Avifaunal Impact Assessment for the ACWA Power SolarReserve Redstone Photovoltaic Power Project

On behalf of

ACWA Power SolarReserve Redstone Solar Thermal Power Plant (RF) (Pty) Ltd

25 April 2018

Prepared By:

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SPECIALISTS' DECLARATION OF INDEPENDENCE AND QUALIFICATIONS

Arcus are independent and have no business, financial or personal interest in the activity, application or appeal in respect of which it was appointed, other than fair remuneration for work carried out. There are no circumstances that compromise the objectivity of their specialists performing such work.

Andrew Pearson is an Avifauna Specialist at Arcus and has a Four Year BSc in Conservation Ecology, certificates in Environmental Law, as well as ten years' experience as an environmental management professional, including seven years as an avifaunal specialist. The findings, results, observations, conclusions and recommendations given in this report are based on this author's best scientific and professional knowledge as well as available information. Andrew conducted the site visit and provided inputs to the species behaviour with regard to the analysis and interpretations of the avifauna data as an Avifauna Specialist. Andrew is a certified Professional Natural Scientist.

Anja Albertyn is an Avifauna Specialist at Arcus and holds an MSc in Ornithology from the FitzPatrick Institute of African Ornithology at the University of Cape Town. She has been involved in avifaunal monitoring activities since 2004 and has worked as an environmental consultant since 2008, including working as an avifaunal consultant and specialist since 2013. The findings, results, observations, conclusions and recommendations given in this report are based on this author's best scientific and professional knowledge as well as available information. Anja is a certified Professional Natural Scientist.

The Natural Scientific Professions Act of 2003 aims to "*Provide for the establishment of the South African Council of Natural Scientific Professions (SACNSP) and for the registration of professional, candidate and certified natural scientists; and to provide for matters connected therewith*." Andrew and Anja are professional members of the SACNSP, as detailed below:

Investigator:	Andrew Pearson (*Pri.Sci.Nat*)
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Registration:	Professional Member

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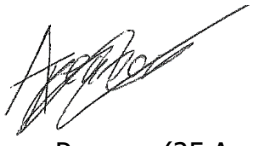
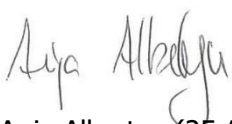
Registration number:	400037/16
Fields of Expertise:	Ecological Science
Registration:	Professional Member



Andrew Pearson (25 April 2018)



Anja Albertyn (25 April 2018)

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/L
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for integrated environmental authorisation and waste management licence in terms of the-

(1) National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2014; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 921, 2013

PROJECT TITLE

ACWA Power SolarReserve Redstone Photovoltaic Power Project, Northern Cape Province

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4.2 The specialist appointed in terms of the Regulations_

I, Andrew Pearson, 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 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Arcus Consultancy Services South Africa (Pty) Ltd
Name of company (if applicable):

25 April 2018
Date:

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

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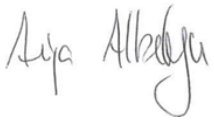
4.2 The specialist appointed in terms of the Regulations_

I, Anja Albertyn, 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 48 and is punishable in terms of section 24F of the Act.



Signature of the specialist:

Arcus Consultancy Services South Africa (Pty) Ltd

Name of company (if applicable):

25 April 2018

Date:

1 INTRODUCTION

1.1 Background

The ACWA Power SolarReserve Redstone Solar Thermal Power Plant (RF) (Pty) Ltd, ("Redstone CSP Project") received an Environmental Authorisation (EA) in 2012 and was subsequently selected as a preferred bidder within the Renewable Energy Independent Power Producers Procurement (REIPPP) programme. An avifaunal specialist impact assessment was conducted by the Endangered Wildlife Trust (EWT) in 2011 (EWT, 2011) as part of the Environmental Impact Assessment (EIA) Process. This study did not included any long term monitoring, although a thorough site visit was conducted. Following EA, and outside of the EIA process, the Applicant initiated one year of additional long-term preconstruction bird monitoring on the Redstone CSP Project, conducted in 2012/2013 in order to expand the bird baseline information for the site.

The Redstone CSP Project now wishes to develop a Photovoltaic (PV) Power Project, within the approved Redstone CSP Project boundary (Figure 1). The project description in the EIA and the original bird impact assessment did not include a PV component or assess PV technologies on the site. The Applicant are therefore conducting a Basic Assessment Process to apply for a separate EA for the proposed PV Power Project, and have appointed Arcus Consultancy Service South Africa (Pty) Ltd. ("Arcus") to conduct an avifaunal impact assessment for the proposed PV Power Project.

1.2 Project Description

The Applicant proposes the development, construction and operation of a PV Power Project with the generation capacity of up to 20 MW, with up to 30MW hour's storage, for the auxiliary load requirements (the "PV Power Project"), of the Redstone CSP Project on the Remaining Extent of the Farm 469, Hay District (the "Project Site"). The planned PV Power Project will be located approximately 30 km east of the town Postmasburg in the Northern Cape Province, adjacent to the Redstone CSP Project (Figure 1).

The Project is designed to allow the ACWA Power SolarReserve Redstone Solar Thermal Power Plant RF (Pty) Ltd to generate renewable green energy for self-consumption in order to operate and run the Redstone CSP Projects auxiliary load requirements. The Redstone CSP Project was authorised under the National Environmental Management Act 107 of 1998 (NEMA) by the Department of Environmental Affairs (DEA) Ref. Nr 12/12/20/2316 (AM7). Two location options are proposed for the 20 MW PV project:

- Option A: The PV Power Project is proposed on the western boundary of the Project Site, adjacent to Redstone CSP Project for ease of access to the power block/substation.
- Option B: The PV Power Project is proposed within the heliostat field of the Redstone CSP Project, for ease of access to the power block/substation.

A detailed project description and overview of the activities that will be conducted during the construction, operation and decommissioning phases of the PV power Project, and upon which the impact assessment has been based, is provided in Appendix 3 (as supplied by SolarReserve).

2 TERMS OF REFERENCE

The following terms of reference were utilised for the preparation of this report:

- Updated description of the site baseline with regard to avifauna for the study area, focussing on the characteristics which may be impacted upon by the proposed development type during construction, operation and decommissioning;

- Describe the sensitivity of the baseline environment with regard to avifauna specifically with regard to the conservation status of species;
- Identify the nature of potential impacts (positive and negative, including cumulative impacts if relevant) of the proposed PV Power Project development on avifauna during construction, operation and decommissioning;
- Identify information gaps and limitations;
- Identify mitigation or enhancement measures to minimise impacts to avifauna or deliver enhancement from the proposed development;
- Assess the significance of the impacts before and after implementation of mitigation;
- Provide a comment on the preferred site location alternative;
- Provide an impact statement et for the proposed PV Power Project in relation to potential avifaunal impacts;
- Provide an updated cumulative impact statement.

3 METHODOLOGY

In order to assess the potential impacts of a Project the baseline environment must first be defined. The potential nature of impacts from the project type is then considered and assessed using a set, repeatable criteria applied by a specialist utilising their professional judgement.

3.1 Defining the Baseline

The baseline environment for the proposed project was defined utilising desk based and field based methods as described below, and relied primarily upon updating the baseline already defined in 2011 by EWT.

3.1.1 Desk-based Sources of Information

As the proposed PV Power Project is to be situated on the site of the already authorised Redstone CSP Project, a large amount of information has already been collected for this site. The original bird impact assessment (EWT, 2011) covered the proposed PV site area, as did the additional pre-construction bird monitoring. Information and data from these studies is relevant, and they are drawn upon here to assist in the updated impact assessment for the PV component. Where aspects of the baseline avifaunal description have changed from what was described in 2011/2012, an updated description has been included in this report. The following data sources were studied in order to update the baseline for avifauna:

- Bird distribution data of the Southern African Bird Atlas Project (SABAP-1) (Harrison *et al.* 1997) and Southern African Bird Atlas Project 2 (SABAP-2) obtained from the Avian Demography Unit of the University of Cape Town (Brooks 2017);
- Co-ordinated Water-bird Count (CWAC) project (Taylor *et. al.* 1999);
- The Important Bird Areas of southern Africa (IBA) project (Marnewick *et al.* 2015);
- Publically available satellite imagery;
- The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015);
- Proposed Humansrus Solar Thermal Energy Power Plant Specialist Avifaunal Impact Assessment EIA Report (EWT, 2011); and
- Results of the long-term pre-construction bird monitoring on the Redstone CSP Project site conducted in 2012 and 2013 (EWT, 2012a; EWT, 2012b and EWT, 2013).

3.1.2 Site Visit

A one day site visit was conducted by the avifaunal specialist on 24 April 2018. The primary aim of this visit was to confirm the status of the available bird micro-habitats, land-use and

vegetation types to determine if there had been any changes with regards to these site characteristics since the original avifaunal report (EWT, 2011). The specialist also searched the site and surrounding area (up to approximately 1 km from the site) for any evidence of breeding of key species. A species list was created of all bird species recorded on the project site during the site visit (Section 4.1).

3.1.3 Terminology

- **Priority species** = all species occurring on the Birdlife South Africa (BLSA) and Endangered Wildlife Trust (EWT) Avian Sensitivity Map priority species list (Retief *et al.* 2011 updated 2014). This list consists of 107 species with a priority score of 170 or more, and most likely to be affected negatively by wind energy facilities (WEFs). While developed with WEFs in mind, these species may have considerable bearing on impact assessments for some kinds of solar projects. The priority score was determined by BLSA and EWT after considering various factors including bird families most impacted upon by WEFs, physical size, species behaviour, endemism, range size and conservation status;
- **Red Data species** = species whose regional conservation status is listed as Near-Threatened, Vulnerable, Endangered or Critically Endangered in the Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al.* 2015);
- **Endemic or Near-endemic** = Endemic or near endemic (i.e. ~70% or more of population in South Africa) to South Africa (not southern Africa as in field guides) or endemic to South Africa, Lesotho and Swaziland. Taken from BLSA Checklist of Birds in South Africa, 2014.

3.2 Impact Assessment Methodology

After updating the baseline data using the methods above the impacts of the proposed project are assessed. The potential impacts of the proposed PV Power Project were identified by conducting a literature review of possible impact to birds and considering the project description (Appendix 3). These impacts were then rated using a set criteria (Appendix 2), again considering the project description, and focussing on the impacts on a group of focal species. Focal species for the assessment are first identified utilising the following method:

1. Identification of the micro-habitats (section 4.2.1 below);
2. Determining which species are likely to be present from desk based resources;
3. Identification of species which have a high likelihood of being present on, and/or utilising, the proposed project site considering steps 1 and 2 and the findings of the site visit; and which of these species has the potential to be impacted upon by the type of development i.e. a PV Power Project (based on the experience and opinion of the specialist);
4. Determining species conservation status or other reasons for protecting the species. This involved primarily consulting the Red List bird species (Taylor, et al. 2015)

In many cases, these species serve as surrogates for other similar species (as mitigation will be effective for both). Assorted more common species may also be relevant to this study, but it is believed that the above focal species will to a large extent serve as surrogates for these in terms of impact assessment and management.

3.3 Limitations and Assumptions

- While a full year of pre-construction monitoring was conducted at the Redstone CSP Project site in 2012 and 2013 by EWT, it is our understanding that a fourth and final

report was not produced. Therefore results from three seasons of surveys were considered when updating the avifaunal baseline. It should be stated though that this information, together with that from EWT, 2011 and the site visit conducted by the Arcus specialist is deemed more than sufficient to conduct an impact assessment, for this proposed PV development;

- There is only one study (that the specialist is aware of and which could be found in the literature search) on avifauna impacts of a utility scale Solar PV plant in South Africa. While the study was conducted on a neighbouring site (Jasper PV), it was limited in that it only covered a period of 3 months (Visser, 2016); and
- Generally there is a lack of information, scientific studies and therefore certainty regarding the avifaunal impacts of solar PV developments, particularly with regards to in direct impacts and impacts of habitat fragmentation, and habitat destruction etc. resulting in displacement and disturbance to birds.

4 RESULTS

4.1 Site Visit

The site visit confirmed that the available bird-microhabitats, both on the proposed PV Power Project site and surrounding areas, had not changed significantly since 2011. The new Jasper and Lesedi PV power plants, which are in close proximity to the proposed PV Power Project were the only visible change of land use in the broader area. In fact, the existing PV plants themselves can be seen as a new micro-habitat used by birds, and indeed various bird species were observed on the Jasper PV site during the site visit. The PV infrastructure provides shade used by birds, as well as perching and nesting substrate. Furthermore, grassy vegetation has been encouraged, and much of the site has re-vegetated providing a source of food for grass seed eating bird such as canaries and finches.

The following species were recorded within (or up to 50 m from the boundary) of the operational Jasper 75 MW PV Plant: Yellow Canary, Ant-eating chat, Cape Sparrow, Capped Wheatear, Pied Crow, Red-headed Finch, Scaly-feathered Finch, Kalahari Scrub-robin, Cape Turtle Dove, Greater Kestrel.

The following species were recorded within (up to 200m of the boundary) of the Proposed project site: Ant-eating chat, Capped Wheatear, Pied Crow, Kalahari Scrub-robin, Cape Turtle Dove, Feral Pigeon, Cisticola spp., Spike-heeled Lark, Familiar Chat, Chat Flycatcher, Helmeted Guineafowl, Layard's Titbabbler, Grey-backed Cisticola, Black-chested Prinia, Temminck's Courser and Greater Kestrel.

4.1.1 Updated Vegetation and Micro-habitats description

The status quo of the biomes and vegetation types remain as described in EWT (2011), with the predominant vegetation type covering the site being Olifantshoek Plains Thornveld (Mucina and Rutherford, 2006).

Beyond the proposed site, in the broader areas, the same micro-habitats identified by EWT (2011) remain and include the following: Drainage Lines and Wetlands; Man-made Dams; Grassland; Bushveld and Thicket patches and Water Trough Points. A detailed description of these habitats and the possible avifauna present is given in EWT (2011) and has not changed.

At a finer scale on the proposed PV Plant site, three microhabitats are present: Grassland; Disturbed Mining areas and Thornveld/Thicket. Grassland is the least represented with only small areas around the extremities of the site. Thornveld/thicket areas predominate, and consist of bushes and small trees, interspersed with patches of grass.

These woody thornveld/thicket areas generally attract smaller passerine species such as Robins, Chats, Finches, Prinias and Shrikes. Weavers and Sparrow-weavers use the tree as structures for nesting and Raptors such the Southern Pale Chanting Goshawk and Greater Kestrel may use these areas for perching.

4.2 South African Bird Atlas Project 2 (SABAP2)

This project is part of an ongoing study by the Animal Demography Unit (ADU), a research unit based at the University of Cape Town (UCT), and data is collected per pentad. Pentads are roughly 8 km x 8 km squares. Reporting rates are calculated as percentages of the number of times a species was recorded in the pentad, divided by the number of times that pentad was counted.

Four full protocol cards have been submitted for the pentad covering the project site (2815_2320) (Figure 1), with a total of 72 species recorded. No red data species or endemics have been recorded. Pale Chanting Goshawk, Lesser Kestrel, and Northern Black Korhaan were the only priority species or raptors recorded. Fiscal Flycatcher and Eastern Long-billed Lark were the only near-endemic species recorded.

Due to a lack of submitted cards for the pentad covering the project site SABAP2 data was therefore also examined for the 8 pentads surrounding the project site. The pentads considered were 2810_2315, 2815_2315, 2820_2315, 2810_2320, 2815_2320, 2820_2320, 2810_2325, 2815_2325, and 2820_2325 (Figure 1).

Generally the counting effort is low in the area, with seven of the nine pentads have less than 5 full protocol cards submitted. Two pentads however have a relatively high counting effort, with 24 and 156 cards submitted.

A total of 198 species have been recorded in the nine pentads considered. Twenty-one of these are priority species, and 13 are Red data listed species, and nine are endemic or near-endemic (Table 1). It must be noted that this relatively high diversity of birds was largely due to the high numbers of cards submitted for pentad 2820_2315, which covers the Lime Acres mine area and includes several large open water ponds. Many birds recorded here (i.e. in pentad 2820_2315), particularly water-associated species such as flamingos, are unlikely to occur on the proposed project site.

Table 1: Red data species, Priority species and endemic or near-endemic species recorded in the SABAP2 pentads covering and surrounding the project site.

Alphabetical Name	Regional Red Data Status[1]	Endemic or Near-endemic	Priority Score[2]	Reporting rate
Bustard, Ludwig's	EN		320	2.01
Buzzard, Common (Steppe)			210	2.51
Courser, Burchell's	VU		210	0.5
Crane, Blue	NT		320	0.5
Duck, Maccoa	NT			6.53
Eagle, African Fish			290	2.01
Eagle, Black-chested Snake			230	5.03
Eagle, Martial	EN		350	0.5

[1] Taylor, M.R. (ed.) 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Birdlife South Africa, Johannesburg.

[2] Retief, E.F., Diamond, M., Anderson, M.D., Smit, Dr. H.A., Jenkins Dr. A. & Brooks, M. 2011, updated 2014. Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures Used.

Eagle, Tawny	EN		290	0.5
Eagle, Verreauxs'	VU		360	3.52
Falcon, Lanner	VU		300	2.01
Flamingo, Greater	NT		290	1.51
Flamingo, Lesser	NT		290	6.53
Flycatcher, Fairy		x		23.12
Flycatcher, Fiscal		x		96.48
Goshawk, Pale Chanting			200	14.57
Kestrel, Greater			174	6.03
Kestrel, Lesser			214	6.03
Kite, Black-shouldered			174	15.08
Korhaan, Northern Black			180	19.6
Lark, Eastern Long-billed		x		1.01
Lark, Large-billed		x		0.5
Owl, Spotted Eagle-			170	2.51
Painted-snipe, Greater	VU			0.5
Secretarybird	VU		320	1.01
Starling, Pied		x		2.01
Stork, White			220	1.51
Thrush, Karoo		x		82.91
Tit-Babbler, Layard's		x		0.5
Vulture, White-backed	EN		300	1.51
White-eye, Cape		x		1.01

4.3 Co-ordinated Avifaunal Roadcounts (CAR)

An evaluation of CAR data revealed that there were no CAR routes through or near to the site, and therefore this data has not been considered further in this study.

4.4 Important Bird Areas (IBA) Project

The site does not fall within an Important Bird Area (IBA) and there were no IBA's within close proximity to the site, and therefore this data has not been considered further in this study.

4.5 Co-ordinated Waterbird Counts (CWAC)

Three CWAC sites are situated to the east of the study area, namely Danielskuil Pan, Great Pan, and Rooipan. All are further than 20 km from the proposed project site, and therefore the avifauna recorded here historically, are unlikely to be present on or around the proposed site with any regularity.

Furthermore, much of the data available for these sites is very outdated. Danielskuil Pan actually consists of two dams and a dam/pan with open shoreline, some shorebird habitat, and almost no fringing vegetation. Formerly, the dam/pan received water from local sewage works. Counts are available for 1996 and 1997, when mainly small numbers of 17 species were recorded, 16 species in summer (only South African Shelduck being missing) and only 3 in winter (SA Shelduck, Three banded Plover and Cape Wagtail). The most numerous birds in summer were White-faced Duck, Blacksmith Plover (a good count of 47 birds in 1997), Curlew Sandpiper and Little Stint. Data was not available for Great Pan, and neither for Rooipan, as both sites are classed as private, and individual cards are not

available for public viewing. The species occurring at these sites are expected to be similar to those present at Danielskuil Pan, discussed above.

4.6 Document Review

4.6.1 Redstone CSP Pre-construction Bird Monitoring

Three pre-construction bird monitoring progress reports (winter 2012, spring 2012 and summer 2013 surveys) for the Humansrus[3] CSP plant conducted by the Endangered Wildlife Trust were reviewed for this report (EWT, 2012; EWT, 2012a; EWT, 2013).

In the winter survey no red data species were recorded. Four priority species (Pale Chanting Goshawk, Greater Kestrel, Northern Black Korhaan and Black-chested Snake Eagle were recorded in 21 priority species flights from vantage points. In addition, Orange River Francolin, Red-knobbed Coot, Southern Yellow-billed Hornbill, Cape Teal, Spur-winged Goose and Red-billed Teal were observed on site incidentally or on transects and focal sites.

In the spring survey one red data species was recorded (Ludwig's Bustard – *Endangered*) Flight activity was also low, with a total of 28 priority species flights recorded. These were by Pale Chanting Goshawk, Black-chested Snake Eagle, Greater Kestrel, Northern Black Korhaan, Red-crested Korhaan and Namaqua Sandgrouse. In addition Orange River Francolin, European bee-eater, Eastern Clapper Lark, Scaly-feathered Finch and Yellow-billed Duck were also recorded as focal species of potential concern.

The summer survey recorded 17 flights of priority species from vantage points and these included Booted Eagle, Secretarybird (*Vulnerable*) and White-backed Vulture (*Critically Endangered*), previously not recorded on site. In addition Cape Vulture (*Endangered*) were recorded during driven transects and focal site surveys on the site. Up to 24 White-backed Vulture were observed perching on pylons just south of the CSP site.

4.6.2 Operational Bird Monitoring at Jasper PV plant

Arcus is aware of only one detailed study in South Africa on the impacts of birds at an operational utility scale PV facility (Visser, 2016). This study at the Jasper PV site recorded 12 bird mortalities, eight of which occurred during the 3-month study (although they could not be conclusively be linked to collision related mortality). At the Jasper PV site there was no significant difference in overall bird density and diversity between the PV collector area and the adjacent rangelands area. Habitat destruction and displacement is therefore potentially less of a concern at PV sites than initially thought. Various species were recorded both foraging, hunting, perching and breeding within the operational Jasper PV site. Visser (2016) estimated an annual bird fatality rate at the Jasper PV site of 4.53 fatalities.$MW^{-1}.yr^{-1}$. One fatality at Jasper, of an Orange River Francolin, resulted from the bird being trapped between the inner and outer fence, where personnel observed the bird stunned after attempting to take flight between the fencing. Red-crested Korhaan were also trapped between fencing on three occasions, but were able to escape when assisted.

4.7 Updated list of Focal Species

After consideration of all the latest available avifauna information discussed above, the following is an updated list of focal species considered for the purposes of the impact Assessment of the PV Power Project: Martial Eagle, Greater Kestrel, Pale Chanting Goshawk, Black-shouldered Kite, White-backed Vulture, Secretarybird, Ludwig's Bustard, Lesser Kestrel, Spotted Eagle-Owl Greater Flamingo, Red-crested Korhaan, Helmeted Guineafowl, Crowned Lapwing, Namaqua Sandgrouse, Namaqua Dove, Burchell's Courser,

[3] The project name was later changed from Humansrus CSP to Redstone CSP.

Kalahari Scrub-Robin, White-browed Sparrow-weaver, Orange River Francolin, European bee-eater, Eastern Clapper Lark, Scaly-feathered Finch and Yellow-billed Duck, Southern Yellow-billed Hornbill, Fiscal Flycatcher, Large-billed Lark, Layard's Titbabbler and Eastern Long-billed Lark.

5 IMPACT ASSESSMENT

5.1 Construction Phase

5.1.1 Habitat Destruction

Habitat destruction (resulting in habitat fragmentation and loss, and displacement of birds) of large areas of natural habitat has stimulated most concern to date about the implications for avifauna of large-scale solar PV development (Lovich and Ennen 2011; RSPB 2011; Smit 2012), particularly in relation to species with restricted ranges and very specific habitat requirements.

Regarding the proposed project, clearing activities during the construction phase will remove vegetation and therefore habitat that birds may require for breeding, foraging and roosting. While some of the impact may be temporary and mitigation through rehabilitation of some areas is possible, there will also be direct long-term loss of vegetation associated with the footprint of the solar arrays, fences and access roads etc.

Habitat loss may effect, and be more significant for important terrestrial species such as larks, coursers and korhaans. Raptors (e.g. Martial Eagle, Greater Kestrel, Black-chested Snake-Eagle and Pale Chanting Goshawk) may also be effected to a lesser degree, through the loss of potential hunting habitat. It is noted though that due to the general uniformity of the broader area, many birds (especially smaller passerines) may quite easily move off and find similar and suitable habitat nearby. The proposed project is relatively small (<20 Ha) and the available habitats on the site are few, with no critical, important or sensitive bird habitats present. Furthermore, the proposed project falls within the site boundary of the already authorised Redstone CSP project, which is likely to result in some level of habitat destruction/disturbance in the proposed PV Power Project area.

Therefore, this impact has been rated as **Moderate** before mitigation and **Low** following the implementation of mitigation (Table 2).

Table 2: Impact Rating Table for Habitat Destruction- Construction Phase

Activity:	Construction of the PV Power Project and all associated infrastructure				
Impact:	Removal of habitat used by birds resulting in displacement and possible reduced breeding success.				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	5	1	4	5	**50 (Moderate)**
Post-Mitigation	5	1	2	3	**24 (Low)**

Mitigation Measures:	• A site specific Construction Environmental Management Plan (CEMP) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted to reduce unnecessary destruction of habitat. All contractors are to adhere to the CEMP and should apply good environmental practice during construction. • Existing roads and farm tracks should be used where possible; • The minimum footprint areas of infrastructure should be used wherever possible, including road widths and lengths; • Environmental Control Officers to oversee activities and ensure that the site specific construction environmental management plan (CEMP) is implemented and enforced; • Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a specialist and included within the Construction Environmental Management Plan (CEMP).

5.1.2 Disturbance and Displacement

Resident bird species (particularly sensitive and breeding species) may be disturbed by construction activities associated with the PV Power Project, which may lead to temporary or permanent displacement and/or a reduction in breeding success. While various species are at risk, of most concern are the effects of this impact on terrestrial species such as Temminck's Courser and Northern Black Korhaan, raptors such as Greater Kestrel and Pale Chanting Goshawk, various larks, as well as Endemic or Near Endemic species. It is noted though that due to the general uniformity of the broader area, many birds (especially smaller passerines) may quite easily move off and find similar and suitable habitat nearby.

Disturbance is likely to be more of a concern to focal species that are breeding on or near the site during construction. While no such breeding has been observed, it is possible that species may breed in the future.

This impact has been rated as **Moderate** before mitigation and **Low** following the implementation of mitigation (Table 3).

Table 3: Impact Rating Table for Disturbance and Displacement- Construction Phase

Activity:	Construction of the PV Power Project and all associated infrastructure				
Impact:	Disturbance of birds (particularly breeding birds that may abandon a breeding attempt), resulting in permanent or temporary displacement.				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	1	2	8	4	**44 (Moderate)**
Post-Mitigation	1	2	4	2	**14 (Low)**
Mitigation Measures:	• A site specific Construction Environmental Management Plan (CEMP) must be implemented, which gives appropriate and detailed description of how construction activities must be conducted. All contractors are to adhere to the CEMP and should apply good environmental practice during construction. • Prior to construction commencing, the appointed Environmental Control Officer (ECO) must be trained by an avifaunal specialist to identify the potential Red Data species as well as the signs that indicate possible breeding by these species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of Red Data species, and such efforts may include the training of construction staff (e.g. in Toolbox talks) to identify Red Data species, followed by regular questioning of staff as to the regular whereabouts on site of these species. If any of the Red Data species are confirmed to be breeding (e.g. if a nest site is found), construction activities within 500 m of the breeding site must cease, and an				

	avifaunal specialist is to be contacted immediately for further assessment of the situation and instruction on how to proceed.

5.2 Operational Phase

5.2.1 Disturbance and Displacement

Resident bird species (particularly sensitive and breeding species) may be disturbed by operational and maintenance activities associated with the PV Power Project, for example grass cutting and cleaning of panels. This may lead to temporary or permanent displacement and/or a reduction in breeding success.

This impact has been rated as **Low** before mitigation and **Low** following the implementation of mitigation (Table 4).

Table 4: Impact Rating Table for Disturbance and Displacement

Activity:	Various operational and maintenance activities e.g. grass cutting and cleaning.				
Impact:	Disturbance of birds (particularly breeding birds that may abandon a breeding attempt), resulting in permanent or temporary displacement.				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	4	1	4	3	**27 (Low)**
Post-Mitigation	4	1	2	2	**14 (Low)**
Mitigation Measures:	• A site specific Operational Environmental Management Plan (OEMP) must be implemented, which gives appropriate and detailed description of how operational and maintenance activities must be conducted to reduce unnecessary disturbance. All contractors are to adhere to the OEMP and should apply good environmental practice during all operations. • The on-site facilities manager (or a suitably appointed Environmental Manager) must be trained by an avifaunal specialist to identify the potential Red Data species as well as the signs that indicate possibly breeding by these species. If a priority species or Red Data species is found to be breeding (e.g. a nest site is located) on or within 1 km of the operational facility, the nest/breeding site must not be disturbed and the avifaunal specialist must be contacted for further instruction. • Operational phase bird monitoring, in line with applicable guidelines, must be implemented.				

5.2.2 Collision with PV panels

Birds may be attracted to, and collide with, the reflective surfaces of the PV panels which may be mistaken for large water bodies and can cause disorientation of flying birds, resulting in injury and/or death. The evaporation and cooling ponds of the Redstone CSP Project may further attract water birds to the area which may result in a greater risk of collision with the proposed project's PV panels.

Recent findings at solar facilities in North America suggest that collision mortality impacts may be underestimated at solar PV plants, with collision trauma with PV panels, perhaps associated with polarised light pollution and/or with waterbirds mistaking large arrays of PV panels as wetlands - the so-called "lake effect" - (Horvath et al. 2009; Lovich and Ennen 2011), emerging as a significant impact factor on a site where mortality monitoring is on-going.

This impact has been rated as **Low** before mitigation and **Low** following the implementation of mitigation (Table 5).

Table 5: Impact Rating Table for Collision with PV Panels

Activity:	Operation of the PV Power Project				
Impact:	Collison of birds with the PV panels resulting in death or injury.				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	4	1	6	3	**33 (Moderate)**
Post-Mitigation	4	1	4	2	**18 (Low)**
Mitigation Measures:	• Where possible, infrastructure should be located away from known bird flight paths or features which are attractive to birds, e.g. natural or man-made open water areas or agricultural fields. • To limit bird traffic across the site, perchable structures should be avoided where possible. • Lighting should be kept to a minimum to avoid attracting insects and birds and light sensors/switches should be utilised to keep lights off when not required. • Lighting fixtures should be hooded and directed downward, to minimize the skyward and horizontal illumination which could attract night-flying birds (Ledec et al., 2010), where practicable. • Where possible, lighting should be intermittent or flashing-beam lights. • Develop and implement an operational monitoring programme for birds in line with applicable guidelines. • Operational phase monitoring data and results must be reviewed by an avifaunal specialist on an annual basis. • The above reviews should strive to identify sensitive locations at the development including that may require additional mitigation. If unacceptable impacts are observed (in the opinion of the bird specialist and independent review), the specialist should conduct a literature review specific to the impact and provide updated and relevant mitigation options to be implemented. As a starting point for the review of possible mitigations, the following may need to be considered: • Assess the suitability of using deterrent devices to reduce collision risk.				

5.2.3 Collision with or entrapment by fencing

This impact has been recorded at the nearby operational Jasper PV site. The site is bordered by two fences, an outer animal proof fence and an inner electrical fence, with an approximate 1 m gap between them (pers. Obs). Larger birds e.g. Korhaans, francolins, bustards, coursers and guineafowl may be trapped if they land in this gap. If disturbed they are likely to fly against the fences, possibly injuring themselves (through collision) or suffering mortality.

Fast flying birds, commuting particularly at dusk or in low light, may not see fences and could also suffer mortality from collision.

This impact has been rated as **Low** before mitigation and **Low** following the implementation of mitigation (Table 6).

Table 6: Impact Rating Table for Collision with or entrapment by

Activity:	Operation of the PV Power Project				
Impact:	Collision of birds with or entrapment by fencing resulting in death or injury				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	4	1	6	3	**33 (Moderate)**
Post-Mitigation	4	1	4	2	**11 (Low)**

Mitigation Measures:	• A single fence should be used, which can be electrified and animal proofed. • Develop and implement an operational monitoring programme for birds in line with applicable guidelines. • Operational phase monitoring data and results must be reviewed by an avifaunal specialist on an annual basis. • If collision with fences occurs, the specialist should consider the need to implement mitigation in the form of visual bird flight diverters attached to the fence to increase its visibility to birds.

5.2.4 Electrocution on electrical infrastructure

Electrocution of birds from electrical infrastructure is a well-documented cause of bird mortality, especially raptors and storks (APLIC, 1994; van Rooyen, 2004). Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen, 2004). Electrocutions are more likely for larger species whose wingspan is able to bridge the gap such as eagles or vultures. Various large raptors (such as White-backed Vulture, Martial Eagle and Black-chested Snake Eagle), susceptible to electrocution (particularly in the absence of safe and mitigated structures) may occur on the PV site.

This impact has been rated as **Moderate** before mitigation and **Low** following the implementation of mitigation (Table 7).

Table 7: Impact Rating Table for Electrocution on electrical infrastructure -

Activity:	Operation of the PV Power Project				
Impact:	Electrocution on electrical infrastructure resulting in death or injury				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	4	1	6	3	**33 (Moderate)**
Post-Mitigation	4	1	4	2	**11 (Low)**
Mitigation Measures:	• All on site power cables should be buried or encapsulated on the surface of the ground • All electrical installations and infrastructure should be properly insulated to prevent any chance of electrical faulting caused by birds				

5.2.5 Chemical Pollution

Chemical pollution from measures taken to keep the PV panels clean, or for dust suppression can lead to injury or death, or a reduction in breeding success in exposed birds, or can result in the pollution of water sources used by avifauna.

This impact has been rated as **Low** before mitigation and **Low** following the implementation of mitigation (Table 8).

Table 8: Impact Rating Table for Chemical Pollution

Activity:	Operation of the PV Power Project				
Impact:	Chemical Pollution				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	1	3	6	3	**30**
Post-Mitigation	1	1	2	2	**8**
Mitigation Measures:	• A site specific Operational Environmental Management Plan (OEMP) must be implemented, which gives appropriate and detailed description of how operational and maintenance activities must be conducted to reduce and				

	avoid chemical pollution. All contractors are to adhere to the OEMP and should apply good environmental practice during all operations. • All cleaning products used on the site should be environmentally friendly and bio-degradable. • Operational phase bird monitoring, in line with applicable guidelines, must be implemented.

5.3 Decommissioning Phase

5.3.1 Habitat Destruction

Habitat destruction (resulting in habitat fragmentation and loss, and displacement of birds) of large areas of natural habitat has stimulated most concern to date about the implications for avifauna of large-scale solar PV development (Lovich and Ennen 2011; RSPB 2011; Smit 2012), particularly in relation to species with restricted ranges and very specific habitat requirements.

Regarding the proposed project, clearing activities during the decommissioning phase will remove some vegetation and therefore habitat that birds may require for breeding, foraging and roosting. Some of the impact may be temporary and mitigation through rehabilitation of some areas is possible

Habitat loss may effect, and be more significant for important terrestrial species such as larks, coursers and korhaans. Raptors (e.g. Martial Eagle, Greater Kestrel, Black-chested Snake-Eagle and Pale Chanting Goshawk) may also be effected to a lesser degree, through the loss of potential hunting habitat. It is noted though that due to the general uniformity of the broader area, many birds (especially smaller passerines) may quite easily move off and find similar and suitable habitat nearby. Furthermore, the proposed project is relatively small (<20 Ha) and the available habitats on the site are few, with no critical, important or sensitive bird habitats present.

This impact has been rated as **Low** before mitigation and **Low** following the implementation of mitigation (Table 9).

Table 9: Impact Rating Table for Habitat Destruction - Decommissioning Phase

Activity:	Decommissioning of the PV Power Project and all associated infrastructure				
Impact:	Habitat destruction				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	1	1	6	3	**24 (Low)**
Post-Mitigation	1	1	4	2	**12 (Low)**
Mitigation Measures:	• A site specific Decommissioning Environmental Management Plan (DEMP) must be implemented, which gives appropriate and detailed description of how decommissioning activities must be conducted to reduce unnecessary destruction of habitat. All contractors are to adhere to the DEMP and should apply good environmental practice during decommissioning. • Existing roads and farm tracks should be used where possible; • The minimum footprint areas of infrastructure should be used wherever possible, including road widths and lengths; • Environmental Control Officers to oversee activities and ensure that the site specific decommissioning environmental management plan (DEMP) is implemented and enforced; • Following decommissioning, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a specialist and included within the Decommissioning Environmental Management Plan (DEMP).				

5.3.2 Disturbance and Displacement

Resident bird species (particularly sensitive and breeding species) may be disturbed by decommissioning activities associated with the PV Power Project, which may lead to temporary or permanent displacement and/or a reduction in breeding success. While various species are at risk, of most concern are the effects of this impact on terrestrial species such as Temminck's Courser and Northern Black Korhaan, raptors such as Greater Kestrel and Pale Chanting Goshawk, various larks, as well as Endemic or Near Endemic species. It is noted though that due to the general uniformity of the broader area, many birds (especially smaller passerines) may quite easily move off and find similar and suitable habitat nearby.

Disturbance is likely to be more of a concern to focal species that are breeding on or near the site during decommissioning. While no such breeding has been observed, it is possible that species may breed in the future.

This impact has been rated as **Moderate** before mitigation and **Low** following the implementation of mitigation (Table 10).

Table 10: Impact Rating Table for Disturbance and Displacement - Decommissioning Phase

Activity:	Decommissioning of the PV Power Project				
Impact:	Disturbance of birds (particularly breeding birds that may abandon a breeding attempt), resulting in permanent or temporary displacement.				
Significance rating:	**Duration**	**Extent**	**Magnitude**	**Probability**	**Significance**
Pre-Mitigation	1	2	8	4	**44 (Moderate)**
Post-Mitigation	1	2	4	2	**14 (Low)**
Mitigation Measures:	• A site specific Decommissioning Environmental Management Plan (DEMP) must be implemented, which gives appropriate and detailed description of how decommissioning activities must be conducted. All contractors are to adhere to the DEMP and should apply good environmental practice during decommissioning. •				

5.4 Cumulative Impacts

All of the above mentioned impacts, and particularly those associated with the operational phase of the proposed project, may be intensified to some degree due to the potential cumulative impacts of a number of proposed commercial scale solar energy projects within 50 km of the project site.

The avifaunal specialists undertook the following process to determine the cumulative impact of the proposed project:

- Large scale (i.e. > 10 MW) solar energy projects (proposed or developed) were identified within 50 km of the proposed project site;
- The size, extent, technology (e.g. PV or CSP) and distance from the proposed site were determined and considered;
- The bird species potentially impacted upon by these developments were considered by the specialist. In some cases this was done by considering the specialist report/s for a project, but in most cases the specialist used his knowledge of the broader area and knowledge of four projects- having visited these sites and done work there (i.e. Arriesfontein PV, Lesedi PV, Jasper PV, and Metsimatala CSP).
- The findings and results of the bird surveys done on the Redstone CSP project site were considered;

Approximately eight large solar energy projects in various stages of the EIA application process fall within this 50 km radius of the project site. Should five or more of these projects be constructed the cumulative impact significance of each impact identified above for the proposed PV Power Project, is likely to be of **moderate significance**.

6 CONCLUSION AND IMPACT STATEMENT

Based on a thorough desk based study and a site visit by the avifaunal specialist, it can be concluded that the proposed PV Power Project site has a low sensitivity in terms of avifauna.

While some key red-listed species have been recorded in the area, e.g. the *Critically Endangered* White-backed Vulture and the *Endangered* Martial Eagle, it is unlikely that these (or many of the potentially present Red Data species) would be negatively impacted upon by the proposed PV project. Species of more concern are those likely to be displaced or suffer collision from PV panels or fences, such as Korhaans, coursers, francolins and various passerines.

Although a relatively diverse number of species and a high number of Red Data species were found to be potentially present after examining the SABAP data, many of these species were not recorded by monitoring, and many are unlikely to occur on the project site due to unsuitable habitat. In most cases the frequency of records and the activity (especially flight activity) of priority species and Red Data species was low.

Commercial scale solar farms are relatively new in South Africa and little information therefore exists on the potential impacts of these technologies on South African avifauna, but what is generally known and accepted is that PV technologies are likely to have the lowest negative effect. The Impact Assessment showed that after the application of mitigation measures, all residual impacts of the PV Power Project were rated as Low significance.

Cumulatively, (i.e. considering all large scale solar projects within a 50 km radius) these impacts are likely to have a moderate significance rating. If all the recommendations and mitigations in this report are implemented as well as those given by the specialists for the other projects considered (in the cumulative assessment), then the cumulative impacts on avifauna are likely to be considered acceptable.

Generally the impacts are not viewed as being of an extent or significance so as to preclude development, and the project may proceed subject to all recommendations (including operational phase monitoring) and proposed mitigations in this report being implemented.

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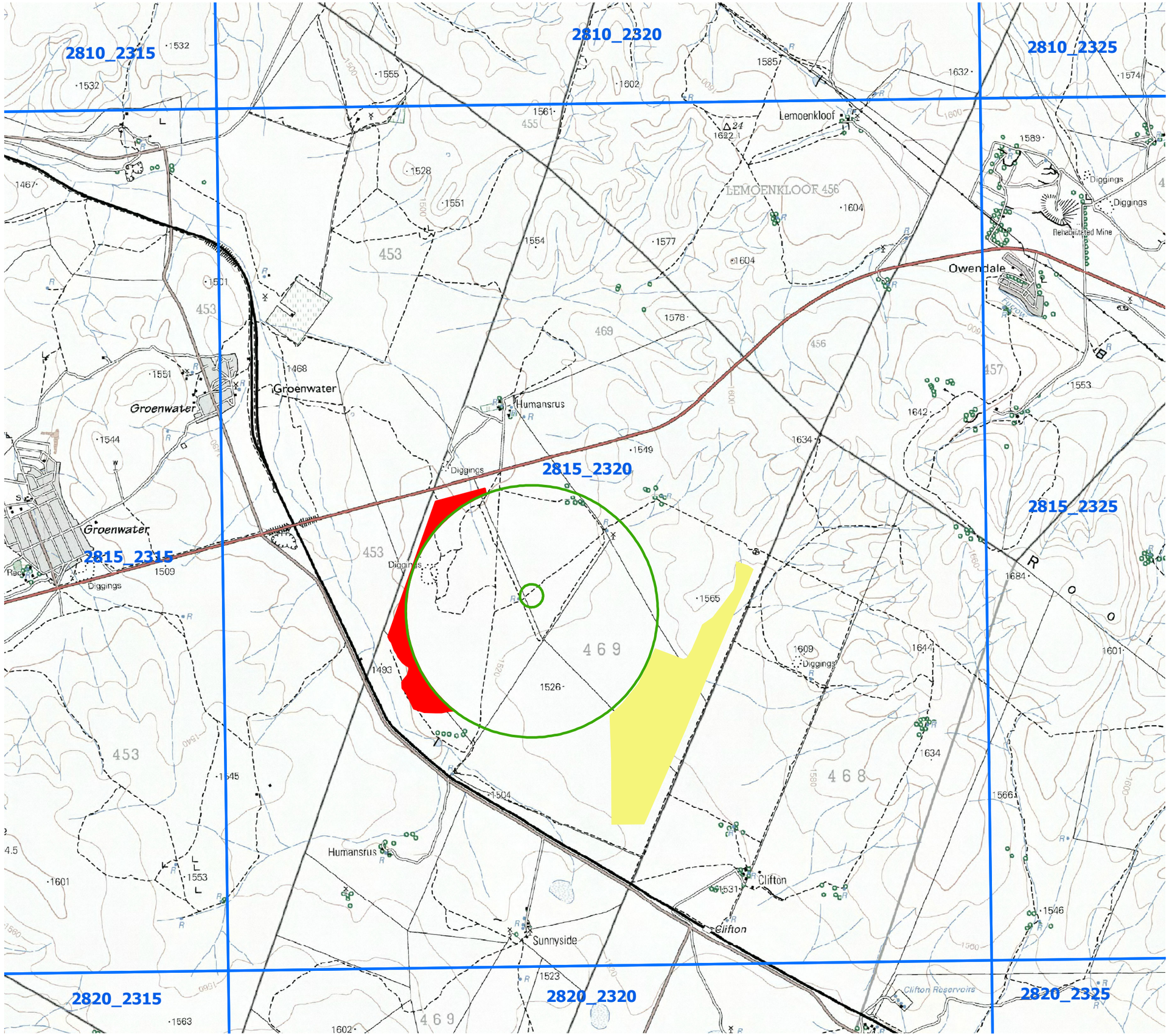
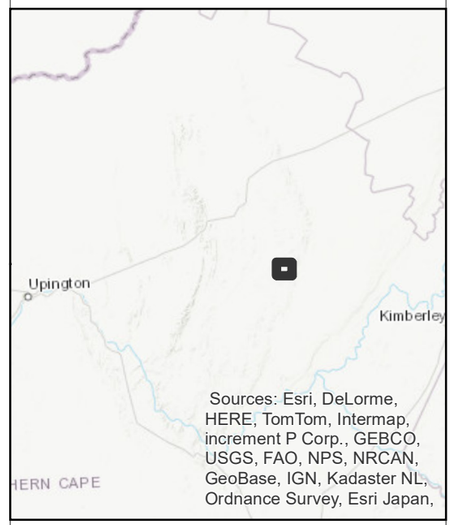


ARCUS

- Proposed PV Plant Site
- Redstone CSP Project
- Existing Jasper PV Plant
- SABAP2 Pentad



1:40,000 Scale @ A3

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0 1 2 km

Produced: AA Reviewed: SC Approved: AB	Ref: 3046/REP/001 Date: 25/04/2018

Site Location
Figure 1

Redstone PV Plant
Avifaunal Report

Mapping from the Chief Directorate: National Geo-Spatial Information

APPENDIX 1: SABAP 2 DATA

Species	Regional Red Data[4]	Endemic or Near-Endemic	Priority Score[5]	SABAP-2 Reporting Rate
Avocet, Pied				2.51
Barbet, Acacia Pied				77.39
Barbet, Black-collared				2.01
Barbet, Crested				50.75
Batis, Pririt				7.04
Bee-eater, European				41.21
Bee-eater, Swallow-tailed				16.58
Bee-eater, White-fronted				28.64
Bishop, Southern Red				81.41
Bishop, Yellow-crowned				1.51
Bokmakierie, Bokmakierie				67.84
Bulbul, African Red-eyed				99.5
Bunting, Cape				14.57
Bunting, Cinnamon-breasted				20.6
Bunting, Golden-breasted				14.57
Bunting, Lark-like				18.09
Bustard, Ludwig's	*Endangered*		320	2.01
Buzzard, Steppe			210	2.51
Canary, Black-throated				36.18
Canary, White-throated				30.15
Canary, Yellow				99.5
Chat, Anteating				48.24
Chat, Familiar				87.44
Cisticola, Desert				27.14
Cisticola, Grey-backed				34.17
Cisticola, Levaillant's				13.57
Cisticola, Zitting				0.5
Coot, Red-knobbed				49.25
Cormorant, Reed				19.1
Cormorant, White-breasted				2.01
Courser, Burchell's	*Vulnerable*		210	0.5

[4] Taylor, M.R. (ed.) 2015. The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Birdlife South Africa, Johannesburg.

[5] Retief, E.F., Diamond, M., Anderson, M.D., Smit, Dr. H.A., Jenkins Dr. A. & Brooks, M. 2011, updated 2014. Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures Used.

Species	Regional Red Data[4]	Endemic or Near-Endemic	Priority Score[5]	SABAP-2 Reporting Rate
Crane, Blue	*Near-threatened*		320	0.5
Crombec, Long-billed				5.53
Crow, Cape				2.51
Crow, Pied				79.9
Cuckoo, Diderick				34.67
Turtle-dove, Cape				81.91
Dove, Laughing				96.48
Dove, Namaqua				32.16
Dove, Red-eyed				82.41
Dove, Rock				0.5
Duck, Maccoa	*Near-Threatened*			6.53
Duck, White-faced				3.02
Duck, Yellow-billed				38.69
Fish-eagle, African			290	2.01
Snake-eagle, Black-chested			230	5.03
Eagle, Martial	*Endangered*		350	0.5
Eagle, Tawny	*Endangered*		290	0.5
Eagle, Verreaux's	*Vulnerable*		360	3.52
Egret, Cattle				2.51
Egret, Little				0.5
Eremomela, Yellow-bellied				9.55
Falcon, Lanner	*Vulnerable*		300	2.01
Finch, Red-headed				8.54
Firefinch, Red-billed				2.51
Fiscal, Common (Southern)				73.37
Flamingo, Greater	*Near-threatened*		290	1.51
Flamingo, Lesser	*Near-threatened*		290	6.53
Flycatcher, Chat				13.07
Flycatcher, Fairy		x		23.12
Flycatcher, Fiscal		x		96.48
Flycatcher, Spotted				11.56
Francolin, Orange River				14.57
Goose, Egyptian				28.64
Goose, Spur-winged				11.06

Species	Regional Red Data[4]	Endemic or Near-Endemic	Priority Score[5]	SABAP-2 Reporting Rate
Goshawk, Gabar				24.62
Goshawk, Southern Pale Chanting			200	14.57
Grebe, Black-necked				3.52
Grebe, Little				44.22
Greenshank, Common				9.05
Guineafowl, Helmeted				55.78
Gull, Grey-headed				0.5
Hamerkop, Hamerkop				8.54
Night-Heron, Black-crowned				2.01
Heron, Black-headed				6.03
Heron, Grey				20.1
Heron, Squacco				1.51
Honeyguide, Greater				0.5
Honeyguide, Lesser				3.52
Hoopoe, African				78.89
Hornbill, African Grey				6.53
Hornbill, Southern Yellow-billed				4.52
Ibis, African Sacred				7.04
Ibis, Glossy				2.51
Ibis, Hadeda				91.46
Kestrel, Greater			174	6.03
Kestrel, Lesser			214	6.03
Kestrel, Rock				23.12
Kingfisher, Malachite				0.5
Kingfisher, Pied				0.5
Kite, Black-shouldered			174	15.08
Korhaan, Northern Black			180	19.6
Korhaan, Red-crested				12.06
Lapwing, Blacksmith				86.93
Lapwing, Crowned				23.62
Sparrowlark, Chestnut-backed				0.5
Lark, Eastern Clapper				36.68
Lark, Eastern Long-billed		x		1.01
Sparrowlark, Grey-backed				3.52
Lark, Karoo Long-billed				1.51
Lark, Large-billed		x		0.5
Lark, Sabota				25.63

Species	Regional Red Data[4]	Endemic or Near-Endemic	Priority Score[5]	SABAP-2 Reporting Rate
Lark, Spike-heeled				8.54
Martin, Banded				13.07
Martin, Brown-throated				25.13
Martin, Rock				82.41
Moorhen, Common				21.61
Mousebird, Red-faced				20.6
Mousebird, White-backed				93.97
Myna, Common				67.84
Neddicky, Neddicky				35.68
Nightjar, Rufous-cheeked				8.04
Ostrich, Common				2.51
Eagle-owl, Spotted			170	2.51
Owl, Barn				0.5
Owlet, Pearl-spotted				0.5
Painted-snipe, Greater	*Vulnerable*			0.5
Penduline-tit, Cape				13.07
Pigeon, Speckled				73.87
Pipit, African				50.25
Pipit, Buffy				1.01
Plover, Kittlitz's				1.51
Plover, Three-banded				31.16
Pochard, Southern				5.53
Prinia, Black-chested				87.44
Quail, Common				2.51
Quailfinch, African				8.54
Quelea, Red-billed				38.19
Scrub-robin, Kalahari				88.44
Scrub-robin, Karoo				48.74
Robin-chat, Cape				83.92
Roller, Lilac-breasted				1.01
Ruff, Ruff				5.03
Sandgrouse, Namaqua				15.08
Sandpiper, Common				1.01
Sandpiper, Curlew				0.5
Sandpiper, Wood				2.51
Secretarybird, Secretarybird	*Vulnerable*		320	1.01
Shelduck, South African				37.19

Species	Regional Red Data[4]	Endemic or Near-Endemic	Priority Score[5]	SABAP-2 Reporting Rate
Shoveler, Cape				11.56
Shrike, Crimson-breasted				25.63
Shrike, Lesser Grey				8.04
Shrike, Red-backed				15.08
Snipe, African				10.05
Sparrow, Cape				98.99
Sparrow, House				76.88
Sparrow, Southern Grey-headed				15.58
Sparrow-weaver, White-browed				61.31
Spoonbill, African				3.02
Starling, Pale-winged				79.9
Starling, Pied		x		2.01
Starling, Wattled				6.53
Stilt, Black-winged				16.58
Stint, Little				4.52
Stonechat, African				10.55
Stork, White			220	1.51
Sunbird, Dusky				12.06
Sunbird, Marico				4.52
Sunbird, White-bellied				3.52
Swallow, Barn				34.67
Swallow, Greater Striped				62.81
Swallow, Red-breasted				3.52
Swallow, White-throated				13.07
Palm-swift, African				9.55
Swift, Alpine				19.1
Swift, Common				6.03
Swift, Little				71.86
Swift, White-rumped				33.17
Tchagra, Brown-crowned				17.09
Teal, Cape				38.19
Teal, Red-billed				39.7
Thick-knee, Spotted				13.07
Thrush, Groundscraper				75.38
Thrush, Karoo		x		82.91
Tit, Ashy				10.55
Tit-babbler, Chestnut-vented				86.43

Species	Regional Red Data[4]	Endemic or Near-Endemic	Priority Score[5]	SABAP-2 Reporting Rate
Tit-babbler, Layard's		x		0.5
Vulture, White-backed	*Endangered*		300	1.51
Wagtail, Cape				92.46
Reed-warbler, African				2.01
Warbler, Icterine				1.01
Swamp-warbler, Lesser				11.06
Warbler, Rufous-eared				15.08
Warbler, Willow				5.53
Waxbill, Black-faced				10.55
Waxbill, Common				8.54
Waxbill, Violet-eared				30.65
Weaver, Sociable				5.53
Masked-weaver, Southern				92.46
Wheatear, Capped				13.07
Wheatear, Mountain				22.11
White-eye, Cape		x		1.01
White-eye, Orange River				78.89
Whydah, Pin-tailed				15.58
Whydah, Shaft-tailed				4.52
Wood-hoopoe, Green				30.15
Woodpecker, Cardinal				0.5
Woodpecker, Golden-tailed				22.61

APPENDIX 2: IMPACT ASSESSMENT CRITERIA

1) The significance (quantification) of potential environmental impacts identified have been determined using a ranking scale, based on the following (terminology has been taken from the Guideline Documentation on EIA Regulations, of the Department of Environmental Affairs and Tourism, April 1998):

Occurrence

- Probability of occurrence (how likely is it that the impact may occur?)
- Duration of occurrence (how long may it last?)

Severity

- Magnitude (severity) of impact (will the impact be of high, moderate or low severity?)
- Scale/extent of impact (will the impact affect the national, regional or local environment, or only that of the site?)

Each of these factors has been assessed for each potential impact using the ranking scales represented

Table: Ranking scale of the four factors considered to determine significance rating

Probability	Duration
1 - very improbable (probably will not happen 2 - improbable (some possibility, but low likelihood) 3 - probable (distinct possibility) 4 - highly probable (most likely) 5 - definite (impact will occur regardless of any prevention measures)	1 - of a very short duration (0–1 years) 2 - of a short duration (2-5 years) 3 - medium-term (5–15 years) 4 - long term (> 15 years) 5 - permanent
Extent	**Magnitude**
1 - limited to the site 2 - limited to the local area 3 - limited to the region 4 - will be national 5 - will be international	0 - small and will have no effect on the environment 2 - minor and will not result in an impact on processes 4 - low and will cause a slight impact on processes 6 - moderate and will result in processes continuing but in a modified way 8 - high (processes are altered to the extent that they temporarily cease) 10 - very high and results in complete destruction of patterns and permanent cessation of processes

The environmental significance of each potential impact is assessed using the following formula:

Significance Points (SP) = (Magnitude + Duration + Extent) x Probability

The maximum value is 100 Significance Points (SP). Potential environmental impacts were rated as high, moderate or low significance on the following basis:

- < 30 significance points = **LOW** environmental significance.
- 31- 60 significance points = **MODERATE** environmental significance
- 60 significance points = **HIGH** environmental significance

This section in the final impacts table then summarises the potential impacts associated to the three different phases of the proposed development activities. The potential impacts and risks are explored by investigating each aspect (i.e. air quality, Wetland and Ecological, heritage and social) associated to the proposed activities.

- For the purpose of this section, the mitigation measures recommended will only be summarise to demonstrate the approach taken to manage each risk. A detailed mitigation plan will form part of the final BAr and EMPr.

Table: Explanation of colour indicator

Colour	Significance Points	Explanation
	≤ 30	**LOW** environmental significance
	31 - 60	**MODERATE** environmental significance
	> 60	**HIGH** environmental significance

APPENDIX 3: PROJECT DESCRIPTION

The ACWA Power SolarReserve Redstone Solar Thermal Power Plant (RF (Pty) Ltd, (**Redstone CSP Project**) proposes the development, construction and operation of a Photovoltaic (PV) Power Project with the generation capacity of up to 20 MW, with up to 30 MW hours storage, for the auxiliary load requirements, on the Remaining Extent of the Farm 469, Hay District. The PV Power Project will be located approximately 30 km east of the town Postmasburg in the Northern Cape Province, adjacent to the Redstone CSP Project.

The proposed Project Site is located within the governing boundaries of the Tsantsabane Local Municipality and the ZF Mgcawu District Municipality The PV Power Project is designed to allow the ACWA Power SolarReserve Redstone Solar Thermal Power Plant RF (Pty) Ltd to generate renewable green energy for self-consumption in order to operate and run the Redstone CSP Projects auxiliary load requirements. The Redstone CSP Project was authorised under the National Environmental Management Act 107 of 1998 (NEMA) by the Department of Environmental Affairs (DEA) Ref. Nr 12/12/20/2316 (AM7). Option A: The PV Power Project is proposed on the western boundary of the Project Site, adjacent to the Redstone CSP Project, for ease of access to the power block/substation.

Option B: The PV Power Project is proposed within the heliostat field of the Redstone CSP Project for ease of access to the power block/substation.

Total construction and development costs of the plant are estimated at approximately US$20million. Details on the proposed power generating technology; auxiliary services and infrastructure; and project phases and associated activities are provided below.

Table A: A brief project overview:

Description of affected farm Portions	Remaining Extent of the Farm 469, Hay District Tsantsabane Local Municipality ZF Mgcawu District Municipality
Generation capacity	Up to 20MW
Type of technology	Crystalline - fixed or tracking
Structure heights	3 – 5m above ground (PV Module)
Surface area to be covered	Less than 20ha
Structure orientation	North facing PV power blocks with inverter and transformer collection
Laydown area dimensions	Not applicable – the PV Power Plant will share infrastructure with the ACWA Power SolarReserve Redstone Solar Thermal Power Plant (RF (Pty) Ltd, CSP Plant. No new areas required for this purpose.
Supplementary facilities and services	Substations and electrical systems Access and security services Operational power supply and use Water supply and use Procurement, storage and use of consumables Maintenance and repair to operational equipment Waste management Emissions management

	Storm-water management infrastructure Management and administration Staff facilities Fire protection

PHOTOVOLTAIC POWER TECHNOLOGY

The proposed PV Power Plant utilises proven technology which produces energy by directly converting solar irradiation into electricity. Power is generated by the solar cells as long as they are exposed to sunlight. PV cell technology has been in continuous operation on earth as well as in space (satellites) for over 30 years. The technology is commercially proven and large multi-megawatt generation plants have been operating since the 1990s. With reference to the process flow diagram and illustrations in Figure 1 and Figure 2, respectively, the PV plant will comprise the following key process components:

PV PANEL FIELD

A PV system consists of PV panels that encase the solar cells. Solar cells are solid-state semiconductor devices that convert light into direct-current electricity. The top layer of the panels is made from a mixture of silicon and phosphorous mixture, which gives it a negative charge. The inner layer, which constitutes the majority of the panel, is a mix of silicon and boron, giving it a positive charge. Where these negative and positively charged layers meet, an electric field (called a junction) is created. A top protective and anti-reflective layer of glass is applied to the surface of the PV panels, to protect the sensitive PV layers below and to prevent photons from reflecting off of the panel resulting in lost energy. As the sun's light (photons) hits the solar cell, they are absorbed into the junction, which "pushes" electrons in the silicon out of the way. When sufficient photons are absorbed, the electrons are pushed past the junction and flow freely to an external circuit.

The panels will be mounted on metal frames with a height of approximately 3-5 m above the ground, supported by rammed, concrete or screw pile foundations, and they will face north in order to capture the optimum amount of sunlight. The facility will either be a fixed PV plant where the solar panels are stationary; or a tracking PV plant where the solar panels rotate to track the sun's movement (the exact type of PV plant system will be determined following on-site solar resource modelling and detailed development design). This will only be determined once the project has reached *Final Engineering Design stages*.

PV panels are typically up to 6 m^2 in size and will be situated in long rows called arrays, usually made up of approximately 100 m sections extending across the proposed site. The length of the rows and the optimal design and layout will be determined during the Final Engineering Design stages. The general arrangement of the panel arrays may be based on [1 - 5 MW] power blocks or more depending on the final engineering design. A panel surface area of less than 20 hectares is required for the project to generate the required auxiliary load of up to 20MW.

ELECTRICAL INVERTERS AND TRANSFORMERS

The PV cells described above produce Direct Current (DC) electricity which will need to be converted into Alternating Current (AC) electricity prior to integration with the internal grid network. In this regard, approximately [40 - 50 separate inverters, one (1) per power block], may be required. The AC power from the inverters may be stepped-up to approximately 33 kV via pad-mounted transformers located at each inverter station. The inverters may be installed outdoors on concrete pads and under sunshades (to prevent the inverter temperatures exceeding manufacturer's recommended operating conditions), or the inverters may be placed in a prefabricated container that will keep the inverter in a climate controlled environment.

STORAGE

The use of renewable energy on a large or utility scale leads to new challenges for grid stability and supply of power during demand periods. Energy storage is a fundamental and critical part of renewable energy systems. This application stabilises power supply, which will allow high quality uninterrupted power supply to the national grid. A modular storage solution is proposed for the Proposed Project. Batteries and control electronics will be housed inside a modular container type structure/unit or within a built structure. These facilities will be constructed in conjunction with each inverter station and will be approximately 15 x 4 m in size, within the assessed development footprint.

The required power and capacity will be achieved through parallel connection of several solar storage units, which will be adapted to the project's particular requirements and based on the final engineering designs. The integration of the cabinets into containerised enclosures allow for safe operations – environmentally and for its operators. Batteries that are commonly used for storage include (but not limited to): lead-acid, lithium-ion, vanadium redox etc. and will only be determined upon final engineering design stages. Each battery type will be evaluated by the engineering team in order to assess the advantages and disadvantages of the each storage system with respect to the project's requirements on a technical level. The storage units/facility will be fitted with appropriate air-conditioning systems to ensure optimum operation at extreme ambient temperatures along with battery management units, solar central inverters, Switchgear, medium-voltage transformer, measuring and monitoring components, and data communication capabilities.

An effective technique combining a PV energy storage system with a unique smoothing strategy known as the Single Moving Average (SMA) may be applied in order to reduce PV power fluctuations but to also produce power during peak demand. A ramp rate limiter may be used to smooth power fluctuations as part of optimisation. The battery bank (battery blocks) may be placed in a prefabricated container that will keep the storage batteries in a climate controlled environment. Battery storage of up to 30MW hours has been considered for the Proposed Project.

AUXILIARY INFRASTRUCTURE AND SERVICES [Shared CSP Infrastructure]

In addition to the key process components/systems described above, the proposed project will require input resources such as water, will generate various waste outputs and will require of a number of support services and facilities such as site access and transportation, electrical systems and network integration, storage and use of consumables, general management and maintenance, safety and security, as well as other general supportive activities. It is further noted that construction-specific services and facilities will be necessary. The decommissioning and closure phase, should the plant not be refurbished once the electricity conversion capacity of the solar cells degrades beyond economic viability, would also involve decommissioning specific services and facilities.

ELECTRICAL SYSTEMS

PV POWER BLOCK WIRING CONFIGURATION

Subject to the final design, a typical power plant includes PV panels that may be wired together in groups of around 24 (dependent on the configuration of the plant), in a series configuration (called module strings) to maintain a DC voltage level always within the maximum power point tracking (MPPT) window of the inverter. The module strings are then paralleled for input into approximately 38 circuit, combiner boxes, distributed throughout the PV field for aggregated input into inverters. These module strings may be harnessed to the PV panel mounting structures, and are usually connected in parallel to meet the DC input requirements of the outdoor-rated, fused combiner boxes pole-mounted onto the mounting structures. The combiner boxes may include current monitoring and fault detection on each of the combiner box inputs and a local disconnect switch.

Approximately 12 combined DC power feeds from combiner boxes will be underground cabled to the line side of each inverter unit. An estimated 36 of these strings are typically brought together in a single junction box in parallel configuration. 12 junction boxes would then feed to each central inverter station which delivers a maximum of 2 MW of AC power. Two step-up transformers may be located adjacent to each central inverter station.

The output generated by the PV Power plant will be fed into an underground AC-network taking the power to the site substation/power block from where it will be absorbed and utilised by the ACWA Power SolarReserve Redstone Solar Thermal Power Plant (RF (Pty) Ltd, CSP Facility for its auxiliary loads.

PROJECT SUBSTATIONS

The project design will include an 11kV step-up substation that will allow the facility to be connected into the on-site Noko substation/power block connection point.

NETWORK INTEGRATION AND SWITCHING YARD

The output generated by the PV Power plant will be fed from the PV step up substation via 11kV underground/surface cablingAC-network to the power to the site substation/power block from where it will be absorbed and utilised by the ACWA Power SolarReserve Redstone Solar Thermal Power Plant (RF (Pty) Ltd, CSP Facility. Two routing options have been selected for the integration of the power generated by the PV Power Plant:

Route 1: Power to be evacuated via 11kV underground cables/surface cabling within the reserve of the Redstone CSP Projectring-road, to the Noko-Olien Substation and the Power Block.

Route 2: Power to be evacuated via 11kV underground cables/surface cabling within the reserve of the Redstone CSP Project power block access roads, to the Noko-Olien Substation and the Power Block.

Please note: the PV Power Project is designed to provide auxiliary load power to the Redstone CSP Project.

CONTROL AND INSTRUMENTATION SYSTEM: [Shared CSP Infrastructure]

The substation which contains the plant switch gear may also contain a pre-engineered power distribution centre (PDC), approximately 3 x 7.5 m, which would house the metering, communication, and Supervisory Control and Data Acquisition (SCADA) equipment. These systems would manage the PV string, mounting structure, combiner and junction box and inverter/transformer unit monitoring, as well as overall system status. The control room may also be equipped with an Ethernet network for inter- and intranet connections and communications.

EARTHING NETWORK [Shared CSP Infrastructure]

An earthing system is required in order to prevent injury to staff as well as damage to equipment. The plant switchyard may incorporate a ground grid for personnel and equipment protection in accordance with IEEE standards. Earthing designs will ensure that the step and contact voltage levels will not be exceeded, whether by staff exposure or external exposure due to voltage transfer. In terms of the PV panel field, earthing may be done by means of grouping and earthing. Overhead tie-lines may include an optical ground wire (OPGW) for lightning protection. The earthing system network will be designed in accordance with SANS 62305 (1-4) & SANS10313.

AUXILIARY INFRASTRUCTURE [Shared CSP Infrastructure]

The PV Power Project will be serviced by internal gravel roads approximately 3m wide in between the PV arrays. As the PV Power Project is proposed to act as an auxiliary power

supply for the existing Redstone CSP Project, additional infrastructure and services requirements will be acquired from

Redstone CSP Project as approved under EA DEA Ref. No.: 12/12/20/2316 (AM7) –

- Substations and electrical systems
- Access and security services
- Water supply, treatment, storage and use
- Procurement, storage and use of consumables
- Maintenance and repair to operational equipment
- Waste management
- Storm-water management infrastructure
- Management and administration
- Staff facilities
- Fire protection for plant services and infrastructure
- Auxiliary power supply

CONSTRUCTION ACTIVITIES AND FACILITIES

The construction phase will involve the construction and assembly of the PV panels, electrical systems, buildings, and other infrastructure required for the operation of the plant. In this regard, the activities and/or facilities relevant to the construction phase are listed below, with further details provided thereafter.

- **Site establishment and the construction of access roads and services**
- **Site clearing and earthworks**
- Bulk material laydown and consumable stores – shared service CSP
- Refuelling and maintenance – shared service CSP
- Power supply and use – shared service CSP
- Water supply and use – shared service CSP
- Construction camp – shared service CSP
- Staff facilities – shared service CSP
- Management and administration – shared service CSP
- Waste management – shared service CSP

The construction period for the PV Power Plant will take approximately 2 – 6 months.

OPERATIONAL AND MAINTENANCE ACTIVITIES AND FACILITIES

The operational phase will involve the generation of power using the PV technology and electrical systems as described as well as the day-to-day management and maintenance of associated support services and infrastructure. In this regard, the activities and/or facilities relevant to the operational phase are listed below, with further details provided thereafter.

- Access and security services – shared service CSP
- **Generation of electricity using PV technology**
- **Operational power supply and use**
- Water supply, storage and use – shared service CSP
- Procurement, storage and use of consumables – shared service CSP
- Maintenance and repair to operational equipment – shared service CSP
- Waste management – shared service CSP
- Storm-water management infrastructure – shared service CSP
- Management and administration facilities – shared service CSP
- Fire protection for plant services and infrastructure – shared service CSP

The operational period for the PV Power Plant will is linked with that of the Redstone CSP Project Power Purchase Agreement of 25 years.

DECOMMISSIONING ACTIVITIES AND FACILITIES

Depending on refitting and maintenance of the plant as well as national energy market conditions, the PV Project could continue to operate – however long it is required to. However, should plant operations be ceased for whatever reason, decommissioning and closure of the PV Project will be undertaken in accordance with the applicable EIA regulations. It is suggested that a detailed plan for the decommissioning and closure of the facility will be drawn up before operations are ceased and submitted to the relevant competent authority for authorisation and ultimate implementation.

Similar to construction, the removal of the infrastructure associated with the project may involve the preparation of the area, given the amount of machinery and workers that will remain and work on the decommissioning. The following decommissioning activities are relevant:

- Operational access roads are expected to be in good condition and be appropriate for the transit of decommissioning equipment (heavy cranes, special trucks, etc.).
- A small temporary decommissioning camp may be established with associated staff facilities.
- Laydown areas may be prepared as required. In this regard vegetation may require stripping and topsoil may be stockpiled for use in rehabilitation.
- All waste materials and chemicals will be removed for reuse in other facilities or proper management through authorised waste management service providers.
- The elimination of all lubricants and chemical products stored in the plant will be carried out. These products may be sold or turned over to an authorised waste management service provider, as they are not the plant's main components.
- Re-usable elements will be components that can be used again, i.e. are not waste. It is advantageous to find a use for these so-called sub-products, due to the reduced costs involved with the consequent economic and environmental benefits. The possible sub-products from the PV plant may be multiple in terms of type, quantity and volume. Thus, certain substances are not considered "usable", such as electrical system oils, other lubricants, etc. Other materials from the plant may be reusable in other such facilities, depending on their condition.
- The PV panels, including the mounting structures, positioners, etc. will be dismantled and either sold (if still usable) or disposed of at appropriate facilities.
- Storage tanks, pipes and pumps may be managed by recycling or reusing.
- Electrical components will be removed and may be sold as second hand equipment (if usable) or for their copper content.
- Steel structures will be dismantled and may be sold as second hand equipment (if usable) or for their scrap value.
- Concrete structures and buildings (including foundations) will be demolished and the rubble will be disposed of at appropriate facilities, unless otherwise agreed for an alternative use in line with the decommissioning and closure plan.

CURRICULUM VITAE

Andrew Pearson

Ecology Specialist (Avifauna)

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Specialisms

- Avifauna Impact Assessment
- Pre-construction Avifauna Monitoring
- Construction Phase and Operational Phase Avifauna Monitoring
- Survey Design and Management
- Environmental Management Process

Summary of Experience

Andrew is an Avifauna Specialist with nine years of environmental management experience. He has worked as an avifaunal specialist for six years. Andrew has gained a strong level of experience in avifauna assessments across a multitude of sectors, including various powerline assessments and walk-downs. To date, Andrew has provided avifaunal specialist services on over 27 solar, power line and wind farm projects in Southern Africa. Andrew provides specialist input into the design of projects and environmental management plans, assesses environmental due diligence and compliance with international environmental policies (World Bank, IFC, Equator Principles) and peer reviews avifaunal specialist reports. Andrew is a professional natural scientist registered with SACNASP, and is a selected member of the Birds and Renewable Energy Specialist Group (BARESG). Andrew has been bird watching for 25 years, has worked as a birding field guide in 2006 and 2007, and attended bird identification training at the Lawson's Birding Academy in 2007.

Professional History

January 2014 to Present - Avifauna Specialist, Arcus Consultancy Services Ltd:

- Specialist Bird Impact Assessment Studies for energy infrastructure;
- Design of high quality bird surveys in line with applicable guidance and legal requirements;
- Design and implementation of operational carcass search programme including the training and management of locally based observers; and
- Specialist raptor nest surveys.

March 2011 to December 2013 - Environmental Impact Assessment & Avifaunal Specialist, Endangered Wildlife Trust

- Specialist Bird Impact Assessment Studies for energy infrastructure;
- Extensive work in the Wind Energy Sector to reduce possible impacts on birds and bats;
- 12 month Bird Monitoring on WEF sites - compilation of monitoring protocol, recruitment, management and co-ordination of observers, on-site bird observation and compilation of final monitoring reports; and
- Presentations and Environmental Training.

January 2008 to March 2011 - Group Environmental Manager, Basil Read (Pty) Ltd

- Environmental management of roads and civil construction projects;
- Implementation and certification of an ISO 14001:2004 Environmental Management System;
- Group Internal Environmental Audits;
- Compilation of EMPs and Environmental site inspections;
- Assistance in ENV authorisations and applications;
- Environmental Awareness Training; and
- Compilation of Group Carbon Footprint.

February 2006 to January 2008 - Game Ranger and Walking Guide, CC Africa (now *&BEYOND*), Phinda Private Game Reserve

- Game drives and walks in a Big 5 reserve;
- Hosting guests and sharing environmental and wildlife knowledge; and
- Environmental management, waste management.

CURRICULUM VITAE

Qualifications and Professional Interests

- **University of Stellenbosch, 2005.**
  Bachelor of Science (Hons.): Conservation Ecology.
- August 2010 - Hazard Identification and Risk Assessment (HIRA) Course, IRCA Global.
- April 2010 - SAMTRAC, NOSA, East Rand Office.
- April 2009 - Green Star Accredited Professional Exam, (GBCSA), PROMETRIC.
- May 2008 - Environmental Auditing: ISO 14001:2004, Lead Auditors' Course (SAACTA approved), Centre for Environmental Management at North West University (NWU), Potchestroom.
- February 2008 - Environmental Law for Managers, Centre for Environmental Management at NWU.
- February 2008 - Implementing Environmental Management Systems - ISO 14001:2004, Centre for Environmental Management at NWU.
- August 2007 - Bird Identification Course, Lawson's Birding Academy, Intensive training in Makuleke, Kruger National Park.

Professional Membership

- South African Council for Natural Scientific Professions (SACNASP), "Ecological Science". Professional Natural Scientist (Pr. Sci. Nat.), Reg. no 400423/11.

Recent Conferences and Seminars

- Windaba 2013, 2014, 2015 and 2016; Solar Indaba 2013; Africa Utility Week 2014, 2015 and 2016.
- IAIA SA National Conference 2011, 2013 and 2016.
- March 2011 Endangered Wildlife Trust (EWT) Wildlife and Energy Symposium.

Additional Skills

- ArcGIS, Google GEO Tools and Google Earth.
- Computer Skills: Office 2013 including Microsoft Word, Excel, Outlook and PowerPoint.
- Field work skills involving various sampling methods, data capturing & analysis.
- Excellent knowledge of fauna (especially birds) and flora.
- 4x4 driving skills.

Project Experience

- **Due Diligence**
  Due Diligence of bird work conducted at the Kangnas WEF (ERM); Due Diligence of Bird Work conducted at the Excelsior WEF (ERM); Due Diligence of Bird Work conducted at the Golden Valley WEF (ERM); Due Diligence of Bird Work at the Roggeveld Wind Farm (IBIS Consulting).

- **Peer Review**
  Peer Review of Operational Monitoring at the Jeffreys Bay Wind Farm (Globeleq South Africa Management Services (Pty) Ltd); Review and design mitigation strategies for birds at the Kinangop Wind Park, Kenya (African Infrastructure Investment Managers).

- **Feasibility Studies**
  Assessment of the Feasibility of a Wind Farm in the Eastern Cape near Somerset East (WKN Windcurrent SA (Pty) Ltd).

- **Pre-Construction Monitoring and/or Impact Assessment - Wind Energy Facility (WEF) Projects:**
  Kouga WEF; Aberdeen WEF; Hidden Valley WEF; Middleton WEF; Springfontein WEF, Moorreesburg WEF; Grassridge WEF; Ukomeleza WEF; Chaba WEF; Waainek WEF; Vryheid WEF; Kouga Western Cluster WEF; Hopefield WEF; DNA Elliot WEF; Confidential WEF near Elliot; Umsinde Emoyeni WEF; Grassridge II WEF; Komsberg East WEF; Komsberg West WEF; Gouda WEF; Confidential WEF near Touws River; Confidential WEF near Kleinsee.

- **Operational Monitoring - WEF Projects:**
  Hopefield WEF; Gouda WEF.

CURRICULUM VITAE

- **Impact Assessment - Powerline Projects:**
  St Francis Bay Kouga 66kV; Ncwane Okuku 88kV; Vulcan Ekangala 132kV; Merapi Everest 400kV; Mathibestad Majaneng 132kV; Majaneng Themba Main-Babelegi 132kV; Ngoma Pandamatenga 400kV (ZIZABONA Phase 2); Estancia Thuli 132kV; Estancia Zamokuhle 132kV; Gumeni Bosloop 132kV; Mbumbu Tsakani 132kV; Normandie Heyshope 132kV; Mookodi Integration Project; Wildebees Bethal 132kV; Zaaifontein Mathondwane 88kV; Hlabisa Nongoma 88kV; Mandeni Gingindlovu 132kV; Tabor Nzhelele 400kV; Leksand St James 88kV; Emondlo St James 88kV; Randfontein Mine 132kV; Droogfontein CSP 132kV; Mtubatuba St Lucia 132kV; Ndumo Gezisa 132kV; Ermelo Uitkoms 88kV; TCTA Spring Grove 88kV; Springfontein 132kV.
- **Pre-construction Monitoring and/or Impact Assessment - Concentrated Solar Power (CSP) Plants and Solar Photovoltaic (PV) Plants:**
  Humansrus 100MW CSP; Arriesfontein 100MW CSP; Arriesfontein 225MW PV; Eenzaamheid PV; Vaal Dam PV; Mokopole PV; Kalkaar CSP and PV; Droogfontein PV; Bokpoort II CSP; Metsimatala CSP.
- **Other:**
  Expansion of Hendrina Power Station Ash Disposal Facilities; Expansion of Majuba Power Station Ash Disposal Facilities; Expansion of Tutuka Power Station Ash Disposal Facilities; Eskom Distribution Cedarville Upgrade; Eskom Limpopo Operating Unit (LOU) Head Office, Polokwane.

CURRICULUM VITAE

Anja Albertyn (neé Terörde), Pr.Sci.Nat.
Avifauna Specialist & Environmental Practitioner
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Specialisms

- Ornithology, Avifaunal Monitoring and Assessments
- Environmental Impact Assessments
- Avian Collision Risk Modelling
- GIS Mapping and Analysis (ArcGIS Pro, ArcMap)

Summary of Experience

Anja is a SACNASP registered Avifauna Specialist with close to 6 years of experience as an environmental consultant, and over 12 years of avifaunal monitoring experience. She has worked on over 22 renewable energy facility projects in South Africa. Anja is also involved in all aspects of environmental impact assessments and functions as Arcus' GIS specialist in Cape Town. She has been trained in Avian Collision Risk Modelling using the Band model.

Anja started her professional career as an environmental consultant in 2009 after graduating with a Master of Science in Zoology (Ornithology) from the Percy FitzPatrick Institute of African Ornithology at the University of Cape Town. She oversaw a large-scale ballast water treatment testing project for over 2 years before continuing to pursue her career in ornithology. To date she has published eight scientific papers on avian and estuarine ecology.

Professional History

2017 to present – Avifauna Specialist and Environmental Assessment Practitioner
2013 to 2017 – Ecology Consultant (Avifauna), Arcus, Cape Town
2011 to 2013 – Avifaunal Monitoring Services (self-employed)
2009 to 2011 – Consultant, Anchor Environmental Consultants, Cape Town
2005 to 2008 – Director & Co-founder, Fishriver Horse Safaris, Port Alfred
2002 to 2003 – Assistant Camp Manager. Mashatu Game Reserve, Botswana
1999 to 2000 – Wildlife Research Assistant, Centre for Wildlife Management, Pretoria

Qualifications and Professional Interests

- **Department of Environmental Science, Rhodes University, 2015**
  Introduction to Environmental Impact Assessment Procedure Short Course, *Highly competent*
- **Percy FitzPatrick Institute, University of Cape Town, 2006-2009**
  Zoology (Ornithology), Master of Science
- **Rhodes University, 2005-2006**
  Zoology, Bachelor of Science (Honours)
- **University of South Africa, 2002 – 2004**
  Zoology & Botany, Bachelor of Science *(cum laude)*
- **Heinrich-Heine Universität, 1999 – 2002**
  Biology, Vordiplom

Professional Membership

- South African Council for Natural Scientific Professions (Registration: 400037/16)
- Birdlife SA
- International Association for Impact Assessment South Africa

Project Experience

- **Pre-construction Avifaunal Monitoring and Avifaunal Impact Assessments for Wind Energy Facilities**
  Confidential WEF, Eastern Cape (WKN-Windcurrent);
  Confidential WEF, Eastern Cape (WKN- Windcurrent);
  Confidential WEF, Northern Cape (juwi);
  Kolkies WEF, Western Cape (Mainstream);
  Karee WEF, Western Cape (Mainstream);
  Komsberg East WEF, Western Cape (ACED);
  Komsberg West WEF, Western Cape (ACED);
  Grassridge II WEF (Innowind);
  Confidential WEF, Eastern Cape (Rainmaker);

Confidental WEF, Eastern Cape (Ventusa);
Koingnaas WEF, Northern Cape (Savannah),
Richtersveld WE, Northern Cape (G7);
Namakwaland WEF Northern Cape (G7);
Springbok WEF, Northern Cape (DJ Consultants).

- **Post-construction Avifaunal Monitoring for Wind Energy Facilities**
  Hopfield WEF, Western Cape (Umoya);
  Gouda WEF, Western Cape (Blue Falcon).

- **Pre-construction Avifaunal monitoring at Solar Energy Facilities**
  Bokpoort Solar Farm, Northern Cape (Golder);
  Metsimatala CSP Facility, Northern Cape (EnviroWorks).

- **Environmental Impact Assessment Practitioner**
  Confidential WEF, Eastern Cape (WKN-Windcurrent);
  Confidential WEF, Eastern Cape (WKN- Windcurrent).
  Phezukomoya WEF, Northern and Eastern Cape (Innowind);
  San Kraal WEF, Northern and Eastern Cape (Innowind);
  Kolkies WEF, Western Cape (Mainstream);
  Karee WEF, Western Cape (Mainstream);
  Komsberg East WEF, Western Cape (ACED);
  Komsberg West WEF, Western Cape (ACED);
  Umsinde Emoyeni Phase 1 WEF, Western Cape (Windlab);
  Umsinde Emoyeni Phase 2 WEF, Western Cape (Windlab);
  Umsinde Emoyeni Phase 1 Grid, Western Cape (Windlab);
  Umsinde Emoyeni Phase 2 Grid, Western Cape (Windlab);

- **Other Avifaunal Studies**
  Avifaunal Walkthrough, Robben Island PV, Western Cape (Sola Future Energy);
  Avifaunal Feasibility Assessment, Confidential WEF, Western Cape (ACED);
  Canal Walk Wetlands Avifauna Study, Cape Town (Sun International);
  Review and mitigation strategy design for birds at the Kinangob Wind Park, Kenya (African Infrastructure Investment Managers)

Scientific Publications

- Cowley, PD, Terörde, AI & Whitfield, AK. **2018**. Birds as major predators of fishes in a small estuary: does this influence the nursery area concept for estuary-associated fish species? African Zoology – ACCEPTED – *in press*
- Maree, BA, Cowley, PD, Naesje, TF Childs, A-R, Terörde, AI & Thorstad, EB. **2016**. Influence of prey abundance and abiotic factors on the long-term home-range and movement dynamics of spotted grunter *Pomadasys commersonnii* in an intermittently open estuary. African Journal of Marine Science 2016: 1-10
- Terörde, AI & Turpie, JK. **2013**. Influence of habitat structure and mouth dynamics on avifauna of intermittently-open estuaries: A study of four small South African estuaries. *Estuarine, Coastal and Shelf Science* 125: 10-19
- Terörde, AI & Turpie, JK. **2012**. Use of a small, intermittently-open estuary by waterbirds: a case study of the East Kleinemonde Estuary, Eastern Cape, South Africa. African Journal of Aquatic Science 37: 183-190
- Terörde, AI, Clark, B. Hutchings, K. Orr, K. **2011**. Ballast water management technology testing. South African Marine Science Symposium 2011.
- Turpie, JK. Clark, B.M., Bornman, T, Cowley, PD & Terörde, AI. **2009.** Integrated Ecological-Economic Modeling as an Estuarine Management Tool: A Case Study of the East Kleinemonde Estuary. Volume II: Model Construction, Evaluation and User Manual. WRC Report No. 1679/2/08

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- Terörde, AI & Turpie, JK. **2008.** Appendix K. Specialist Report: Birds. In: van Niekerk, L., Bate, G.C. & Whitfield, A.K. (eds). East Kleinemonde Estuary Reserve determination study: Technical report. Department of Water Affairs & Forestry, Pretoria.
- Whitfield, AK, Adams, JB, Bate, GC, Bezuidenhout, K, Bornman, TG, Cowley, PD, Froneman, PW, Gama, PT, James, NC, Mackenzie, B, Riddin, T, Snow, GC, Strydom, NA, Taljaard, S, Terörde, AI, Theron, AK, Turpie, JK, van Niekerk, L, Vorwerk, PD & Wooldridge, T.H. **2008.** A multidisciplinary study of a small, intermittently open South African estuary, with particular emphasis on the influence of mouth state on the ecology of the system. African Journal of Marine Science 30: 453-474
- Terörde, AI & Turpie, JK. **2008.** Use of a small, intermittently-open estuary by waterbirds: a case study of the East Kleinemonde estuary, Eastern Cape, South Africa. South African Marine Science Symposium 2008. (Awarded **best student** oral presentation)
- Terörde, AI & Turpie, JK. **2007.** Birds. In: Whitfield AK, Bate GC (eds). A Review of Information on Temporarily Open/closed Estuaries in the Warm and Cool Temperate Biogeographic Regions of South Africa, with Particular Emphasis on the Influence of River Flow on these Systems. WRC Report No. 1581/1/07.