out during construction. Keep peripheral developments to a minimum and as close to planned development nodes as possible. Rehabilitate all disturbed areas immediately after the completion of construction. Consult an ecologist to give input into rehabilitation specifications.

6.2 Reduce impacts in the developed area

Use low-impact methods of excavation and avoid the use of explosives. Where possible, create lay-downs in previously disturbed areas and make use of existing power lines and substations. After construction, remove all infrastructure and equipment not required for the post-decommissioning functioning of the facility.

6.3 Pollutants

Do not use herbicides or pesticides on site. During the construction phase, apply standard measures to avoid spills and mitigate those that occur. Specifically spoil or waste material should not be dumped within 50 m of natural areas, remove it to a licensed dump site. Effluents or polluted water generated during construction must not be discharged into natural areas.

6.4 Dust

Reduce and control construction dust through the use of approved dust-suppression techniques, e.g. 1) Use fine water sprays used to dampen down the site; 2) screen the whole site to stop dust spreading; 3) cover skips and trucks loaded with construction materials and continually damp down with low levels of water.

6.5 Disturbance

Keep construction and maintenance periods as short as possible. Restrict construction and maintenance activities to daylight hours. Keep blasting to an absolute minimum. If blasting is necessary, employ techniques that minimise noise, vibration and dust. Reduce the noise associated with construction and maintenance activities as far as possible.

6.6 Limit light pollution

To minimize any impacts on birds, all lighting at the SEF should be kept to a minimum. Where lighting is necessary, it is recommended that long-wavelength (red or orange) low-pressure sodium lights are used, or that lights are fitted with ultraviolet filters. Light fittings should be directional and shielded. Install sealed light fittings so that insects cannot reach the light source. Screen interior lighting with blinds, curtains, etc. to prevent exterior light pollution. Long lines of lights should be avoided.

7. IMPACT EVALUATIONS

Suggested mitigations will have minor effects on significance and probability

Criteria	Rating	Description	Significance	Probability
HABITAT LOSS & FRAGMENTATION				
Extent of spatial influence	Low	Site specific	Low	Definite
Impact magnitude	High	No mitigation is possible		
Duration	High	Beyond de-commissioning		
POLARIZING LIGHT POLLUTION				
Extent of spatial influence	Medium	Within 10 km radius	High	Definite
Impact magnitude	Medium	Design modification		

Duration	Medium	Project lifespan		
ECOLOGICAL LIGHT POLLUTION				
Extent of spatial influence	Low	Site specific	Low	Definite
Impact magnitude	Very low			
Duration	Medium	Project lifespan		
ELECTROMAGNETIC RADIATION				
Extent of spatial influence	Low	Site specific	Medium	Definite
Impact magnitude	Medium			
Duration	Medium	Project lifespan		
DUST POLLUTION				
Extent of spatial influence	Medium		Low	Definite
Impact magnitude	Medium			
Duration	High	Beyond de-commissioning		
NOISE				
Extent of spatial influence	Low	Site specific	Low	Probable
Impact magnitude	Very low			
Duration	Medium	Project lifespan		

8. CONCLUSIONS

The loss of habitat due to development of the Grootpoort SEF will have the greatest impact on those bird species that are dependent on the scrubland. These species have generally extensive distributions in the Free State and Northern Cape Provinces and the small number of individuals displaced from the proposed development is not considered of conservation importance. No conservation priority species will be particularly impacted as they range over considerably wider areas than that to be affected. Nor, currently, are there other substantial new developments known in the region that might stress regional bird populations through an accumulation of negative impacts.

The one issue of concern is the potential for waterbirds traversing the area at night to mistake the polarized light from the PV panels for a waterbody with the subsequent risk of their death through collision with the structures, or, having landed, through subsequent inability to take-off.

Based on currently available information the impact significance on birds is expected to be low and this assessment is viewed as having acceptable detail in terms of impact assessment.

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10 LIST OF BIRD SPECIES OBSERVED

Bird species recorded during the six days of observations

A 1 signifies that the species was recorded. A 0 that it was not recorded in the particular observation period. Species in italics occurred in areas marginal to the main area designated for the solar array

	8/12 pm	*9/12 am*	*9/12 pm*	*10/12 am*	*9/3 pm*	*10/3 am*	*10/3 pm*	*11/3 am*	*11/3 pm*
Bishop, Southern Red	0	**1**	0	**1**	0	0	0	0	0
Bokmakierie	***1***	*0*	*0*	*0*	*0*	*0*	**1**	**1**	*0*
Bunting, Lark-like	*0*	***1***	*0*	***1***	*0*	*0*	*0*	*0*	*0*
Bunting, Cinnamon-breasted	*0*	*0*	***1***	***1***	*0*	*0*	*0*	*0*	*0*
Canary, White-throated	*0*	*0*	*0*	***1***	***1***	*0*	*0*	*0*	*0*
Chat, Ant-eating	*0*	***1***	***1***	***1***	***1***	*0*	*0*	***1***	***1***
Chat, Familiar	*0*	***1***	*0*	***1***	*0*	*0*	*0*	*0*	*0*
Crow, Pied	**1**	0	**1**	**1**	*0*	*0*	*0*	*0*	*0*
Dove, Laughing	**1**	0	0	**1**	*0*	*0*	*0*	*0*	*0*
Dove, Namaqua	**1**	**1**	0	**1**	*0*	*0*	*0*	*0*	*0*
Dove, Turtle	*0*	***1***	***1***	***1***	*0*	*0*	*0*	*0*	*0*
Eagle, Black-breasted Snake	*0*	*0*	*0*	*0*	***1***	*0*	*0*	*0*	*0*
Eremomela, Yellow-bellied	0	**1**	0	0	*0*	*0*	*0*	*0*	*0*
Finch, Scaly-feathered	*0*	*0*	*0*	***1***	*0*	*0*	*0*	***1***	*0*
Flycatcher, Chat	0	**1**	**1**	**1**	*0*	*0*	*0*	***1***	***1***
Goshawk, Pale Chanting	0	0	0	0	***1***	*0*	*0*	*0*	*0*
Guineafowl, Helmeted	0	0	**1**	**1**	*0*	*0*	*0*	*0*	*0*
Hoopoe, African	*0*	*0*	*0*	***1***	*0*	*0*	*0*	*0*	*0*
Ibis, Hadeda	*0*	*0*	*0*	*0*	*0*	*0*	*0*	***1***	*0*
Kestrel, Rock	*0*	*0*	*0*	*0*	***1***	***1***	*0*	*0*	*0*
Korhaan, Northern Black	**1**	**1**	**1**	**1**	***1***	***1***	***1***	***1***	***1***
Lapwing, Crowned	0	**1**	0	0	*0*	*0*	*0*	*0*	*0*
Lark, Eastern Clapper	0	**1**	0	**1**	***1***	***1***	***1***	*0*	***1***
Lark, Fawn-coloured	**1**	0	0	0	*0*	*0*	***1***	*0*	*0*
Lark, Sabota	0	0	**1**	0	*0*	*0*	*0*	*0*	*0*
Lark, Spike-heeled	0	**1**	**1**	0	***1***	*0*	*0*	*0*	*0*
Pigeon, Speckled	*0*	*0*	***1***	***1***	***1***	*0*	***1***	***1***	*0*
Pipit, African	0	0	**1**	**1**	*0*	*0*	*0*	*0*	*0*
Scrub-robin, Karoo	0	**1**	0	0	*0*	*0*	*0*	***1***	*0*
Shrike, Fiscal	**1**	**1**	**1**	0	*0*	***1***	*0*	***1***	*0*
Shrike, Red-backed	0	0	0	0	*0*	*0*	***1***	*0*	***1***
Sparrow, Cape	0	**1**	**1**	0	*0*	*0*	*0*	*0*	*0*
Sparrow-lark, Grey-backed	0	**1**	0	**1**	*0*	*0*	*0*	*0*	*0*
Starling, Cape Glossy	*0*	*0*	*0*	***1***	*0*	*0*	*0*	*0*	*0*
Swallow, Barn	**1**	**1**	**1**	**1**	**1**	**1**	**1**	**1**	0
Swift, Little	*0*	*0*	*0*	*0*	***1***	*0*	*0*	*0*	*0*
Tit-Babbler, Chestnut-vented	**1**	**1**	0	**1**	*0*	*0*	*0*	*0*	*0*
Warbler Rufous-eared	**1**	**1**	0	**1**	*0*	*0*	*0*	*0*	*0*
Weaver, Southern Masked	0	**1**	**1**	**1**	*0*	*0*	*0*	*0*	*0*
Whydah, Pin-tailed	*0*	*0*	*0*	***1***	*0*	*0*	*0*	*0*	*0*

Overall species: 40	**9**	**18**	**14**	**24**	***10***	***6***	***8***	***10***	***5***

11 DECLARATION OF CONSULTANT'S INDEPENDENCE AND QUALIFICATIONS

Dr. Anthony (Tony) Williams is an independent consultant. He has no business, financial, personal or other interest in the activity, application or appeal in respect of which he was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of this specialist performing such work.

Dr. Williams has been a professional ornithologist for 46 years, including: 1) 9 years as a researcher at the FitzPatrick Institute of African Ornithology, at Cape Town University; 2) 25 years as specialist ornithologist in the conservation departments of (then) South West Africa (1982-1988) and the Cape (latterly Western Cape) Province of South Africa (including five years secondment at the (then) Avian Demography Unit at Cape Town University; and 3) 12 years as a ornithological consultant and independent researcher.

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge, as well as available information.

12. CONSULTANT'S CURRICULUM VITAE

Dr A.J. (Tony) Williams

SA ID: 420902 5541 080

QUALIFICATIONS

B.Sc. *Cum laude,* in Geography, University of Sheffield, UK 1964

Postgraduate Certificate in Museum Studies, University of Leicester, UK 1968

M.Sc. Zoology, University of Sheffield, UK 1972

Ph.D. Zoology, University of Cape Town, South Africa 1980

EMPLOYMENT

2008-present:	**Consultant. Co-director: African Insights. Director: Dr Williams Bird Surveys**
2001-2007	Seconded, as ornithological researcher, by Cape Nature to **Avian Demography Unit, University of Cape Town.**
1994-2007	Senior Professional Officer (Ornithology) at **Western Cape Nature Conservatio**n (later renamed as **Cape Nature**). Provision ofexpert avifaunal advice to the organisation and the Government of the Western Cape Province. Conducting research and directing researchers. Representing the organisation on EIA appraisals
1988-1994	Senior Ornithologist **Cape Provincial Nature Conservation**: Responsible for Walvis Bay and all guano islands 1988-1994; Conducting research and directing researchers. Representing the organisation on EIA appraisals
1982-1988:	Ornithologist for **Department of Conservation and TourismSW Africa/ Namibia**
1973-1982:	Research officer at **Percy Fitzpatrick Institute of African Ornithology, University of Cape Town**: dealing with sub-Antarctic Marion and Gough Islands (23 published scientific papers) and coastal birds in the southwestern Cape (6 papers)
1969-1972	**Norway** – research assistant at University of Tromso
1967-1968	**UK** Museum Studies course at Leicester University
1965-1966	**Canada** - Assistant Planner in Vancouver, British Columbia
1964-1965	**UK** Peak District National Park - Assistant planner
Overall:	43 years as a professional ornithologist; 25 years as a conservation ornithologist; and 20 years involvement in consultancy.

CONSULTATIONS

Fields of expertise:

Specialist avifaunal assessments/ surveys;

Development of tourism concepts;

Provision of nature interpretational material/signage

TERRESTRIAL DEVELOPMENTS

Energy projects:

***Eskom*:** Appraisal of new power lines at Kimberley and at Misverstand (Swartland); and three lines related to wind energy facilities in the Roggeveld (border between Northern and Western Cape Provinces). Review of the potential impacts of electricity infrastructure on birds in the entire West Coast District Municipality.

***Wind Energy Facilities (WEF*)**: Work on 10 WEFs. Scoping for a WEF, with associated radar survey and full moon observations of bird movements, near Vredenburg; Scoping for Denham WEF near Struis Bay; Avifaunal EIA section for Zen WEF near Gouda (2013-2014); Seasonal pre-construction avifaunal field monitoring for 5 WEFs in the Roggeveld region between Matjiesfontein and Sutherland (2013-16); Socio-economic plans related to Witteberg WEF near Laingsburg, and for proposed WEFs near Klawer and in the Richtersveld.

Solar Power Plants (SPP) Avifaunal EIAs for 8 PV solar arrays: near Langebaan (2014); near Touws River (2015); and 6 proposed SPPs near Vryburg in the North West Province (2015-2016).

Nuclear Power Plants

Specialist peer-reviewer for faunal reports prepared for 3 proposed nuclear plants (2009).

URBAN PROJECTS:

Residential developments: Strandfontein (2008), Paarl golf estate (1999), Atlantic Hills (Cape Town) (2012)

Landfills: Avifaunal appraisals in terms of habitat loss, bird use, and problems in developed landfills for proposed new regional landfills for Eden (2011) and Winelands (2013) District Municipalities

Roads: Impacts of new roads on birds, including pollution and disturbance: R 300 Strandfontein (2004) & Military Road (2008) proposals; R27 Elands Bay to Lamberts Bay phases 1 (2000) and 2 (2004). Prepared global review of road impacts on reptiles

WETLAND RELATED DEVELOPMENTS

Century City, Cape Town – Reports on: the control of building heights (2007); Canoeist disturbance of birds (2008); Impacts on birds of rotenone poisoning of fish (2009). Also 20 years as ornithologist on the environmental advisory committee for the Intaka Island Nature reserve within Century City.

Paardevlei, Somerset West:- Pre-draining appraisal (2004), Impacts on birds of rotenone poisoning of fish (2005), wetland development plan and bird monitoring ongoing 2013-2016

Flamink Vlei, Berg River: 2006-2011 impacts on birdlife of this major – 900 residential units – development; reports on potentials for avi-tourism (2007) and for establishing a guano enterprise (2007)

Paarl: 10 years in advisory role for the Bird Sanctuary/ WWTW; Advice to the Paarl Golf Estate;

Miscellaneous: Assessment of impacts on birds of developments at Uilenkraal (2 separate residential development proposals eastern (2002) western (2005)); Thesen Island, Knysna (1996); De Plaat – on Berg River (2005-2011); Atlantic Hills, Richwoood (2012): – How to reduce waterbird use of wetlands to avoid collision mortalities.

MARINE/ COASTAL DEVELOPMENTS

Offshore: Marine oil, gas and diamond EIAs (1998-2004). Assessment of proposed salmon farm in Saldanha Bay (2012)

Onshore: Avifaunal advisor for Saldanha Port development (2014-2016); Site selection for the proposed West Coast District Municipality desalination plant (2012); Report on the potential for further guano platforms along the Namibian coast (1989). Effects of off-road vehicles on beach birds (published scientific paper)

Coastal residential developments: in the Uilenkraal valley, near Gansbaai (1999), Laaiplek (2005), Doring Bay (2008), Strandfontein (near Olifants River) (2008).

TOURISM/ ECO-EDUCATION DEVELOPMENTS

Concept developer, fund raiser, and partial project manager of numerous tourism developments most connected with the development of local communities

Rietvlei wetland eco-centre: Developedconcept,motivated funding, taken to full Scoping level.

West Coast Investment Initiative: 1997-1999. Prepared tourism development proposals for Verloren Vlei and Pakhuis Pass (Cederberg). Concept development, fund motivator, and project manager for Lamberts Bay Bird Island tourism phases 1 (completed 1998) and 2 (completed 2001).

Cape Nature: Project manager for the Whale Hiking Route at De Hoop Nature Reserve (2002). Rocher Pan – provision of interpretation material (2009).

Coastcare: 2005> Developed proposals for Coastcare funding of tourism facilities at Kleinbaai (near Gansbay), Bettys Bay, and Lamberts Bay. All were short-listed, field inspected, and endorsed by the authorities. However, the foreign donor withdrew funding at national level. The Bettys Bay development at Stoney Point has been developed under different funding and I provided the interpretation material (2012-2014).

Flandos & associates: Matzikama Eco-park in Vredendal taken from concept to completion (2002-2004). Proposed developments at Doring Bay (2007), Graafwater, Citrusdal, and near Darling are still being considered.

Miscellaneous: Boschberg eco-residential/ ecotourism development (Somerset East) for Blue Crane Route (2010); Paardevlei (Heartlands); Flamenco Eco-centre, De Plaat; provision of interpretation material for Lamberts Bay Bird Island tourism phase 3 (2012-2015).

SCIENTIFIC ACHIEVEMENT

110 peer-reviewed papers in the international scientific literature.

(List available on request)

SANCCOB

(South African National Council for Conservation of Oiled Birds). Member of the executive committee 1994-1998, chairperson 1998-2000. High level involvement during the *Apollo Sea* spill in 1994; directed research into subsequent survivability and reproduction of de-oiled penguins 1994-1999; and advisor to the top level daily response committee for the *Treasure* spill of 2000.