APPENDIX I

Avifaunal Assessment

12 MONTH PRE-CONSTRUCTION AVIFAUNA MONITORING FOR BOKPOORT II SOLAR FARM, NORTHERN CAPE

Progress Report 1

Revision 1

On behalf of

ACWA Power Africa Holdings (Pty) Ltd

December 2015

Prepared By:

Arcus Consultancy Services

Office 211
Cube Workspace
Cnr Long St and Hans Strijdom Rd
Cape Town
8001

T+27 (0) 21 412 1529 I **E** AndrewP@arcusconsulting.co.za
W www.arcusconsulting.co.za

Registered in South Africa No. 2012/215000/10

Written By	Andrew Pearson	02 July 2015
Checked By	Jonathan Aronson	02 July 2015
Approved By	Ashlin Bodasing	03 July 2015
Revision 01	Ashlin Bodasing	07 December 2015

EXECUTIVE SUMMARY

This report is the first progress report relating to 12 months pre-construction bird surveys for the proposed Bokpoort II Solar Farm. The purpose of this report is to outline:

- The survey method for the winter survey;
- Observations from the winter survey; and
- Future recommendations for the survey approach and solar farm design.

The first of four seasonal survey visits was carried out between 03 and 11 June 2015. Bird monitoring comprised flight activity surveys from three vantage points, five walked transects (each 1 km in length), five driven transects, and four focal sites as well as incidental observations.

Key findings from the winter survey can be summarised as follows:

- The majority of target species flights were by Namaqua Sandgrouse.
- Flight activity of raptors, large terrestrial species and/or red-listed species was low in both the control site and broader project area.
- A total of 49 species were recorded within the boundaries of the project site.
- Thirty-six species were recorded on the control site.
- Five regionally red listed species (Taylor, 2014) were recorded during the winter survey in the broader project area. One of these, Verreaux's Eagle, was not recorded on either the project site or control site.
- Two South African near-endemic species were recorded in the broader project area.
- There has been one confirmed active nest site of a priority species or raptor to date, namely Verreaux's Eagle.
- Martial Eagle is suspected to be nesting on a power line pylon in the broader project area, approximately 1.5 km from the project site, however the suspected nest could not be confirmed as active.
- Records of groups of Ludwig's Bustard and Kori Bustard suggest that the broader project area may be an important foraging area for these species which may also breed in the area.
- The following small passerine species were either regularly recorded or recorded in abundance: Lark-like Bunting, Sociable Weaver, Scaly-feathered Finch, Black-chested Prinia, Cape Turtle Dove, Chestnut-vented Tit-babbler, Dusky Sunbird, Fawn-coloured Lark, Kalahari Scrub-robin and Namaqua Sandgrouse.

It is recommended that additional effort be put in to monitoring of focal sites, including designating the suspected Martial Eagle nest as a focal site and subsequent monitoring thereof.

SPECIALISTS' DECLARATION OF INDEPENDENCE AND QUALIFICATIONS

Andrew Pearson is an Avifauna Specialist at Arcus. Andrew has a four year BSc in Conservation Ecology, certificates in Environmental Law, as well as seven years' experience as an environmental management professional. 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 will perform the work required in an objective manner, and declares that there are no circumstances which may compromise the objectivity in performing such work. Arcus has no business financial or other in the proposed project except for financial compensation for specialist work conducted. Andrew designed and set up the field surveys, conducted data collection and provided inputs to the analysis and interpretations of the avifauna data as an Avifauna Specialist.

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 is a professional member of the SACNSP, as detailed below:

Investigator:	Andrew Pearson (Pri.Sci.Nat)
Qualification:	BSc (hons) Conservation Ecology
Affiliation:	South African Council for Natural Scientific Professions
Registration number:	400423/11
Fields of Expertise:	Ecological Science
Registration:	Professional Member

3 July 2015

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1 INTRODUCTION

This report is the first progress report relating to 12 months pre-construction bird surveys for the proposed Bokpoort II Solar Farm ('the project'). This report presents the survey design, methodology and results of the winter seasonal survey.

The aim of the avifauna survey and assessment is to inform the final design of the project with regards to the risks associated with birds and to supply data to inform the final Avifaunal Impact Assessment (AIA) for inclusion into the environmental impact assessment (EIA) process.

The purpose of this report is to outline:

- The survey method for the winter survey;
- Observations from the winter survey; and
- Future recommendations for the survey approach and the project design.

1.1 The Proposed Project

ACWA Power Africa Holdings (Pty) Ltd (ACWA)) are proposing to construct 1 x 150 MW concentrated solar power (CSP) towers and 2 x 75 MW photovoltaic (PV) plant on the Remaining Extent of Farm Bokpoort 390, Groblershoop, Northern Cape ('the project site') (Figure 1). The project site covers an area of approximately 1,437 ha and includes the following available bird micro habitats: open gravel plains; livestock enclosures or 'kraals'; reservoirs/water points; grassy shrubland/scrub; grassy thorn veld; and dunes. Land use in the project site is predominantly stock farming.

The project site borders on, and lies to the north east of, the Bokpoort I CSP project (Figure 2) which is nearing the end of its construction phase.

2 SURVEY DESIGN

There are currently no best practise guidelines for long term bird monitoring on potential solar facilities in South Africa. The survey was therefore designed by the avifaunal specialist to be broadly in line with the best practice guidelines[1] for wind farms ('the guidelines').

However, the specialist is aware that guidelines requiring 12 month pre-construction bird monitoring for large CSP tower projects are in development by Birdlife South Africa (BLSA) and the Birds and Renewable Energy Specialist Group (BARESG)[2]. Knowledge of these imminent guidelines and international best practise, were considered in the design of the surveys.

Due to the inherent mobility of birds, it is important to consider avifauna not only on the project site, but also the avifauna and available avifaunal microhabitats beyond the project site. Therefore, an arbitrary delineation of a 'broader project area' was done by the specialist, incorporating all relevant and important habitats, and within which the surveys would be conducted. The broader project area includes the project site and is shown in Figure 2.

In order to provide useful comparative data in the event of the construction and operation of the project, surveys were undertaken within the broader project area, both within the project site and at variable distances from the project site, as well as at a control site.

[1] Jenkins, A.R., van Rooyen, C.S., Smallie, J.J., Harrison, J., Diamond, M. and Smit, H.A. (2011 amended 2012). Best Practice Guidelines for Avian Monitoring and Impact Mitigation at Proposed Wind Energy Development Sites in Southern Africa. BirdLife South Africa/Endangered Wildlife Trust.

[2] The specialist is a member of this group and received a draft copy of the solar guidelines for comment and input shortly after the monitoring proposal was submitted by Arcus to ACWA.

The control site is located approximately 6 km south west of the project site (Figure 2) was selected primarily on the basis of its accessibility and similarity of the predominant habitats to the project site.

The broader project area, project site and control site were visited on 2 and 3 June 2015 by the avifaunal specialist in order to confirm accessibility, identify focal sites (FS) and confirm the location of vantage points (VP), driven transects (DT) and walked transects (WT).

The following survey methods were performed during the winter survey and are intended to be carried out during each of the remaining seasonal survey visits across the 12-month period:

- Walked transects;
- Driven transects;
- Vantage point surveys;
- Focal site surveys; and
- Incidental observation recording.

It is intended that the survey protocols described below are flexible and could be amended in response to the preliminary findings and feasibility of undertaking the surveys at the broader project area and control site.

3 SURVEY METHODS (WINTER)

The first of the four seasonal survey visits to be carried out over the 12 month period was completed between 3 and 11 June 2015. Surveys were conducted by the avifaunal specialist, assisted by a qualified and experienced field surveyor.

The following definitions apply:

- Priority species: all species occurring on the BLSA and Endangered Wildlife Trust (EWT) Avian Sensitivity Map priority species list[3].
- Target species: those particular bird species that were[4] recorded by a specific survey method.
- Target species per survey method:
    - Walked transects: all birds;
    - Driven transects: all raptors; all large (non-passerine) priority species; corvids (crows and ravens); hornbills; korhaans; and lapwings.
    - Vantage point surveys: all raptors; all large (non-passerine) priority species; doves; corvids (crows and ravens) sandgrouse; korhaans; aerial foragers and flocking species[5] e.g. swallows, swifts and martins; and larks (display flights only).
    - Incidental observations: all red-listed species (Taylor, 2014); all raptors; all large (non-passerine) priority species; hornbills; korhaans; and
    - Focal sites: all species associated, utilising or interacting at/with the focal site.

[3] Retief, E, Anderson, M., Diamond, M., Smit, H., Jenkins, A. & Brooks, M. (2011) Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures used. Priority species list updated in 2014 by BLSA. This list consists of 107 species with a priority score of 170 or more. The priority score was determined by BLSA and EWT after considering various factors including bird families most impacted upon by Wind Energy Facilities (WEFs), physical size, species behaviour, endemism, range size and conservation status.

[4] Species/groups of species may be added to a particular survey method's target species list as the programme progresses.

[5] Note that flight paths were not recorded for these species.

3.1 Walked Transects

Three walked transects were established and conducted on the project site as well as two walked transects on the control site, referred to as control walked transects (CWT) (Figure 2). Each transect was 1 km in length and was conducted twice during the winter survey. The location and the times of the walked transects are presented in Table 1. Transects are named according to location and visit within the season; i.e. WT2.1 is transect location two, first visit; WT2.2 is transect location two, second visit.

Two observers walked between the start and end points of the transects whilst recording all birds seen or heard up to 250 m on either side of the transect. Beyond 250 m, only priority species were noted and were recorded as incidental sightings.

Table 1: Geographic Co-ordinates for Walked Transect Routes and Survey Date/Times

Ref	Transect Co-ordinates (Start)		Transect Co-ordinates (Finish)		Survey Details		
	South	East	South	East	Date	Start Time	Finish Time
WT1.1	-28.680960°	22.023580°	-28.689900°	22.023540°	09/06/2015	11:38	12:08
WT1.2	-28.680960°	22.023580°	-28.689900°	22.023540°	11/06/2015	14:30	14:56
WT2.1	-28.705320°	21.998880°	-28.713910°	21.995530°	06/06/2015	07:55	08:33
WT2.2	-28.705320°	21.998880°	-28.713910°	21.995530°	11/06/2015	10:19	10:43
WT3.1	-28.705050°	22.014970°	-28.700360°	22.006230°	10/06/2015	14:05	14:46
WT3.2	-28.705050°	22.014970°	-28.700360°	22.006230°	11/06/2015	09:06	09:45
CWT1.1	-28.755650°	21.954050°	-28.748460°	21.947850°	07/06/2015	08:43	09:26
CWT1.2	-28.755650°	21.954050°	-28.748460°	21.947850°	10/06/2015	07:55	08:26
CWT2.1	-28.774050°	21.937080°	-28.770620°	21.927640°	09/06/2015	14:47	15:17
CWT2.2	-28.774050°	21.937080°	-28.770620°	21.927640°	11/06/2015	07:53	08:25

3.2 Vantage Points

Two vantage points were surveyed in the project site (VP1 and VP2), and one in the control site (CVP) (Figure 2). Observer pairs monitored a viewshed of 360 degrees with a radius of 2.25 km from each VP. These viewsheds were the focus of observation, however if target species were noted beyond these (or if a species being recorded flew out of the viewshed but was still visible), they were also recorded. For each flight of a target species (except for aerial foragers and flocking species) the flight path was recorded on a large scale map along with data on the number/species of bird(s) and type of flight. Aerial foragers and flocking species were recorded for additional information during the VP surveys and their presence noted where applicable.

Where flight paths were recorded, flight heights were recorded through five height bands: 1: <10 m; 2: 10-90 m; 3: 90-170 m; 4: 170-210 m and 5: >210 m. Each VP was surveyed for a total of 12 hours. Therefore, a total of 36 hours of VP observations were carried out. The co-ordinates of the VPs and hours surveyed are provided in Table 2 below.

Table 2: Vantage Point Geographic Co-ordinates and Hours Surveyed

VP	Co-ordinates		04.06.15	05.06.15	06.06.15	07.06.15	08.06.15	09.06.15	10.06.15	Total Time
	South	East								
VP1	-28.680720°	22.023860°	3h	3h	-	-	3h	3h	-	**12h**
VP2	-28.705130°	21.998984°	3h	3h	3h	3h	-	-	-	**12h**
CVP	-28.747820°	21.947270°	-	-	3h	3h	3h	-	3h	**12h**

3.3 Driven Transects

Driven transect target species were sampled using five driven transects (Figure 2), three in the broader project area and two on the control site. Two observers' conducted each transect on two occasions by driving slowly (approximately 30 km/h) and stopped regularly to scan surrounding open areas. The locations and times of the driven transects are shown in Table 3. Transects are named according to location and visit within the season; i.e. DT1.1 is transect location one, first visit; DT1.2 is transect location one, second visit.

DT1 runs near the southern boundary of the project site, following the railway line and service road. Two drive transects traverse the project site and neighbouring areas up to 2 km from the project site (DT2 and DT3). Two drive transects (CDT1 and CDT2) run on and around the control site.

Table 3: Geographic Co-Ordinates and Approximate Lengths for Driven Transects and Survey Date/Times

Transect Name	Length (km)	Transect Co-ordinates (Start)		Transect Co-ordinates (Finish)		Survey Details		
		South	East	South	East	Date	Start Time	Finish Time
DT1.1	10.3 km	-28.739388°	21.999576°	-28.689782°	22.078781°	03/06/2015	09:03	09:49
DT1.2	10.3 km	-28.739388°	21.999576°	-28.689782°	22.078781°	08/06/2015	09:05	09:32
DT2.1	10.6 km	-28.699189°	22.052513°	-28.671372°	22.013056°	04/06/2015	08:14	09:05
DT2.2	10.6 km	-28.699189°	22.052513°	-28.671372°	22.013056°	11/06/2015	12:00	12:47
DT3.1	5.9 km	-28.731022°	22.005815°	-28.682639°	22.002591°	10/06/2015	13:22	13:50
DT3.2	5.9 km	-28.731022°	22.005815°	-28.682639°	22.002591°	11/06/2015	11:18	11:52
CDT1.1	4.65 km	-28.778240°	21.933382°	-28.750492°	21.962642°	07/06/2015	08:15	08:33
CDT1.2	4.65 km	-28.778240°	21.933382°	-28.750492°	21.962642°	09/06/2015	13:59	14:16
CDT2.1	2.55 km	-28.735274°	21.965228°	-28.733288°	21.944551°	07/06/2015	13:06	13:22
CDT2.2	2.55 km	-28.735274°	21.965228°	-28.733288°	21.944551°	10/06/2015	12:45	13:01

3.4 Focal Sites

Focal sites are any identifiable features within the landscape that are likely to support notable avifauna (e.g. a roost or nesting site) or have the potential to support breeding pairs or large densities of avifauna (e.g. dams, wetlands, river systems) and these sites may change as monitoring progresses and other focal sites become evident.

Four focal sites were identified (Figure 2). A viewpoint on the Orange River, approximately 12.9 km from the project site was designated as Focal Site one (FS1). No focal sites were conducted on the project site. One focal site (FS3) was identified approximately 1.4 km north east of the project site, another (FS2) approximately 4.4 km to the east while one on the control site (CFS1) was identified.

Each focal site was surveyed twice during the winter survey for a period of 15 minutes each time during which time target species were counted and any relevant notes were taken. In Table 4, FS1.1 refers to the first visit to FS1, while FS1.2 is the second visit during the winter survey.

Table 4: Geographic Positions and Descriptions of Focal Sites

Focal Site	Co-ordinates		Description	Survey Details		
	South	East		Date	Start time	Finish Time
FS1.1	-28.788022°	21.882755°	View of the Orange River from the eastern bank, including open water, islands, banks, rocks and reed bed habitats.	05/06/2015	07:40	07:55
FS1.2	-28.788022°	21.882755°		10/06/2015	15:37	15:52
FS2.1	-28.688900°	22.080510°	Two cliff faces (north and south) approximately 450 m apart, viewed from the same point (FS2). Northern cliff face has two Verreaux's Eagle nest structures, while southern face has one.	03/06/2015	09:50	10:05
FS2.2	-28.688900°	22.080510°		08/06/2015	09:34	09:49
FS3.1	-28.674830°	22.037520°	Reservoir and water trough fed by windmill pump, with surrounding 'kraal' and trees.	04/06/2015	16:15	16:30
FS3.2	-28.674830°	22.037520°		09/06/2015	12:55	13:10
CFS1.1	-28.768900°	21.937500°	Reservoir and water trough fed by windmill pump, with surrounding 'kraal' and trees.	09/06/2015	15:21	15:36
CFS1.2	-28.768900°	21.937500°		10/06/2015	11:59	12:14

3.5 Incidental Observations

Relevant observations of target species were recorded while commuting to or from, or in the broader project area and control site, but outside the survey protocols and times described above.

4 SURVEY RESULTS (WINTER)

4.1 Walked Transects

The purpose of the walked transect surveys is to estimate small bird populations and densities, and the method used was found to be suitable in all of the habitats surveyed.

On the project site, 197 observations of 31 species were recorded during 6 WT surveys while on the control site 23 species were recorded in 114 observations during 4 WT surveys. An observation occurs whenever a target species is observed (seen or heard), and may include more than one bird of the same target species.WT3 resulted in the most number of observations (99) and species (26) while WT1 and CWT2 had lower numbers of observations (43 and 47 respectively) with each recording a total of 17 species (Table 5).

The locations of Priority Species, raptors or large terrestrial species recorded during the walked transects are displayed in Figure 3 along with the other incidental and drive transect records.

Table 5: Small Terrestrial Species Transect Results

Transect Name	Total Observations (Number of Individual Birds)	Total Species Recorded	Priority Species (P), Red Listed Species (Status)* or Focal Species (F)	Frequently Recorded and/or Abundant.
WT1	43 (58)	17	-	Black-chested Prinia, Bokmakierie, Chestnut-vented Tit-babbler, Dusky Sunbird, Fawn-coloured Lark, Lark-like Bunting, Scaly-feathered Finch.
WT2	55 (79)	20	Ludwig's Bustard (EN), Namaqua Sandgrouse (F).	Acacia Pied Barbet, Black-chested Prinia, Chestnut-vented Tit-babbler, Fawn-colored Lark, Kalahari Scrub-robin, Karoo Long-billed Lark, African Red-eyed Bulbul, Red-faced Mousebird, Yellow Canary.
WT3	99 (176)	26	Kori Bustard (NT), Ludwig's Bustard (EN), Namaqua Sandgrouse (F), Northern Black Korhaan (F), Red-crested Korhaan (F).	Black-chested Prinia, Cape Turtle Dove, Chestnut-vented Tit-babbler, Dusky Sunbird, Fawn-coloured Lark, Kalahari Scrub-robin, Kori Bustard, Namaqua Sandgrouse, Northern Black Korhaan, Red-faced Mousebird, Scaly-feathered Finch, Southern Masked Weaver, Yellow Canary, Yellow-bellied Eremomela.
CWT1	67 (97)	21	Namaqua Sandgrouse (F), Northern black Korhaan (F), Red-crested Korhaan (F).	Black-chested Prinia, Chestnut-vented Tit-babbler, Dusky Sunbird, Eastern Clapper Lark, Fawn-coloured Lark, Red-billed Quelea, Yellow Canary.
CWT2	47 (187)	17	Namaqua Sandgrouse (F), Northern black Korhaan (F).	Fawn-colored Lark, Lark-like Bunting, Namaqua Sandgrouse, Red-billed Quelea, Southern Red Bishop.

**Red List (Taylor, 2014) status: EN=Endangered. NT=Near Threatened. F=Focal species deemed relevant and important to highlight by the specialist.*

4.2 Vantage Points

A total of 492 birds of 11 target species were recorded by observing a total of 99 flight paths (i.e. one flight path may include a number of birds = flock) during the VP monitoring at both the project and control sites.

It must be noted that separate flight paths may have been conducted by the same bird/s and that the figures presented here are not an indication of abundance, but rather flight activity. Flight paths of Doves and Sandgrouse on both the project and control sites are shown in Figure 4a, while Figure 4b shows all other target species flights.

Table 6 presents a summary of the flight activity data of each target species for the broader project area, while table 7 summarises flight activity data from the control site.

The most regular recorded target species was Namaqua Sandgrouse, accounting for 36 % and 57 % of flight paths in the broader project area and control sites respectively. The species was also often recorded in large flocks of more than 10 birds, and up to 42 birds. In the broader project area, Pied Crow (19 % of flight paths) was the second most recorded species at VP watches followed closely by Pale Chanting Goshawk (17 %). Short, low and direct flights of Namaqua Dove and Cape Turtle Dove were also recorded along with five display flights of Eastern Clapper Lark in the broader project area.

No detailed analysis of flight heights has yet been done, however, preliminary analyses of flight paths in the broader project area indicates that 98 % of flights included at least some time below 210 m. The project information supplied to date is that the CSP tower will be approximately 200 m in height, and it is therefore assumed that flights below 210 m may be susceptible to collision and/or burning impacts.

Table 6: Flight Path Target Species – Broader Project Area

Species	Priority Score (Retief et al, 2011)	Red List Status (Taylor, 2014)	Total no. of flight paths recorded.	Total no. of birds recorded*	No. of flights with a portion below 210 m
Cape Turtle Dove	-	-	5	5	3 (100%)
Crowned Lapwing	-	-	1	5	1 (100%)
Eastern Clapper Lark	-	-	5	5	5 (100%)
Ludwig's Bustard	320	EN	1	1	1 (100%)
Namaqua Dove	-	-	5	7	5 (100%)
Namaqua Sandgrouse	-	-	23	138	23 (100%)
Northern Black Korhaan	180	-	1	1	1 (100%)
Pale Chanting Goshawk	200	-	11	12	11 (100%)
Pied Crow	-	-	12	24	11 (92%)
Totals			**64**	**198**	**63 (98%)**

**Indicates that in some cases a single flight path recorded was a flight consisting of more than one bird. This figure does not indicate abundance of a species as numerous flights may have been conducted by the same bird/s at different times.*

Table 7: Flight Path Target Species - Control Site

Species	Priority Score (Retief et al, 2011)	Red List Status (Taylor, 2014)	Total no. of flight paths recorded.	Total no. of birds recorded*	No. of flights with a portion below 210 m
Cape Turtle Dove	-	-	1	2	1 (100%)
Eastern Clapper Lark	-	-	4	4	4 (100%)
Martial Eagle	350	EN	2	2	2 (100%)
Namaqua Sandgrouse	-	-	20	261	17 (85%)
Pied Crow	-	-	8	25	8 (100%)
Totals			**35**	**294**	**32 (91%)**

**Indicates that in some cases a single flight path recorded was a flight consisting of more than one bird. This figure does not indicate abundance of a species as numerous flights may have been conducted by the same bird/s at different times.*

In the control site, Pied Crow (23 % of flight paths) was the second most recorded species at VP watches followed Eastern Clapper Lark (11 %). Two flights of Martial Eagle, believed to be by the same individual bird, were recorded near to an existing powerline, north east of the control site VP. No detailed analysis of flight heights has yet been done, however, preliminary analyses of flight paths in the control site indicates that 91 % of flights included at least some time below 210 m.

The overall average passage rate of target species was 8.25 (SD±11.53) birds per hour for the project site and 24.5 (SD±25.4) birds per hour for the control site (Table 8). The passage rate is the number of target species birds per hour of observation recorded at the VPs. This data must be treated with caution as it is strongly influenced by flights of Namaqua Sandgrouse flocks.

The results and data presented in this progress report is preliminary analysis, and more detailed analysis of flight activity and associated risk will be undertaken in the final report.

Table 8: Average Passage Rate per Hour for Target Species

VP	Birds/hour Session 1	Birds/hour Session 2	Birds/hour Session 3	Birds/hour Session 4	Average Birds/ hour ± SD*
Project Site					
VP1	3.0	1.0	2.3	1.7	2 ± 0.9
VP2	15.7	3.3	34.3	4.7	14.5 ± 14.3
Control Site					
CVP	1.0	52.3	5.0	39.7	24.5 ± 25.4

**SD=Standard Deviation*

4.3 Driven Transects

The driven transects on the control site resulted in only one record of one bird, a Pied Crow. The driven transects in the broader project area resulted in 25 records of 9 species, totalling 40 birds (Table 9 and Figure 4).

DT2 recorded the most target species records (13), while CDT2 did not record any target species. The species most regularly recorded was Northern Black Korhaan (11 records), followed by Pied Crow (4 records) and Ludwig's Bustard, Martial Eagle, Pale Chanting Goshawk and Red-crested Korhaan each with 2 records.

Table 9: Summary of Driven Transect Results

Species	Total Birds Recorded	Maximum Flock Count**	Number of Records					
			DT1	DT2	DT3	CDT1	CDT2	*ALL*
Grey Hornbill	7	7	-	1	-	-	-	*1*
Kori Bustard*	1	1	-	1	-	-	-	*1*
Ludwig's Bustard*	8	5	-	-	2	-	-	*2*
Martial Eagle*	2	1	2	-	-	-	-	*2*
Northern Black Korhaan*	12	2	1	8	2	-	-	*11*
Pale Chanting Goshawk*	2	1	-	1	1	-	-	*2*
Pied Crow	6	2	1	-	2	1	-	*4*
Red-crested Korhaan	2	1	-	2	-	-	-	*2*
Rock Kestrel	1	1	1	-	-	-	-	*1*
Total	**41**	**NA**	**5**	**13**	**7**	**1**	**0**	***26***

**Priority species (Retief et al., 2011, updated 2014)*

***Size of the biggest group/flock of birds of the same species observed in one record.*

4.4 Focal Sites

Observations from the visits to the focal sites (Figure 2) are presented in Table 10 below. The focal sites were located by the avifaunal specialist during the site set up, prior to the surveys commencing and additional sites may be added as the seasonal surveys progress.

Observations at the Orange River focal site (FS1) recorded various water associated species including herons, egrets, kingfishers and cormorants. White-breasted Cormorants breed on an island visible from FS1.

Three Verreaux's Eagle nest structures were located on cliffs approximately 4 km east of the project site (Figure 5). Two nest structures are located on a more northerly cliff, and have been designated 'Verreaux's Eagle Nest B' and 'Verreaux's Eagle Nest C' while 'Verreaux's Eagle Nest A' is located on the more southerly cliff face (in close proximity to the railway line). Both cliff faces (and all nest structures) were surveyed from FS2 and the results are presented below. Verreaux's Eagle Nest A is regarded as active.

FS3 and CFS1 revealed the presence of various small passerines, attracted to the water, some of which were not recorded elsewhere such as Black-headed Canary and Cape Bunting.

Table 10: Summary of Focal Site Results (number of individuals counted during each of the two counts is given in brackets)

Focal Site visit	Species recorded (number of individuals)	Notes
FS1.1	African Darter (5), Cape Robin-chat (1), Cape Wagtail (2), Cattle Egret (35), Egyptian Goose (4), Giant Kingfisher (1), Goliath Heron (1), Little Egret (1), Namaqua Sandgrouse (8), Orange River White-eye (6), Reed Cormorant (25), Sacred Ibis (4), Speckled Pigeon (10), White-breasted Cormorant (30).	Breeding colony of White-breasted Cormorants 100 m to the south west on an island.
FS1.2	African Fish-Eagle (2), Cape Turtle Dove (4), Grey Heron (1), Little Egret (1), African Red-eyed Bulbul (6), Reed Cormorant (13), Rock Martin (2), Speckled Pigeon (35), White-breasted Cormorant (32).	Both individual African Fish-Eagles observed were sub-adult birds. Breeding colony of White-breasted Cormorants 100 m to the south west on an island.
FS2.2	Pale-winged Starling (10), Rock Kestrel (1).	White-wash observed on rock face near Verreaux's Eagle Nest A.
FS2.2	Pale-winged Starling (8), Rock Kestrel (1), Verreaux's Eagle (1).	An adult Verreaux's Eagle (suspected to be a female bird) was observed initially flying near to the northern nest structures (Verreaux's Eagle Nests B and C) and then landed on the southern cliff face next to Nest A.
FS3.1	Cape Turtle Dove (2), Crimson-breasted Shrike (1), Unidentifiable lark (1), Lark-like Bunting (6), Laughing Dove (2), Orange River White-eye (8), Sociable Weaver (16), White-browed Sparrow-weaver (2), Yellow-bellied Eremomela (1).	
FS3.3	Black-throated Canary (1), Black-headed Canary (1), Cape Bunting (2), Lark-like Bunting (10), Unidentifiable passerine (1), Namaqua Dove (5), Orange River White-eye (7), Red-billed Quelea (7), African Red-eyed Bulbul (2), Violet-eared Waxbill (2), White-throated Canary (2), Yellow Canary (5).	
CFS1.1	Cape Wagtail (1), Lark-like Bunting (30), Laughing dove (2), Namaqua Dove (1), Pied Crow (2), Red-billed Quelea (25), Southern Red Bishop (10), White-browed Sparrow-weaver (1).	
CFS1.2	Cape Glossy Starling (1), Lark-like Bunting (9), Laughing dove (2), Namaqua Dove (5), Red-billed Quelea (12), Southern Masked Weaver (10), Southern Red Bishop (10).	

4.5 Incidental Observations

Thirty-one incidental observations were made of eight target species comprising 71 birds (a single observation may include numerous birds of one species i.e a flock) across the broader project area and control site (Table 11 and Figure 3).

The species most regularly observed incidentally was Northern Black Korhaan accounting for 39 % of all the incidental observations. Although the 12 observations of this species counted a total of 15 birds, it's likely that on some occasions the same bird was observed more than once. It is estimated that the incidental observations of this species were of approximately 8 – 10 separate individual birds. Pale Chanting Goshawk was the second most recorded species. This relatively common raptor regularly perches conspicuously on fence poles, electricity pylons and isolated trees making it an easily observed species. Again, it is likely that the incidental observations of this species were often of the same individual bird, and it is estimated that about 6 separate individual birds make up the incidental observations. An interesting observation was a flock of between 15-20 African Grey Hornbills. They were observed in relatively the same area on two separate occasions, and the project site is on the south western extremity of this species range.

Table 11: Number of Incidental Observations of Target Species.

Species	Number of observations	Total birds	Maximum flock count	Notes
African Fish Eagle*	1	2	2	Both sub adults. Possibly the same birds observed during the FS1.2 survey at the river.
African Grey Hornbill	2	35	20	Individuals from the same flock were observed on two separate occasions.
Karoo Korhaan*	2	3	2	
Kori Bustard*	3	4	2	
Martial Eagle*	1	1	1	Perched on power line pylon
Northern Black Korhaan*	12	15	2	Many observations are likely to be of the same individual/s.
Pale Chanting Goshawk*	8	9	2	Many observations are likely to be of the same individual/s.
Red-crested Korhaan	2	2	1	
TOTAL	**31**	**71**	**NA**	

**Priority species (Retief et al., 2011, updated 2014)*

4.6 Species Summary and Discussion

4.6.1 Winter Survey

A total of 49 species were recorded within the boundaries of the project site. An additional 14 species were recorded beyond the project site boundary, but within the broader project area. Therefore, 63 species were recorded within the broader project area (which includes the project site).

Thirty-six species were recorded on the control site (Appendix 1). All of these species except three (Martial Eagle, Karoo Korhaan and Cape Wagtail) were also recorded on the project site. However, both Martial Eagle and Karoo Korhaan were recorded in the broader project area. Forty species were recorded in the Orange River Valley either during observations at FS1, or incidentally at the author's accommodation or while travelling to and from the site.

The full species list indicating their conservation status, endemism, priority species score and where a species had been recorded is provided in Appendix I. This reporting table will be expanded as further data become available through subsequent surveys.

As birds are inherently mobile, it is likely that all species observed in the broader project area and some in the Orange River Valley may at some point traverse or utilise the project site. However, at this time it seems unlikely that water associated birds such as ducks, grebes, cormorants and kingfishers would occur or pass through the project site. Further discussions below therefore consider the species list for the broader project area.

Five regionally red listed species (Taylor, 2014) were recorded during the winter survey (Table 12) in the broader project area. One of these, Verreaux's Eagle, was not recorded on either the project site or control site. No red listed species were recorded in the Orange River Valley.

Table 12: Regionally Red Listed Species Recorded During the Winter Survey in the Broader Project Area and Control Site.

Species	Status (Taylor, 2014)	Broader Project Area	Project Site	Control Site
Karoo Korhaan	Near Threatened	X		X
Kori Bustard	Near Threatened	X	X	X
Ludwig's Bustard	Endangered	X	X	
Martial Eagle	Endangered	X		X
Verreauxs' Eagle	Vulnerable	X		

A total of 4 South African near-endemic species[6] were recorded in the winter survey (Appendix 1). Of these, only two species (Black-headed Canary and Sickle-winged Chat) were recorded in the broader project area, while the other two (Fiscal Flycatcher and Namaqua Warbler) were recorded in the Orange River Valley.

There has been one confirmed active nest site of a priority species or raptor to date, namely Verreaux's Eagle.

A Martial Eagle was observed soaring to the east of the project site, in the vicinity of a large powerline pylon. The same bird was then observed perched on a large Sociable Weaver nest on the pylon in question. Although outside of the scope of the survey, the avifaunal specialist made time to walk to and inspect this pylon. While doing so, a Martial Eagle was again observed but was flushed and flew out of sight. Closer inspection of the Sociable Weaver nest showed that numerous large sticks and branches were on top of it, and it is strongly suspected that the Martial Eagle observed has a nest on top of the Sociable Weaver nest, or is attempting to construct a nest there (Figure 5). Whether the Martial Eagle has bred here before, or will breed could not be confirmed and this will require further observation in subsequent seasonal surveys.

The presence of groups of Ludwig's Bustard and Kori Bustard suggest that the broader project area may be an important foraging area for these species which may also possibly breed within the broader project area. The likelihood of these species breeding in the broader project area may become more evident after subsequent surveys as Bustards generally breed in spring (between August and December). It is also possible that all three Korhaan species observed (Karoo, Red-crested and Northern Black Korhaan) may breed on the project site. This is especially likely for Northern Black Korhaan, for which territorial male birds were regularly observed displaying.

Generally, the surveys revealed a moderate diversity and abundance of small passerine species especially considering that this was the winter season, when many migratory species are not present and when many species are less conspicuous as they are not breeding at this time. International experience has shown that passerines are vulnerable not only to displacement but also to collision and burning effects.

[6] Near-endemic (i.e. ~70% or more of population in RSA) to South Africa according to the BirdLife South Africa Checklist of Birds in South Africa, 2014.

To date there have been no red-listed or fully endemic passerines recorded. However, what was notable in terms of small passerines is the high number of Sociable Weaver nests (present on almost every large pylon structure) and the high abundance (in both the control and the project site) of the following species: Lark-like Bunting, Scaly-feathered Finch, Black-chested Prinia, Cape Turtle Dove, Chestnut-vented Tit-babbler, Dusky Sunbird, Fawn-coloured Lark, Kalahari Scrub-robin and Namaqua Sandgrouse.

Waterbirds were generally not observed on either the control site or in the broader project areas, as there are no large water bodies to attract them. It's possible, that seasonal presence of pans following rains may attract some of the species observed in the Orange River Valley to the broader project area, although this will only be confirmed following additional surveys.

While it is difficult to draw firm conclusions at this early stage of the monitoring process (and in the absence of detailed data analysis which will be conducted following the completion of monitoring), the species that appear more likely to be directly impacted upon (by collision or burning effects) are Namaqua Sandgrouse, Eastern Clapper Lark, Cape Turtle dove, Pale Chanting Goshawk and Pied Crow. These species were recorded flying most often from VPs. Species of concern that are likely to be displaced or disturbed by the development, are the two Bustard species and the three Korhaan species. Martial Eagle and Verreaux's Eagle are also a concern, however, their flight activity to date has been low, with the latter having only been recorded at the nest site (FS20).

5 KEY DESIGN CONSIDERATIONS

CSP tower projects have the potential to impact birds through habitat loss, disturbance, displacement, collision, burning and barrier effects. The magnitude of the potential effects on birds will differ between species, depending on their abundance, distribution, flight activity and behaviour in the project site. The significance of the impacts will be influenced by the conservation status and sensitivity of the species to the impacts of CSP tower projects.

To date, there have been no clear patterns in the data sufficient to inform the design.

6 NEXT SURVEY CONSIDERATIONS

The current survey design and effort is to be carried over for use in the second seasonal survey (tentatively scheduled for 12 – 20 September 2015) with the following enhancements being recommended for the second seasonal survey:

- An additional Focal Site (in the form of a water trough point) be added and located within the Project site.
- The suspected Martial Eagle nest be designated as a focal site and be visited on four occasions during each subsequent seasonal survey.
- FS2 be surveyed on 3 occasions in order to determine if Verreaux's Eagle has been successfully breeding.

In order to accommodate the above, the survey team will require an additional 5 hours on site per seasonal survey.

7 REFERENCES

Jenkins, A.R., van Rooyen, C.S., Smallie, J.J., Harrison, J., Diamond, M. and Smit, H.A. (2011 amended 2012) Best Practice Guidelines for Avian Monitoring and Impact Mitigation at Proposed Wind Energy Development Sites in Southern Africa. BirdLife South Africa/Endangered Wildlife Trust.

Retief, E, Anderson, M., Diamond, M., Smit, H., Jenkins, A. & Brooks, M. (2011) Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures used.

Taylor, M.R. (ed.) (2014) The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. BirdLife South Africa, Johannesburg. In press

APPENDIX 1: CUMULATIVE SPECIES LIST

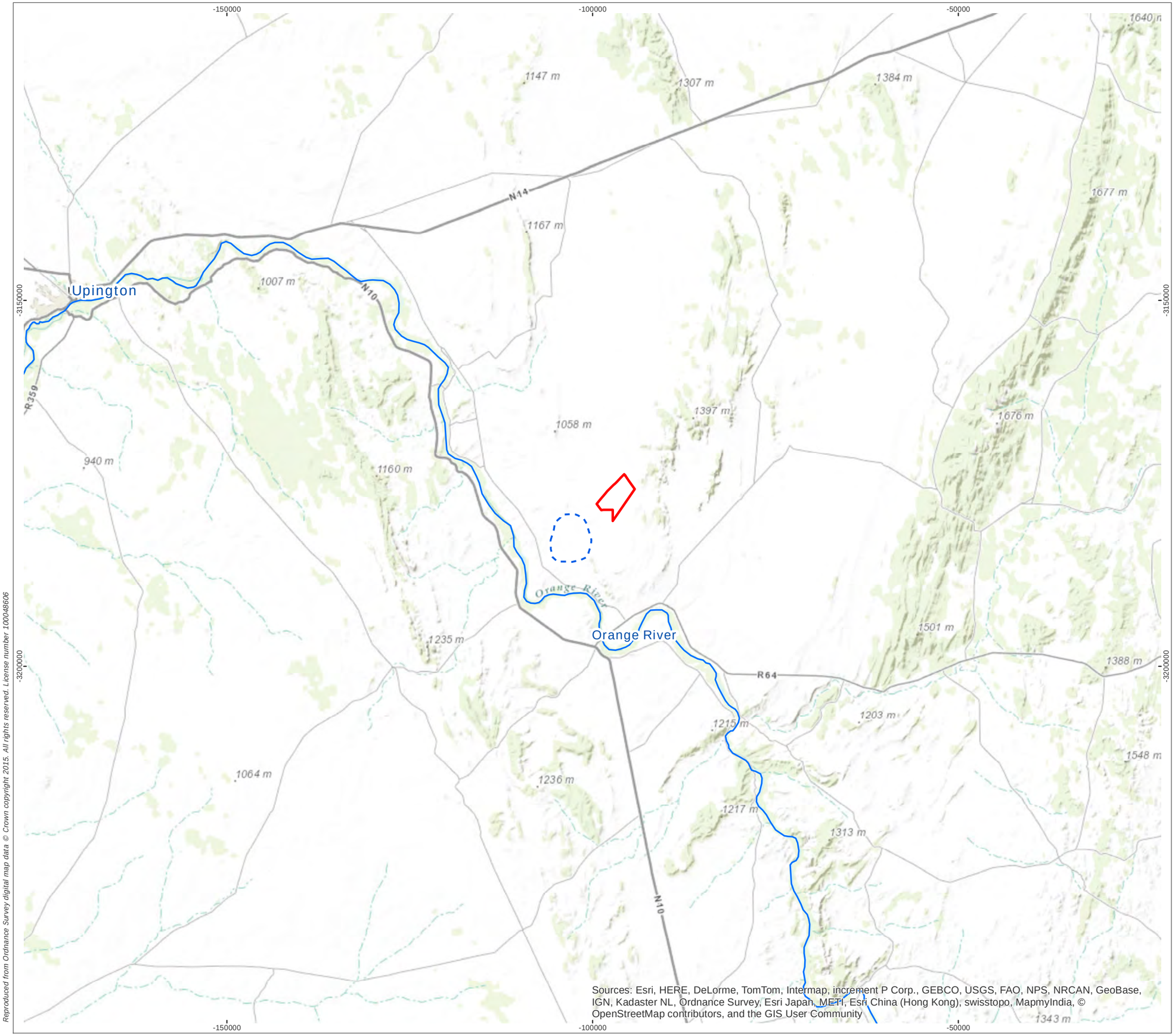
Common Name	Red List Status (Taylor, 2014)	Endemic*	Priority Score (Retief et al, 2011)	Area Recorded			
				Broader Project Area	Project Site	Control Site	Orange River Valley
Barbet, Acacia Pied				1	1	1	
Bokmakierie				1	1	1	
Bulbul, African Red-eyed				1	1	1	1
Bunting, Cape				1			
Bunting, Cinnamon-breasted				1			
Bunting, Lark-like				1	1	1	1
Bustard, Kori	NT		260	1	1	1	
Bustard, Ludwig's	EN		320	1	1		
Canary, Black-headed		x		1			
Canary, Black-throated				1	1		
Canary, White-throated				1	1		
Canary, Yellow				1	1	1	
Chat, Ant-eating				1	1	1	
Chat, Familiar				1	1		1
Chat, Sickle-winged		x		1	1		
Cisticola, Grey-backed							1
Cormorant, Reed							1
Cormorant, White-breasted							1
Crombec, Long-billed				1	1		
Crow, Pied				1	1	1	1
Darter, African							1
Dove, Cape Turtle				1	1	1	1
Dove, Laughing				1	1	1	
Dove, Namaqua				1	1	1	1
Duck, African Black							1
Eagle, African Fish			290	1			1
Eagle, Martial	EN		350	1		1	
Eagle, Verreauxs'	VU		360	1			
Egret, Little							1
Egret, Western Cattle							1
Eremomela, Yellow-bellied				1	1	1	
Falcon, Pygmy				1			
Finch, Red-headed				1			
Finch, Scaly-feathered				1	1	1	1
Fiscal, Common				1	1	1	1
Flycatcher, Fiscal		x					1
Goose, Egyptian							1
Goose, Spur-winged							1

Common Name	Red List Status (Taylor, 2014)	Endemic*	Priority Score (Retief et al, 2011)	Area Recorded			
				Broader Project Area	Project Site	Control Site	Orange River Valley
Goshawk, Pale Chanting			200	1	1		
Grebe, Little							1
Heron, Black-headed							1
Heron, Goliath							1
Heron, Grey							1
Hornbill, African Grey				1	1		
Ibis, African Sacred							1
Ibis, Hadeda							1
Kestrel, Rock				1			
Kingfisher, Giant							1
Kingfisher, Malachite							1
Kite, Black-shouldered			174				1
Korhaan, Karoo	NT		240	1		1	
Korhaan, Northern Black			180	1	1	1	
Korhaan, Red-crested				1	1	1	
Lapwing, Crowned				1	1		
Lark, Eastern Clapper				1	1	1	
Lark, Fawn-coloured				1	1	1	
Lark, Grey-backed Sparrow				1	1		
Lark, Sabota				1	1	1	
Martin, Rock				1	1	1	1
Mousebird, Red-faced				1	1	1	
Mousebird, White-backed				1	1	1	1
Owlet, Pearl-spotted							1
Pigeon, Speckled							1
Pipit, African				1	1		
Prinia, Black-chested				1	1	1	
Quelea, Red-billed				1	1	1	
Robin, Kalahari Scrub				1	1		
Robin-chat, Cape							1
Sandgrouse, Namaqua				1	1	1	1
Scimitarbill, Common				1	1		
Shrike, Crimson-breasted				1			
Sparrow, Cape							1
Sparrow, Great							1
Sparrow-weaver, White-browed				1	1	1	
Starling, Pale-winged				1			
Sunbird, Dusky				1	1	1	
Swift, Little				1	1		
Thrush, Short-toed Rock				1			

Common Name	Red List Status (Taylor, 2014)	Endemic*	Priority Score (Retief et al, 2011)	Area Recorded			
				Broader Project Area	Project Site	Control Site	Orange River Valley
Tit, Ashy				1	1	1	
Tit-Babbler, Chestnut-vented				1	1	1	
Wagtail, Cape						1	1
Warbler, Namaqua		x					1
Warbler, Rufous-eared				1	1	1	
Waxbill, Violet-eared				1	1	1	
Weaver, Sociable				1	1	1	
Weaver, Southern Masked				1	1	1	1
Wheatear, Capped				1	1		
Wheatear, Mountain				1			
White-eye, Orange River				1	1		1
			TOTAL	63	49	36	40

* Endemic or near-endemic (i.e. ~70% or more of population in RSA) to South Africa (not southern Africa as in field guides) or endemic to South Africa, Lesotho and Swaziland. Taken from BirdLife South Africa Checklist of Birds in South Africa, 2014.

EN=Endangered. VU=Vulnerable. NT=Near Threatened.



Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), swisstopo, MapmyIndia, © OpenStreetMap contributors, and the GIS User Community

ARCUS

Project Site

Control Site

Watercourse

Sources: Esri, HERE, DeLorme, TomTom, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan,

1:500,000 Scale @ A3

N

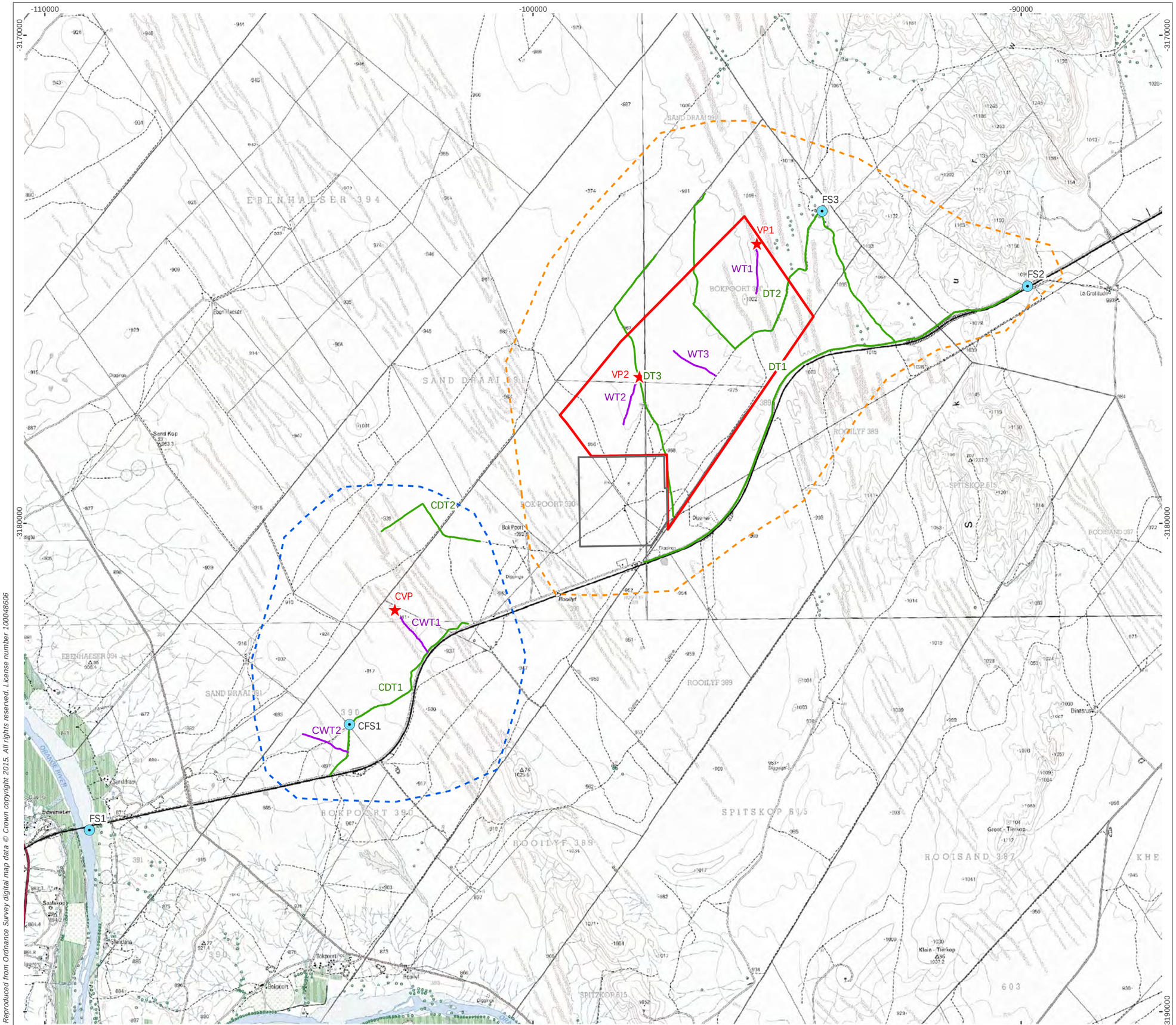
0 10 20 km

Produced: RMc Reviewed: SC Approved: AP	Ref: 2059/REP/001 Date: 25/06/2015

Project Site and Control Site Locations
Figure 1

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 1

P:\Projects\2059 Bokpoort Solar\Document Files\Reports\Bokpoort II Solar Farm Pre-construction Bird Monitoring. Progress Report 1\2059 Fig01 Project Site and Control Site Location.mxd



Project Site
Control Site
Broader Project Area
Bokpoort I Area
Walked Transect
Driven Transect
VP Location
Focal Site

1:75,000 Scale @ A3

N

0 1.5 3 km

Produced: RMc Reviewed: SC Approved: AP	Ref: 2059/REP/002 Date: 29/06/2015

Vantage Point, Focal Site, Driven and Walked Transect Locations
Figure 2

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 1

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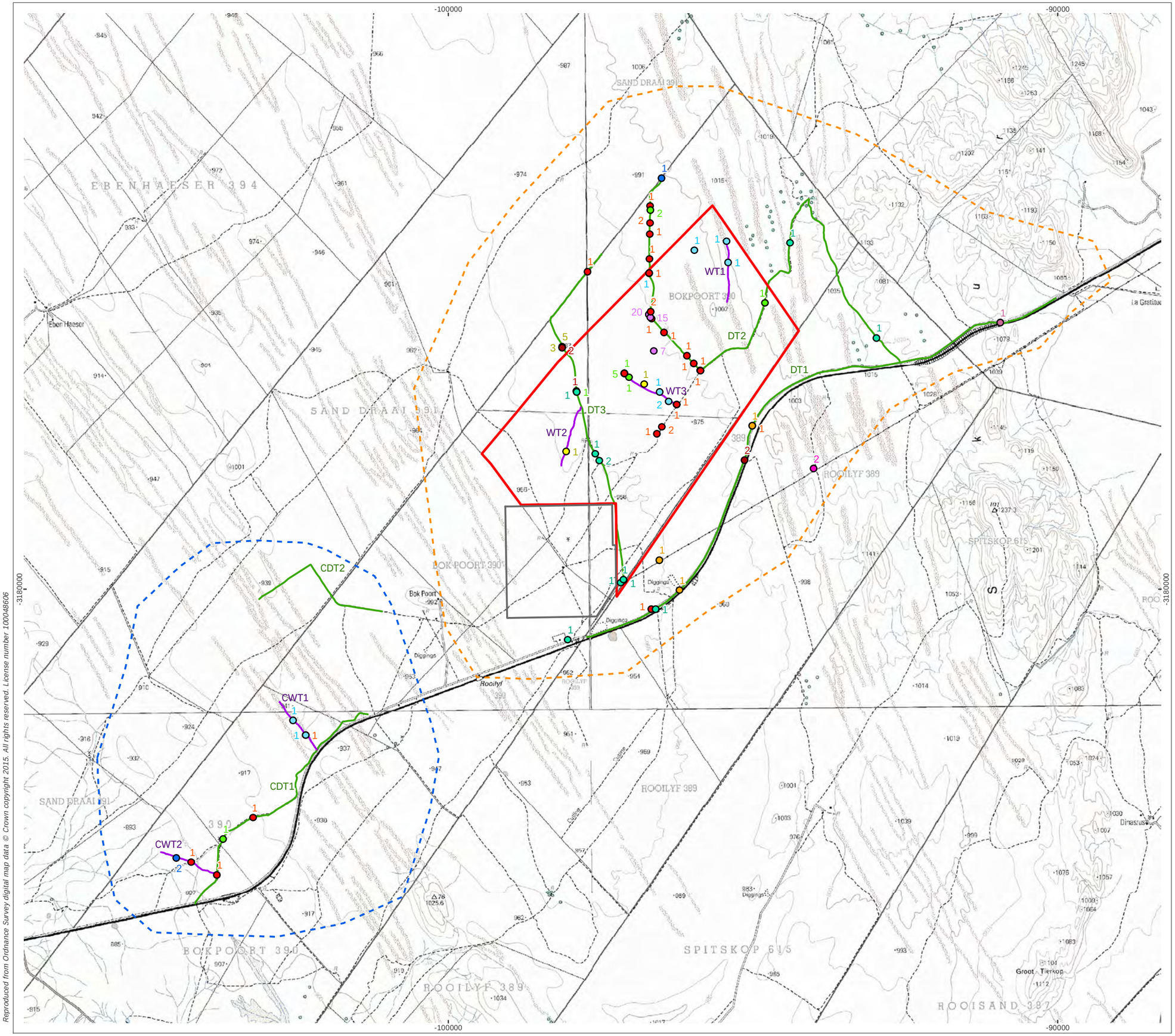

ARCUS

- Project Site
- Control Site
- Broader Project Area
- Bokpoort I Area
- Walked Transect
- Driven Transect

Transect and Incidental Species

- African Fish Eagle
- Grey Hornbill
- Karoo Korhaan
- Kori Bustard
- Ludwig's Bustard
- Martial Eagle
- Northern Black Korhaan
- Pale Chanting Goshawk
- Pied Crow
- Red-crested Korhaan
- Rock Kestrel

1:60,000 Scale @ A3

N

0 1 2 km

Produced: RMc Reviewed: SC Approved: AP	Ref: 2059/REP/005 Date: 03/07/2015

Transect and Incidental Target Species Records
Figure 3

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 1

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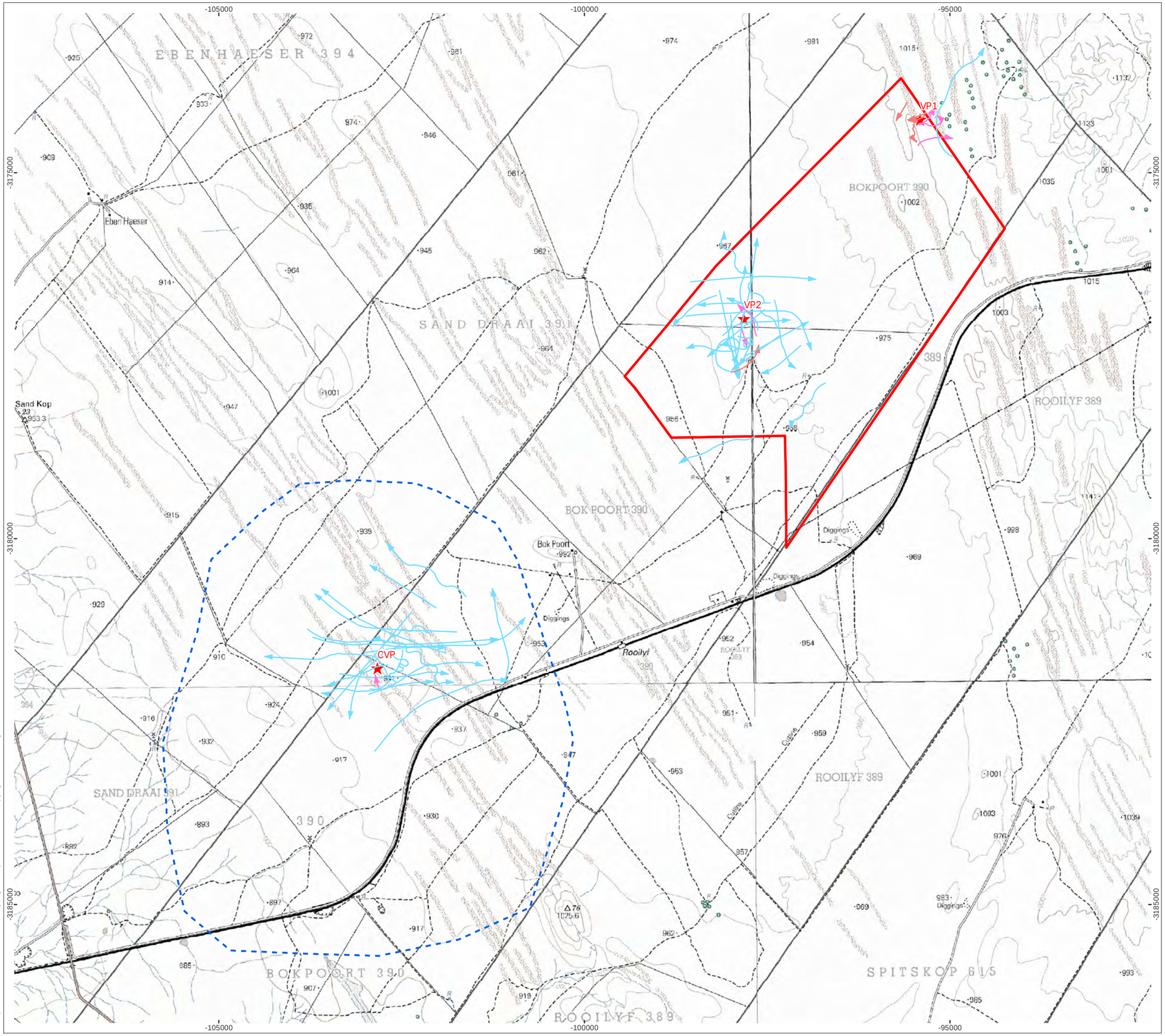

ARCUS

- Project Site
- Control Site
- VP Location
- Cape Turtle Dove
- Namaqua Dove
- Namaqua Sungrouse

1:50,000 Scale @ A3

N

0 1 2 km

Produced: RMc Reviewed: SC Approved: AP	Ref: 2059/REP/003 Date: 02/07/2015

Dove and Sandgrouse Flights
Figure 4a

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 1

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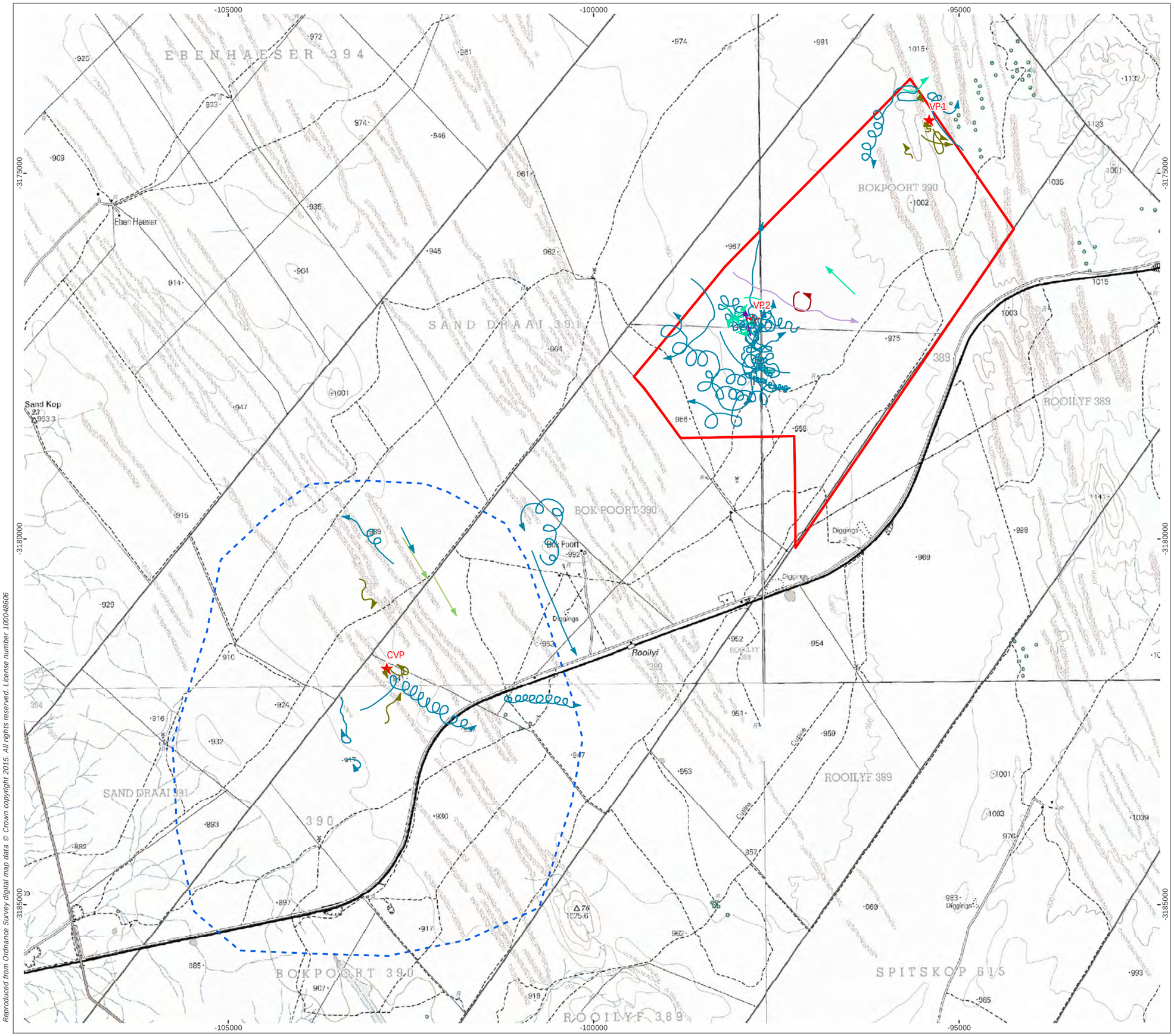

ARCUS

- Project Site
- Control Site
- VP Location
- Crowned Lapwing
- Eastern Clapper Lark
- Ludwig's Bustard
- Martial Eagle
- Northern Black Korhann
- Pale Chanting Goshawk
- Pied Crow

1:50,000 Scale @ A3

0 1 2 km

N

Produced: RMc Reviewed: SC Approved: AP	Ref: 2059/REP/004 Date: 02/07/2015

Other Target Species Flights
Figure 4b

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 1

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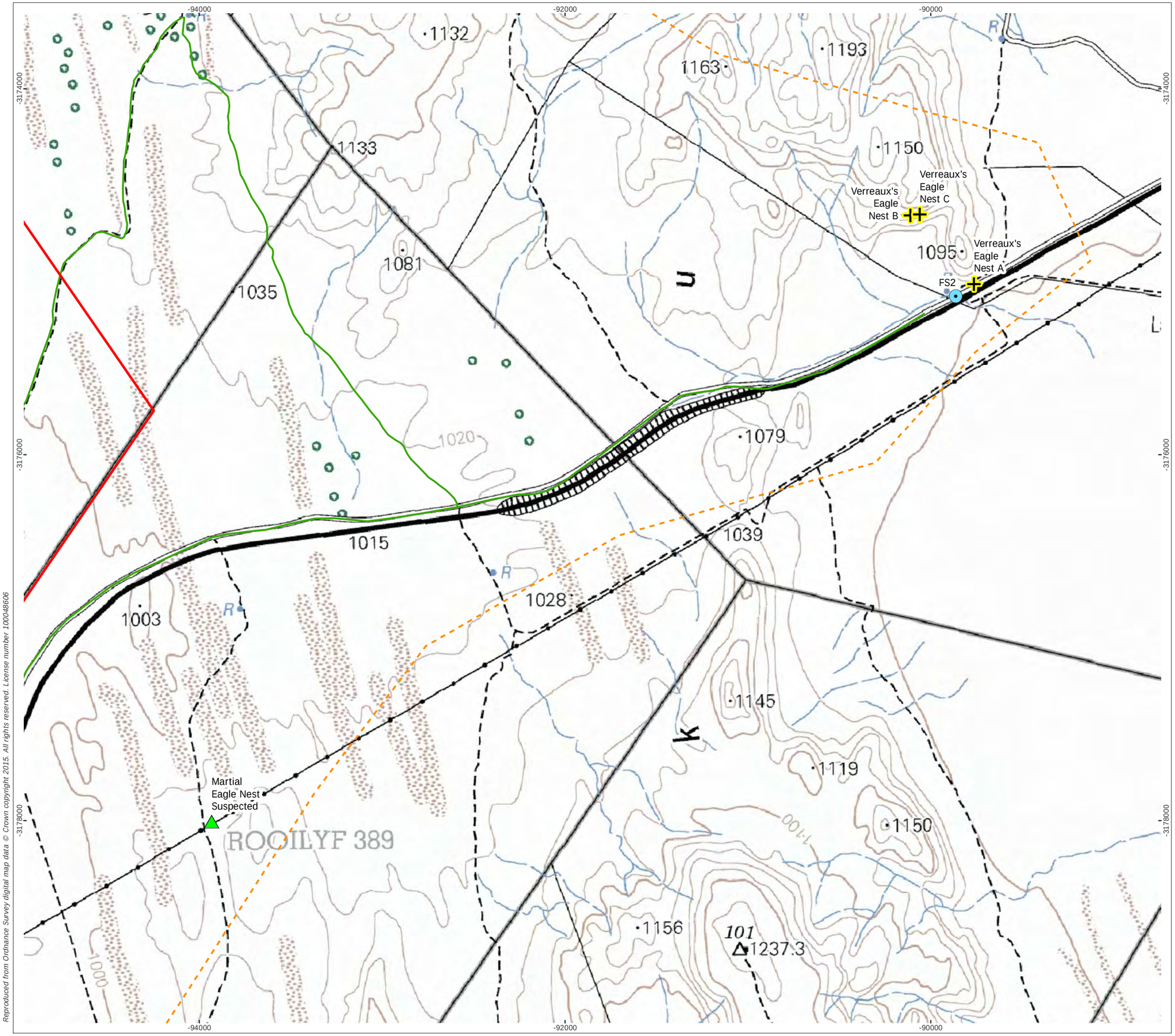

Project Site
Broader Project Area
Driven Transect
Nest Site
Suspected Nest Site

1:20,000 Scale @ A3

0 0.5 1 km

N

Produced: RMc Reviewed: SC Approved: AP	Ref: 2059/REP/006 Date: 02/07/2015

Eagle Nest Sites
Figure 5

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 1

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12 MONTH PRE-CONSTRUCTION AVIFAUNA MONITORING FOR BOKPOORT II SOLAR FARM

Progress Report 2

Revision 1

On behalf of

ACWA Power Africa Holdings (Pty) Ltd

December 2015

Prepared By:

Arcus Consultancy Services

Office 220 Cube Workspace
Icon Building
Cnr Long Street and Hans Strijdom Avenue
Cape Town
8001

T +27 (0) 21 412 1529 I **E** AshlinB@arcusconsulting.co.za
W www.arcusconsulting.co.za

Registered in South Africa No. 2012/215000/10

Written By	Andrew Pearson	12 October 2015
Checked By	Dr. Owen Davies	12 October 2015
Version 1 Approved By	Ashlin Bodasing	13 October 2015
Revision 01 Approved By	Ashlin Bodasing	07 December 2015

EXECUTIVE SUMMARY

This report is the second progress report relating to 12 months pre-construction bird surveys for the proposed Bokpoort II Solar Farm. The purpose of this report is to outline:

- The survey method for the spring survey;
- Observations from the spring survey;
- A summary of the combined results of the winter and spring surveys; and
- Future recommendations for the survey approach and the project design.

The second of four seasonal survey visits was carried out between 14 and 21 September 2015. Bird monitoring comprised flight activity surveys from three vantage points, five walked transects (each 1 km in length), five driven transects, and six focal sites as well as incidental observations.

Key findings from the spring survey can be summarised as follows:

- A total of 61 species were recorded within the boundaries of the project site, while 66 species were recorded within the broader project area (which includes the project site) and 47 species were recorded on the control site.
- It is unlikely that water associated birds such as ducks, grebes, cormorants and kingfishers would occur or pass through the project site.
- Five regionally red listed species (Taylor, 2014) were recorded during the spring survey.
- Two regionally red listed species were recorded for the first time during spring namely Double-banded Courser *Near-threatened* and Burchell's Courser *Vulnerable.*
- Two regionally red listed species recorded in winter, were not recorded during the spring survey namely Ludwig's Bustard *Endangered* and Karoo Korhaan *Near-threatened.*
- Two South African near-endemic species were recorded in the spring survey (Fiscal Flycatcher and Black-eared Sparrow-lark).
- Water sources attracted large numbers of doves and sandgrouse, particularly in the morning.
- The suspected Martial Eagle Nest identified during the winter survey was confirmed to be active.
- African Grey Hornbill were recorded during the winter survey but were absent during the spring survey, while Yellow-billed Hornbills were recorded only during the spring survey.
- An increase in the recorded numbers of korhaan from the winter to spring survey was noted.
- Activity of small birds was relatively high (in the author's experience of similar arid areas). The following passerine species were either regularly recorded or recorded in abundance: Black-chested Prinia, Cape Turtle Dove, Chestnut-vented Tit-babbler, Common Fiscal, Dusky Sunbird, Eastern Clapper Lark, Fawn-coloured Lark, Kalahari Scrub-Robin, Namaqua Sandgrouse, Pririt Batis, Red-eyed Bulbul, Rufous-eared Warbler, Sociable Weaver, Spike-heeled Lark, Scaly-feathered Finch, Yellow Canary and Yellow-bellied Eremomela.
- A total of 110 birds of 12 target species were recorded by observing a total of 82 flight paths during the Vantage Point (VP) monitoring at both the broader project area (which includes the project site) and control sites.
- Namaqua Dove, Pied Crow, Pale Chanting Goshawk, Namaqua Sandgrouse, Eastern Clapper Lark and Northern Black Korhaan were regularly recorded flying from VP watches.
- All recorded flights were below 210 m in height.

CSP tower projects may impact birds through habitat loss, disturbance, displacement, collision, burning and barrier effects. The significance of these potential impacts will be rated following the completion of the 12 month monitoring and will depend on the species

sensitivity and conservation status, abundance, distribution, flight activity and behaviour in the project site.

Based on the data collected to date project design considerations include the need to prevent open water sources which may attract high numbers of sandgrouse and doves. In the absence of more detailed distribution data, it is likely that a buffer of between 2 km and 5 km around the confirmed active Martial Eagle nest may be required. Martial Eagle is regionally red listed as *Endangered*, and it is recommended that ACWA, assisted by Arcus, determine the feasibility of GPS tagging at least one of the eagles that utilise the nest located near the project site.

SPECIALISTS' DECLARATION OF INDEPENDENCE AND QUALIFICATIONS

Andrew Pearson is an Avifauna Specialist at Arcus. Andrew has a four year BSc in Conservation Ecology, certificates in Environmental Law, as well as seven years' experience as an environmental management professional. 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 will perform the work required in an objective manner, and declares that there are no circumstances which may compromise the objectivity in performing such work. Arcus has no business financial or other in the proposed project except for financial compensation for specialist work conducted. Andrew designed and set up the field surveys, conducted data collection and provided inputs to the analysis and interpretations of the avifauna data as an Avifauna Specialist.

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 is a professional member of the SACNSP, as detailed below:

Investigator:	Andrew Pearson (Pri.Sci.Nat)
Qualification:	BSc (hons) Conservation Ecology
Affiliation:	South African Council for Natural Scientific Professions
Registration number:	400423/11
Fields of Expertise:	Ecological Science
Registration:	Professional Member

12 October 2015

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1 INTRODUCTION

This report is the second progress report relating to 12 months pre-construction bird surveys for the proposed Bokpoort II Solar Farm ('the project'). This report presents the survey design, methodology and results of the spring seasonal survey.

The aim of the avifauna survey and assessment is to inform the final design of the project with regards to the risks associated with birds and to supply data to inform the final Avifaunal Impact Assessment (AIA) for inclusion into the environmental impact assessment (EIA) process.

The purpose of this report is to outline:

- The survey method for the spring survey;
- Observations from the spring survey;
- A summary of the combined results of the winter and spring surveys; and
- Future recommendations for the survey approach and the project design.

1.1 The Proposed Project

ACWA Power Africa Holdings (Pty) Ltd (ACWA)) are proposing to construct 1 x 150 MW concentrated solar power (CSP) tower and 2 x 75 MW photovoltaic (PV) plants on the Remaining Extent of Farm Bokpoort 390, Groblershoop, Northern Cape ('the project site') (Figure 1). The project site covers an area of approximately 1,437 ha and includes the following available bird micro habitats: open gravel plains; livestock enclosures or 'kraals'; reservoirs/water points; grassy shrubland/scrub; grassy thorn veld; and dunes. Land use in the project site is predominantly stock farming.

The project site borders on, and lies to the north east of, the Bokpoort I CSP project (Figure 2) which is in its commissioning phase and due to begin operations in early 2016.

2 SURVEY DESIGN

There are currently no published best practise guidelines for long term bird monitoring on potential solar facilities in South Africa. The survey was therefore designed by the avifaunal specialist to be broadly in line with the applicable best practice guidelines[1] for wind farms ('the guidelines'). However, the specialist is aware that guidelines requiring 12 month pre-construction bird monitoring for large CSP tower projects are in development by Birdlife South Africa (BLSA) and the Birds and Renewable Energy Specialist Group (BARESG)[2]. Knowledge of these imminent guidelines and international best practise, were considered in the design of the surveys.

Due to the inherent mobility of birds, it is important to consider avifauna not only on the project site, but also the avifauna and available avifaunal microhabitats beyond the project site. Therefore, a delineation of a 'broader project area' was done by the specialist, incorporating all relevant and important habitats, and within which the surveys would be conducted. The broader project area includes the project site and is shown in Figure 2.

In order to provide useful 'before-after' comparative data in the event of the construction and operation of the project, surveys were undertaken within the broader project area, both within the project site and at variable distances from the project site, as well as at a control site.

[1] Jenkins, A.R., van Rooyen, C.S., Smallie, J.J., Harrison, J., Diamond, M. and Smit, H.A. (2011 amended 2012). Best Practice Guidelines for Avian Monitoring and Impact Mitigation at Proposed Wind Energy Development Sites in Southern Africa. BirdLife South Africa/Endangered Wildlife Trust.

[2] The specialist is a member of this group and received a draft copy of the solar guidelines for comment and input shortly after the monitoring proposal was submitted by Arcus to ACWA.

The control site is located approximately 6 km south west of the project site (Figure 2) and was selected primarily on the basis of its accessibility and similarity of the predominant habitats to the project site.

3 SURVEY METHODS (SPRING)

The second of the four seasonal survey visits to be carried out over the 12 month period was completed between 14 and 21 September 2015. Surveys were conducted by the avifaunal specialist, assisted by a qualified and experienced field surveyor.

The following survey methods were performed during the spring survey and are intended to be carried out during each of the remaining seasonal survey visits across the 12-month period:

- Walked transects (WT);
- Driven transects (DT);
- Vantage point (VP) surveys;
- Focal site (FS) surveys; and
- Incidental observation recording.

It is intended that the survey protocols described below are flexible and could be amended in response to the preliminary findings and feasibility of undertaking the surveys at the broader project area and control site.

The following definitions apply:

- Priority species: all species occurring on the BLSA and Endangered Wildlife Trust (EWT) Avian Sensitivity Map priority species list[3].
- Target species: those particular bird species that were[4] recorded by a specific survey method. Target species per survey method:
    - Walked transects: all birds;
    - Driven transects: all raptors; all large (non-passerine) priority species; corvids (crows and ravens); hornbills; korhaans; and lapwings.
    - Vantage point surveys: all raptors; all large (non-passerine) priority species; corvids (crows and ravens); doves; ibises; hornbills and korhaans. Sandgrouse, aerial foragers and flocking species (e.g. swallows, swifts and martins) and larks (display flights only), were recorded for additional information, however their flight paths were not mapped.
    - Incidental observations: all red-listed species (Taylor, 2014); all raptors; all large (non-passerine) priority species; hornbills; and korhaans; and
    - Focal sites: all species associated, utilising or interacting at/with the focal site.

3.1 Walked Transects

Three walked transects were established and conducted on the project site as well as two walked transects on the control site, referred to as control walked transects (CWT) (Figure 2). Each transect was 1 km in length and was conducted twice during the spring survey. The location and the times of the walked transects are presented in Table 1. Transects are named according to location and visit within the season; i.e. WT2.1 is transect location two, first visit; WT2.2 is transect location two, second visit.

[3] Retief, E, Anderson, M., Diamond, M., Smit, H., Jenkins, A. & Brooks, M. (2011) Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures used. Priority species list updated in 2014 by BLSA. This list consists of 107 species with a priority score of 170 or more. The priority score was determined by BLSA and EWT after considering various factors including bird families most impacted upon by Wind Energy Facilities (WEFs), physical size, species behaviour, endemism, range size and conservation status.

[4] Species/groups of species may be added to a particular survey method's target species list as the programme progresses.

Two observers walked between the start and end points of the transects whilst recording all birds seen or heard up to 250 m on either side of the transect. Beyond 250 m, only priority species were noted and were recorded as incidental sightings.

Table 1: Geographic Co-ordinates for Walked Transect Routes and Survey Date/Times

Ref	Transect Co-ordinates (Start)		Transect Co-ordinates (Finish)		Survey Details		
	South	East	South	East	Date	Start Time	Finish Time
WT1.1	-28.680960°	22.023580°	-28.689900°	22.023540°	15/09/2015	15:39	16:08
WT1.2	-28.680960°	22.023580°	-28.689900°	22.023540°	21/09/2015	08:02	08:32
WT2.1	-28.705320°	21.998880°	-28.713910°	21.995530°	16/09/2015	16:33	17:02
WT2.2	-28.705320°	21.998880°	-28.713910°	21.995530°	17/09/2015	07:18	07:46
WT3.1	-28.705050°	22.014970°	-28.700360°	22.006230°	15/09/2015	11:18	11:57
WT3.2	-28.705050°	22.014970°	-28.700360°	22.006230°	16/09/2015	07:47	08:22
CWT1.1	-28.755650°	21.954050°	-28.748460°	21.947850°	17/09/2015	15:26	15:48
CWT1.2	-28.755650°	21.954050°	-28.748460°	21.947850°	18/09/2015	07:14	07:52
CWT2.1	-28.774050°	21.937080°	-28.770620°	21.927640°	19/09/2015	15:48	16:14
CWT2.2	-28.774050°	21.937080°	-28.770620°	21.927640°	20/09/2015	07:18	07:48

3.2 Vantage Points

Two vantage points were surveyed in the project site (VP1 and VP2), and one in the control site (CVP1) (Figure 2). Observer pairs monitored a viewshed of 360 degrees with a radius of 2.25 km from each VP. These viewsheds were the focus of observation, however if target species were noted beyond these (or if a species being recorded flew out of the viewshed but was still visible), they were also recorded. For each flight of a target species (except for sandgrouse, larks, aerial foragers and flocking species) the flight path was recorded on a large scale map along with data on the number/species of bird(s) and type of flight. Aerial foragers, flocking species, sandgrouse and larks were recorded for additional information during the VP surveys and their presence noted where applicable. This marked a change in method from the first season, when flight paths of sandgrouse and larks were recorded and mapped. During the spring survey, flights of these species (and especially sandgrouse) were too frequent and numerous, particularly in the mornings, to record and map.

Where flight paths were recorded, flight heights were recorded through five height bands: 1: <10 m; 2: 10-90 m; 3: 90-170 m; 4: 170-210 m and 5: >210 m. Each VP was surveyed for a total of 12 hours. Therefore, a total of 36 hours of VP observations were carried out. The co-ordinates of the VPs and hours surveyed are provided in Table 2 below.

Table 2: Vantage Point Geographic Co-ordinates and Hours Surveyed

VP	Co-ordinates		15.09.15	16.09.15	17.09.15	18.09.15	19.09.15	20.09.15	Total Time
	South	East							
VP1	-28.680720°	22.023860°	3h	3h	-	-	3h	2.5h	**11.5h***
VP2	-28.705130°	21.998984°	3h	3h	3h	3h	-	-	**12h**
CVP1	-28.747820°	21.947270°	-	-	3h	3h	3h	3h	**12h**

**The final session at VP1 was stopped after 2.5 hours due to a lightning storm. h=hours*

3.3 Driven Transects

Driven transect target species were sampled using five driven transects (Figure 2), three in the broader project area and two on the control site. Two observers' conducted each transect on two occasions by driving slowly (approximately 30 km/h) and stopping regularly to scan surrounding open areas. The locations and times of the driven transects are shown in Table 3. Transects are named according to location and visit within the season; i.e. DT1.1 is transect location one, first visit; DT1.2 is transect location one, second visit.

DT1 runs near the southern and eastern boundary of the project site, following the railway line and service road. Two drive transects traverse the project site and and broader project area up to 2 km from the project site (DT2 and DT3). Two drive transects (CDT1 and CDT2) run on and around the control site.

Table 3: Geographic Co-Ordinates and Approximate Lengths for Driven Transects and Survey Date/Times

Transect Name	Length (km)	Transect Co-ordinates (Start)		Transect Co-ordinates (Finish)		Survey Details		
		South	East	South	East	Date	Start Time	Finish Time
DT1.1	10.3 km	-28.739388°	21.999576°	-28.689782°	22.078781°	14/09/2015	12:53	13:23
DT1.2	10.3 km	-28.739388°	21.999576°	-28.689782°	22.078781°	18/09/2015	15:46	16:15
DT2.1	10.6 km	-28.699189°	22.052513°	-28.671372°	22.013056°	15/09/2015	16:40	17:29
DT2.2	10.6 km	-28.699189°	22.052513°	-28.671372°	22.013056°	16/09/2015	12:19	13:16
DT3.1	5.9 km	-28.731022°	22.005815°	-28.682639°	22.002591°	15/09/2015	07:20	07:51
DT3.2	5.9 km	-28.731022°	22.005815°	-28.682639°	22.002591°	18/09/2015	11:36	12:05
CDT1.1	4.65 km	-28.778240°	21.933382°	-28.750492°	21.962642°	14/09/2015	14:18	14:35
CDT1.2	4.65 km	-28.778240°	21.933382°	-28.750492°	21.962642°	17/09/2015	06:46	07:05
CDT2.1	2.55 km	-28.735274°	21.965228°	-28.733288°	21.944551°	17/09/2015	11:29	11:44
CDT2.2	2.55 km	-28.735274°	21.965228°	-28.733288°	21.944551°	20/09/2015	12:07	12:22

3.4 Focal Sites

Focal sites are any identifiable features within the landscape that are likely to support notable avifauna (e.g. a roost or nesting site) or have the potential to support breeding pairs or large densities of avifauna (e.g. dams, wetlands, river systems) and these sites may change as monitoring progresses and other focal sites become evident.

The same four focal sites surveyed during the winter season were again surveyed while an additional two focal sites (FS4 and FS5) were added and surveyed during the spring season.

FS4 was surveyed on four occasions during the spring surveys, while all other FS were surveyed twice, for a period of 15 minutes each time, during which target species were counted and any relevant notes were taken. In Table 4, FS1.1 refers to the first visit to FS1, while FS1.2 is the second visit during the spring survey.

Table 4: Geographic Positions and Descriptions of Focal Sites

Focal Site	Co-ordinates		Description	Survey Details		
	South	East		Date	Start time	Finish Time
FS1.1	-28.788022°	21.882755°	View of the Orange River from the eastern bank, including open water, islands, banks, rocks and reed bed habitats. Rail bridge over river.	2015/09/14	12:15	12:30
FS1.2	-28.788022°	21.882755°		2015/09/16	07:00	07:15
FS2.1	-28.688900°	22.080510°	Two cliff faces (north and south) approximately 450 m apart, viewed from the same point (FS2). Northern cliff face has two Verreaux's Eagle nest structures, while southern face has one.	2015/09/14	13:25	13:40
FS2.2	-28.688900°	22.080510°		2015/09/18	16:17	16:29
FS3.1	-28.674830°	22.037520°	Reservoir and water trough fed by windmill pump, with surrounding 'kraal' and trees.	2015/09/16	12:53	13:08
FS3.2	-28.674830°	22.037520°		2015/09/19	07:57	08:12
FS4.1	-28.714505°	22.038635°	Martial Eagle nest, on top off a Sociable Weaver nest, on a power line tower.	2015/09/14	10:40	10:55
FS4.2				2015/09/18	16:40	16:55
FS4.3				2015/09/19	07:20	07:35
FS4.4				2015/09/21	07:20	07:25
FS5.1	-28.71024°	21.99956	Reservoir and water troughs fed by windmill pump, with surrounding 'kraal' and trees.	2015/09/18	15:18	15:33
FS5.2				2015/09/21	09:14	09:29
CFS1.1	-28.768900°	21.937500°	Reservoir and water trough fed by windmill pump, with surrounding 'kraal' and trees.	2015/09/14	14:37	14:56
CFS1.2	-28.768900°	21.937500°		2015/09/17	15:53	16:08

3.5 Incidental Observations

Relevant observations of target species were recorded while commuting to or from, or in the broader project area and control site, but outside the survey protocols and times described above.

4 SURVEY RESULTS (SPRING)

4.1 Walked Transects

The purpose of the walked transect surveys is to estimate small bird populations and densities, and the method used was found to be suitable in all of the habitats surveyed.

On the project site, 188 observations were made totalling 366 individual birds and 32 species during 6 WT surveys while on the control site 31 species were recorded in 104 observations totalling 239 birds during 4 WT surveys. An observation occurs whenever a target species is observed (seen or heard), and may include one or more than one bird of the same target species.

WT3 resulted in the highest number of observations (72), species (24) and individuals (195), many of these individuals were Scaly-feathered Finch (74). A pair of Burchell's Courser [red-listed as *Vulnerable* (Taylor, 2014)] were observed on a gravel patch along the transect. Relatively few observations (46) and species (17) were recorded on WT2 but notably a pair of Double-banded Courser (*Near-threatened*) were observed on a gravel plain along the transect. A large number of individual birds were observed on CWT2 (156), but 85 of these individuals were recorded from two flocks of Red-billed Quelea. Table 5

shows a summary of results from each walked transect conducted on the control and project sites.

The locations of the observer when recording large terrestrial species and coursers during the walked transects are displayed in Figure 3 along with the other incidental and drive transect target species records.

Table 5: Small Terrestrial Species Transect Results

Transect Name	Total Observations (Number of Individual Birds)	Total Species Recorded	Priority Species (P), Red Listed Species (Status)* or Focal Species (F)	Frequently Recorded and/or Abundant.
WT1	62 (92)	20	Red-crested Korhaan (F), Namaqua Sandgrouse (F).	Black-chested Prinia, Cape Turtle Dove, Chestnut-vented Tit-babbler, Dusky Sunbird, Eastern Clapper Lark, Fawn-coloured Lark, Kalahari Scrub-Robin, Namaqua Sandgrouse, Pririt Batis, Red-crested Korhaan, Scaly-feathered Finch, Yellow Canary, Yellow-bellied Eremomela.
WT2	46 (79)	17	Double-banded Courser (NT), Northern Black Korhaan (P), Red-crested Korhaan (F), Namaqua Sandgrouse (F).	Black-chested Prinia, Cape Turtle Dove, Fawn-colored Lark, Kalahari Scrub-robin, Pririt Batis, Rufous-eared Warbler, Sociable Weaver, Spike-heeled Lark, Yellow Canary, Yellow-bellied Eremomela.
WT3	72 (195)	24	Burchell's Courser (P, VU), Namaqua Sandgrouse (F), Northern Black Korhaan (P), Red-crested Korhaan (F).	Black-chested Prinia, Chestnut-vented Tit-babbler, Common Fiscal, Eastern Clapper Lark, Fawn-coloured Lark, Kalahari Scrub-robin, Lark-like Bunting, Namaqua Sandgrouse, Pririt Batis, Scaly-feathered Finch, Yellow-bellied Eremomela.
CWT1	56 (83)	18	Red-crested Korhaan (F).	Black-chested Prinia, Chestnut-vented Tit-babbler, Dusky Sunbird, Eastern Clapper Lark, Fawn-coloured Lark, Kalahari Scrub-robin, Pied Crow, Red-crested Korhaan, Red-eyed Bulbul, Yellow Canary.
CWT2	48 (156)	23	Kori Bustard (NT, P), Northern Black Korhaan (P).	Black-chested Prinia, Eastern Clapper Lark, Fawn-coloured Lark, Lark-like Bunting, Red-billed Quelea, Kalahari Scrub-robin, Southern Masked Weaver, Yellow-bellied Eremomela.

**Red List (Taylor, 2014) status: EN=Endangered. VU= Vulnerable. NT=Near Threatened. F=Focal species deemed relevant and important to highlight by the specialist. P=Priority Species (Retief et al. 2011. Updated 2014).*

4.2 Vantage Points

A total of 110 birds of 12 target species were recorded by observing a total of 82 flight paths (i.e. one flight path may include a number of birds = flock) during the VP monitoring at both the broader project area and control sites.

It must be noted that separate flight paths may have been conducted by the same bird/s and that the figures presented here are not an indication of abundance, but rather flight

activity. Flight paths of selected target species in both the broader project area and control sites are shown in Figure 4.

Table 6 presents a summary of the flight activity data of each target species for the broader project area, while table 7 summarises flight activity data from the control site. Eleven species were recorded from VPs in the broader project area represented by 83 birds in 61 flight paths. Six species were recorded from VPs in the control site represented by 27 birds in 21 flight paths.

In the broader project area, Namaqua Dove (41 % of flight paths) was the most recorded species at VP watches, with the majority of flights being short, low and direct. This was followed by Pied Crow (18 %) and Pale Chanting Goshawk (15 %). Flights of the latter species were likely all made by one of a pair of birds observed regularly near VP2. Flights of four priority species (including two regionally red listed species) were recorded in the broader project area. Although the number of flights of these species was low, they are important to note due to the status of the species. Kori Bustard (*Near Threatened*) the heaviest flying bird in the world, is generally not often seen flying as it spends most of the day foraging on the ground. The two Martial Eagle (*Endangered*) flights were both very long in duration (19 min. 04 sec. and 7 min. 35 sec.), as was the single Booted Eagle Flight (6 min. 42 sec.), representing a longer amount of time within a potential risk area (i.e. <210 m). In comparison, the nine Pale Chanting Goshawk flights had a total flight duration of 3 min. 47 sec. More detailed analysis of flight durations will be done following the completion of the monitoring programme.

No detailed analysis of flight heights has yet been done, however, preliminary analyses of flight paths in the broader project area indicates that 100% of flights included at least some time below 210 m. The project information supplied to date is that the CSP tower will be approximately 200 m in height, and it is therefore assumed that flights below 210 m may be more susceptible to collision and/or burning impacts.

Table 6: Flight Path Target Species – Broader Project Area

Species	Priority Score (Retief et al, 2011)	Red List Status (Taylor, 2014)	Total no. of flight paths recorded.	Total no. of birds recorded*	No. of flights with a portion below 210 m
Booted Eagle	230	-	1	1	1 (100%)
Cape Turtle Dove	-	-	5	7	5 (100%)
Hadeda Ibis	-	-	2	7	2 (100%)
Kori Bustard	260	NT	2	2	2 (100%)
Laughing Dove	-	-	1	1	1 (100%)
Martial Eagle	350	EN	2	2	2 (100%)
Namaqua Dove	-	-	25	31	25 (100%)
Pale Chanting Goshawk	200	-	9	9	9 (100%)
Pied Crow	-	-	11	16	11 (100%)
Speckled Pigeon	-	-	2	5	2 (100%)
Yellow-billed Hornbill	-	-	1	2	1 (100%)
Totals			**61**	**83**	**61 (100%)**

**Indicates that in some cases a single flight path recorded was a flight consisting of more than one bird. This figure does not indicate abundance of a species as numerous flights may have been conducted by the same bird/s at different times.*

Table 7: Flight Path Target Species - Control Site

Species	Priority Score (Retief et al, 2011)	Red List Status (Taylor, 2014)	Total no. of flight paths recorded.	Total no. of birds recorded*	No. of flights with a portion below 210 m
Hadeda Ibis	-	-	2	3	2 (100%)
Kori Bustard	260	NT	1	1	1 (100%)
Laughing dove	-	-	1	2	1 (100%)
Namaqua Dove	-	-	1	1	1 (100%)
Northern Black Korhaan	180	-	4	4	4 (100%)
Pied Crow	-	-	12	16	12 (100%)
Totals			**21**	**27**	**21 (100%)**

**Indicates that in some cases a single flight path recorded was a flight consisting of more than one bird. This figure does not indicate abundance of a species as numerous flights may have been conducted by the same bird/s at different times.*

NT=Near Threatened

In the control site, Pied Crow (57 % of flight paths) was the most recorded species at VP watches followed Northern Black Korhaan (19 %). One flight of one red listed species, Kori Bustard (*Near Threatened*), was recorded from the control VP. No detailed analysis of flight heights has yet been done, however, preliminary analyses of flight paths in the control site indicates that 100 % of flights included at least some time below 210 m.

The overall average passage rate of target species was 3.50 (SD±2.81) birds per hour for the project site and 2.25 (SD±2.60) birds per hour for the control site (Table 8). The passage rate is the number of target species birds per hour of observation recorded at the VPs. These passage rates are not directly comparable with the passage rates reported in the first progress report covering the winter survey as Namaqua Sandgrouse flights have been excluded from these analyses.

Aerial foragers and/or flocking species recorded for additional information during the VP watches on both the project site and control site were Little Swift and White-throated Swallow. Both these species displayed relatively low activity. Activity of sandgrouse and larks, however, was relatively high. Eastern Clapper Lark was observed in display flights at heights of between 20 m and 100m, and was generally more abundant and active at CVP1 and VP1. Namaqua Sandgrouse were numerous throughout the project and control sites and were recorded at all three VPs, but were particularly active in the morning and around VP2. From VP2 numerous flocks varying in size between 2 and 50 birds were observed going to and from the water source at FS5 (approximately 600 m south of VP2). The highest number of birds was recorded between approximately 08:00 am and 09:00 am in the morning.

The results and data presented in this progress report is preliminary analysis, and more detailed analysis of flight activity and associated risk will be undertaken in the final report.

Table 8: Average Passage Rate per Hour for Target Species

VP	Birds/hour	Birds/hour	Birds/hour	Birds/hour	Average Birds/
	Session 1	Session 2	Session 3	Session 4	hour ± SD*
Project Site					
VP1	1.67	3.67	6	1	3.08 ± 2.91

VP2	6	2	3.33	4.33	3.92 ± 2.78
Control Site					
CVP	1.67	3.33	0.67	3.33	2.25 ± 2.60

**SD=Standard Deviation*

4.3 Driven Transects

The driven transects on the control site resulted in 6 records of 3 species, totalling 8 birds. The driven transects in the broader project area resulted in 21 records of 6 species, totalling 25 birds (Table 9 and Figure 3).

DT2 recorded the most target species records (11), while CDT1 recorded the least target species records (2). The species most regularly recorded was Northern Black Korhaan (10 records), followed by Pied Crow (7 records), Red-crested Korhaan (6 records), Kori Bustard (2 records) and Crowned Lapwing and Verreaux's Eagle with 1 record each. A notable record was the pair of Verreaux's Eagle observed soaring above the rocky outcrops approximately 3km to the east of the project site, the first record of this species away from the nest locations.

Table 9: Summary of Driven Transect Results

Species	**Total Birds Recorded**	**Maximum Flock Count****	**Number of Records**					
			DT1	**DT2**	**DT3**	**CDT1**	**CDT2**	***ALL***
Crowned Lapwing	1	1			1			*1*
Kori Bustard*	4	2			2			*2*
Northern Black Korhaan*	10	1		6	2	2		*10*
Pied Crow	10	2	2	2			3	*7*
Red-crested Korhaan	6	1		3	2		1	*6*
Verreaux's Eagle	2	2	1					*1*
Total	**33**	**NA**	**3**	**11**	**7**	**2**	**4**	***27***

**Priority species (Retief et al., 2011, updated 2014)*

***Size of the biggest group/flock of birds of the same species observed in one record.*

4.4 Focal Sites

Observations from the visits to the focal sites (Figure 2) are presented in Table 10 below. The focal sites were located by the avifaunal specialist during the site set up and the first seasonal survey. Additional sites may be added as the seasonal surveys progress.

Observations at the Orange River focal site (FS1) recorded various water associated species including herons, egrets, kingfishers and cormorants. White-breasted Cormorants breed on an island visible from FS1, while Little Swift are nesting in relatively large numbers under a rail bridge that crosses the Orange River at FS1.

Three Verreaux's Eagle nest structures are located on cliffs approximately 4 km east of the project site (Figure 5). Two nest structures are located on a more northerly cliff, and have been designated 'Verreaux's Eagle Nest B' and 'Verreaux's Eagle Nest C' while 'Verreaux's Eagle Nest A' is located on the more southerly cliff face (in close proximity to the railway line). Both cliff faces (and all nest structures) were surveyed from FS2 and the results are presented below. Verreaux's Eagle Nest A is active as a sub-adult was seen perched above

the nest during the spring survey, along with substantial 'white-wash' caused by bird excrement below the nest.

Various small passerine birds were attracted to the water sources present at FS5 and CFS1. FS5 attracted a large number of doves and sandgrouse. During the spring survey it was observed that the water pump at FS3 was not functioning and hence there was very little fresh water available, resulting in fewer observations at this FS. However, passerines were still observed searching for water and utilising the trees at the FS.

The suspected Martial Eagle nest that was identified during the winter survey was confirmed as active during the spring survey and a sub-adult Martial Eagle was observed perching on or near the nest during each of the four times FS4 was surveyed.

Table 10: Summary of Focal Site Results (number of individuals counted during each of the counts is given in brackets)

Focal Site visit	Species recorded (number of individuals)	Notes
FS1.1	African Darter (11), African Fish Eagle (2), African Sacred Ibis (20), Cape Turtle Dove (4), Cape Wagtail (1), Common Waxbill (4), Egyptian Goose (2), Giant Kingfisher (1), Goliath Heron (1), Grey Heron (2), Little Swift (330), Orange River White-eye (6), Pied Wagtail (2), Reed Cormorant (30), South African Shelduck (1), White-breasted Cormorant (105), White-throated Swallow (15), Unidentified Warbler (1).	Little Swifts nesting under rail bridge. Cormorant breeding colony approximately 100 m south (up river). African Fish Eagle sighting consisted of two birds, one juvenile and one adult.
FS1.2	African Darter (6), African Fish Eagle (1), Cape Turtle Dove (4), Common Waxbill (4), Egyptian Goose (2), Giant Kingfisher (1), Goliath Heron (1), Grey Heron (1), Little Swift (~300), Pied Wagtail (2), Reed Cormorant (20), South African Shelduck (1), White-breasted Cormorant (60), White-throated Swallow (10), Unidentified Warbler (1).	
FS2.1	Verreaux's Eagle (1), Pale-winged Starling (7).	Verreaux's Eagle sub-adult perched just above Verreaux's Eagle Nest A.
FS2.2	Verreaux's Eagle (1), Pale-winged Starling (6)	Verreaux's Eagle sub-adult perched just above Verreaux's Eagle Nest A.
FS3.1	African Red-eyed Bulbul (1), Cape Bunting (2), Fiscal Flycatcher (2), Lark-like Bunting (2), Laughing Dove (1), Namaqua Dove (7), Orange River White-eye (2), Red-billed Quelea (1), Red-faced Mousebird (3), Sociable Weaver (5).	Sociable Weaver nest on top of wind pump. Very little water. Wind pump broken.
FS3.2	African Red-eyed Bulbul (4), Cape Turtle Dove (1), Fiscal Flycatcher (2), Laughing Dove (6), Sociable Weaver (6).	
FS4.1	Martial Eagle (1)	Sub-adult perched on nest. Viewed from long distance with a spotting scope.
FS4.2	Martial Eagle (1)	Sub-adult perched on nest.
FS4.3	Martial Eagle (1)	Went to cliff above nest, confirmed active. Sub-adult perched on pylon.

Focal Site visit	Species recorded (number of individuals)	Notes
FS4.4	Martial Eagle (1)	Viewed from long distance with a spotting scope. Sub-adult perched on nest.
FS5.1	African Red-eyed Bulbul (1), Cape Turtle Dove (2), Namaqua Dove (1), Red-billed Quelea (15), Sociable Weaver (7), Southern Masked Weaver (1), Yellow Canary (2), Unidentified Canary (1).	
FS5.2	Cape Turtle Dove (1), Fawn-coloured Lark (1), Laughing Dove (1), Namaqua Dove (5), Namaqua Sandgrouse (17), Red-billed Quelea (35), Red-faced Mousebird (4), Red-headed Finch (2).	
CFS1.1	Cape Turtle Dove (2), Laughing Dove (2), Pied Crow (3), Unidentified passerine (2).	
CFS1.2	Cape Turtle Dove (4), Laughing Dove (4), Pied Crow (2), Rock Martin (1), Southern Masked Weaver (1), White-browed Sparrow-weaver (2).	

4.5 Incidental Observations

Twenty-six incidental observations were made of six target species comprising 29 birds (a single observation may include numerous birds of one species i.e. a flock) across the broader project area and control site (Table 11 and Figure 3).

The species most regularly observed incidentally was Northern Black Korhaan accounting for 42 % of all the incidental observations. Although the 11 observations of this species counted a total of 14 birds, it's likely that on some occasions the same bird was observed more than once. It is estimated that the incidental observations of this species were of approximately 7 – 10 separate individual birds.

Red-crested Korhaan was the second most recorded species, accounting for 34.6 % of all the incidental observations. The increase in incidental recordings of this species during the spring survey (9 observations) may be a result of an increase in displaying behaviour of this species making them more noticeable than during the winter survey (2 observations).

Cape Eagle Owl, an uncommon, easily overlooked, nocturnal priority species, was observed for the first time in spring. One individual was flushed from the ground, and flew a short distance before landing on the ground and slowly walking away from the surveyors.

Table 11: Number of Incidental Observations of Target Species.

Species	Number of observations	Total birds	Maximum flock count	Notes
African Fish Eagle*	1	1	1	
Cape Eagle Owl*	1	1	1	
Kori Bustard*	2	2	1	
Northern Black Korhaan*	11	14	2	Many observations are likely to be of the same individual/s.

Species	Number of observations	Total birds	Maximum flock count	Notes
Pale Chanting Goshawk*	2	2	1	Many observations are likely to be of the same individual/s.
Red-crested Korhaan	9	9	1	
TOTAL	**26**	**29**	**NA**	

**Priority species (Retief et al., 2011, updated 2014)*

4.6 Species Summary and Discussion

4.6.1 Spring Survey

A total of 61 positively identified species were recorded within the boundaries of the project site. An additional five species were recorded beyond the project site boundary, but within the broader project area. Therefore, 66 species were recorded within the broader project area (which includes the project site).

Forty-seven species were recorded on the control site (Appendix 1). All of these species except Karoo Scrub Robin, Cape Glossy Starling and African Fish Eagle were also recorded on the project site. Forty-five species were recorded in the Orange River Valley either during observations at FS1, or incidentally at the specialist's accommodation or while travelling to and from the site.

The full species list indicating their conservation status, endemism, priority species score and where a species had been recorded is provided in Appendix I. This reporting table will be expanded as further data become available through subsequent surveys.

As birds are inherently mobile, it is likely that all species observed in the broader project area and some in the Orange River Valley may at some point traverse or utilise the project site. However, at this time it seems unlikely that water associated birds such as ducks, grebes, cormorants and kingfishers would occur or pass through the project site. Further discussions below therefore consider the species list for the broader project area and exclude species observed only at the Orange River Valley.

Five regionally red listed species (Taylor, 2014) were recorded during the spring survey (Table 12). One of these Verreaux's Eagle was not recorded on either the project site or control site, but was recorded within the broader project area. Of the five red listed species, three (Martial Eagle, Verreaux's Eagle and Kori Bustard) were recorded during the previous (winter) survey while Double-banded Courser *Near-threatened* and Burchell's Courser *Vulnerable* were recorded for the first time in spring, both on gravel patches within the project site. Two red listed species (Ludwig's Bustard *Endangered* and Karoo Korhaan *Near-threatened*, were recorded during the first winter survey, but not during spring.

Table 12: Regionally Red Listed Species Recorded During the Winter Survey in the Broader Project Area and Control Site

Species	Red Data Status (Taylor, 2014)	Broader Project Area	Project Site	Control Site
Martial Eagle	Endangered	X	X	
Verreaux's Eagle	Vulnerable	X		
Burchell's Courser	Vulnerable	X	X	
Double-banded Courser	Near-threatened	X	X	

Kori Bustard	Near-threatened	X	X	X

Two South African near-endemic species[5] were recorded in the spring survey (Fiscal Flycatcher and Black-eared Sparrow-lark).

Open water sources attracted large numbers of doves and sandgrouse, with flocks of sandgrouse heading towards and away from these points in all directions, particularly in the morning.

The suspected Martial Eagle Nest identified during the winter survey was confirmed to be active during the spring survey, with a sub-adult perching on or around the nest on each of the four visits to the nest.

The pair of Verreaux's Eagle at FS2 have bred successfully between the winter and spring surveys, and a sub-adult bird was observed at the active nest site.

4.6.2 Winter and Spring Surveys Combined

A total of 116 positively identified species have been recorded during the winter and spring surveys combined, including seven species regionally red-listed (Taylor, 2014): Ludwig's Bustard (*Endangered*), Martial Eagle (*Endangered*), Karoo Korhaan (*Near-threatened*), Double-banded Courser (*Near-threatened*), Kori Bustard (*Near-threatened*), Verreaux's Eagle (*Vulnerable*) and Burchell's Courser (*Vulnerable*).

Six endemic or near-endemic species were recorded across both surveys including Fiscal Flycatcher, Sickle-winged Chat, Karoo Thrush, Namaqua Warbler, Black-eared Sparrow-lark and Black-headed Canary. Namaqua Warbler has been recorded in the Orange River Valley and prefer reed-beds and are therefore unlikely to occur on the project site.

Other raptors recorded during the winter and spring surveys include African Fish Eagle, Cape Eagle-owl, Pale Chanting Goshawk, Black-shouldered Kite as well as Booted Eagle. The latter was only recorded during the spring survey and not the winter survey as it is a migrant that returns to the region for spring and summer.

Ludwig's Bustard were regularly encountered during the winter survey but none were recorded during the spring survey. This species' movements have been correlated to rainfall (Hockey *et al*. 2005), and it generally migrates into the winter rainfall succulent Karoo during winter and spring, which may explain its absence on the project site during spring.

African Grey Hornbill were recorded during the winter survey but were notably absent during the spring survey, while Yellow-billed Hornbills were recorded only during the spring survey suggesting that there may be local movements of these species in and out of the area. A consideration of current South African Bird Atlas Project 2 (SABAP2) data[6] reveals that these species have not yet been recorded on the pentad (an approximately 8km x 8km square) covering the project site, and that the project site is on the far south western boundary of these species' ranges.

An increase in the recorded numbers of Red-crested and Northern Black Korhaans from the winter to spring survey was expected as males of these species become more conspicuous during breeding displays. It should be noted that estimating the number of female korhaan is difficult as they are far more cryptic than males. Species such as the Red-crested Korhaan are sedentary and resident to areas year-round but they are often overlooked unless they are displaying. Both Red-crested Korhaan and Northern Black Korhaan were regularly encountered during spring. Hockey *et al.* 2005 reports densities of Red-crested Korhaan in the central Kalahari to be approximately 5 males per square kilometre and between 3 – 9 males per square kilometre for Northern Black Korhaan (depending on location). These

[5] Near-endemic (i.e. ~70% or more of population in RSA) to South Africa according to the BirdLife South Africa Checklist of Birds in South Africa, 2014.

[6] http://sabap2.adu.org.za (accessed 12/10/2015).

densities would predict that around 70 male Red-crested Korhaan and 40 – 120 individual male Northern Black Korhaan may occur in the project site. It is expected that reporting rates of these species may increase during the summer survey.

4.6.3 General

The potential Martial Eagle nest that was identified during the winter survey was confirmed as being an active Martial Eagle nest during the spring survey. A sub-adult was present on or around the nest each time the nest was visited. Comparison of South African Bird Atlas Project data from 1987-1993 and 2007-2012 suggests that the species has undergone rapid and drastic population declines, reducing in number by nearly 60% in 20 years (Cloete 2013).

Martial Eagle are red-listed as *Endangered* (Taylor, 2014) and exhibit strong fidelity to nesting sites (Herholdt & Mendelsohn 1995) but a breeding pair may alternate breeding attempts between multiple nests in their breeding territory (Machange *et al.* 2005), which was estimated to be a minimum of 284 km^2 for Martial Eagles breeding in transmission towers in the Nama-Karoo (Boshoff 1993). The extent of the breeding territory of the Martial Eagles breeding near the project site is not known, but if it is assumed that the nest is the central point of the territory and a circle with a radius of 9.5 km is projected around the nest site (giving total area of approximately 280 km^2), the project area falls completely within the potential minimum breeding territory of these eagles. Martial Eagle was observed foraging over the project site during the spring survey and may face impact through loss of habitat and injury or fatality caused by solar flux

While the project site occupies approximately 5% of the minimum breeding territory this percentage may decrease if the extent of the breeding territory is larger than the minimum area estimated by Boshoff (1993), if the shape of the territory is not uniform or if the project site does not fall within preferred foraging areas.

Such information could potentially be gathered by fitting one or more of the Martial Eagle's with satellite/GPS tracking device/s. The collection of detailed movement data of these eagles would provide clarity on the extent of potential impact that this development, and future developments in the area may have on these birds. If it can be demonstrated that the eagles have a larger territory than the minimum estimates of Boshoff (1993), then the relative percentage of the total territorial area that will be occupied by development would decrease. If it can be demonstrated that these eagles forage preferentially in other areas (for example to the east of the nest site or in the nearby Kalahari Oryx Game Reserve) and spend proportionately less time over the project site (which is mostly domestic stock farms) the potential impact of the project may be lower than it may appear when looking at general trends from the literature.

These data may provide support for assessing the potential impact of this project on Martial Eagles as being lower than would otherwise be assumed without access to detailed movement data. Understanding the movement of these eagles during all phases of project would also be a highly beneficial in determining possible 'before and after' effects such as potential displacement and change in foraging behaviour.

It is therefore recommended that ACWA, assisted by Arcus, determine the feasibility of GPS tagging at least one of the eagles that utilise the nest located near the project site. Arcus would welcome the opportunity to discuss this further with ACWA.

5 KEY DESIGN CONSIDERATIONS

CSP tower projects have the potential to impact birds through habitat loss, disturbance, displacement, collision, burning and barrier effects. The magnitude of the potential effects on birds will differ between species, depending on their abundance, distribution, flight activity and behaviour in the project site. The significance of the impacts will be influenced

by the conservation status and sensitivity of the species to the impacts of CSP tower projects.

An active Martial Eagle nest was located on a transmission line pylon approximately 1.5 km to the east of the project site (-28.714505°; 22.038635°). In the absence of detailed foraging data, and in the absence of information regarding observed impacts of CSP tower projects on this species (and on large eagles for that matter), a precautionary approach may need to be adopted which would include buffering the nest site by approximately 2 km – 5 km. The final buffer distance would be determined following the completion of 12 months monitoring, final detailed data analysis, and further review of literature and best practise recommendations

Given the high densities of the flocks of sandgrouse and doves moving towards or away from water sources and the generally low-level flight that these birds exhibit, it is advised that all water points be covered and leaks prevented to reduce the passage of these species through the project site and reduce the potential for these species to collide with infrastructure or suffer solar flux fatalities.

6 NEXT SURVEY CONSIDERATIONS

During the spring survey, high temperatures (+ 30 degrees Celsius) along with hot dry winds were encountered making fieldwork challenging, particularly associated with the control VP where + 2 km of walking over sand dunes is required for access. Temperatures in excess of 35 degrees and possibly 40 degrees Celsius are expected during the next summer survey (tentatively scheduled for 07-15 December 2015). While every effort will be made to complete all surveys in line with the proposed methods, and utilising the current survey locations, the following changes may be required:

- One spare/reserve day should be added to the survey length, allowing for the field team to temporarily suspend monitoring activities should extremely high temperatures (+35 degrees) be encountered.
- The control VP be re-located approximately 1 km to the south.
- The use and access to Bokpoort I offices to allow field staff to take breaks during the mid-day heat

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APPENDIX I: CUMULATIVE SPECIES LIST

Common Name	Red List Status (Taylor, 2014)	Endemic*	Priority Score (Retief et al, 2011)	Area Recorded							
				Winter				Spring			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Barbet, Acacia Pied				1	1	1		1	1	1	1
Barbet, Crested											1
Batis, Pririt								1	1	1	
Bee-eater, Swallow-tailed											1
Bee-eater, White-fronted											1
Bishop, Southern Red						1		1	1	1	
Bokmakierie				1	1	1		1	1	1	1
Bulbul, African Red-eyed				1	1	1	1	1	1	1	1
Bunting, Cape				1				1			1
Bunting, Cinnamon-breasted				1							
Bunting, Golden-breasted								1	1		
Bunting, Lark-like				1	1	1	1	1	1	1	
Bustard, Kori	NT		260	1	1	1		1	1	1	
Bustard, Ludwig's	EN		320	1	1						
Canary, Black-headed		X		1							
Canary, Black-throated				1	1			1	1		
Canary, White-throated				1	1						
Canary, Yellow				1	1	1		1	1	1	
Chat, Ant-eating				1	1	1		1	1	1	
Chat, Familiar				1	1		1	1	1		1

Common Name	Red List Status (Taylor, 2014)	Endemic*	Priority Score (Retief et al, 2011)	Area Recorded							
				Winter				Spring			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Chat, Sickle-winged		X		1	1						
Cisticola, Grey-backed							1	1			
Cormorant, Reed							1				1
Cormorant, White-breasted							1				1
Courser, Burchell's	VU		210					1	1		
Courser, Double-banded	NT		204					1	1		
Crombec, Long-billed				1	1			1	1	1	
Crow, Pied				1	1	1	1	1	1	1	1
Darter, African							1				1
Dove, Cape Turtle				1	1	1	1	1	1	1	1
Dove, Laughing				1	1	1		1	1	1	1
Dove, Namaqua				1	1	1	1	1	1	1	
Duck, African Black							1				1
Eagle, African Fish			290	1			1			1	1
Eagle, Booted			230					1	1		
Eagle, Martial	EN		350	1		1		1	1		
Eagle, Verreauxs'	VU		360	1				1			
Egret, Little							1				1
Egret, Western Cattle							1				
Eremomela, Yellow-bellied				1	1	1		1	1	1	
Falcon, Pygmy				1							
Finch, Red-headed				1				1	1		
Finch, Scaly-feathered				1	1	1	1	1	1	1	

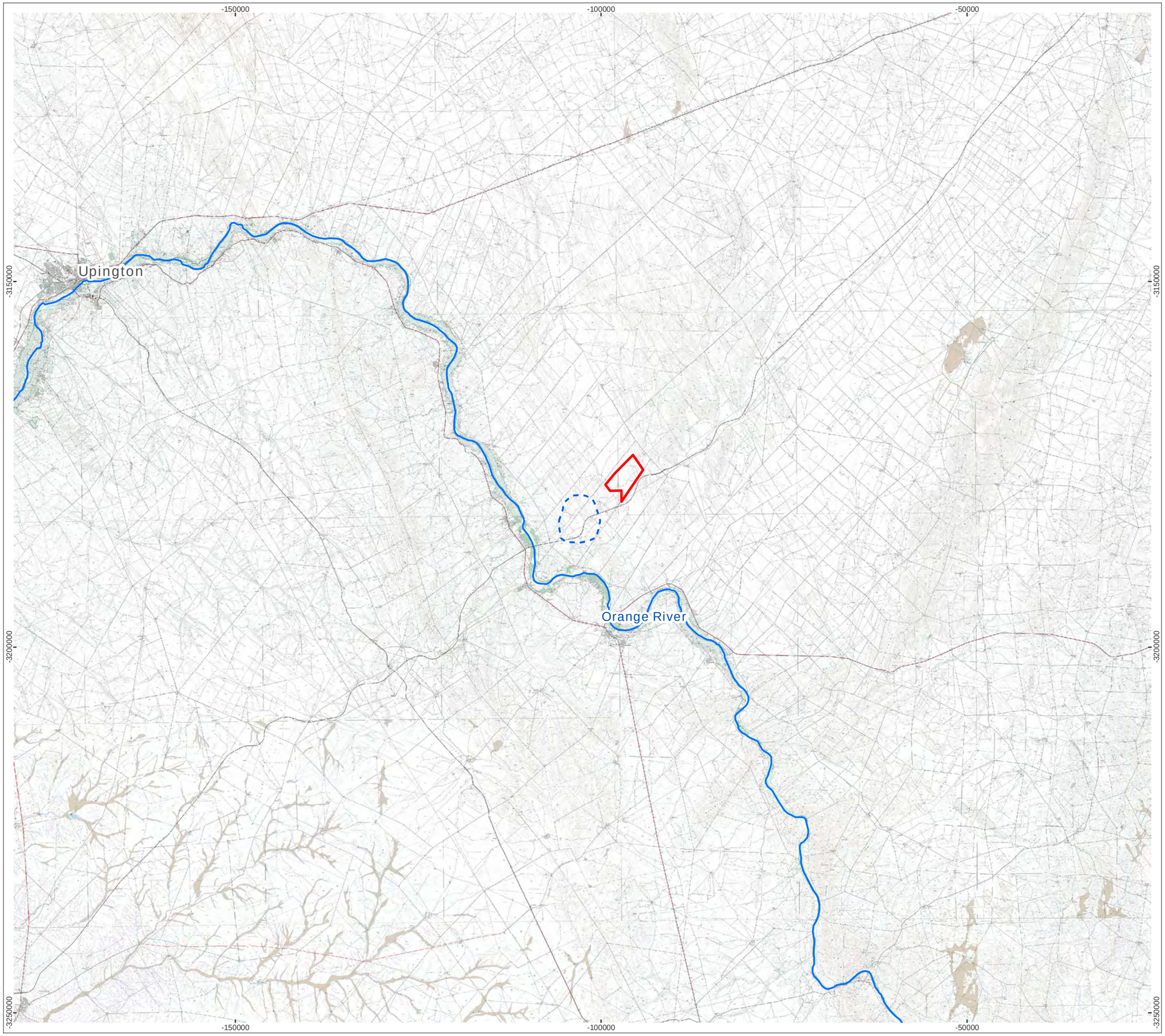
Common Name	Red List Status (Taylor, 2014)	Endemic*	Priority Score (Retief et al, 2011)	Area Recorded							
				Winter				Spring			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Fiscal, Common				1	1	1	1	1	1	1	1
Flycatcher, Fiscal		X					1	1	1	1	1
Goose, Egyptian							1	1			1
Goose, Spur-winged							1				
Goshawk, Pale Chanting			200	1	1			1	1		
Grebe, Little							1				
Heron, Black-headed							1				
Heron, Goliath							1				1
Heron, Grey							1				1
Hoopoe, African											1
Hornbill, African Grey				1	1						
Hornbill, Yellow-billed								1	1		
Ibis, African Sacred							1				1
Ibis, Hadeda							1	1	1	1	1
Kestrel, Rock				1							
Kingfisher, Giant							1				1
Kingfisher, Malachite							1				
Kite, Black-shouldered			174				1				
Korhaan, Karoo	NT		240	1		1					
Korhaan, Northern Black			180	1	1	1		1	1	1	
Korhaan, Red-crested				1	1	1		1	1	1	
Lapwing, Blacksmith											1

Common Name	Red List Status (Taylor, 2014)	Endemic*	Priority Score (Retief et al, 2011)	Area Recorded							
				Winter				Spring			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Lapwing, Crowned				1	1			1	1		
Lark, Black-eared Sparrow-		X						1	1		
Lark, Eastern Clapper				1	1	1		1	1	1	
Lark, Fawn-coloured				1	1	1		1	1	1	
Lark, Grey-backed Sparrow				1	1			1	1	1	
Lark, Sabota				1	1	1					
Lark, Spike-heeled								1	1	1	
Martin, Rock				1	1	1	1	1	1	1	
Mousebird, Red-faced				1	1	1		1	1	1	1
Mousebird, White-backed				1	1	1	1	1	1	1	
Owl, Cape Eagle-			250					1	1		
Owlet, Pearl-spotted							1				
Penduline-tit, Cape								1	1		
Pigeon, Speckled							1	1	1	1	1
Pipit, African				1	1			1	1		
Plover, Three-banded											1
Prinia, Black-chested				1	1	1		1	1	1	
Quelea, Red-billed				1	1	1		1	1	1	
Robin, Kalahari Scrub				1	1			1	1	1	
Robin, Karoo Scrub										1	1
Robin-chat, Cape							1				
Sandgrouse, Namaqua				1	1	1	1	1	1	1	
Scimitarbill, Common				1	1			1	1	1	

Common Name	Red List Status (Taylor, 2014)	Endemic*	Priority Score (Retief et al, 2011)	Area Recorded							
				Winter				Spring			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Shelduck, South African											1
Shrike, Crimson-breasted				1							
Sparrow, Cape							1	1	1		1
Sparrow, Great							1				
Sparrow, House											1
Sparrow-weaver, White-browed				1	1	1		1	1	1	
Starling, Cape Glossy										1	1
Starling, Pale-winged				1				1			
Sunbird, Dusky				1	1	1		1	1	1	
Swallow, White-throated								1	1	1	1
Swift, Bradfield's											1
Swift, Little				1	1			1	1	1	1
Thrush, Karoo		X									1
Thrush, Short-toed Rock				1							
Tit, Ashy				1	1	1		1	1	1	
Tit-Babbler, Chestnut-vented				1	1	1		1	1	1	
Wagtail, African Pied											1
Wagtail, Cape						1	1				1
Warbler, Namaqua		X					1				
Warbler, Rufous-eared				1	1	1		1	1	1	
Waxbill, Common											1
Waxbill, Violet-eared				1	1	1					

Common Name	Red List Status (Taylor, 2014)	Endemic*	Priority Score (Retief et al, 2011)	Area Recorded							
				Winter				Spring			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Weaver, Sociable				1	1	1		1	1	1	
Weaver, Southern Masked				1	1	1	1	1	1	1	1
Wheatear, Capped				1	1						
Wheatear, Mountain				1							
White-eye, Orange River				1	1		1	1	1	1	1
Woodpecker, Cardinal								1	1		1

** Near-endemic (i.e. ~70% or more of population in RSA) to South Africa according to the BirdLife South Africa Checklist of Birds in South Africa, 2014.*



Basemapping from the Chief Directorate National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

Project Site

Control Site

Watercourse

1:500,000 Scale @ A3

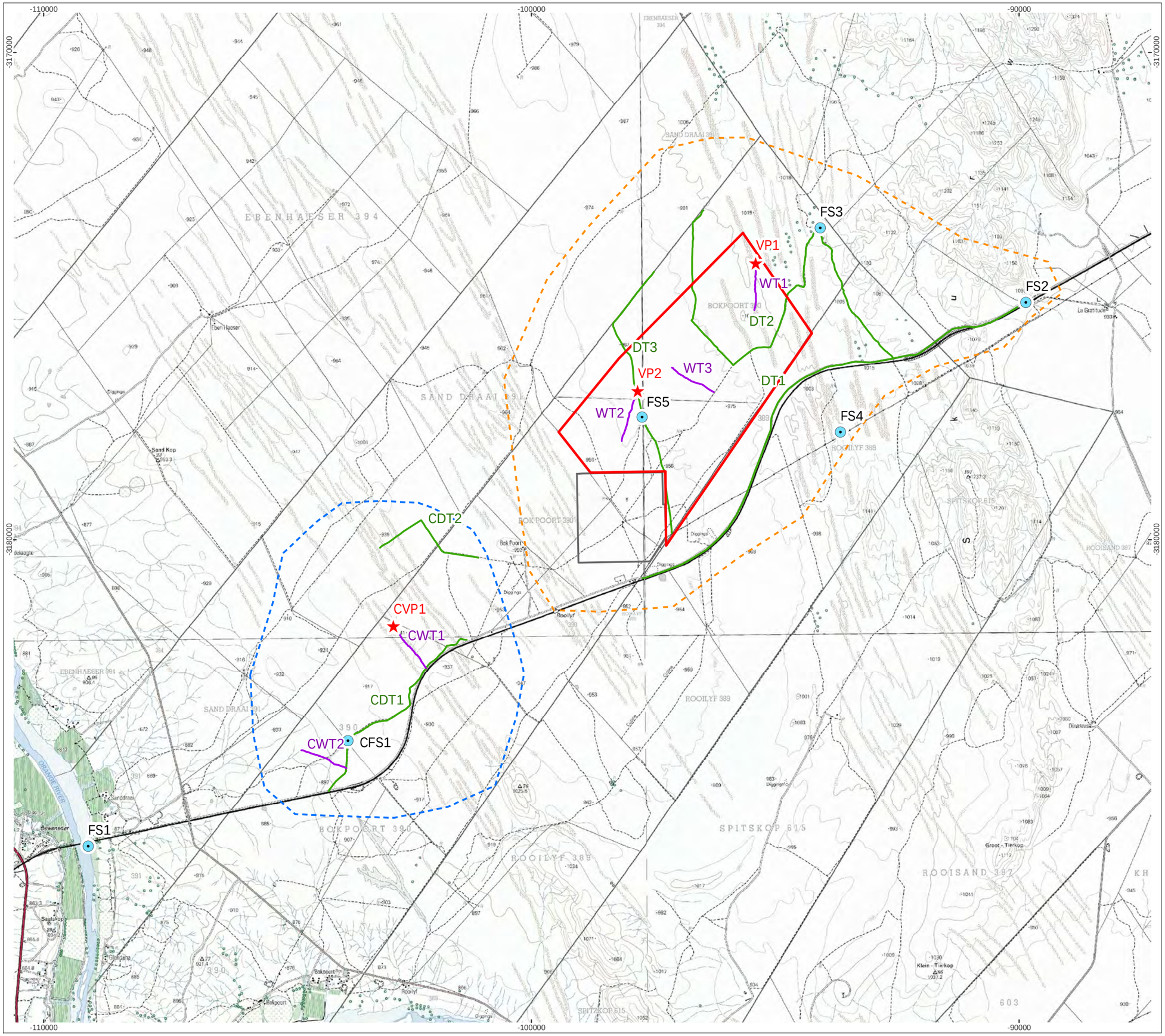
N

0 10 20 km

Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/007 Date: 08/10/2015

Project Site and
Control Site Locations
Figure 1

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 2



Basemapping from the Chief Directorate National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

- Project Site
- Control Site
- Broader Project Area
- Bokpoort I Area
- Walked Transect
- Driven Transect
- VP Location
- Focal Sites

1:75,000 Scale @ A3

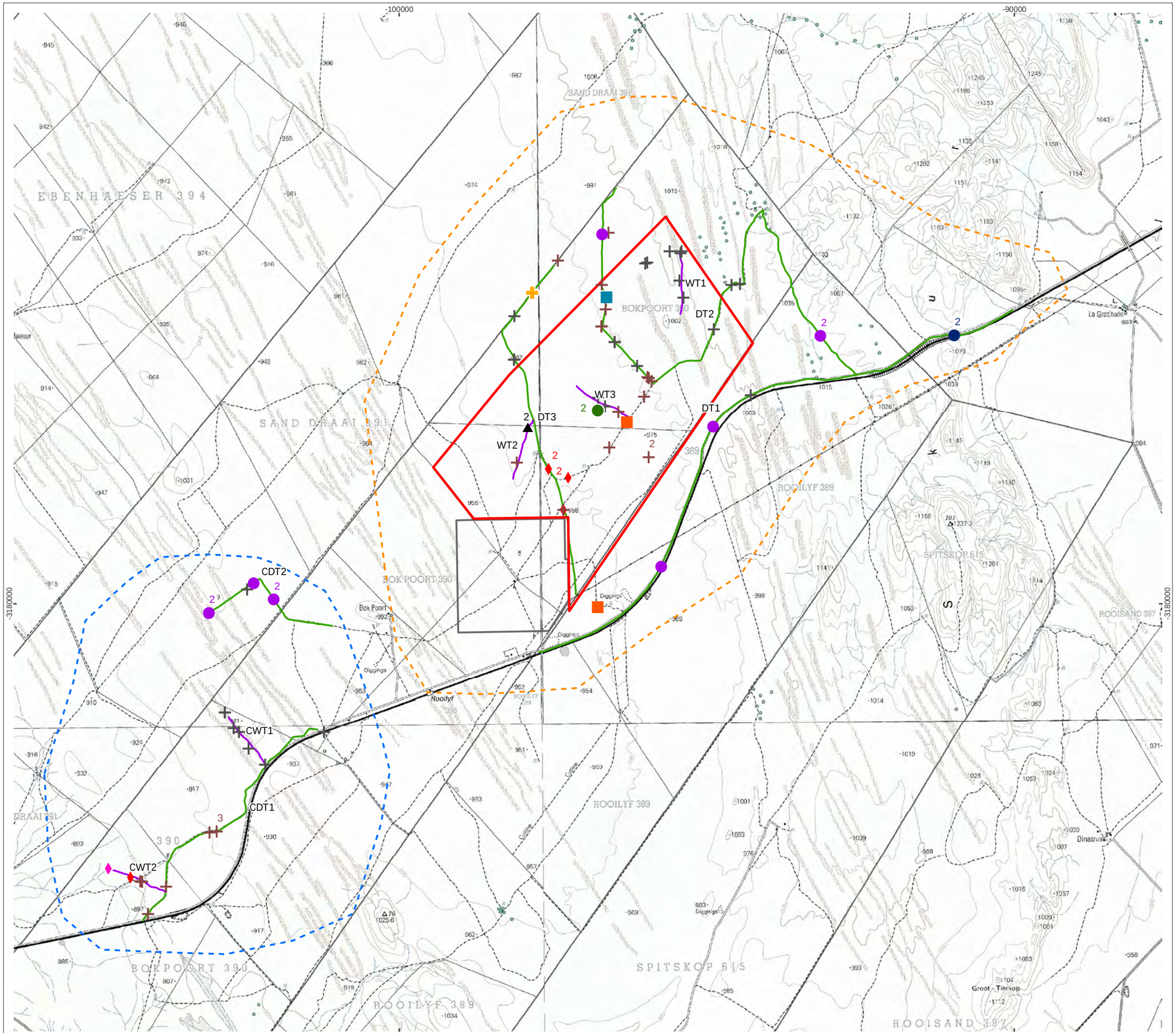
N

0 1.5 3 km

Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/008 Date: 08/10/2015

Vantage Point, Focal Site, Driven and Walked Transect Locations
Figure 2

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 2



Basemapping from the Chief Directorate National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

- Project Site
- Control_Site
- Broader Project Area
- Bokpoort I Area
- Walked Transect
- Driven Transect

Transect and Incidental Species

- African Fish Eagle
- Burchells Courser
- Cape Eagle Owl
- Crowned Lapwing
- Double-banded Courser
- Kori Bustard
- Northern Black Korhaan
- Pied Crow
- Pale Chanting Goshawk
- Red-crested Korhaan
- Verreaux's Eagle

Where more than 1 bird was identified at the location, the number of birds seen is indicated.

1:60,000 Scale @ A3

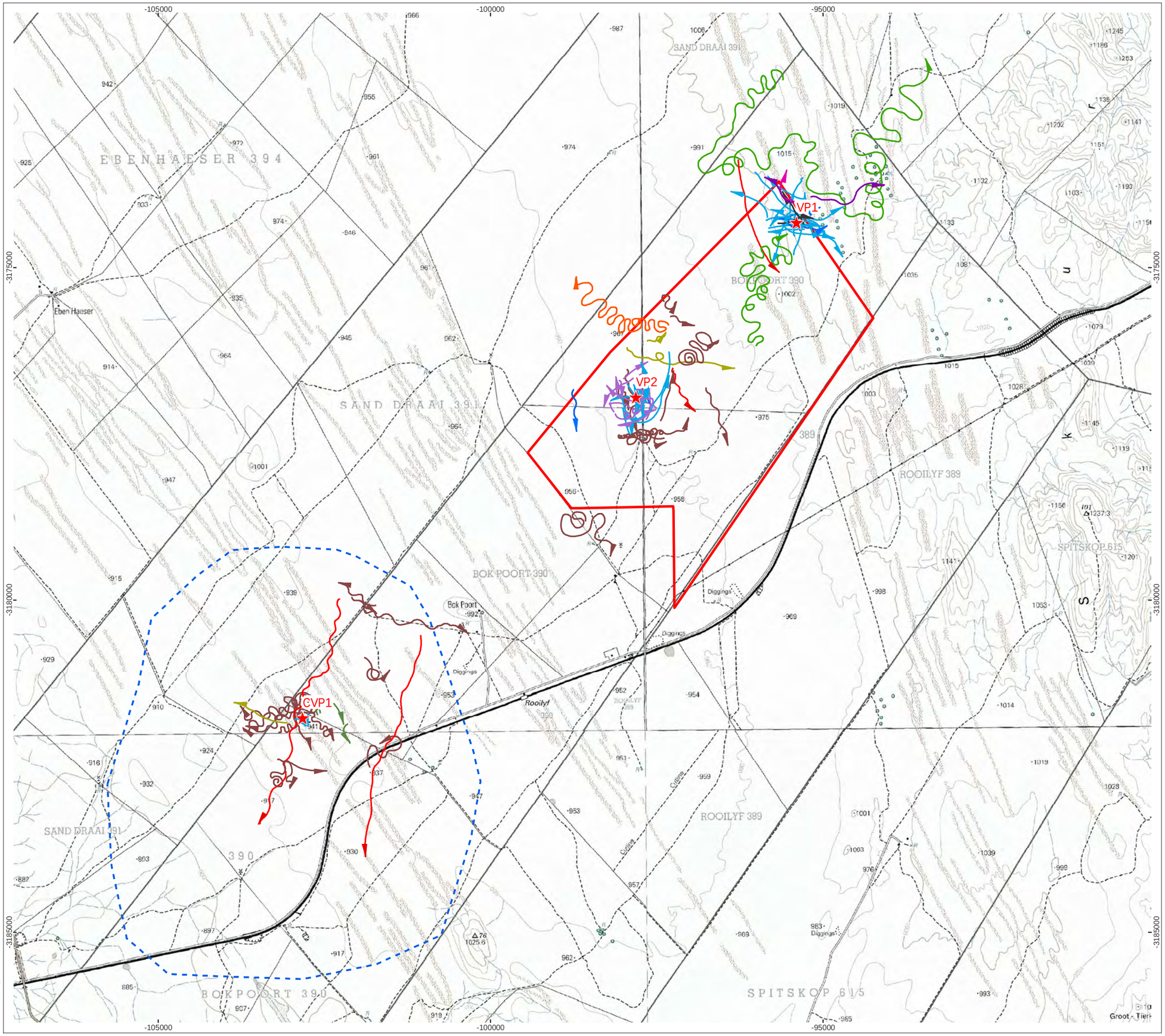
N

0 1 2 km

Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/009 Date: 12/10/2015

Drive Transect, Selected Walk Transect and Incidental Target Species Records
Figure 3

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 2



Basemapping from the Chief Directorate National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

- Project Site
- Control Site
- VP Location
- Booted Eagle
- Cape Turtle Dove
- Hadeda Ibis
- Kori Bustard
- Laughing Dove
- Martial Eagle
- Namaqua Dove
- Northern Black Korhaan
- Pale Chanting Goshawk
- Pied Crow
- Speckled Pigeon
- Yellow-billed Hornbill

1:55,000 Scale @ A3

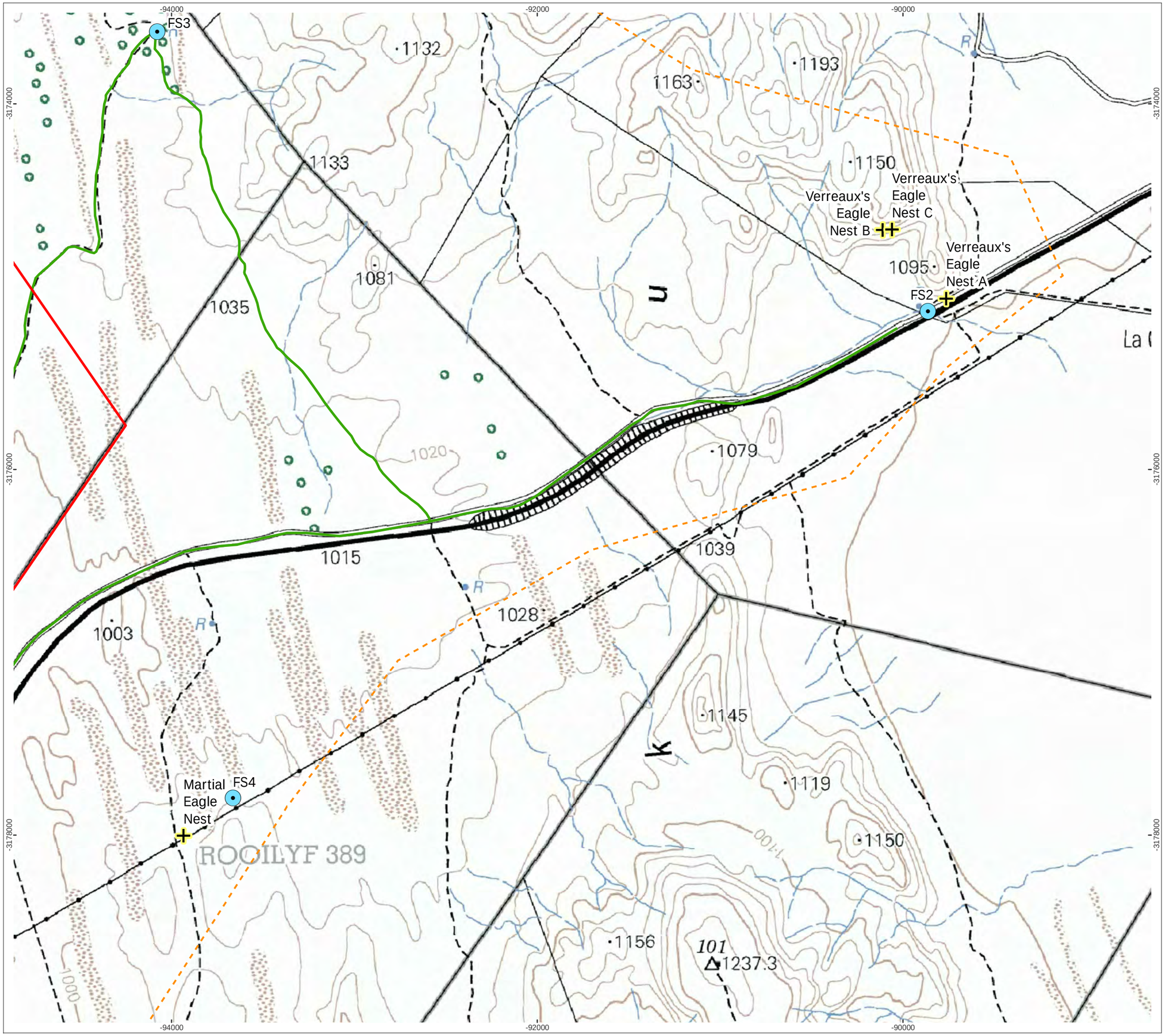
N

0 1 2 km

Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/010 Date: 12/10/2015

Selected Target Species Flights
Figure 4

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 2

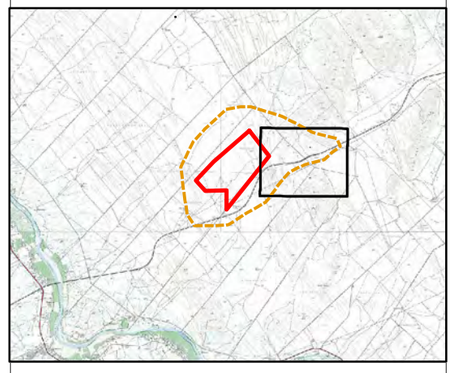


Basemapping from the Chief Directorate National Geo-Spatial Information of South Africa.

ACWA POWER

ARCUS

- Project Site
- Broader Project Area
- Driven Transect
- Focal Site
- Nest Site



1:20,000 Scale @ A3

0 0.5 1 km

N

Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/011 Date: 13/10/2015

Eagle Nest Sites
Figure 5

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 2

12 MONTH PRE-CONSTRUCTION AVIFAUNA MONITORING FOR BOKPOORT II SOLAR FARM

Progress Report 3

On behalf of

ACWA Power Africa Holdings (Pty) Ltd

January 2016

Prepared By:

Arcus Consultancy Services

Office 220 Cube Workspace
Icon Building
Cnr Long Street and Hans Strijdom Avenue
Cape Town
8001

T +27 (0) 21 412 1529 l **E** AshlinB@arcusconsulting.co.za
W www.arcusconsulting.co.za

Registered in South Africa No. 2012/215000/10

Written By	Andrew Pearson	22 January 2016
Checked By	Dr. Owen Davies	22 January 2016
Approved By	Ashlin Bodasing	25 January 2016

EXECUTIVE SUMMARY

This report is the third progress report relating to 12 months pre-construction bird surveys for the proposed Bokpoort II Solar Farm. The purpose of this report is to outline:

- The survey method for the summer survey;
- Observations from the summer survey;
- A summary of the combined results of the winter, spring and summer surveys; and
- Future recommendations for the survey approach and the project design.

The third of four seasonal survey visits was carried out between 07 and 14 December 2015. Bird monitoring comprised flight activity surveys from three vantage points, five walked transects (each 1 km in length), five driven transects, and six focal sites as well as incidental observations.

Key findings from the summer survey can be summarised as follows:

- A total of 60 species were recorded within the broader project area, all of which were also recorded within the boundaries of the project site and 48 species were recorded on the control site.
- Sixty-eight species were recorded in the Orange River Valley, although it remains unlikely that water associated birds such as ducks, grebes, cormorants and kingfishers would occur or pass through the project site.
- Seven regionally red listed species (Taylor, 2015) were recorded during the summer survey.
- One regionally red listed species, Lanner Falcon, was recorded for the first time during summer.
- No South African endemic or near-endemic species were recorded on the project site, control site or within the broader project area during the summer survey.
- Water sources attracted large numbers of doves and sandgrouse, particularly in the morning and evening.
- Northern Black Korhaan and Red-crested Korhaan were regularly recorded.
- Activity of small birds was generally lower than during spring.
- A total of 65 birds of 11 target species were recorded by observing a total of 44 flight paths during the vantage point monitoring at both the broader project area (which includes the project site) and control sites.
- Pied Crow, Namaqua Dove, Namaqua Sandgrouse, Eastern Clapper Lark and Northern Black Korhaan were regularly recorded flying from VP watches.
- The majority of flights were below 210 m in height.
- Verreaux's Eagle was observed flying (during observations at VP1) in the broader project area for the first time during the summer survey.

Solar projects combining CSP tower and PV technologies may impact birds through habitat loss, disturbance, displacement, collision, burning and barrier effects. The significance of these potential impacts will be rated following the completion of the 12 month monitoring and will depend on the species sensitivity and conservation status, abundance, distribution, flight activity and behaviour in the project site.

Based on the data collected to date, project design considerations include the need to prevent open water sources which may attract high numbers of sandgrouse and doves. In the absence of more detailed distribution data, it is likely that a buffer of between 1 km and 5 km around the confirmed active Martial Eagle nest may be required.

SPECIALISTS' DECLARATION OF INDEPENDENCE AND QUALIFICATIONS

Andrew Pearson is an Avifauna Specialist at Arcus. Andrew has a four year BSc in Conservation Ecology, certificates in Environmental Law, as well as eight years' experience as an environmental management professional. 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 will perform the work required in an objective manner, and declares that there are no circumstances which may compromise the objectivity in performing such work. Arcus has no business financial or other in the proposed project except for financial compensation for specialist work conducted. Andrew designed and set up the field surveys, conducted data collection and provided inputs to the analysis and interpretations of the avifauna data as an Avifauna Specialist.

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 is a professional member of the SACNSP, as detailed below:

Investigator:	Andrew Pearson (Pri.Sci.Nat)
Qualification:	BSc (hons) Conservation Ecology
Affiliation:	South African Council for Natural Scientific Professions
Registration number:	400423/11
Fields of Expertise:	Ecological Science
Registration:	Professional Member

22 January 2016

TABLE OF CONTENTS

1 INTRODUCTION

This report is the third progress report relating to 12 months pre-construction bird surveys for the proposed Bokpoort II Solar Farm ('the project'). This report presents the survey design, methodology and results of the summer seasonal survey.

The aim of the avifauna survey and assessment is to inform the final design of the project with regards to the risks associated with birds and to supply data to inform the final Avifaunal Impact Assessment (AIA) for inclusion into the environmental impact assessment (EIA) process.

The purpose of this report is to outline:

- The survey method for the summer survey;
- Observations from the summer survey;
- A summary of the combined results of the winter, spring and summer surveys; and
- Future recommendations for the survey approach and the project design.

1.1 The Proposed Project

ACWA Power Africa Holdings (Pty) Ltd (ACWA)) are proposing to construct 1 x 150 MW concentrated solar power (CSP) tower plant and 2 x 75 MW photovoltaic (PV) plants on the Remaining Extent of Farm Bokpoort 390, Groblershoop, Northern Cape ('the project site') (Figure 1). The proposed CSP tower will be approximately 250 m high. The project site covers an area of approximately 1,437 ha and includes the following available bird micro habitats: open gravel plains; livestock enclosures or 'kraals'; reservoirs/water points; grassy shrubland/scrub; grassy thorn veld; and dunes. Land use in the project site is predominantly stock farming.

The project site borders on, and lies to the north east of, the Bokpoort I CSP project (Figure 2) which is in its commissioning phase and due to begin operations in early 2016.

2 SURVEY DESIGN

There are currently no published best practise guidelines for long term bird monitoring on potential solar facilities in South Africa. The survey was therefore designed by the avifaunal specialist to be broadly in line with the applicable best practice guidelines[1] for wind farms ('the guidelines'). However, the specialist is aware that guidelines requiring 12 month pre-construction bird monitoring for large CSP tower projects are in development by Birdlife South Africa (BLSA) and the Birds and Renewable Energy Specialist Group (BARESG)[2]. Knowledge of these imminent guidelines and international best practise, were considered in the design of the surveys.

Due to the inherent mobility of birds, it is important to consider avifauna not only on the project site, but also the avifauna and available avifaunal microhabitats beyond the project site. Therefore, a delineation of a 'broader project area' was done by the specialist, incorporating all relevant and important habitats, and within which the surveys would be conducted. The broader project area includes the project site and is shown in Figure 2.

In order to provide useful 'before-after' comparative data in the event of the construction and operation of the project, surveys were undertaken within the broader project area, both within the project site and at variable distances from the project site, as well as at a control site.

[1] Jenkins, A.R., van Rooyen, C.S., Smallie, J.J., Harrison, J., Diamond, M. and Smit, H.A. (2011 amended 2012). Best Practice Guidelines for Avian Monitoring and Impact Mitigation at Proposed Wind Energy Development Sites in Southern Africa. BirdLife South Africa/Endangered Wildlife Trust.

[2] The specialist is a member of this group and received a draft copy of the solar guidelines for comment and input shortly after the monitoring proposal was submitted by Arcus to ACWA.

The control site is located approximately 6 km south west of the project site (Figure 2) and was selected primarily on the basis of its accessibility and similarity of the predominant habitats to the project site.

3 SURVEY METHODS (SUMMER)

The third of the four seasonal survey visits to be carried out over the 12 month period was completed between 07 and 14 December 2015. Surveys were conducted by the avifaunal assistant specialist, assisted by an experienced field surveyor.

The following survey methods were performed during the summer survey:

- Walked transects (WT);
- Driven transects (DT);
- Vantage point (VP) surveys;
- Focal site (FS) surveys; and
- Incidental observation recording.

The following definitions apply:

- Priority species: all species occurring on the BLSA and Endangered Wildlife Trust (EWT) Avian Sensitivity Map priority species list[3].
- Target species: those particular bird species that were[4] recorded by a specific survey method. Target species per survey method:
    - Walked transects: all birds;
    - Driven transects: all raptors; all large (non-passerine) priority species; corvids (crows and ravens); hornbills; korhaans; and lapwings.
    - Vantage point surveys: all raptors; all large (non-passerine) priority species; corvids (crows and ravens); doves; ibises; hornbills and korhaans. Sandgrouse, aerial foragers and flocking species (e.g. swallows, swifts and martins) and larks (display flights only), were recorded for additional information, however their flight paths were not mapped.
    - Incidental observations: all red-listed species (Taylor, 2015); all raptors; all large (non-passerine) priority species; hornbills; and korhaans; and
    - Focal sites: all species associated, utilising or interacting at/with the focal site.

3.1 Walked Transects

Three walked transects were established and conducted on the project site as well as two walked transects on the control site, referred to as control walked transects (CWT) (Figure 2). Each transect was 1 km in length and was conducted twice during the summer survey. The location and the times of the walked transects are presented in Table 1. Transects are named according to location and visit within the season; i.e. WT2.1 is transect location two, first visit; WT2.2 is transect location two, second visit.

Two observers walked between the start and end points of the transects whilst recording all birds seen or heard up to 250 m on either side of the transect. Beyond 250 m, only priority species were noted and were recorded as incidental sightings.

[3] Retief, E, Anderson, M., Diamond, M., Smit, H., Jenkins, A. & Brooks, M. (2011) Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures used. Priority species list updated in 2014 by BLSA. This list consists of 107 species with a priority score of 170 or more. The priority score was determined by BLSA and EWT after considering various factors including bird families most impacted upon by Wind Energy Facilities (WEFs), physical size, species behaviour, endemism, range size and conservation status.

[4] Species/groups of species may be added to a particular survey method's target species list as the programme progresses.

Table 1: Geographic Co-ordinates for Walked Transect Routes and Survey Date/Times

Ref	Transect Co-ordinates (Start)		Transect Co-ordinates (Finish)		Survey Details		
	South	East	South	East	Date	Start Time	Finish Time
WT1.1	-28.680960°	22.023580°	-28.689900°	22.023540°	09/12/2015	07:45	08:24
WT1.2	-28.680960°	22.023580°	-28.689900°	22.023540°	13/12/2015	07:08	07:45
WT2.1	-28.705320°	21.998880°	-28.713910°	21.995530°	10/12/2015	05:41	06:11
WT2.2	-28.705320°	21.998880°	-28.713910°	21.995530°	14/12/2015	06:58	07:21
WT3.1	-28.705050°	22.014970°	-28.700360°	22.006230°	08/12/2015	06:08	06:50
WT3.2	-28.705050°	22.014970°	-28.700360°	22.006230°	14/12/2015	05:45	06:23
CWT1.1	-28.755650°	21.954050°	-28.748460°	21.947850°	10/12/2015	08:08	08:37
CWT1.2	-28.755650°	21.954050°	-28.748460°	21.947850°	11/12/2015	05:26	05:53
CWT2.1	-28.774050°	21.937080°	-28.770620°	21.927640°	10/12/2015	07:03	07:28
CWT2.2	-28.774050°	21.937080°	-28.770620°	21.927640°	13/12/2015	05:30	05:52

3.2 Vantage Points

Two vantage points were surveyed in the project site (VP1 and VP2), and one in the control site (CVP1) (Figure 2). Observer pairs monitored a viewshed of 360 degrees with a radius of 2.25 km from each VP. These viewsheds were the focus of observation, however if target species were noted beyond these (or if a species being recorded flew out of the viewshed but was still visible), they were also recorded. For each flight of a target species (except for sandgrouse, larks, and aerial foraging species) the flight path was recorded on a large scale map along with data on the number/species of bird(s) and type of flight.

Where flight paths were recorded, flight heights were recorded through five height bands[5]: 1: <10 m; 2: 10-90 m; 3: 90-210 m; 4: 210-260 m and 5: >260 m. Each VP was surveyed for a total of 12 hours. Note that the final three hour session for CVP1, was carried out at an alternative location (CVP1a) approximately 1 km south west of CVP1 (Figure 2) to allow vehicular access (and prevent the need to walk through thick sand for over 2 km) for safety reasons due to extreme heat. Therefore, a total of 36 hours of VP observations were carried out. The co-ordinates of the VPs and hours surveyed are provided in Table 2 below.

Table 2: Vantage Point Geographic Co-ordinates and Hours Surveyed

VP	Co-ordinates		08.12.15	09.12.15	10.12.15	11.12.15	12.12.15	13.12.15	Total Time
	South	East							
VP1	-28.680720°	22.023860°	3h	3h			3h	3h	**12h**
VP2	-28.705130°	21.998984°	3h	3h	3h	3h			**12h**
CVP1	-28.747820°	21.947270°			3h	3h	3h		**9h**

[5] Note, this constitutes a change in methodology. Following the second season of monitoring, new information was supplied which showed a change in the proposed CSP tower height to 250 m. The height bands used in season 1 and 2 were: 1: <10 m; 2: 10-90 m; 3: 90-170 m; 4: 170-210 m and 5: >210 m, based on tower height of 200m.

VP	Co-ordinates		08.12.15	09.12.15	10.12.15	11.12.15	12.12.15	13.12.15	Total Time
	South	East							
CVP1a*	-28.757870°	21.946440°						3h	**3h**

**The final session at CVP1 was conducted at an alternate location for safety reasons. h=hours*

3.3 Driven Transects

Driven transect target species were sampled using five driven transects (Figure 2), three in the broader project area and two on the control site. Two observers conducted each transect on two occasions by driving slowly (approximately 30 km/h) and stopping regularly to scan surrounding open areas. The locations and times of the driven transects are shown in Table 3. Transects are named according to location and visit within the season; i.e. DT1.1 is transect location one, first visit; DT1.2 is transect location one, second visit.

DT1 runs near the southern and eastern boundary of the project site, following the railway line and service road. Two drive transects traverse the project site and broader project area up to 2 km from the project site (DT2 and DT3). Two drive transects (CDT1 and CDT2) run on and around the control site.

Table 3: Geographic Co-Ordinates and Approximate Lengths for Driven Transects and Survey Date/Times

Transect Name	Length (km)	Transect Co-ordinates (Start)		Transect Co-ordinates (Finish)		Survey Details		
		South	East	South	East	Date	Start Time	Finish Time
DT1.1	10.3 km	-28.739388°	21.999576°	-28.689782°	22.078781°	07/12/2015	12:38	13:00
DT1.2	10.3 km	-28.739388°	21.999576°	-28.689782°	22.078781°	12/12/2015	13:47	14:04
DT2.1	10.6 km	-28.699189°	22.052513°	-28.671372°	22.013056°	08/12/2015	11:11	12:19
DT2.2	10.6 km	-28.699189°	22.052513°	-28.671372°	22.013056°	09/12/2015	06:21	07:21
DT3.1	5.9 km	-28.731022°	22.005815°	-28.682639°	22.002591°	10/12/2015	14:17	14:33
DT3.2	5.9 km	-28.731022°	22.005815°	-28.682639°	22.002591°	11/12/2015	15:41	15:57
CDT1.1	4.65 km	-28.778240°	21.933382°	-28.750492°	21.962642°	12/12/2015	09:23	09:59
CDT1.2	4.65 km	-28.778240°	21.933382°	-28.750492°	21.962642°	13/12/2015	11:13	11:30
CDT2.1	2.55 km	-28.735274°	21.965228°	-28.733288°	21.944551°	13/12/2015	10:44	11:01
CDT2.2	2.55 km	-28.735274°	21.965228°	-28.733288°	21.944551°	14/12/2015	08:08	08:20

3.4 Focal Sites

Focal sites are any identifiable features within the landscape that are likely to support notable avifauna (e.g. a roost or nesting site) or have the potential to support breeding pairs or large densities of avifauna (e.g. dams, wetlands, river systems) and these sites may change as monitoring progresses and other focal sites become evident.

The same six focal sites surveyed during the spring season were again surveyed twice, for a period of 15 minutes each time, during which target species were counted and any relevant notes were taken. In Table 4, FS1.1 refers to the first visit to FS1, while FS1.2 is the second visit during the summer survey.

Table 4: Geographic Positions and Descriptions of Focal Sites

Focal Site	Co-ordinates		Description	Survey Details		
	South	East		Date	Start time	Finish Time
FS1.1	-28.788022°	21.882755°	View of the Orange River from the eastern bank, including open water, islands, banks, rocks and reed bed habitats. Rail bridge over river.	07/12/2015	11:55	12:10
FS1.2	-28.788022°	21.882755°		09/12/2015	05:30	05:45
FS2.1	-28.688900°	22.080510°	Two cliff faces (north and south) approximately 450 m apart, viewed from the same point (FS2). Northern cliff face has two Verreaux's Eagle nest structures, while southern face has one.	07/12/2015	13:00	13:15
FS2.2	-28.688900°	22.080510°		12/12/2015	14:04	14:19
FS3.1	-28.674830°	22.037520°	Reservoir and water trough fed by windmill pump[6], with surrounding 'kraal' and trees.	08/12/2015	11:28	11:43
FS3.2	-28.674830°	22.037520°		09/12/2015	06:34	06:49
FS4.1	-28.714505°	22.038635°	Martial Eagle nest, on top off a Sociable Weaver nest, on a power line tower.	07/12/2015	13:24	13:39
FS4.2				09/12/2015	06:14	06:29
FS5.1	-28.71024°	21.99956	Reservoir and water troughs fed by windmill pump, with surrounding 'kraal' and trees.	08/12/2015	10:33	10:48
FS5.2				11/12/2015	19:07	19:22
CFS1.1	-28.768900°	21.937500°	Reservoir and water trough fed by windmill pump, with surrounding 'kraal' and trees.	10/12/2015	12:11	12:26
CFS1.2	-28.768900°	21.937500°		12/12/2015	09:39	09:54

3.5 Incidental Observations

Relevant observations of target species were recorded while commuting to or from, or in the broader project area and control site, but outside the survey protocols and times described above.

4 SURVEY RESULTS (SUMMER)

4.1 Walked Transects

The purpose of the walked transect surveys is to estimate small bird populations and densities, and the method used was found to be suitable in all of the habitats surveyed.

On the project site, 157 observations were made totalling 582 individual birds (including two observations of flocks of approximately 100 birds) and 33 species during 6 WT surveys. On the control site 19 species were recorded in 50 observations totalling 116 birds during 4 WT surveys. An observation occurs whenever a target species is observed (seen or heard), and may include one or more than one bird of the same target species.

As was the case during the spring survey, WT3 resulted in the highest number of observations (66) and species (23). WT2 resulted in the highest number of individual birds (318) being recorded primarily due to large flocks of Sociable Weavers and Red-headed Finch's being recorded. The numbers of observations, individuals and species recorded on the control site walked transects were relatively low.

While both Burchell's Courser [red-listed as *Vulnerable* (Taylor, 2015)] and Double-banded Courser (*Near-threatened*) were observed on a gravel patches during WTs in spring, no coursers were recorded during the WTs in summer.

[6] In spring and summer, the pump was broken and there was no water present.

Table 5 shows a summary of results from each walked transect conducted on the control and project sites. The Priority Species recorded were Kori Bustard, Northern Black Korhaan and Karoo Korhaan of which Kori Bustard and Karoo Korhaan are Red-Listed. The locations of the observers when recording these species during the walked transects are displayed in Figure 3 along with the other incidental and drive transect target species records.

Other species deemed relevant and important to highlight were Red-Crested Korhaan and Namaqua Sandgrouse, with the latter being particularly abundant.

Table 5: Small Terrestrial Species Transect Results

Transect Name	Total Observations (Number of Individual Birds)	Total Species Recorded	Priority Species (P), Red Listed Species (Status)* or Focal Species (F)	Frequently Recorded and/or Abundant.
WT1	58 (105)	20	Red-crested Korhaan (F), Namaqua Sandgrouse (F).	Black-chested Prinia, Chestnut-vented Tit-babbler, Eastern Clapper Lark, Kalahari Scrub-Robin, Long-billed Crombec, Namaqua Sandgrouse, Pririt Batis, Scaly-feathered Finch.
WT2	33 (318)	19	Namaqua Sandgrouse (F).	Kalahari Scrub-robin, Namaqua Sandgrouse, Red-headed Finch, Rufous-eared Warbler, Sociable Weaver.
WT3	66 (159)	23	Kori Bustard (NT, P), Namaqua Sandgrouse (F), Northern Black Korhaan (P).	Black-chested Prinia, Fawn-coloured Lark, Kalahari Scrub-robin, Namaqua Sandgrouse, Northern Black Korhaan, Scaly-feathered Finch.
CWT1	25 (31)	8	None Recorded	Barn Swallow, Chestnut-vented Tit-babbler, Fawn-coloured Lark, Kalahari Scrub-robin.
CWT2	25 (85)	15	Karoo Korhaan (NT, P) Namaqua Sandgrouse (F).	Grey-backed Sparrow-lark, Kalahari Scrub-robin, Namaqua Sandgrouse, Spike-heeled Lark, Yellow-bellied Eremomela.

**Red List (Taylor, 2015) status: EN=Endangered. VU= Vulnerable. NT=Near Threatened. F=Focal species deemed relevant and important to highlight by the specialist. P=Priority Species (Retief et al. 2011. Updated 2014).*

4.2 Vantage Points

A total of 65 birds of 11 target species were recorded by observing a total of 44 flight paths (i.e. one flight path may include a number of birds = flock) during the VP monitoring at both the broader project area and control sites.

It must be noted that separate flight paths may have been conducted by the same bird/s and that the figures presented here are not an indication of abundance, but rather flight activity. Flight paths of selected target species in both the broader project area and control sites are shown in Figure 4.

Table 6 presents a summary of the flight activity data of each target species for the broader project area, while Table 7 summarises flight activity data from the control site. Seven species were recorded from VPs in the broader project area represented by 44 birds in 30 flight paths. Six positively identified species (and one unidentifiable bird) were recorded from VPs in the control site represented by 21 birds in 14 flight paths.

In the broader project area, Pied Crow (63 % of flight paths) was the most recorded species at VP watches. This was followed by Namaqua Dove with 13 % of the recorded flights, the majority of flights being short, low and direct.

A total of 5 raptor flights were recorded in the broader project area, one of a Lanner Falcon and two each of Verreaux's Eagle and Pale Chanting Goshawk. One of the Verreaux's Eagle flights was of two birds (a male and female) while the other flight was of three birds (of undetermined sex and age but most likely by the same adult pair, and a juvenile) and both flights were relatively long; 7min 15sec and 8min respectively. Lanner falcon was recorded in the broader project area for the first time during the summer VP observations.

Flights of four priority species (including three regionally red listed species) were recorded in the broader project area namely: Kori Bustard (*Near Threatened*), Lanner Falcon (*Vulnerable*), Pale Chanting Goshawk and Verreaux's Eagle (*Vulnerable*). Although the number of flights of these species was low, they are important to note due to the status of the species.

No detailed analysis of flight heights has yet been done, however, preliminary analyses of flight paths in the broader project area indicates that 100 % of flights included at least some time below 260 m. The CSP tower will be approximately 250 m in height, and it is therefore assumed that flights below 260 m may be more susceptible to collision and/or burning impacts, with flights in height band 4 (210 m – 260 m) at most risk of burning impacts. Six flights (20 %) included time in height band 4, indicating that the majority of flights recorded (80%), were lower and entirely in height bands 1 -3. The data in table 6 shows that Pied Crow, with 5 flights in height band 4, is likely to be at highest risk of burning impacts.

Table 6: Flight Path Target Species – Broader Project Area

Species	Priority Score (Retief et al, 2011)	Red List Status (Taylor, 2015)	Total no. of flight paths recorded.	Total no. of birds recorded*	No. of flights with a portion below 260 m	No. of flights with a portion in height band 4
Kori Bustard	260	NT	1	2	1 (100%)	0
Lanner Falcon	300	VU	1	1	1 (100%)	0
Namaqua Dove	-	-	4	5	4 (100%)	0
Pale Chanting Goshawk	200	-	2	2	2 (100%)	0
Pied Crow	-	-	19	27	19 (100%)	5 (26%)
Speckled Pigeon	-	-	1	2	1 (100%)	0
Verreaux's Eagle	360	VU	2	5	2 (100%)	1 (50%)
Totals			**30**	**44**	**30 (100%)**	**6 (20%)**

**Indicates that in some cases a single flight path recorded was a flight consisting of more than one bird. This figure does not indicate abundance of a species as numerous flights may have been conducted by the same bird/s at different times. VU=Vulnerable. NT=Near Threatened.*

Table 7: Flight Path Target Species - Control Site

Species	Priority Score (Retief et al, 2011)	Red List Status (Taylor, 2015)	Total no. of flight paths recorded.	Total no. of birds recorded*	No. of flights with a portion below 260 m	No. of flights with a portion in height band 4
Cape Turtle Dove	-	-	1	1	1 (100%)	0
Hadeda Ibis	-	-	1	1	1 (100%)	0
Laughing dove	-	-	1	1	1 (100%)	0
Namaqua Dove	-	-	1	2	1 (100%)	0
Northern Black Korhaan	180	-	4	5	4 (100%)	0
Pied Crow	-	-	5	10	5 (100%)	0
Unidentifiable Bird	-	-	1	1	1 (100%)	0
Totals			**14**	**21**	**14 (100%)**	**0**

**Indicates that in some cases a single flight path recorded was a flight consisting of more than one bird. This figure does not indicate abundance of a species as numerous flights may have been conducted by the same bird/s at different times.*

In the control site, Pied Crow (36 % of flight paths) was the most recorded species at VP watches followed Northern Black Korhaan (29 %), the only priority species recorded. No flights of Red-listed species were recorded during VP watches in the control site. No detailed analysis of flight heights has yet been done, however, preliminary analyses of flight paths in the control site indicates that 100 % of flights included at least some time below 260 m.

The overall average passage rate of target species was 1.83 (SD±1.99) birds per hour for the project site and 1.75 (SD±2.22) birds per hour for the control site (Table 8). The passage rate is the number of target species birds per hour of observation recorded at the VPs.

Aerial foraging species recorded for additional information during the VP watches on both the project site and control site were Little Swift, Barn Swallow and an Unidentifiable Swallow, all of which displayed relatively moderate to low activity. Eastern Clapper Lark, although somewhat less active than in spring, was again observed in display flights at heights of between 20 m and 100 m.

Namaqua Sandgrouse were numerous throughout the project and control sites and were recorded at all three VPs, but were particularly active in the morning and evening around VP2. From VP2 numerous flocks of more than 10 birds, and up to 120 birds were observed going to and from the water source at FS5 (approximately 600 m south of VP2). The highest number of birds was recorded between approximately 07:25 am and 08:25 am, and 18:00 pm and 19:00 pm.

The results and data presented in this progress report is preliminary analysis, and more detailed analysis of flight activity and associated risk will be undertaken in the final report.

Table 8: Average Passage Rate per Hour for Target Species

VP	Birds/hour	Birds/hour	Birds/hour	Birds/hour	Average Birds/
	Session 1	Session 2	Session 3	Session 4	hour ± SD*
Project Site					
VP1	0.67	1	3.67	2.67	2.00 ± 2.49
VP2	2.67	0.67	0.33	3	1.67 ± 1.44
Control Site					
CVP	0	1.33	2	3.67	1.75 ± 2.22

**SD=Standard Deviation*

4.3 Driven Transects

The driven transects in the broader project area resulted in 12 records of 5 species, totalling 19 birds (Table 9 and Figure 3). The driven transects on the control site resulted in 7 records of 4 species, totalling 16 birds.

DT2 recorded the most target species records (12), while DT1 and DT3 had no records. The species most regularly recorded was Pied Crow (6 records), followed by Red-crested Korhaan (5 records) and Northern Black Korhaan (4 records).

Table 9: Summary of Driven Transect Results

Species	Total Birds Recorded	Maximum Flock Count**	Number of Records					
			DT1	DT2	DT3	CDT1	CDT2	*ALL*
Martial Eagle*	1	1		1				*1*
Northern Black Korhaan*	5	2		3		1		*4*
Pale Chanting Goshawk*	2	1		1		1		*2*
Pied Crow	21	9		2		1	3	*6*
Red-crested Korhaan	5	1		5				*5*
Rock Kestrel	1	1					1	*1*
Total	**35**	**NA**	**0**	**12**	**0**	**3**	**4**	***19***

**Priority species (Retief et al., 2011, updated 2014)*

***Size of the biggest group/flock of birds of the same species observed in one record.*

4.4 Focal Sites

Observations from the visits to the focal sites (Figure 2) are presented in Table 10 below. The focal sites were located by the avifaunal specialist during the site set up and the first seasonal survey.

Observations at the Orange River focal site (FS1) again recorded various water associated species including herons, egrets, darter and cormorants. Little Swift continued to nest in relatively large numbers under a rail bridge that crosses the Orange River at FS1, while a Little Egret Roost was observed on one of the Islands in the river. Small passerines observed, that are usually seen in riverine habitat and therefore have not been recorded

in the broader project area, include Lesser Swamp Warbler, Pied Wagtail and Levaillant's Cisticola.

No Verreaux's Eagles were observed on any of the nest structures visible from FS2 during the summer surveys. A rock Kestrel was observed on two occasions on the southerly cliff face near 'Verreaux's Eagle Nest A' and it's behaviour (entering a crevice and disappearing from view), along with 'white-wash' indicates that it is likely that this species also breeds on this cliff face.

Various passerine birds were attracted to the water sources present at FS5 and CFS1, most abundant being African Red-eyed Bulbul, Cape Turtle Dove, Laughing Dove, Namaqua Dove, Lark-like Bunting, Sociable Weaver, Black-throated Canary, Grey-backed Sparrowlark, Red-headed Finch and Yellow Canary.

The Martial Eagle nest, confirmed as active during the previous survey, was again visited and a single bird was seen perched on the nest. A sub-adult was seen perched on the nest during the spring survey, and while it is common for sub-adult birds to remain in the vicinity of the nest for several months after fledging (Hockey *et al.* 2005) an adult bird was observed using this structure as a roost during the summer survey. It is expected that the sub-adult Martial Eagle may disperse from the area before the onset of the next breeding season where the adult pair may attempt to breed again at the nest location.

Table 10: Summary of Focal Site Results (number of individuals counted during each of the counts is given in brackets)

Focal Site visit	Species recorded (number of individuals)	Notes
FS1.1	African Darter (8), African Fish Eagle (1), African Sacred Ibis (28), Barn Swallow (1), Cattle Egret (13), Giant Kingfisher (1), Goliath Heron (3), Great Sparrow (2), Little Swift (6), Pied Wagtail (1), Reed Cormorant (5), Southern Masked Weaver (3), Southern Red Bishop (2), White-breasted Cormorant (5).	
FS1.2	African Darter (10), African Red-eyed Bulbul (3), Black-headed Heron (2), Cape Turtle Dove (10), European Bee-eater (15), Great Sparrow (2), Lesser Swamp Warbler (1), Levaillant's Cisticola (1), Little Egret (100), Little Swift (200), Pied Wagtail (1), Reed Cormorant (5), Southern Masked Weaver (3), Southern Red Bishop (2), White-breasted Cormorant (5).	Little Egret Roost on Island. Little Sifts nesting under bridge.
FS2.1	Rock Kestrel (1).	No birds recorded at Verreaux's Eagle Nests
FS2.2	Rock Kestrel (1).	No birds recorded at Verreaux's Eagle Nests. Rock Kestrel observed entering a crevice on southern cliff face and may be nesting.
FS3.1	African Red-eyed Bulbul (4), Cape Turtle Dove (4), Lark-like Bunting (1), Sociable Weaver (15) Unidentifiable Swallow (2), Violet-eared Waxbill (2).	
FS3.2	African Red-eyed Bulbul (2), Black-throated Canary (2), Cape Bunting (1), Lark-like Bunting (3), Laughing Dove (1), Sociable Weaver (5), White Throated Canary (1).	

Focal Site visit	Species recorded (number of individuals)	Notes
FS4.1	None Recorded	
FS4.2	Martial Eagle (1)	Adult Martial Eagle perched on nest.
FS5.1	Black-throated Canary (2), Grey-backed Sparrowlark (17), Little Swift (2), Red-headed Finch (12), Sociable Weaver (5), Yellow Canary (2).	
FS5.2	Cape Turtle Dove (1), Red-headed Finch (15), Yellow Canary (3).	
CFS1.1	None Recorded	
CFS1.2	Barn Swallow (3), Cape Turtle Dove (2), Grey-backed Sparrowlark (10), Laughing Dove (2), Namaqua Dove (2), White-browed Sparrow-weaver (1).	White-browed Sparrow-weaver nests in tree next to reservoir.

4.5 Incidental Observations

Twenty-five incidental observations were made of eight target species comprising 28 birds (a single observation may include numerous birds of one species i.e. a flock) across the broader project area and control site (Table 11 and Figure 3).

The species most regularly observed incidentally was Northern Black Korhaan accounting for 68 % of all the incidental observations. Although there were 17 observations of this species, it's likely that on some occasions the same bird was observed more than once. It is estimated that the incidental observations of this species were of approximately 7 – 10 separate individual birds.

Table 11: Number of Incidental Observations of Target Species.

Species	Number of observations	Total birds	Maximum flock count	Notes
Burchell's Courser*	1	4	4	Observed in an open 'gravel' area.
Lanner Falcon*	1	1	1	
Martial Eagle*	1	1	1	Perched on pylon.
Northern black Korhaan*	17	17	1	Mostly observed doing display flights or when flushed.
Pale Chanting Goshawk*	2	2	1	
Pygmy Falcon	1	1	1	
Red-crested Korhaan	1	1	1	
Verreaux's Eagle*	1	1	1	
TOTAL	**25**	**28**	**NA**	

**Priority species (Retief et al., 2011, updated 2014)*

4.6 Species Summary and Discussion

4.6.1 Summer Survey

A total of 60 positively identified species were recorded within the broader project area, all of which were also recorded within the boundaries of the project site.

Forty-eight species were recorded on the control site (Appendix 1). All of these species except Karoo Korhaan were also recorded on the project site. Sixty-eight species were recorded in the Orange River Valley either during observations at FS1, or incidentally at the specialist's accommodation or while travelling to and from the site.

The full species list indicating their conservation status, endemism, priority species score and where a species had been recorded is provided in Appendix I. This reporting table will be expanded as further data become available through subsequent surveys.

As birds are inherently mobile, it is likely that all species observed in the broader project area and some in the Orange River Valley may at some point traverse or utilise the project site. However, it is unlikely that water associated birds such as ducks, grebes, cormorants and kingfishers would occur or pass through the project site. Further discussions below therefore consider the species list for the broader project area and exclude species observed only at the Orange River Valley.

Seven regionally red listed species (Taylor, 2015) were recorded during the summer survey (Table 12). One of these, Karoo Korhaan, was recorded on the control site and not on the project site or within the broader project area. One new red listed species, Lanner Falcon, was recorded for the first time during the summer surveys.

Table 12: Regionally Red Listed Species Recorded During the Summer Survey in the Broader Project Area and Control Site

Species	Red Data Status (Taylor, 2015)	Broader Project Area	Project Site	Control Site
Martial Eagle	Endangered	X	X	
Verreaux's Eagle	Vulnerable	X	X	
Lanner Falcon	Vulnerable	X	X	
Burchell's Courser	Vulnerable	X	X	
Double-banded Courser	Near-threatened	X	X	
Karoo Korhaan	Near-threatened			X
Kori Bustard	Near-threatened	X	X	

No South African endemic or near-endemic species[7] were recorded on the project site, control site or within the broader project area during the summer survey.

Open water sources attracted large numbers of doves and sandgrouse, with flocks of sandgrouse heading towards and away from these points in all directions, particularly in the morning and evening.

Both Red-crested Korhaan and Northern Black Korhaan were again regularly encountered on the project site during summer, and particularly the latter. A third korhaan species, Karoo Korhaan, was recorded on the control site during summer.

A Martial Eagle was again observed perched at the nest site on the powerline pylon approximately 1.5 km from the project site (Figure 5), and it is possible that the sub-adult

[7] Endemic or Near-endemic (i.e. ~70% or more of population in RSA) to South Africa according to the BirdLife South Africa Checklist of Birds in South Africa, 2014.

bird seen previously may soon disperse, and that the adult pair will again breed at the nest site in the upcoming winter breeding season.

The pair of Verreaux's Eagle at FS2, were not observed at or near the nest site on both visits to the focal site. This is understandable, as it is outside of the breeding season, and the birds were likely foraging away from the nest. This species was observed flying during observations at (VP1) for the first time during the summer survey.

4.6.2 Winter, Spring and Summer Surveys Combined

A total of 128 positively identified species have been recorded during the winter, spring and summer surveys combined, including eight species regionally red-listed (Taylor, 2015): Ludwig's Bustard (*Endangered*), Martial Eagle (*Endangered*), Verreaux's Eagle (*Vulnerable*), Burchell's Courser (*Vulnerable*), Lanner Falcon (*Vulnerable*), Karoo Korhaan (*Near-threatened*), Double-banded Courser (*Near-threatened*), and Kori Bustard (*Near-threatened*). Of these, Kori Bustard, Martial Eagle and Verreaux's Eagle have been seen in the broader project area during all three seasonal surveys.

Six endemic or near-endemic species were recorded across all surveys including Fiscal Flycatcher, Sickle-winged Chat, Karoo Thrush, Namaqua Warbler, Black-eared Sparrow-lark and Black-headed Canary. Namaqua Warblers has been recorded in the Orange River Valley and prefer reed-beds and are therefore unlikely to occur on the project site.

Other raptors recorded to date within the broader project area include African Fish Eagle, Cape Eagle-owl, Pale Chanting Goshawk, Rock Kestrel, Pygmy Falcon, as well as Booted Eagle. The latter was only recorded during the spring survey and not the winter or summer surveys.

Ludwig's Bustard were regularly encountered during the winter survey but none were recorded during the spring and summer surveys. This species' movements have been correlated to rainfall (Hockey *et al*. 2005) which may explain its absence on the project site during spring and summer.

African Grey Hornbill were recorded during the winter survey only, while Yellow-billed Hornbills were recorded only during the spring survey with neither being recorded during summer suggesting that there may be local movements of these species in and out of the area.

4.6.3 General

During summer observations of the active Martial Eagle nest, only a single adult Martial Eagle was observed on one occasion perching at the nest and it is expected that the adult breeding pair will attempt to breed at the same location during the next breeding cycle, beginning approximately in April- June. During the previous, spring survey, a sub-adult Martial Eagle was seen at this location and it is not uncommon for sub-adult birds to remain in the vicinity of the nest for several months after fledging and then dispersing at the onset of the next breeding cycle (Hockey *et al.* 2005). The possibility of fitting a tracking device to one of the Martial Eagle's utilising the active nest site, has been discussed with ACWA, and Arcus have presented a separate proposal and costing for such a study.

5 KEY DESIGN CONSIDERATIONS

CSP tower projects have the potential to impact birds through habitat loss, disturbance, displacement, collision, burning and barrier effects. PV projects can also impact birds primarily through habitat loss, disturbance, displacement and collision. The magnitude of the potential effects on birds will differ between species, depending on their abundance, distribution, flight activity and behaviour in the project site. The significance of the impacts will be influenced by the conservation status and sensitivity of the species to the impacts of CSP tower and PV projects.

In the absence of detailed foraging data, and in the absence of information regarding observed impacts of CSP tower projects on this species (and on large eagles for that matter), a precautionary approach may need to be adopted which would include buffering the active Martial Eagle nest site (-28.714505°; 22.038635°) by approximately 1 km – 5 km. The final buffer distance would be determined following the completion of 12 months monitoring, final detailed data analysis, and further review of literature and best practise recommendations. The restrictions imposed within the buffers would also be finalised following monitoring, and may not necessarily indicate no-go areas. Figure 5 shows indicative circular distances from the active Martial Eagle nest site, to illustrate the distance of the nest from the proposed project infrastructure. Should detailed tracking of a Martial Eagle utilising the active nest be undertaken, the data obtained could be used to more accurately design, and potentially reduce or emit buffers.

Given the continued high levels of activity of sandgrouse and doves moving towards or away from water sources and the generally low-level flight that these birds exhibit, it is still advised that all water points be covered and leaks prevented to reduce the passage of these species through the project site and reduce the potential for these species to collide with infrastructure or suffer solar flux fatalities (i.e. 'burning'). Mitigation may also need to be designed to reduce potential impacts on sandgrouse during periods of highest activity (e.g. mornings and evenings), such as altering the position of heliostats so that solar flux is reduced in areas nearer to water at these times.

6 NEXT SURVEY CONSIDERATIONS

Apart from the recommended Martial Eagle tracking study (which will be run separately to the current monitoring project), no changes to the survey scope, design or methods are recommended for the next and final seasonal survey (autumn survey), tentatively scheduled for 28 March 2016 to 04 April 2016.

7 REFERENCES

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APPENDIX I: CUMULATIVE SPECIES LIST

Common Name	Red List Status (Taylor, 2015)	Endemic*	Priority Score (Retief et al, 2011)	Area Recorded											
				Winter				Spring				Summer			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Barbet, Acacia Pied				1	1	1		1	1	1	1	1	1	1	1
Barbet, Crested											1				1
Batis, Pririt								1	1	1		1	1	1	1
Bee-eater, European												1	1	1	1
Bee-eater, Swallow-tailed											1				
Bee-eater, White-fronted											1				
Bishop, Southern Red								1	1	1					1
Bokmakierie				1	1	1		1	1	1	1	1	1	1	1
Bulbul, African Red-eyed				1	1	1	1	1	1	1	1	1	1	1	1
Bunting, Cape				1				1			1	1	1		
Bunting, Cinnamon-breasted				1											
Bunting, Golden-breasted								1	1						
Bunting, Lark-like				1	1	1	1	1	1	1		1	1	1	
Bustard, Kori	NT		260	1	1	1		1	1	1		1	1		1
Bustard, Ludwig's	EN		320	1	1										
Canary, Black-headed		X		1											
Canary, Black-throated				1	1			1	1			1	1	1	
Canary, White-throated				1	1							1	1	1	
Canary, Yellow				1	1	1		1	1	1		1	1	1	1
Chat, Ant-eating				1	1	1		1	1	1		1	1	1	1
Chat, Familiar				1	1		1	1	1		1				1
Chat, Sickle-winged		X		1	1										
Cisticola, Grey-backed							1	1							
Cisticola, Levaillant's															1
Cormorant, Reed							1				1				1
Cormorant, White-breasted							1				1				1
Coucal, Burchell's															1

Common Name	Red List Status (Taylor, 2015)	Endemic*	Priority Score (Retief et al, 2011)	Area Recorded											
				Winter				Spring				Summer			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Courser, Burchell's	VU		210					1	1			1	1		
Courser, Double-banded	NT		204					1	1			1	1		
Crombec, Long-billed				1	1			1	1	1		1	1	1	1
Crow, Pied				1	1	1	1	1	1	1	1	1	1	1	1
Cuckoo, Jacobin												1	1		1
Darter, African							1				1				1
Dove, Cape Turtle				1	1	1	1	1	1	1	1	1	1	1	1
Dove, Laughing				1	1	1		1	1	1	1	1	1	1	
Dove, Namaqua				1	1	1	1	1	1	1		1	1	1	1
Dove, Rock															1
Duck, African Black							1				1				1
Eagle, African Fish			290	1			1			1	1				1
Eagle, Black-chested Snake			230												1
Eagle, Booted			230					1	1						
Eagle, Martial	EN		350	1		1		1	1			1	1		
Eagle, Verreauxs'	VU		360	1				1				1	1		1
Egret, Little							1				1				1
Egret, Western Cattle							1								1
Eremomela, Yellow-bellied				1	1	1		1	1	1		1	1	1	
Falcon, Lanner	VU		300									1	1		
Falcon, Pygmy				1								1	1	1	
Finch, Red-headed				1				1	1			1	1	1	
Finch, Scaly-feathered				1	1	1	1	1	1	1		1	1	1	1
Fiscal, Common				1	1	1	1	1	1	1	1	1	1	1	1
Flycatcher, Fiscal		X					1	1	1	1	1				1
Goose, Egyptian							1	1			1				1
Goose, Spur-winged							1								1
Goshawk, Pale Chanting			200	1	1			1	1			1	1	1	1
Grebe, Little							1								
Guineafowl, Helmeted															1

Common Name	Red List Status (Taylor, 2015)	Endemic*	Priority Score (Retief et al, 2011)	Area Recorded											
				Winter				Spring				Summer			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Heron, Black-headed							1								1
Heron, Goliath							1				1				1
Heron, Grey							1				1				1
Hoopoe, African											1				1
Hornbill, African Grey				1	1										
Hornbill, Southern Yellow-billed								1	1						
Ibis, African Sacred							1				1				1
Ibis, Hadeda							1	1	1	1	1	1	1	1	1
Kestrel, Rock				1								1	1	1	
Kingfisher, Giant							1				1				1
Kingfisher, Malachite							1								
Kite, Black-shouldered			174				1								
Kite, Yellow-billed															1
Korhaan, Karoo	NT		240	1		1								1	1
Korhaan, Northern Black			180	1	1	1		1	1	1		1	1	1	
Korhaan, Red-crested				1	1	1		1	1	1		1	1	1	1
Lapwing, Blacksmith											1				1
Lapwing, Crowned				1	1			1	1						
Lark, Black-eared Sparrow-		X						1	1						
Lark, Eastern Clapper				1	1	1		1	1	1		1	1	1	
Lark, Fawn-coloured				1	1	1		1	1	1		1	1	1	
Lark, Grey-backed Sparrow				1	1			1	1	1		1	1	1	
Lark, Sabota				1	1	1									
Lark, Spike-heeled								1	1	1		1	1	1	
Lark, Stark's												1	1	1	
Martin, Rock				1	1	1	1	1	1	1		1	1	1	1
Mousebird, Red-faced				1	1	1		1	1	1	1	1	1	1	1
Mousebird, White-backed				1	1	1	1	1	1	1		1	1	1	1
Owl, Cape Eagle-			250					1	1						

Common Name	Red List Status (Taylor, 2015)	Endemic*	Priority Score (Retief et al, 2011)	Area Recorded											
				Winter				Spring				Summer			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Owlet, Pearl-spotted							1								1
Penduline-tit, Cape								1	1						
Pigeon, Speckled							1	1	1	1	1	1	1	1	1
Pipit, African				1	1			1	1						
Plover, Three-banded											1				
Prinia, Black-chested				1	1	1		1	1	1		1	1	1	1
Quelea, Red-billed				1	1	1		1	1	1					
Robin, Kalahari Scrub				1	1			1	1	1		1	1	1	1
Robin, Karoo Scrub										1	1				
Robin-chat, Cape							1								1
Sandgrouse, Namaqua				1	1	1	1	1	1	1		1	1	1	
Scimitarbill, Common				1	1			1	1	1		1	1	1	
Shelduck, South African											1				
Shrike, Crimson-breasted				1								1	1		
Sparrow, Cape							1	1	1		1				1
Sparrow, Great							1								1
Sparrow, House											1				1
Sparrow-weaver, White-browed				1	1	1		1	1	1		1	1	1	
Starling, Cape Glossy										1	1				1
Starling, Pale-winged				1				1							
Sunbird, Dusky				1	1	1		1	1	1		1	1	1	
Swallow, Barn												1	1	1	1
Swallow, White-throated								1	1	1	1				
Swift, Bradfield's											1				
Swift, Little				1	1			1	1	1	1	1	1	1	1
Tchagra, Brown-crowned												1	1		
Thrush, Karoo		X									1				1
Thrush, Short-toed Rock				1											
Tit, Ashy				1	1	1		1	1	1		1	1	1	1
Tit-Babbler, Chestnut-vented				1	1	1		1	1	1		1	1	1	1

Common Name	Red List Status (Taylor, 2015)	Endemic*	Priority Score (Retief et al, 2011)	Area Recorded											
				Winter				Spring				Summer			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Wagtail, African Pied											1				1
Wagtail, Cape						1	1				1				
Warbler, Namaqua		X					1								
Warbler, Rufous-eared				1	1	1		1	1	1		1	1	1	
Waxbill, Common											1	1	1		
Waxbill, Violet-eared				1	1	1						1	1	1	
Weaver, Sociable				1	1	1		1	1	1		1	1	1	1
Weaver, Southern Masked				1	1	1	1	1	1	1	1				1
Wheatear, Capped				1	1							1	1		
Wheatear, Mountain				1											
White-eye, Orange River				1	1		1	1	1	1	1	1	1		1
Woodpecker, Cardinal								1	1		1				1

** Near-endemic (i.e. ~70% or more of population in RSA) to South Africa according to the BirdLife South Africa Checklist of Birds in South Africa, 2014. 1 = Shows one or more records of a particular species and does not indicate that only one individual has been seen or that the species has only been recorded once. EN=Endangered; VU=Vulnerable; NT=Near Threatened.*

Basemapping from the Chief Directorate National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

Project Site

Control Site

Watercourse

1:500,000 Scale @ A3

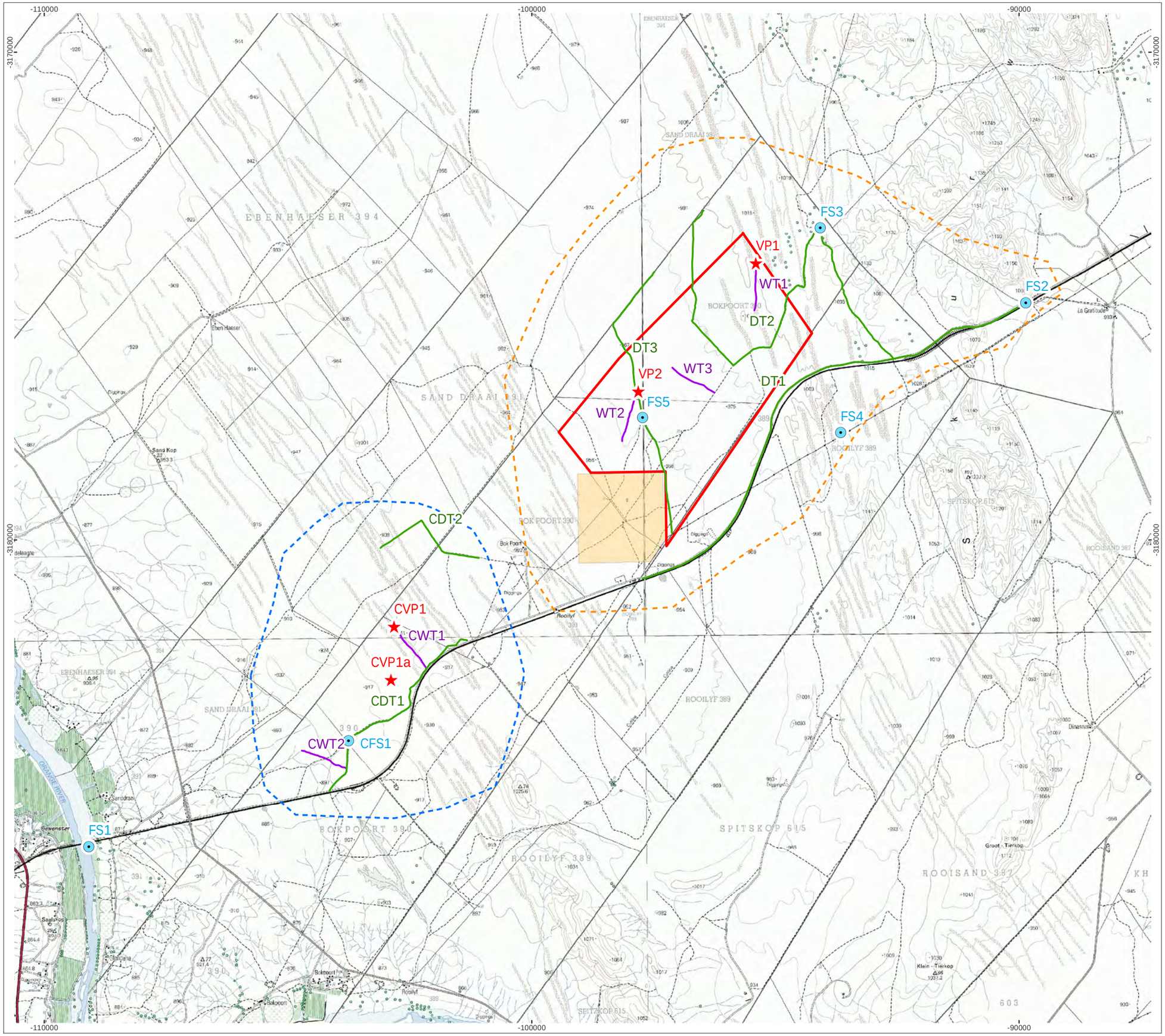
N

0 10 20 km

Produced: AT Reviewed: SC Approved: AP	Ref: 2059/REP/012 Date: 13/01/2016

Project Site and
Control Site Locations
Figure 1

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 3



Basemapping from the Chief Directorate National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

- Project Site
- Control Site
- Broader Project Area
- Bokpoort I Area
- Walked Transect
- Driven Transect
- VP Location
- Focal Site

1:75,000 Scale @ A3

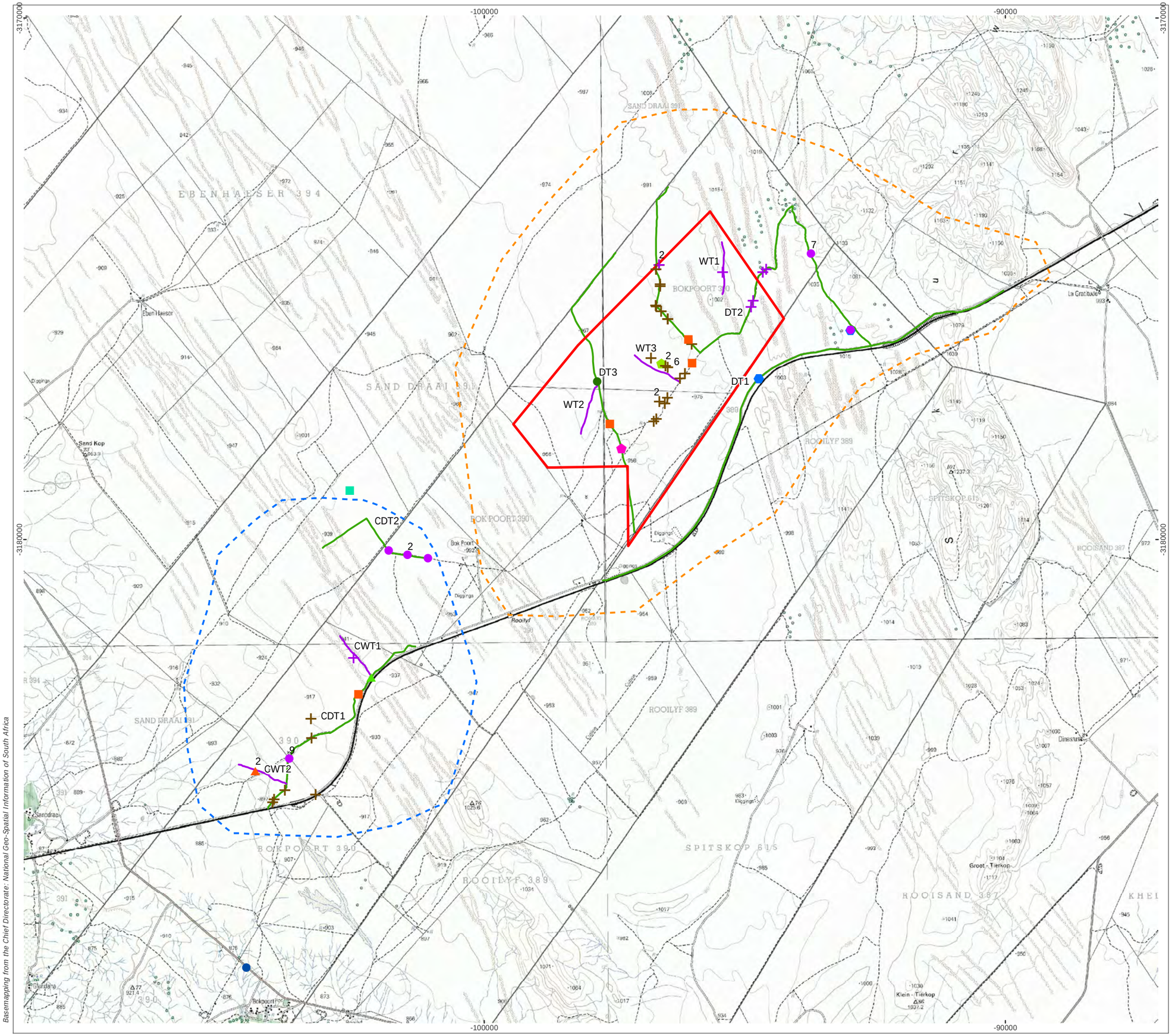
N

0 1.5 3 km

Produced: AT Reviewed: SC Approved: AP	Ref: 2059/REP/013
	Date: 20/01/2016

Vantage Point, Focal Site, Driven and Walked Transect Locations
Figure 2

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 3



Basemapping from the Chief Directorate: National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

- Project Site
- Control Site
- Broader Project Area
- Walked Transect
- Driven Transect
- Burchell's Courser
- Karoo Korhaan
- Kori Bustard
- Lanner Falcon
- Martial Eagle
- Northern Black Korhaan
- Pale Chanting Goshawk
- Pied Crow
- Pygmy Falcon
- Red-crested Korhaan
- Rock Kestrel
- Verreaux's Eagle

1:70,000 Scale @ A3

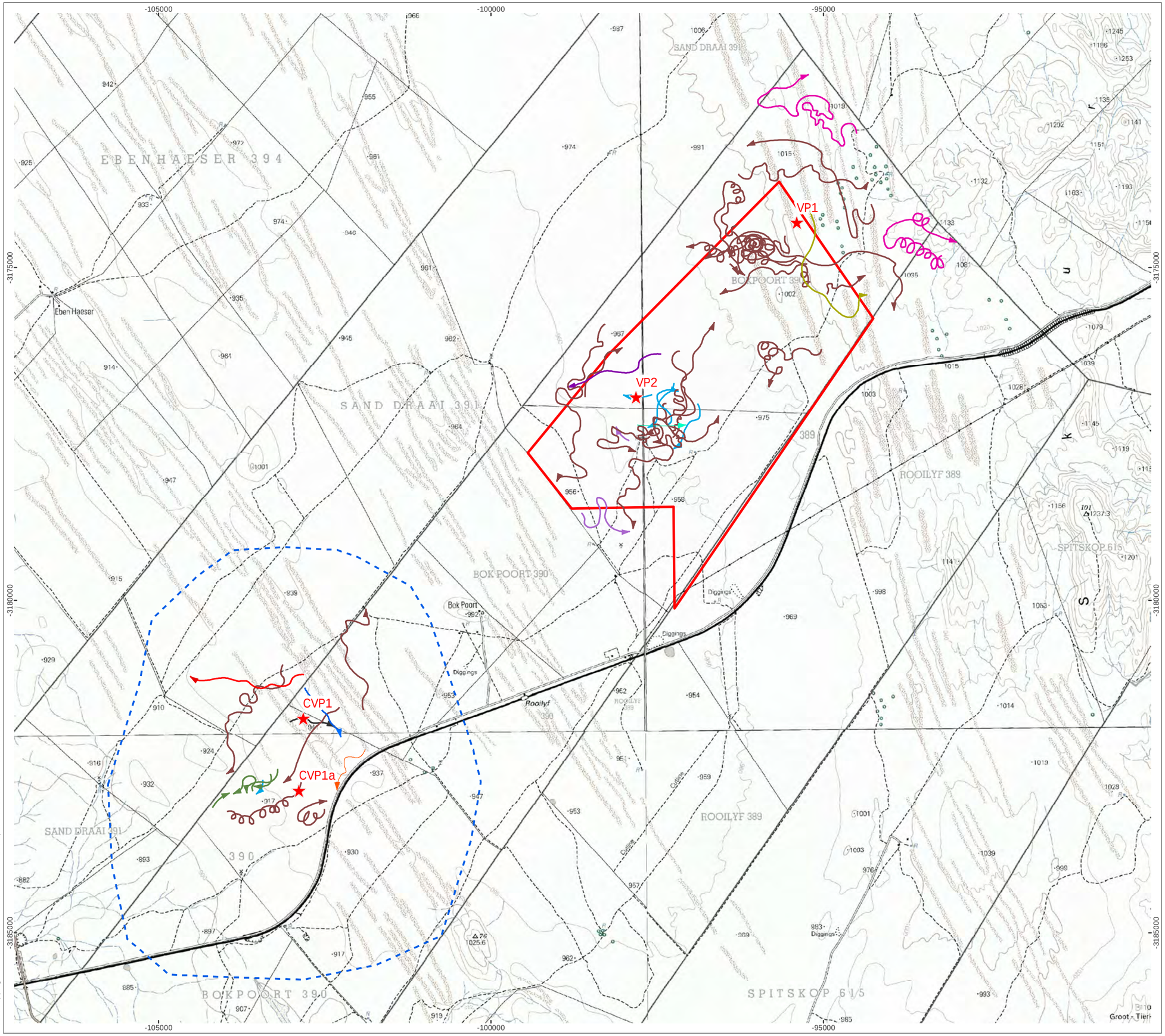
0 1 2 km

N

Produced: AT Reviewed: SC Approved: AP	Ref: 2059/REP/014 Date: 20/01/2016

Drive Transect, Selected Walk Transect and Incidental Target Species Records
Figure 3

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 3



Basemapping from the Chief Directorate National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

- Project Site
- Control Site
- VP Location
- Cape Turtle Dove Flight
- Hadeda Ibis Flight
- Kori Bustard Flight
- Laughing Dove Flight
- Lanner Falcon Flight
- Namaqua Dove Flight
- Northern Black Korhaan Flight
- Pale Chanting Goshawk Flight
- Pied Crow Flight
- Speckled Pigeon Flight
- Unidentified Species Flight
- Verreaux's Eagle Flight

1:55,000 Scale @ A3

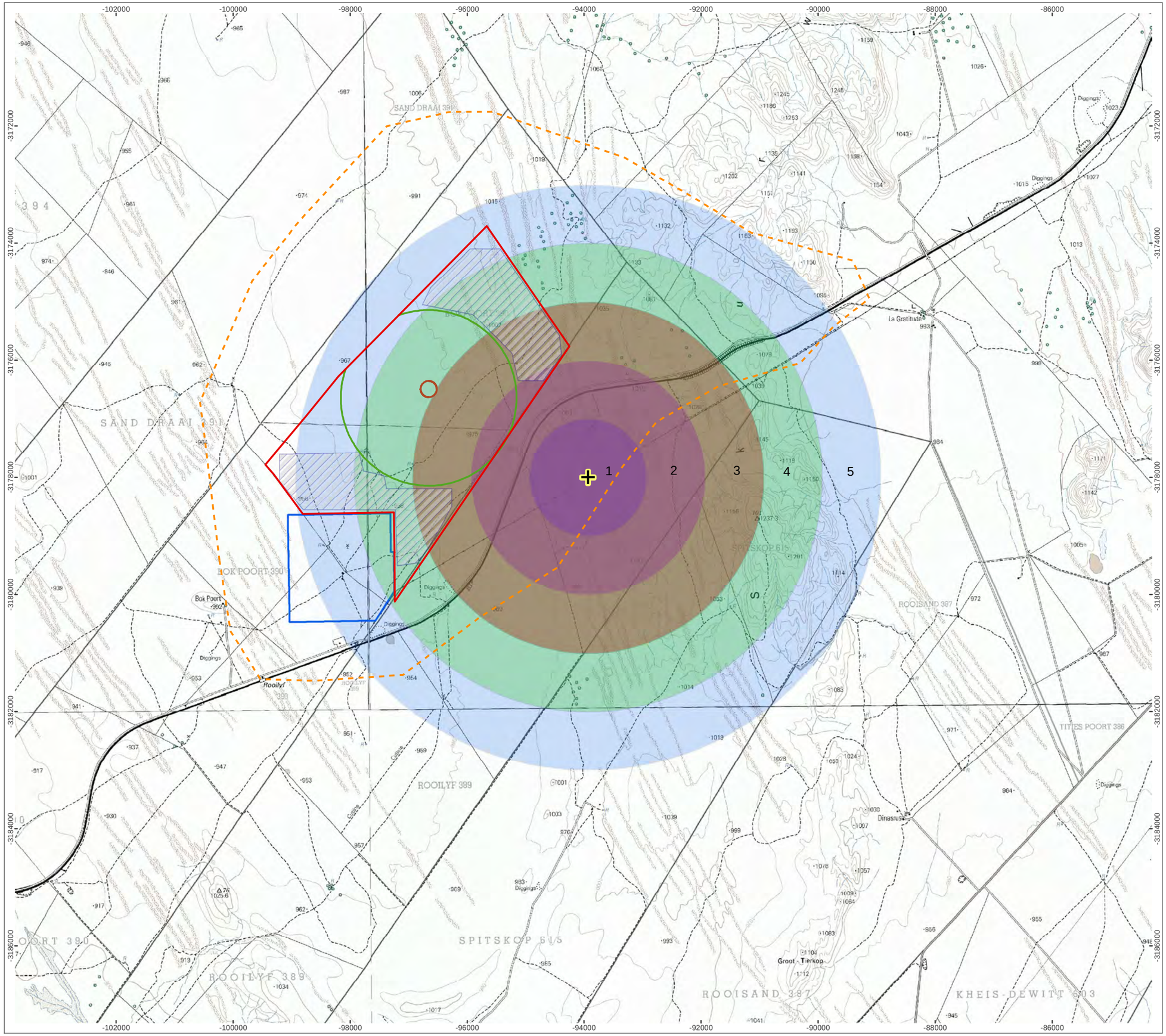
N

0 1 2 km

Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/015 Date: 20/01/2016

Selected Target Species Flights
Figure 4

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 3



Basemapping from the Chief Directorate National Geo-Sptial Information of South Africa.

ACWA POWER

ARCUS

- Martial Eagle Nest
- 1 — 0 - 1 km Distance from Nest
- 2 — 1 - 2 km Distance from Nest
- 3 — 2 - 3 km Distance from Nest
- 4 — 3 - 4 km Distance from Nest
- 5 — 4 - 5 km Distance from Nest
- Broader Project Area
- CSP Tower Area
- Heliostat Field Area
- Project Site
- Approximate PV Area

1:62,500 Scale @ A3

N

0 1.5 3 km

Produced: AT Reviewed: SC Approved: AP	Ref: 2059/REP/016 Date: 22/01/2016

Indicative Distances from Martial Eagle Nest
Figure 5

Bokpoort II Solar Farm
Pre-construction Bird Monitoring
Progress Report 3

AVIFAUNAL IMPACT ASSESSMENT REPORT: BOKPOORT II SOLAR FARM

On behalf of

ACWA Power Africa Holdings (Pty) Ltd

May 2016

Prepared By:

Arcus Consultancy Services

Office 220 Cube Workspace
Icon Building
Cnr Long Street and Hans Strijdom Avenue
Cape Town
8001

T +27 (0) 21 412 1529 l E AshlinB@arcusconsulting.co.za
W www.arcusconsulting.co.za

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SPECIALISTS' DECLARATION OF INDEPENDENCE AND QUALIFICATIONS

Arcus is independent and has 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 eight years' experience as an environmental management professional. 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 site visits and provided inputs to the species behaviour with regard to the analysis and interpretations of the avifauna data as an Avifauna Specialist. 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 is a professional member of the SACNSP, as detailed below:

Specialist:	Andrew Pearson (Pr.Sci.Nat)
Qualification:	BSc (hons) Conservation Ecology
Affiliation:	South African Council for Natural Scientific Professions
Registration number:	400423/11
Fields of Expertise:	Ecological Science
Registration:	Professional Member

Andrew Pearson (12 May 2016)

1 INTRODUCTION

ACWA Power Africa Holdings (Pty) Ltd (ACWA) are proposing to construct 1 x 150 MW concentrated solar power (CSP) tower and 2 x 75 MW photovoltaic (PV) plant on the Remaining Extent of Farm Bokpoort 390, Groblershoop, Northern Cape Province ('the project site'), approximately 80 km south east of Upington (Figure 1). Arcus Consultancy Services Ltd ('Arcus') have been appointed to provide avifaunal specialist input in the form of a specialist Impact Assessment Report for the project. Arcus were also appointed to conduct 12 months of pre-construction avifaunal monitoring, the results of which are presented in this report and have advised the impact assessment.

1.1 Purpose and Aims

The purpose and aims of this report is to provide:

- A confirmation of the terms of reference adopted for the avifaunal study;
- A description of the monitoring programme and the methods used as part of the Impact Assessment;
- The results of the 12 month monitoring programme;
- A description of the avifaunal baseline, including a description of avifaunal microhabitats available on the project site; and
- A description of potential predicted impacts to avifauna as well as a significance rating, impact assessment and mitigation measures.

1.2 The Project Site and Project Description

The project site is situated approximately 13 km north east of the Orange River and covers an area of approximately 1,437 ha, bordering the Bokpoort I CSP project (Figure 2) which began operations in March 2016.

ACWA are proposing to construct 1 x 150 MW concentrated solar power (CSP) tower and 2 x 75 MW photovoltaic (PV) plants. The CSP tower facility will consist of a central receiver tower (up to 250 m high) surrounded by a field of reflective mirrors, called heliostats, which track the sun and concentrate sunlight to the top of the central receiver tower. The concentrated beam is used to heat a molten salt solution that in turn, is used to heat water to create steam to power a turbine. Evaporation ponds are usually required to store water from the process, and some hazardous waste may be a by-product. The PV plants will consist of numerous rows of mounted PV panels.

The list of ancillary infrastructure within the project site, for both the PV and CSP installations, includes:

- A high voltage yard within the power station precinct;
- Water and waste water treatment facilities;
- Water storage tanks for cleaning;
- Demineralisation plant;
- Access roads (temporary and permanent, and external and internal roads);
- Maintenance, medical, administrative, services, control buildings;
- Water supply pipeline for construction and operation phase;
- Raw water pipeline and reservoirs;
- Transmission line to Eskom substation;
- Power supply for the construction phase;
- Communications mast/telecommunications facilities;
- General and hazardous waste storage and handling facilities (temporary and permanent);
- Batching plant (including concrete and asphalt);

- Construction accommodation and canteen;
- Meteorological station;
- Salt melting unit;
- Petrol station;
- Firefighting water storage tanks;
- Water pump station;
- Covered and uncovered parking;
- Rain water buffer basin;
- Rain water storage;
- Compressed air unit;
- Truck water filling station for cleaning;
- Backup diesel generator for safe shut down; and
- A new 5 km long 132 kV overhead line: Tower height = 35 m, servitude = 50 m each side.

1.3 Terms of Reference

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

- Conduct an avifaunal monitoring study for the project site, to be broadly in line with draft guidelines for bird monitoring at solar facilities in South Africa ('the solar guidelines'.
- The study must cover at a minimum the summer and winter seasons.
- The study must be include vantage point surveys as well as the recording of flight paths to consider how relevant avifauna move across the project site.
- Description of existing avifaunal baseline conditions through field and desktop research including a description of the methodology adopted;
- Identification of information gaps and limitations;
- Identification of the sensitivity of the avifaunal baseline to the development, specifically with regard to the conservation status of species;
- Identification of the Regional Red Data species present and potentially present on the project site;
- Prediction of likely potential impacts on the avifauna, including cumulative impacts, during construction and operation of the power plant and the grid connection powerline;
- Assessment of identified likely potential impacts, as well as cumulative impacts; and
- Identification of appropriate mitigation measures and monitoring requirements, or enhancement measures, to minimise impacts on avifauna or deliver enhancement from the proposed project.

2 POLICY AND LEGISLATIVE CONTEXT

The legislation relevant to this specialist field and the proposed project are as follows:

2.1 The Convention on Biological Diversity (CBD), 1993

A multilateral treaty for the international conservation of biodiversity, the sustainable use of its components and fair and equitable sharing of benefits arising from natural resources. Signatories have the sovereign right to exploit their own resources pursuant to their own environmental policies, and the responsibility to ensure that activities within their jurisdiction or control do not cause damage to the environment of other States or of areas beyond the limits of national jurisdiction. The convention prescribes that signatories identify components of biological diversity important or conservation and monitor these components in light of any activities that have been identified which are likely to have adverse impacts on biodiversity. The CBD is based on the precautionary principle which states that where there is a threat of significant reduction or loss of biological diversity,

lack of full scientific certainty should not be used as a reason for postponing measures to avoid or minimize such a threat and that in the absence of scientific consensus the burden of proof that the action or policy is not harmful falls on those proposing or taking the action.

2.2 The Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention), 1983

An intergovernmental treaty, concluded under the aegis of the United Nations Environment Programme, concerned with the conservation of wildlife and habitats on a global scale. The fundamental principles listed in Article II of this treaty states that signatories acknowledge the importance of migratory species being conserved and agree to take action to this end "whenever possible and appropriate", "paying special attention to migratory species the conservation status of which is unfavourable and taking individually or in cooperation appropriate and necessary steps to conserve such species and their habitat".

2.3 The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA), 1999

An intergovernmental treaty developed under the framework of the Convention on Migratory Species (CMS), concerned with the coordinated conservation and management of migratory waterbirds throughout their entire migratory range.

Signatories of the Agreement have expressed their commitment to work towards the conservation and sustainable management of migratory waterbirds, paying special attention to endangered species as well as to those with an unfavourable conservation status. The assessment of the ecology and identification of sites and habitats for migratory waterbirds is required to coordinate efforts that ensure that networks of suitable habitats is maintained and investigate problems likely posed by human activities.

2.4 National Environmental Management: Biodiversity Act, 2004 (Act No. 10 of 2004) – Threatened or Protected Species List (TOPS)

Amendments to the TOPS Regulations and species list were published on 31 March 2015 in Government Gazette No. 38600 and Notice 256 of 2015. The amended species list excluded all species threatened by habitat destruction and which are not affected by other restricted activities, but included the following target species that may be relevant for this study: *Endangered* – Martial Eagle, Lappet-faced Vulture, White-backed Vulture, and Ludwig's Bustard. *Protected* – Kori Bustard.

2.5 The Nature and Environmental Conservation Ordinance No 19 of 1974; Northern Cape Nature Conservation Act, 2009 (Act No. 9 of 2009)

These were developed to protect both animal and plant species within the various provinces of the country which warrant protection. These may be species which are under threat or which are already considered to be endangered and species are listed in the relevant documents. The provincial environmental authorities are responsible for the issuing of permits in terms of this legislation.

2.6 The Civil Aviation Authority Regulations, 2011

These are relevant to the issue of lighting of energy facilities which may be are relevant to bird collisions.

2.7 The Equator Principles (EPs) III, 2013

The principles applicable to the project are likely to include:

- Principle 2: Environmental and Social Assessment;

- Principle 3: Applicable Environmental and Social Standards;
- Principle 4: Environmental and Social Management System and Equator Principles Action Plan;
- Principle 5: Stakeholder Engagement;
- Principle 6: Grievance Mechanism;
- Principle 7: Independent Review ;
- Principle 8: Covenants;
- Principle 9: Independent Monitoring and Reporting; and
- Principle 10: Reporting and Transparency.

These principles, among various requirements, include a requirement for an assessment process (e.g. EIA process), an Environmental and Social Management Plan (ESMP) to be prepared by the client to address issues raised in the Assessment process and incorporate actions required to comply with the applicable standards, and the appointment of an independent environmental expert to verify monitoring information.

3 METHODOLOGY

3.1 Defining the Baseline

The baseline avifaunal environment for the broader project area was defined utilising a desk based study and informed by the results of the 12 month pre-construction monitoring programme, which included four seasonal site visits (winter, spring, summer and autumn) and was completed in April 2016. All this information was examined to determine the potential location, abundance and behaviour of avifauna which may be sensitive to development, and to understand their conservation status and sensitivity.

3.1.1 Sources of information

- Bird distribution data of the Southern African Bird Atlas Project (SABAP1; Harrison *et al*. 1997) and Southern African Bird Atlas Project 2 (SABAP2) obtained from the Avian Demography Unit of the University of Cape Town;
- Co-ordinated Water-bird Count (CWAC) project (Taylor *et al*. 1999);
- The Important Bird Areas (IBA) of southern Africa project (Marnewick *et al*. 2015);
- Avifaunal Impact Assessment Report for the neighbouring Bokpoort I project (van Rooyen, UNDATED);
- Publically available satellite imagery;
- Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor *et al*. 2015); and
- Results of the 12 month pre-construction avifaunal monitoring programme.

3.2 Identification and Rating of Potential Impacts

After collation of the baseline data from the sources of information listed above the potential impacts of the project were identified, for both the construction and operational phases. This was done by reviewing existing literature and data available (both locally and internationally) on the potential impacts of solar energy facilities on avifauna and considering the potential avifaunal community on the project site. Generally, the key potential impact types on avifauna from CSP and PV projects and associated infrastructure include: burning; collision; electrocution; disturbance and displacement; habitat destruction; water pollution; and use of large amounts water.

Once identified, the potential impacts were rated, considering all focal species, and based on set criteria and methodology as supplied to Arcus by the Environmental Assessment Practitioner (EAP) and shown in Appendix 1.

Focal species for the assessment were identified utilising the following method:

- Identification of the micro-habitats (section 4.2 below);
- Determining which species are likely to be present from the information sources;
- Identification of species which have a high likelihood of being present on, and/or utilising, the project site considering steps 1 and 2 and the findings of 12 months monitoring; and which of these species has the potential to be impacted upon by the type of development i.e. CSP, PV and associated infrastructure (based on a review of international literature and the experience and opinion of the specialist);
- Determining species conservation status or other reasons for protecting the species. This involved primarily consulting the Red data species (Taylor *et al.,* 2015).

3.3 12 Month Pre-Construction Bird Monitoring

3.3.1 Survey Design

As no formal solar facility guidelines for bird monitoring are currently in place in South Africa, the survey was designed by the avifaunal specialist to be broadly in line with the best practice guidelines for wind farms ('the guidelines[1]'). However, the specialist is aware that guidelines requiring 12 month pre-construction bird monitoring for large CSP tower projects are in development by Birdlife South Africa (BLSA) and the Birds and Renewable Energy Specialist Group (BARESG). Knowledge of these imminent solar guidelines ('the solar guidelines') and international best practise were also considered in the design of the surveys.

Due to the inherent mobility of birds, it is important to consider avifauna not only on the project site, but also the avifauna and available avifaunal microhabitats beyond the project site. Therefore, an arbitrary delineation of a 'broader project area' was done by the specialist, incorporating all relevant and important habitats, and within which the surveys would be conducted. The broader project area includes the project site and is shown in Figure 2. Supplementary data was also collected beyond the broader project area, within the Orange River Valley.

In order to provide useful comparative data in the event of the construction and operation of the project, surveys were undertaken within the broader project area (both within the project site and at variable distances from the project site) as well as at a control site. The control site, located approximately 6 km south west of the project site (Figure 2), was selected primarily on the basis of its accessibility and similarity of the predominant habitats to the project site.

The following survey types were performed in the broader project area and control site during the 12-month pre-construction surveys:

- Walked transects;
- Driven transects;
- Vantage point surveys;
- Focal site surveys; and
- Incidental observation recording.

The broader project area, project site and control site were initially visited on 2 and 3 June 2015 by the avifaunal specialist in order to confirm accessibility, identify focal sites (FS) and confirm the location of vantage points (VP), driven transects (DT) and walked transects (WT). Following this initial set up visit, four seasonal visits of 7-8 days in length were conducted during which the required surveys were completed.

[1] Jenkins *et al* (2015a)

The following definitions apply:

- Priority species: all species occurring on the BLSA and Endangered Wildlife Trust (EWT) Avian Sensitivity Map priority species list[2].
- Target species: those particular bird species that were recorded by a specific survey method.
- Target species per survey method:
  - Walked transects: all birds;
  - Driven transects: all raptors; all large (non-passerine) priority species; corvids[3] (crows and ravens); hornbills; korhaans; waterfowl (e.g. geese and ducks) and lapwings.
  - Vantage point surveys: all raptors; all large (non-passerine) priority species; corvids (crows and ravens); doves; ibises; hornbills and korhaans. Sandgrouse, aerial foragers and flocking species (e.g. swallows, swifts and martins) and larks (display flights only), were recorded for additional information, however their flight paths were not mapped[4].
  - Incidental observations: all red-listed species (Taylor, 2015); all raptors; all large (non-passerine) priority species; coursers; hornbills; korhaans; and
  - Focal sites: all species associated, utilising or interacting at/with the focal site.

3.3.2 Survey Methodology

Four seasonal surveys were carried out: winter (03-11 June 2015); spring (14-21 September 2015); summer (07 and 14 December 2015); and autumn (01-08 April 2016).

3.3.2.1 Walked Transects

The purpose of the walked transect surveys was to estimate bird populations and densities across the site, with a particular focus on small terrestrial species and passerines. Three walked transects were established and conducted on the project site as well as two walked transects on the control site, referred to as control walked transects (CWT) (Figure 2). Each transect was 1 km in length and was conducted twice during each seasonal survey, resulting in eight replications of each transect across the monitoring programme.

Two observers walked between the start and end points of the transects whilst recording all birds seen or heard up to 250 m on either side of the transect. The perpendicular distance in meters to the transect line was noted as well as number and age of individuals, their behaviour and if they were seen or heard. Beyond 250 m, only priority species were noted and were recorded as incidental sightings. Locations, dates and times of the WT are presented in Appendix II.

To estimate density Index of Kilometric Abundance (IKA) values were calculated by taking the sum of the number of individual birds observed per 1 km transect over each season divided by the number of seasons. Species richness reports the average number of species recorded per transect over each season.

[2] Retief, E, Anderson, M., Diamond, M., Smit, H., Jenkins, A. & Brooks, M. (2011) Avian Wind Farm Sensitivity Map for South Africa: Criteria and Procedures used. Priority species list updated in 2014 by BLSA. This list consists of 107 species with a priority score of 170 or more. The priority score was determined by BLSA and EWT after considering various factors including bird families most impacted upon by Wind Energy Facilities (WEFs), physical size, species behaviour, endemism, range size and conservation status.

[3] Except in the final autumn survey where observers did not regard corvids as DT target species.

[4] Except during the first winter survey where flights of Namaqua Sandgrouse and Eastern Clapper Lark were mapped.

3.3.2.2 Vantage Points

Two vantage points were surveyed in the project site (VP1 and VP2), and one in the control site (CVP1)[5] (Figure 2).

Observer pairs monitored a viewshed of 360 degrees with a radius of 2.25 km from each VP. These viewsheds were the focus of observation, however if target species were noted beyond these (or if a species being recorded flew out of the viewshed but was still visible), they were also recorded. For each flight of a target species (except for sandgrouse, larks, and aerial foraging species) the flight path was recorded on a large scale map along with data on the number/species of bird(s) and type of flight.

Where flight paths were recorded, flight heights were recorded through five height bands[6]: 1: <10 m; 2: 10-90 m; 3: 90-210 m; 4: 210-260 m and 5: >260 m. Each VP was surveyed for a total of 12 hours[7], each seasonal survey. This was done by surveying for three hours over four separate sessions, where possible spread over different days and different times of the day, per VP. Therefore a total of approximately 144 hours of VP observations was carried out on the project and control sites during the 12 month programme. The co-ordinates of the VPs and the total hours surveyed are presented in Table 1 below.

Average passage rates and standard deviations (SD) were calculated as the average number of individuals recorded flying per hour of vantage point observations.

Table 1 Geographic Positions of Vantage Points and Seasonal Survey Durations.

VP	Co-ordinates		Winter	Spring	Summer	Autumn	Total time surveyed
	South	East					
1	-28.680720°	22.023860°	12 h	11.5 h*	12 h	12 h	*47.5 h*
2	-28.705130°	21.998984°	12 h	12 h	12 h	12 h	*48 h*
CVP1	-28.747820°	21.947270°	12 h	12 h	9 h	12 h	*45 h*
CVP1a	-28.757870°	21.946440°	-	-	3 h	-	*3 h*
		Total	*36 h*	*35.5 h*	*36 h*	*36 h*	*143.5 hours*

**The final session at VP1 in spring was stopped after 2.5 hours due to a lightning storm. h=hours*

3.3.2.3 Driven Transects

Driven transect target species were sampled using five driven transects (Figure 2), three in the broader project area and two on the control site. Two observers conducted each transect twice during each seasonal survey, resulting in eight replications of each transect across the monitoring programme. Transects were conducted by a pair of observers driving slowly (approximately 30 km/h) with the vehicle windows open, and stopping regularly to scan surrounding open areas. All target species were recorded, along with the geographical location of the observers for each record where possible.

DT1 runs near the southern and eastern boundary of the project site, following the railway line and service road. Two drive transects traverse the project site and broader project area up to 2 km from the project site (DT2 and DT3). Two drive transects (CDT1 and CDT2) run on and around the control site. Locations, dates and times of the driven transects are presented in Appendix III.

[5] In summer the final three hour session for CVP1, was carried out at an alternative location (CVP1a) approximately 1 km south west of CVP1 to allow vehicular access (and prevent the need to walk through thick sand for over 2 km) for safety reasons due to extreme heat.

[6] Note, this constitutes a change in methodology. Following the second season of monitoring, new information was supplied which showed a change in the proposed CSP tower height to 250 m. The height bands used in season 1 and 2 were: 1: <10 m; 2: 10-90 m; 3: 90-170 m; 4: 170-210 m and 5: >210 m, based on tower height of 200m.

[7] VP 1 was surveyed for 11.5 hours in spring due to interruptions by a lightning storm.

3.3.2.4 Focal Sites

Focal sites are any identifiable features within the landscape that are likely to support notable avifauna (e.g. a roost or nesting site) or have the potential to support breeding pairs or large densities of avifauna (e.g. dams, wetlands, river systems) and these sites may change as monitoring progresses and other focal sites become evident.

Prior to the first seasonal survey (winter), three focal sites (FS1-FS3) were identified in the broader project area, and one on the control site (CFS1). For the second, third and fourth seasonal surveys, focal site monitoring was conducted at an additional two focal sites (FS4 and FS5) (Table 2). Each season, each focal site was surveyed twice for a period of 15 minutes at a time, during which target species were counted and any relevant notes were taken.

Table 2 Focal Site Positions, Descriptions and the Seasons Surveyed.

Focal Site	Co-ordinates		Description	Winter	Spring	Summer	Autumn
	South	East					
FS1	-28.788022°	21.882755°	View of the Orange River from the eastern bank, including open water, islands, banks, rocks and reed bed habitats. Rail bridge over river.	✓	✓	✓	✓
FS2	-28.688900°	22.080510°	Two cliff faces (north and south) approximately 450 m apart, viewed from the same point (FS2). Northern cliff face has two Verreaux's Eagle nest structures, while southern face has one.	✓	✓	✓	✓
FS3	-28.674830°	22.037520°	Reservoir and water trough fed by windmill pump[8], with surrounding 'kraal' and trees.	✓	✓	✓	✓
FS4	-28.714505°	22.038635°	Martial Eagle nest, on top off a Sociable Weaver nest, on a power line tower.		✓	✓	✓
FS5	-28.71024°	21.99956	Reservoir and water troughs fed by windmill pump, with surrounding 'kraal' and trees.		✓	✓	✓
CFS1	-28.768900°	21.937500°	Reservoir and water trough fed by windmill pump, with surrounding 'kraal' and trees.	✓	✓	✓	✓

3.3.2.5 Incidental Records

Relevant observations of target species were recorded while commuting to or from, or in the broader project area and control site, but outside the survey protocols and times described above.

3.4 Assumptions and Limitations

- The SABAP1 data covers the period 1986-1997. Bird distribution patterns can change regularly according to availability of food and nesting substrate. (For a full discussion of potential limitations in the SABAP1 data, see Harrison *et al*. 1997).
- There is still limited information available on the environmental effects of large scale solar energy facilities in South Africa. No operational monitoring reports (detailing impacts) were available for operational facilities in South Africa. Therefore, estimates of impacts are mostly based on knowledge gained internationally, which should be applied with caution to local species and conditions.
- While sampling effort was as recommended in the solar guidelines, to achieve statistically powerful results it would need to be increased beyond practical possibilities.

[8] In spring and summer, the pump was broken and there was no water present.

The data was therefore analysed at a relatively basic level and interpreted using a precautionary approach.
- Relatively dry, drought conditions were experienced during the year of monitoring, and the study was therefore not able to consider the effects of inter-annual variation in avifauna, for example following a good rain season.

4 BASELINE ENVIRONMENT

4.1 Vegetation and Land Use

The project site is situated within the arid Northern Cape Province, within the Nama Karoo Biome. The most prominent vegetation type on the project site is Kalahari Karroid Shrubland, while elements of Gordonia Duneveld are present (Mucina and Rutherford, 2006; Figure 6). Other vegetation types present in the broader project area include Oliphantshoek Plains Thornveld and Koranna-Langeberg Mountain Bushveld. Land use in the project site is predominantly stock farming. In the broader project area, there is also game farming/ranching, while agricultural activities (e.g. vineyards) are present in the Orange River Valley.

4.2 Bird Micro-habitats

It is important to consider habitats that are generally evident at a much smaller spatial scale than vegetation types, and are determined by a host of factors such as vegetation type, topography, land use and man-made infrastructure. Inspection of the broader project area, control site and surrounding areas, revealed the presence of the following bird micro-habitats.

4.2.1 Kraals and Associated Reservoirs and/or Water Troughs

Through overgrazing and the clearance of vegetation by livestock at these feeding and watering points, a microhabitat favoured by certain species has been created. Species such as doves, finches, buntings, canaries, wagtails and sandgrouse are attracted to the water troughs to drink or bathe, while the open areas surrounding water points may be favoured by terrestrial species such as coursers, lapwings, korhaans and passerines such as larks, buntings and sparrowlarks.

4.2.2 Thornveld/Scrubland

Much of the project site consist of relatively bushy areas with scattered small to medium sized trees, scrubs and thickets, which can be broadly described as thornveld or scrubland. Although some of the natural scrubland/thrornveld is disturbed, these areas may attract numerous smaller passerine species such as finches, chats, doves, sunbirds, mousebirds, canaries, buntings, larks, batis, warblers, bulbuls, and tits, many of which would use the trees and bushes as structures for nesting. Raptors such the Southern Pale Chanting Goshawk and Lanner Falcon may use larger trees for perching, while a variety of other raptors may forage and hunt in these areas. Northern Black Korhaan and Red-crested Korhaan may also be found in this habitat.

4.2.3 Open Grassy Scrubland

Some open and grass covered scrubland areas are also present. This habitat is similar to the one described above (4.2.2) but with fewer bushes and trees, and more open. These more open scrubland areas would be favoured by Northern Black Korhaan and Bustards. Secretarybird may also utilise these areas along with numerous passerines that tend to favour open areas such larks, pipits, and chats.

4.2.4 Drainage Lines and Rivers

Although there may be some drainage lines present in the hills to the north east of the project site which may occasionally hold water, and in proximity to the Orange River, none were recorded on the project site. An examination of the National Freshwater Ecosystem Priority Areas (NFEPA) rivers and wetlands database, revealed no NFEPA rivers or wetlands on the project site. The closest watercourse is the Orange River, approximately 13 km south west of the project site. African Fish Eagle are resident on this river, and may occasionally forage/fly further afield and pass over the project site.

Drainage lines and rivers are often associated with trees and thickets, and as such may be important to a host of passerine species, as they are often used as fly-ways for various species e.g. ducks, herons, geese and ibises.

4.2.5 Hills and Ridges

Although limited on the project site, rocky hills and ridges are prevalent in the broader project area, particularly to the north east, east and south east of the project site. These areas are associated with 'denser' more 'woody thicket' vegetation and thus would be utilised by a variety of common passerines. Where rock ridges and cliffs are present, raptors such as Verreaux's Eagle may be attracted to the Rock Hyrax (if present) prey source. Raptors such as Rock Kestrel and Martial Eagle may hunt over hills and ridges and use slopes to 'gain lift' and for slope soaring.

4.2.6 Open Gravel Plains

Gravel plains are a patchy, yet important habitat for birds in the arid north and north-west of South Africa. Gravel plains are present in the central and south western areas of the project site, generally running across the site in a north-south direction. These areas are generally devoid of vegetation or sparsely vegetated, although patches of bush and isolated trees or clumps of trees, may be present. Species such as larks, sandgrouse and chats are found in these open areas along with other passerines. Important species utilising this habitat included Burchell's Courser, Double-banded Courser and Ludwig's Bustard.

4.2.7 Duneveld

Dunes are present in the north-east of the project site and in the broader project area, as well as to the west of the project site and in the control site. These areas are made up of long ridges of dunes running generally in a north-south direction. The dunes are relatively well vegetated with trees, grasses and scrub. Species that may favour these areas include Kori Bustard, Red-crested Korhaan, Fawn-coloured Lark as well as numerous common passerines utilising the grassy and woody vegetation such as tit-babblers, canaries, warblers, buntings, doves, waxbills and finches. Duneveld may also be utilised for foraging and hunting by raptor such as Lappet-faced Vulture, Martial Eagle, Greater Kestrel, and Black-chested Snake-Eagle.

4.3 Results of the Avifaunal Community Desktop Study

4.3.1 Southern African Bird Atlas Project 1

The SABAP1 data (Harrison *et al.*,1997) was collected between 1986 and 1997 and, although somewhat outdated, is one of the best long term data sets on bird distribution and abundance available in South Africa at present. A total of 117 species were recorded in the quarter degree squares 2821DB and 2822CA, within which the project site is situated (Figure 2). This included 14 raptors, 11 priority species, six endemic or near-endemic species and five species with a regional Red Data Status (Taylor *et al.* 2015), detailed in Table 3 below.

Table 3 Raptors, endemic or near-endemic and Priority Species (Retief et al. 2011) recorded by SABAP1 in the Quarter Degree Squares.

Quarter Degree Square				2821DB	2822CA
Number of cards				*8*	*10*
Number of species				*101*	*61*
Species	Regional red data status (Taylor *et al.* 2015)	Endemic or near-endemic *	Priority species score	Reporting rate (%)**	
Eagle, Verreaux's	VU		360		20
Eagle, Martial	EN		350	13	
Vulture, Lappet-faced	EN		310		10
Vulture, White-backed	EN		300		10
Falcon, Lanner	VU		300		30
Eagle, African Fish			290	13	
Eagle, Booted			230	13	
Goshawk, Pale Chanting			200	25	10
Kestrel, Greater			174		20
Kite, Black-shouldered			174	25	40
Owl, Spotted Eagle-			170		10
White-eye, Cape (Pre-split)		x		25	10
Flycatcher, Fairy		x		25	
Flycatcher, Fiscal		x		13	
Warbler, Namaqua		x		25	
Starling, Pied		x			60
Kestrel, Rock					30
Owl, Western Barn				13	
Owlet, Pearl-spotted				25	

*EN = Endangered; VU = Vulnerable. * Endemic or near endemic (i.e. ~70% or more of population in RSA) to South Africa (not southern Africa as in field guides) or endemic to South Africa, Lesotho and Swaziland. Taken from BirdLife South Africa Checklist of Birds in South Africa, 2014.**Reporting rates are percentages of the number of times a species was recorded in the square, divided by the number of times that square was counted. It is important to note that these species were recorded in the entire quarter degree square in each case and may not actually have been recorded on the proposed project area.*

4.3.2 Southern African Bird Atlas Project 2

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). SABAP2 data was examined for the pentads (which are roughly 8 km x 8 km squares, and are smaller than the squares used in SABAP1) 2840_2200, 2835_2200, 2840_2155, 2835_2155 and 2840_2205 (Figure 2). The number of counts conducted in these pentads was generally low, with three out of the five pentads only having one submitted card (i.e. counted/sampled once). A total of 90 species have been recorded by SABAP2 in the pentads listed. These species included seven priority species, six raptors, five species with Red Data Status (Taylor *et al.* 2015) and two endemic or near-endemic species (detailed in Table 4 below).

Table 4 Raptors and Priority Species (Retief et al. 2011) Recorded in the SABAP2 Pentad Squares Covering the Project Site and the Immediate Surrounding Area.

Pentad number				2840_2200	2835_2200	2840_2155	2835_2155	2840_2205
Number of cards				*1*	*3*	*1*	*1*	*4*
Number of species				*47*	*65*	*45*	*29*	*69*
Species	Regional red data status (Taylor *et al.* 2015)	Endemic or near-endemic	Priority species score	Reporting rate (%)**				
Eagle, Verreaux's	VU		360	100		100		
Falcon, Lanner	VU		300					50
Bustard, Kori	NT		260		66.67	100	100	50
Courser, Double-banded	NT		204			100	100	
Pipit, African Rock	NT	x	200	100	66.67			100
Goshawk, Pale Chanting			200		66.67			75
Korhaan, Northern Black			180		66.67	100	100	
Tit-Babbler, Layard's		x		100				100
Falcon, Pygmy					33.33			50
Kestrel, Rock				100	33.33			75
Owl, Western Barn				100				

*SABAP2 data as accessed on 04 April 2016. VU = Vulnerable; NT = Near-threatened. **Reporting rates are essentially percentages of the number of times a species was recorded in the pentad, divided by the number of times that pentad was counted. It is important to note that these species were recorded in the entire pentad in each case and may not actually have been recorded on the proposed project area.*

4.3.3 Coordinated Waterbird Count (CWAC) Data

The location of possible CWAC site was examined and it was found that there are no CWAC locations within 100 km of the proposed project site. It is unlikely that numbers of key waterbird species potentially present at CWAC sites further than 100 km from the project site would regularly interact with the project site, and therefore information from this source was no longer considered.

4.3.4 Coordinated Avifaunal Road-count (CAR) Data

There are no CAR routes within 100 km of the proposed project site. It is unlikely that numbers of key species recorded on CAR routes further than 100 km from the project site would regularly interact with the project site, and therefore information from this source was no longer considered.

4.3.5 Important Bird Area (IBA) Project

IBAs are sites of global significance for bird conservation. They are identified nationally by experts using globally standardised and scientifically agreed criteria. These are based on the significant presence of globally and regionally threatened bird species, assemblages of restricted-range and biome-restricted species, and large concentrations of congregatory species (Marnewick *et al*. 2015). Since the late 1970s, more than 12 000 IBAs have been

identified in virtually all of the world's countries and territories, both on land and at sea. In 1998, 122 South African IBAs were identified and listed in Barnes (1998). This inventory was revised to 112 IBAs in 2015 (Marnewick *et al*. 2015).

There are no IBAs within 150 km of the proposed project site. It is unlikely that numbers of key species potentially present at IBA's further than 150 km from the project site would regularly interact with the project site, and therefore information from this source was no longer considered.

4.4 12 Month Pre-construction Monitoring Results

4.4.1 Walked Transects

The purpose of the walked transect surveys is to estimate small bird populations and densities, and the method used was found to be suitable in all of the habitats surveyed.

In the broader project area bird numbers were variable across the three walked transects, ranging from 42.5 to 84.88 birds per kilometre transect, with an overall average of 64.83 64.83 (SD±46.85) (Table 5). The mean number of species per transect was 14.04 (SD±3.53) in the broader project area. The transects on the control site had slightly fewer birds and species on average per kilometre resulting in a mean IKA for all birds of 61.38 (SD±32.64) and a mean number of species per kilometre transect of 11.31 (SD±3.93).

Table 5: Summary of 1 km walked transect results across all seasons.

Transect Ref.	IKA* (all birds)	IKA (target species)	Species richness
	Mean ± SD	Mean ± SD	Mean ± SD
WT1	42.5 (±12.32)	0.5 (±0.76)	13.25 (±2.94)
WT2	67.13 (±70.09)	0.5 (±0.53)	12.38 (±3.16)
WT3	84.88 (±33.34)	2.38 (±2.13)	16.63 (±3.25)
WT Total	64.83 (±46.85)	1.13 (±1.57)	14.04 (±3.53)
CWT1	51.25 (±36.64)	0.88 (±1.13)	11.88 (±4.76)
CWT2	71.5 (±25.57)	0.63 (±0.74)	10.75 (±3.11)
CWT Total	61.38 (±32.64)	0.75 (±0.93)	11.31 (±3.93)

**IKA: Index of Kilometric Abundance = Birds/km; SD = Standard Deviation*

On the project site, 732 observations were made totalling 1557 individual birds (including observations of flocks of approximately 100 birds) and 48 species during 24 WT surveys conducted over the 12 month period (i.e. each of the three WTs were conducted on 8 occasions each). On the control site 47 species were recorded in 415 observations totalling 982 birds during 16 WT surveys. An observation occurs whenever a target species is observed (seen or heard), and may include one or more than one bird of the same target species.

WT3 resulted in the highest number of observations (334) and birds (679). All five transects across the project site and control site recorded similar numbers of species, ranging from 33 species on WT1 to 39 species on CWT2.

Generally, the species seen across transects were similar, within certain common species being abundant on all transects such as Black-chested Prinia, Eastern Clapper Lark, Fawn-

coloured Lark, Kalahari Scrub-robin, Scaly-feathered Finch, Yellow Canary, Lark-like Bunting, Namaqua Sandgrouse and Namaqua Dove.

While both Burchell's Courser [red-listed as Vulnerable (Taylor, 2015)] and Double-banded Courser (Near-threatened) were observed on a gravel patches during WTs in spring (on WTS 3 and 2 respectively), no coursers were recorded during the other seasons. This is most likely due to the secretive and cryptic nature of these birds, rather than them being absent in those seasons.

Table 6 shows a summary of results from each walked transect conducted on the control and project sites. The priority species recorded were Kori Bustard, Ludwig's Bustard, Northern Black Korhaan, Karoo Korhaan, Burchell's Courser, Double-banded Courser, all of which are red data species apart from Northern Black Korhaan. The locations of the observers when recording these species during the walked transects are displayed in Figures 3a and 3b along with the other incidental and drive transect target species records.

Other species deemed relevant and important to highlight were African Darter (a largely water dependent species) Red-Crested Korhaan and Namaqua Sandgrouse, with the latter being particularly abundant.

Table 6 Small Terrestrial Species Transect Results

Transect Name	Total Observations (Number of Individual Birds)	Total Species	Priority species (P), Red data species (Status)* or Focal species (F)	Frequently recorded and/or abundant.
WT1	223 (341)	33	Red-crested Korhaan (F), Namaqua Sandgrouse (F).	Black-chested Prinia, Chestnut-vented Tit-babbler, Dusky Sunbird, Eastern Clapper Lark, Fawn-coloured Lark, Grey-backed Sparrowlark, Kalahari Scrub-Robin, Lark-like Bunting, Long-billed Crombec, Namaqua Dove, Namaqua Sandgrouse, Pririt Batis, Scaly-feathered Finch.
WT2	175 (537)	35	Ludwig's Bustard (P, EN), Double-banded Courser (P, NT), Northern Black Korhaan (P), Namaqua Sandgrouse (F).	Acacia Pied Barbet, Black-chested Prinia, Cape Turtle Dove, Capped Wheatear, Chestnut-vented Tit-Babbler, Eastern Clapper Lark, Fawn-coloured Lark, Lark-like Bunting, Kalahari Scrub-robin, Namaqua Sandgrouse, Red-faced Mousebird, Red-headed Finch, Rufous-eared Warbler, scaly-feathered Finch, Sociable Weaver, Yellow Canary, Yellow-bellied Eremomela.
WT3	334 (679)	37	Ludwig's Bustard (P, EN), Kori Bustard (P, NT), Burchell's Courser (P, VU), Northern Black Korhaan (P), Red-crested Korhaan (F), Namaqua Sandgrouse (F).	Ant-eating Chat, Black-chested Prinia, Cape Turtle Dove, Chestnut-vented Tit-Babbler, Common Fiscal, Dusky Sunbird, Eastern Clapper Lark, Fawn-coloured Lark, Kalahari Scrub-robin, Lark-like Bunting, Namaqua Dove, Namaqua Sandgrouse, Northern Black Korhaan, Pied Crow, Pririt Batis, Red-faced Mousebird, Scaly-feathered Finch, Yellow Canary, Yellow-bellied Eremomela.
CWT1	224 (410)	37	Northern Black Korhaan (P), Red-crested Korhaan (F), African	Barn Swallow, Black-chested Prinia, Chestnut-vented Tit-babbler, Dusky Sunbird, Eastern Clapper Lark, Fawn-coloured Lark, Grey-backed Sparrow-lark, Kalahari Scrub-

Transect Name	Total Observations (Number of Individual Birds)	Total Species	Priority species (P), Red data species (Status)* or Focal species (F)	Frequently recorded and/or abundant.
			Darter (F), Namaqua Sandgrouse (F).	robin, Lark-like Bunting, Namaqua Dove, Namaqua Sandgrouse, Red-crested Korhaan, Red-eyed Bulbul, Red-billed Quelea, Scaly-feathered Finch, Yellow Canary, Yellow-bellied Eremomela.
CWT2	191 (572)	39	Kori Bustard (P, NT), Karoo Korhaan (P, NT), Northern Black Korhaan (P), Namaqua Sandgrouse (F).	Black-chested Prinia, Eastern Clapper Lark, Fawn-coloured Lark, Grey-backed Sparrow-lark, Kalahari Scrub-robin, Lark-like Bunting, Namaqua Sandgrouse, Red-billed Quelea, Scaly-feathered Finch, Southern Red Bishop, Spike-heeled Lark, Yellow-bellied Eremomela.

**Red List (Taylor, 2015) status: EN=Endangered. VU= Vulnerable. NT=Near Threatened. F=Focal species deemed relevant and important to highlight by the specialist. P=priority species (Retief et al. 2011. Updated 2014).*

4.4.2 Vantage Points

A total of 383 birds of 19 target species were recorded by observing a total of 263 flight paths (i.e. one flight path may include a number of birds = flock) during the VP monitoring over 12 months (i.e ~144 hours of observation time) at both the broader project area and control sites.

It must be noted that separate flight paths may have been conducted by the same bird/s and that the figures presented here are not an indication of abundance, but rather flight activity. Flight paths of selected target species in both the broader project area and control sites are shown in Figures 4a -4c.

Tables 7 and 8 present summaries of the flight activity data[9] of each target species for the broader project area and control site respectively. Nineteen species were recorded from VPs in the broader project area represented by 269 birds in 179 flight paths. Eight positively identified species were recorded from VPs in the control site represented by 114 birds in 75 flight paths.

In the broader project area, Pied Crow (56 flight paths) was the most recorded species during VP watches. This was followed closely by Namaqua Dove with 52 recorded flights, the majority of flights being short, low and direct. Together these two species represent 60 % of all flight paths recorded.

A total of 37 raptor flights were recorded in the broader project area, of which 24 were by Pale Chanting Goshawk (including numerous flights of the same individuals of a pair frequenting the area around VP2). One of the three Verreaux's Eagle flights was of two birds (a male and female), one was of three birds (of undetermined sex and age but most likely by the same adult pair, and a juvenile) and both flights were relatively long; 7min 15sec and 8min respectively. The third flight was of a juvenile only. Flights of Verreaux's Eagle were primarily outside of the proposed project site (Figure 4b). Two flights of Martial

[9] These figures exclude flights of Namaqua Sandgrouse and Eastern Clapper Lark, initially identified as VP target species, the flight paths of which were recorded and mapped in the first (winter) seasonal survey only. Difficulties in locating calling/displaying larks, and accurately mapping flights of these birds beyond a certain distance, along with high numbers of flights of Sandgrouse, made it impractical to continue mapping these birds, and in subsequent seasons their presence was recorded, but their flight paths were not mapped and flight numbers were not recorded.

Eagle were recorded in the Broader Project Area, one of which was entirely outside of the project site. A significant record was two flights in autumn of Lappet-faced Vulture, totalling 7 separate birds. The seven birds were essentially in one group, with two birds appearing before the other five were located, and hence were recorded separately.

Flights of 10 priority species, including five regionally red listed species, were recorded in the broader project area. Although the number of flights of these species was low (40 flights or 22 % of all recorded species), they are important to note due to the status of the species.

Analysis of flight paths in the broader project area indicates that 98 % of flights included at least some time below 260 m. The CSP tower will be approximately 250 m in height, and it is therefore assumed that flights below 260 m may be more susceptible to collision and/or burning impacts, with flights in height band 4 (210 m – 260 m) at most risk of burning impacts. Twenty-one flights (11 %) included time in height band 4, indicating that the majority of flights recorded (89%) were lower and entirely in height bands 1 -3. The data in table 6 shows that Pied Crow, with 13 flights in height band 4, is likely to be at highest risk of burning impacts. The two Martial Eagle flights as well as the two Lappet-faced Vulture flights also had a portion of time within height band 4.

Table 7 Flight Path Target Species – Broader Project Area

Species	Priority species score	Red data status (Taylor, 2015)	Total no. of flight paths recorded.	Total no. of birds recorded*	No. of flights with a portion below 260 m	No. of flights with a portion in height band 4
Booted Eagle	230	-	1	1	1 (100%)	0
Cape Turtle Dove	-	-	12	14	12 (100%)	0
Crowned Lapwing	-	-	7	25	7 (100%)	0
Greater Kestrel	174	-	1	1	1 (100%)	1 (100%)
Hadeda Ibis	-	-	2	7	2 (100%)	1 (50%)
Jackal Buzzard	250	-	1	1	1 (100%)	1 (100%)
Kori Bustard	260	NT	3	4	3 (100%)	0
Laughing Dove	-	-	3	3	3 (100%)	0
Lanner Falcon	300	VU	2	2	2 (100%)	0
Lappet-faced Vulture	310	EN	2	9	2 (100%)	2 (100%)
Ludwig's Bustard	320	EN	1	1	1 (100%)	0
Martial Eagle	-	-	2	2	2 (100%)	2 (100%)
Namaqua Dove	-	-	52	64	52 (100%)	0
Northern Black Korhaan	180	-	2	2	2 (100%)	0
Pale Chanting Goshawk	200	-	24	25	24 (100%)	0
Pied Crow	-	-	56	92	54 (97%)	13 (23%)

Species	Priority species score	Red data status (Taylor, 2015)	Total no. of flight paths recorded.	Total no. of birds recorded*	No. of flights with a portion below 260 m	No. of flights with a portion in height band 4
Speckled Pigeon	-	-	3	7	3 (100%)	0
Southern Yellow-billed Hornbill	-	-	1	2	1 (100%)	0
Unidentified Raptor	-	-	1	1	1 (100%)	0
Verreaux's Eagle	360	VU	3	6	2 (66.7%)	1 (33.3%)
Totals			179	269	176 (98%)	21 (11%)

**Indicates that in some cases a single flight path recorded was a flight consisting of more than one bird. This figure does not indicate abundance of a species as numerous flights may have been conducted by the same bird/s at different times. EN = Endangered, VU=Vulnerable, NT=Near Threatened.*

Table 8 Flight Path Target Species - Control Site

Species	Priority species score	Red data status (Taylor, 2015)	Total no. of flight paths recorded.	Total no. of birds recorded*	No. of flights with a portion below 260 m	No. of flights with a portion in height band 4
Cape Turtle Dove	-	-	2	3	2 (100%)	0
Hadeda Ibis	-	-	3	4	3 (100%)	0
Kori Bustard	260	NT	1	1	1 (100%)	0
Laughing dove	-	-	5	6	5 (100%)	0
Martial Eagle	350	EN	2	2	2 (100%)	0
Namaqua Dove	-	-	25	34	25 (100%)	0
Northern Black Korhaan	180	-	9	10	9 (100%)	0
Pied Crow	-	-	26	52	26 (100%)	1 (4%)
Unidentified Bird	-	-	1	1	1 (100%)	0
Unidentified Raptor	-	-	1	1	1 (100%)	1 (100%)
Totals			75	114	75 (100%)	2 (3%)

**Indicates that in some cases a single flight path recorded was a flight consisting of more than one bird. This figure does not indicate abundance of a species as numerous flights may have been conducted by the same bird/s at different times.*

In the control site, Pied Crow (26 flight paths) was the most recorded species during VP watches followed by Namaqua Dove (25 flight paths). Northern Black Korhaan, a priority species, was the third most recorded with 9 flight paths. Two other priority species were recorded, namely Martial Eagle and Kori Bustard, both of which are red data species, however their activity was low with only two flights and one flights recorded respectively.

Analysis of flight paths in the control site indicates that 100 % of flights included at least some time below 260 m, and two flights (3%) including a portion of time in height band 4.

The overall average passage rates of target species was highest at VP2 on the project site which recorded 3.69 (SD±2.98) birds per hour. VP1 on the project site recorded an average of 2.60 (SD±2.92) birds per hour, while the control site VP had very similar levels of activity and recorded 2.60 (SD±3.31) birds per hour (Table 9). The passage rate is the number of target species birds (excluding Namaqua Sandgrouse and Eastern Clapper Lark) per hour of observation recorded at the VPs.

Aerial foraging species regularly recorded for additional information during the VP watches on both the project site and control site were Little Swift, Barn Swallow and White-throated Swallow, all of which displayed relatively moderate to low activity. Eastern Clapper Lark was observed in display flights at heights of between 20 m and 100 m, particularly during winter and spring.

Namaqua Sandgrouse were numerous throughout the project and control sites and were recorded at all three VPs, but were particularly active in the morning and evening around VP2. From VP2 numerous flocks of more than 10 birds, and up to 120 birds were observed going to and from the water source at FS5 (approximately 600 m south of VP2). The highest number of birds was recorded for approximately the first three hours after sunrise and a second peak of activity started approximately an hour and a half before sunset.

Table 9 Average Passage Rate per Hour for Target Species

VP	Birds/hour	Birds/hour	Birds/hour	Birds/hour	Average Birds/hour (± SD)*
	Winter	Spring	Summer	Autumn	
Project Site					
VP1	2.50	3.83	2.17	1.92	2.60 ± 2.92
VP2	3.83	3.92	1.67	5.33	3.69 ± 2.98
Control Site					
CVP	2.75	2.83	1.75	3.08	2.60 ± 3.31

**SD=Standard Deviation*

4.4.3 Driven Transects

Over the 12 months of monitoring, the driven transects in the broader project area resulted in 76 records of 12 target species, totalling 105 birds (Table 10 and Figure 3a -3c). The driven transects on the control site resulted in 16 records of 6 species, totalling 28 birds.

DT2 recorded the most target species records (43), followed by DT3 (24 records). The longest transect, DT1, had relatively few records (9) of target species, possibly because it was conducted along the busiest road in the area (serving as the access road to the existing Bokpoort I project) and alongside the railway line. DT3 was the shortest of the three drive transects (5.9 km) and the highest abundance of target species per kilometre was recorded on this transect (0.78 ±0.57 target species per km, Table 12). Resident Northern Black Korhaan have a high chance of being encountered multiple times if their territory is close to a drive transect and therefore it is likely that the same individuals may be flushed (and recorded) during each transect. Overall the average number of individuals encountered per transect were similar between the project site (0.49 ±0.48) and the control site (0.48 ±0.69, Table 12), however the average of the project site is brought down by the low number of target species encountered on the main gravel road during DT1 (0.13 ±0.15), possibly due to higher levels of disturbance (from trains and vehicles) and limited visibility caused by the elevated train tracks along some sections of the transect.

The species most regularly recorded Northern Black Korhaan (38 records), followed by Pied Crow[10] (17 records), Red-crested Korhaan (13 records) and Kori Bustard (4 records). Although the 38 observations of Northern Black Korhaan were made, it's possible that on many occasions the same bird was observed/recorded more than once. It is estimated that the DT observations of this species were of approximately 8 – 12 separate individual birds, the majority of which were males observed during display flights or recorded calling.

Table 10 Summary of Driven Transect Results

Species (Red Data Status)	Total Birds Recorded	Maximum Flock Count**	Number of Records					
			DT1	DT2	DT3	CDT1	CDT2	*ALL*
Crowned Lapwing	1	1			1			*1*
Egyptian Goose	2	2					1	*1*
Grey Hornbill	7	7		1				*1*
Kori Bustard (NT)*	6	2		1	3			*4*
Lanner Falcon (VU)*	3	2	1		1			*2*
Ludwig's Bustard (EN)*	8	5			2			*2*
Martial Eagle (EN)*	3	1	2	1				*3*
Northern Black Korhaan*	41	2	1	23	10	4		*38*
Pale Chanting Goshawk*	8	2		3	3	1		*7*
Pied Crow	37	9	3	4	2	2	6	*17*
Red-crested Korhaan	13	1		10	2		1	*13*
Rock Kestrel	2	1	1				1	*2*
Verreaux's Eagle (VU)*	2	2	1					*1*
Total	133	NA	9	43	24	7	9	*92*

**Priority species (Retief et al., 2011) **Size of the biggest group/flock of birds of the same species observed in one record. EN=Endangered; VU=Vulnerable; NT=Near Threatened.*

Table 11 shows the seasonal distribution of driven transect records, indicating that in spring the most records of target species were made (27), followed closely by winter (26 records). Northern Black Korhaan was the only priority species recorded in all seasons. Kori Bustard was recorded in winter, spring and autumn, while Ludwig's Bustard was only recorded in winter.

[10] It is noted that during the final autumn survey Pied Crow was not regarded as a DT target species and therefore were purposely not recorded by observers.

Table 11 Summary of Seasonal Driven Transect Results for the Broader Project Area and Control Sites combined

Species (Red Data Status)	Winter		Spring		Summer		Autumn	
	No. of Records	No. of Birds	No. of Records	No. of Birds	No. of Records	No. of Birds	No. of Records	No. of Birds
Crowned Lapwing	-	-	1	1	-	-	-	-
Egyptian Goose	-	-	-	-	-	-	1	2
Grey Hornbill	1	7	-	-	-	-	-	-
Kori Bustard (NT)*	1	1	2	4	-	-	1	1
Lanner Falcon (VU)*	-	-	-	-	-	-	2	3
Ludwig's Bustard (EN)*	2	8	-	-	-	-	-	-
Martial Eagle (EN)*	2	2	-	-	1	1	-	-
Northern Black Korhaan*	11	12	10	10	4	5	13	14
Pale Chanting Goshawk*	2	2	-	-	2	2	3	4
Pied Crow[$]	4	6	7	10	6	21	-	-
Red-crested Korhaan	2	2	6	6	5	5	-	-
Rock Kestrel	1	1	-	-	1	1	-	-
Verreaux's Eagle (VU)*	-	-	1	2	-	-	-	-
Total	26	41	27	33	19	35	20	24

**Priority species (Retief et al., 2011, updated 2014) **Size of the biggest group/flock of birds of the same species observed in one record. EN=Endangered; VU=Vulnerable; NT=Near Threatened. $ Pied Crow was not designated as a DT target species in autumn, and was therefore purposefully not recorded in that season on DTs.*

Table 12 Summary of Abundance of Target Species for the Combined Driven Transect Results

Transect Ref	IKA* (target species) Mean ± SD
DT1	0.13 (±0.15)
DT2	0.67 (±0.39)
DT3	0.78 (±0.57)
Total	0.49 (±0.48)
CDT1	0.40 (±0.72)
CDT2	0.63 (±0.69)
Total	0.48 (±0.69)

**IKA: Index of Kilometric Abundance = Birds/km; SD = Standard Deviation*

4.4.4 Focal Sites

Observations from the visits to the focal sites (Figure 2) are presented in Table 13 below. The focal sites were located by the avifaunal specialist during the site set up and the first seasonal survey.

Observations at the Orange River focal site (FS1) recorded various water associated species including herons, egrets, geese, shelducks, kingfishers, darters, cormorants and African Fish Eagles. Passerines associated with riverine vegetation and river banks included Levaillant's Cisticola, Orange River White-eye, Lesser Swamp Warbler, African Reed Warbler, Southern Masked Weaver, Southern Red Bishop, Cape Wagtail and Pied Wagtail. Little Swift were found nesting in relatively large numbers under a rail bridge that crosses the Orange River at FS1, a Little Egret roost as well as breeding colony of White-breasted Cormorants were observed on the islands in the river.

Three Verreaux's Eagle nest structures were located on cliffs approximately 4 km east of the project site (Figure 5). Two nest structures are located on a more northerly cliff, and have been designated 'Verreaux's Eagle Nest B' and 'Verreaux's Eagle Nest C' while 'Verreaux's Eagle Nest A' is located on the more southerly cliff face (in close proximity to the railway line). Both cliff faces (and all nest structures) were surveyed from FS2 and the results are presented below. Verreaux's Eagle Nest A is regarded as active, as a young sub-adult bird was observed perched next to nest A during the spring survey along with substantial 'white-wash' caused by bird excrement below the nest. No Verreaux's Eagles were recorded at the nest site during the summer survey, and it is believed that the sub-adult may have dispersed from the nest by this stage, and that the adults may have been away from the nest foraging. During autumn, the adult pair was observed perched near to the nest site. A Rock Kestrel was observed on two occasions during summer on the southerly cliff face near 'Verreaux's Eagle Nest A' and it's behaviour (entering a crevice and disappearing from view), along with 'white-wash' indicates that it is likely that this species also breeds on this cliff face.

Various passerine birds were attracted to the water sources (and associated surrounding trees and vegetation) present at FS3 and FS5, most abundant and/or regularly recorded being African Red-eyed Bulbul, Red-faced Mousebird, Cape Turtle Dove, Laughing Dove, Namaqua Dove, Cape Bunting, Lark-like Bunting, Sociable Weaver, Orange River White-eye, Red-billed Quelea, Namaqua Sandgrouse, Red-headed Finch and Yellow Canary. On the control site, at CFS1, the most regularly recorded and/or abundant species were Lark-like Bunting, Red-billed Quelea, Southern Red Bishop, Southern Masked Weaver, Cape Turtle Dove, Laughing Dove, Pied Crow, Grey-backed Sparrowlark and White-browed Sparrow-weaver (which was also nesting in a nearby try). A Lanner Falcon was observed perched on a tree at CFS1 during the autumn season.

The Martial Eagle nest (FS4) was confirmed as active during the spring survey and a sub-adult Martial Eagle was observed perching on or near the nest during each of the four times FS4 was surveyed in spring. While it is common for sub-adult birds to remain in the vicinity of the nest for several months after fledging (Hockey *et al.* 2005) an adult bird was observed using this structure as a roost during the summer survey. It is expected that the sub-adult Martial Eagle may disperse from the area before the onset of the next breeding season (roughly winter 2016) where the adult pair may attempt to breed again at the nest location.

Table 13 Summary of Focal Site Results (number of individuals counted during each of the two counts, per season, is given in brackets) Incidental Records

Focal Site visit	Survey 1 (winter)		Survey 2 (spring)		Survey 3 (summer)		Survey 4 (autumn)	
	Red data species, priority species, and/or relevant important species (number of individuals)	Notes	Red data species, priority species, and/or relevant important species (number of individuals)	Notes	Red data species, priority species, and/or relevant important species (number of individuals)	Notes	Red data species, priority species, and/or relevant important species (number of individuals)	Notes
FS1.1	African Darter (5), Cattle Egret (35), Egyptian Goose (4), Giant Kingfisher (1), Goliath Heron (1), Little Egret (1), Orange River White-eye (6), Reed Cormorant (25), Sacred Ibis (4), White-breasted Cormorant (30).	Breeding colony of White-breasted Cormorants 100 m to the south west on an island.	African Darter (11), African Fish Eagle (2), African Sacred Ibis (20), Common Waxbill (4), Egyptian Goose (2), Giant Kingfisher (1), Goliath Heron (1), Grey Heron (2), Little Swift (330), Orange River White-eye (6), Pied Wagtail (2), Reed Cormorant (30), South African Shelduck (1), White-breasted Cormorant (105), White-throated Swallow (15).	Little Swifts nesting under rail bridge. Cormorant breeding colony approximately 100 m south (up river). African Fish Eagle sighting consisted of two birds, one juvenile and one adult.	African Darter (8), African Fish Eagle (1), African Sacred Ibis (28), Barn Swallow (1), Cattle Egret (13), Giant Kingfisher (1), Goliath Heron (3), Great Sparrow (2), Little Swift (6), Reed Cormorant (5), Southern Masked Weaver (3), Southern Red Bishop (2), White-breasted Cormorant (5).	Little Egret Roost on Island. Little Sifts nesting under bridge.	African Fish Eagle (2), African Reed Warbler (1), Cape Wagtail (2), Reed Cormorant (2), Western Cattle Egret (18), White-breasted Cormorant (10).	
FS1.2	African Fish-Eagle (2), Grey Heron (1), Little Egret (1), Reed Cormorant (13), Rock Martin (2), White-breasted Cormorant (32).	Both individual African Fish-Eagles observed were sub-adult birds. Breeding colony of White-breasted Cormorants 100 m to the south west on an island.	African Darter (6), Egyptian Goose (2), Giant Kingfisher (1), Goliath Heron (1), Grey Heron (1), Little Swift (~300), Reed Cormorant (20), South African Shelduck (1), White-breasted Cormorant (60), White-throated Swallow (10).		African Darter (10), African Red-eyed Bulbul (3), Black-headed Heron (2), European Bee-eater (15, Lesser Swamp Warbler (1), Levaillant's Cisticola (1), Little Egret (100), Little Swift (200), Pied Wagtail (1), Reed Cormorant (5), White-breasted Cormorant (5).		African Darter (19), African Fish Eagle (1), African Harrier-Hawk (1), Egyptian Goose (10), Hadeda Ibis (4), House Sparrow (5), Little Swift (50), Malachite Kingfisher (1), Western Cattle Egret (92), White-breasted Cormorant (9).	
FS2.1	Pale-winged Starling (10), Rock Kestrel (1).	White-wash observed on rock face near Verreaux's Eagle Nest A.	Verreaux's Eagle (1), Pale-winged Starling (7).	Verreaux's Eagle sub-adult perched just above Verreaux's Eagle Nest A.	Rock Kestrel (1).	No Verreaux's Eagles recorded. Rock Kestrel observed entering a crevice on southern cliff face and may be nesting.	Verreaux's Eagle (2).	Verreaux's Eagle pair on cliff above nest
FS2.2	Pale-winged Starling (8), Rock Kestrel (1), Verreaux's Eagle (1).	An adult Verreaux's Eagle landed on the southern cliff face next to Nest A.	Verreaux's Eagle (1), Pale-winged Starling (6)	Verreaux's Eagle sub-adult perched just above Verreaux's Eagle Nest A.	Rock Kestrel (1).		Nothing recorded	-
FS3.1	Crimson-breasted Shrike (1), Lark-like Bunting (6), Orange River White-eye (8), Sociable Weaver (16), White-browed Sparrow-weaver (2).		Cape Bunting (2), Fiscal Flycatcher (2), Lark-like Bunting (2), Namaqua Dove (7), Red-billed Quelea (1), Red-faced Mousebird (3), Sociable Weaver (5).	Sociable Weaver nest on top of wind pump. Very little water. Wind pump broken.	African Red-eyed Bulbul (4), Cape Turtle Dove (4), Sociable Weaver (15), Violet-eared Waxbill (2).		Lark-like Bunting (30), Laughing Dove (2), Sociable Weaver (5), Yellow Canary (3).	No water
FS3.2	Black-throated Canary (1), Black-headed Canary (1), Cape Bunting (2), Lark-like Bunting (10), Namaqua Dove (5),		African Red-eyed Bulbul (4), Cape Turtle Dove (1), Fiscal Flycatcher (2), Laughing Dove (6), Sociable Weaver (6).		Black-throated Canary (2), Cape Bunting (1), Lark-like Bunting (3), White Throated Canary (1).		Cape Weaver (2), Chestnut-vented Titbabbler (1), Dusky Sunbird (1), Lark-like Bunting (30), Pale-winged Starling (2).	No water

Focal Site visit	Survey 1 (winter)		Survey 2 (spring)		Survey 3 (summer)		Survey 4 (autumn)	
	Red data species, priority species, and/or relevant important species (number of individuals)	Notes	Red data species, priority species, and/or relevant important species (number of individuals)	Notes	Red data species, priority species, and/or relevant important species (number of individuals)	Notes	Red data species, priority species, and/or relevant important species (number of individuals)	Notes
	Orange River White-eye (7), Red-billed Quelea (7), African Red-eyed Bulbul (2), Violet-eared Waxbill (2), White-throated Canary (2), Yellow Canary (5).							
FS4.1	Not surveyed	-	Martial Eagle (1)	Sub-adult perched on nest.	None Recorded		Martial Eagle (1).	Martial Eagle initially soaring high above nest, then perched on adjacent pylon.
FS4.2		-	Martial Eagle (1)	Sub-adult perched on nest.	Martial Eagle (1)	Adult Martial Eagle perched on nest.	None Recorded.	-
FS4.3			Martial Eagle (1)	Nest confirmed as active. Sub-adult perched on pylon.	Not surveyed		Not surveyed.	
FS4.4			Martial Eagle (1)	Sub-adult perched on nest.	Not surveyed		Not surveyed	
FS5.1	Not surveyed	-	Red-billed Quelea (15), Sociable Weaver (7), Southern Masked Weaver (1), Yellow Canary (2).		Black-throated Canary (2), Grey-backed Sparrowlark (17), Little Swift (2), Red-headed Finch (12), Sociable Weaver (5).		Grey-backed Cisticola (1), Lark-like Bunting (8), Namaqua Dove (5), Yellow Canary (12).	
FS5.2		-	Fawn-coloured Lark (1), Namaqua Dove (5), Namaqua Sandgrouse (17), Red-billed Quelea (35), Red-faced Mousebird (4), Red-headed Finch (2).		Cape Turtle Dove (1), Red-headed Finch (15), Yellow Canary (3).		Cape Sparrow (2), Lark-like Bunting (2), Namaqua Dove (6), Yellow Canary (4).	
CFS.1	Lark-like Bunting (30), Red-billed Quelea (25), Southern Red Bishop (10), White-browed Sparrow-weaver (1).	White-browed Sparrow-weaver nesting in tree.	Cape Turtle Dove (2), Laughing Dove (2), Pied Crow (3).	White-browed Sparrow-weaver nesting in tree.	None Recorded	White-browed Sparrow-weaver nesting in tree	Grey-backed Sparrowlark (1), Laughing Dove (1), Namaqua Dove (3), Red-faced Mousebird (2)	
CFS.2	Cape Glossy Starling (1), Lark-like Bunting (9), Red-billed Quelea (12), Southern Masked Weaver (10), Southern Red Bishop (10).		Cape Turtle Dove (4), Laughing Dove (4), Pied Crow (2), Rock Martin (1), Southern Masked Weaver (1), White-browed Sparrow-weaver (2).		Barn Swallow (3), Cape Turtle Dove (2), Grey-backed Sparrowlark (10), Laughing Dove (2), Namaqua Dove (2), White-browed Sparrow-weaver (1).		Capped Wheatear (1), Lanner Falcon (1), Wattled Starling (5), and White-browed Sparrow Weaver (1).	

4.4.5 Incidental Observations

Ninety-five incidental observations were made of 13 target species comprising 146 birds (a single observation may include numerous birds of one species i.e. a flock) across the broader project area and control site (Table 14 and Figures 3a and 3b). The 13 target species included six red data species.

The species most regularly observed incidentally was Northern Black Korhaan accounting for 53 % of all the incidental observations. Although the 50 observations of this species counted a total of 60 birds, it's likely that on many occasions the same bird was observed/recorded more than once. It is estimated that the incidental observations of this species were of approximately 8 – 12 separate individual birds, the majority of which were males observed during display flights or recorded calling.

Pale Chanting Goshawk was the second most recorded species, accounting for 16 % of all the incidental observations, and many of these observations may have been of the same bird. Red-crested Korhaan was the third most recorded species, accounting for 13 % of all the incidental observations. The increase in incidental recordings of this species during the spring survey (9 observations) may be a result of an increase in displaying behaviour of this species during that season making them more noticeable than during the winter survey (2 observations), summer survey (1 observation) or autumn survey (0 observations).

The Near Threatened Kori Bustard was observed incidentally on five occasions, including an observation of a pair of birds in winter, a relatively high number of records as it is generally uncommon outside of protected areas. This species breeds approximately between August and March with a peak in egg laying in October/November (i.e spring) Hockey *et al*. (2005). However, no nest sites were found and no evidence of breeding (e.g. displaying males) was observed. This generally sparse to locally common species has its major strongholds in the open savannahs of Botswana and Namibia. In South Africa Hockey *et al*. (2005) estimated 2000 – 5000 individuals the majority of which occur in large national parks (i.e Kruger National Park and Kgalagadi National Park).

Cape Eagle Owl, an uncommon, easily overlooked, nocturnal priority species, was observed once in spring. One individual was flushed from the ground, and flew a short distance before landing on the ground and slowly walking away from the surveyors.

Table 14 Number of Incidental Records of Target Species during Four Seasonal Surveys

Species (Red Data Status)	Number of observations	Total individuals**	Maximum flock count	Season/s observed
African Fish Eagle	2	3	2	Winter; Spring
Burchell's Courser (VU)*	1	4	4	Summer
Cape Eagle Owl	1	1	1	Spring
Grey Hornbill	2	35	20	Winter
Karoo Korhaan (NT)*	2	3	2	Winter
Kori Bustard (NT)*	5	6	2	Winter; Spring
Lanner Falcon (VU)*	1	1	1	Summer
Martial Eagle (EN)*	2	2	1	Winter; Summer
Northern Black Korhaan*	50	60	3	Winter; Spring; Summer; Autumn
Pale Chanting Goshawk*	15	17	2	Winter; Spring; Summer; Autumn
Pygmy Falcon	1	1	1	Summer
Red-crested Korhaan	12	12	1	Winter; Spring; Summer
Verreaux's Eagle (VU)*	1	1	1	Summer

Species (Red Data Status)	Number of observations	Total individuals**	Maximum flock count	Season/s observed
TOTALS	95	146	NA	

**Priority species (Retief et al. 2011). Italics = endemics or near-endemics. ** Multiple observations may have been made of the same individuals at different times.*

4.4.6 Summary

A total of 103 positively identified species were recorded within the broader project area over four seasonal surveys, 89 of which were recorded on the project site itself. Seventy species were recorded on the control site, the majority of which were also recorded on the project site. Ninety-one species were recorded in the Orange River Valley either during observations at FS1, or incidentally at the specialist's accommodation or while travelling to and from the site. A combined total of 145 species (including 19 priority species) was recorded during the four seasonal surveys (Appendix I) across all four areas, the project site, broader project area, control site and the Orange River Valley. This includes 19 priority species and 8 South African endemic or near endemic species.

The full species list indicating their conservation status, endemism, priority species score and where a species had been recorded is provided in Appendix I.

As birds are inherently mobile, it is likely that all species observed in the broader project area and some in the Orange River Valley may at some point traverse or utilise the project site. However, it is unlikely that water associated birds such as ducks, grebes, cormorants and kingfishers would occur on or pass through the project site (although an observation of two African Darters was made over flying the control site, which is closer to the Orange River than the project site). Further discussions below therefore consider the species list for the broader project area and exclude species observed only at the Orange River Valley.

Nine regionally red listed species (Taylor, 2015) were recorded during the 12 month monitoring programme (Table 15). One of these, Karoo Korhaan, was recorded on the control site and within the broader project area, but not on the project site.

Table 15 Regionally Red Listed Species Recorded During the Summer Survey in the Broader Project Area and Control Site

Species	Red Data Status (Taylor, 2015)	Broader Project Area	Project Site	Control Site
Martial Eagle	Endangered	X	X	X
Lappet-faced Vulture	Endangered	X	X	
Ludwig's Bustard	Endangered	X	X	
Verreaux's Eagle	Vulnerable	X	X	
Lanner Falcon	Vulnerable	X	X	X
Burchell's Courser	Vulnerable	X	X	
Double-banded Courser	Near-threatened	X	X	
Karoo Korhaan	Near-threatened	X		X
Kori Bustard	Near-threatened	X	X	X

Eight South African endemic or near-endemic species[11], recorded during the surveys, four of which were recorded on the project site, and two which were only recorded in the Orange River Valley.

Martial Eagle was recorded during all four seasons in the broader project area, usually perched on pylons at or near to the active nest site.

Verreaux's Eagle were recorded in the Broader Project over all four seasons, however it was only recorded flying on two occasions near, but outside of, the project site to the north east.

4.5 Discussion

Seasonal differences in the compilation of the bird community in an arid environment are expected to be large (Dean, 2004). This arises for several reasons for different groups of birds: wetland species (e.g. flamingos, stilts, snipes and crakes) are attracted to the sudden appearance of wetlands in flooded pans, and may follow rain fronts to find such ephemeral wetlands (Simmons *et al.*, 1999). Passerine birds (e.g. larks, canaries, queleas, buntings) are attracted to seeding grasses following good rain events, and may accumulate in very large flocks (Dean, 2004). For raptors, rain means more prey potentially resulting in increased hunting activity and breeding success after rains. Nomadic species such as Bustards are attracted to high rainfall areas because of the explosion of insects that follows rains. Such extreme seasonal variations were not overly clear in the bird data observed, and may be due to the area experience relatively dry conditions during monitoring.Therefore some species may not have been present during the monitoring period (or were present in lower numbers). Furthermore, open artificial water sources attracted large numbers of doves and sandgrouse, with flocks of sandgrouse heading towards and away from these points in all directions, particularly in the morning and evening.

Both Red-crested Korhaan and Northern Black Korhaan were regularly encountered on the project site, and particularly the latter. A third Korhaan species, Karoo Korhaan, was recorded on the control site only. Although not red data species, both Northern Black and Red-crested Korhaans are considered important to the study as they are potentially at risk of impacts from collision and displacement.

Two red data Bustard species were recorded, Ludwig's Bustard and Kori Bustard and even though predominantly dry conditions were experienced, the site appears to be relatively important as a foraging area for these birds (and may be even more important following high levels of rainfall, particularly for Ludwig's Bustard). It is likely though that large areas of suitable habitat exist for this species on neighbouring farms beyond the project site.

The Verreaux's Eagle pair that were recorded breeding successfully on a cliff face to the east of the project site (Figure 5), are likely to utilise the hills/mountains and rocky habitats to the east, north east and south east of the project site, and are unlikely to forage regularly on or near the project site. All three flights recorded for this species over 12 months were above or near these hills to the east of the project site.

Comparison of South African Bird Atlas Project data from 1987-1993 and 2007-2012 suggests that Martial Eagle have undergone rapid and drastic population declines, reducing in number by nearly 60% in 20 years (Cloete, 2013). Martial Eagle are listed as *Endangered* (Taylor, 2015) as a result of these declines, with an estimated population size of only 600 pairs in South Africa (Cloete, 2013). Martial Eagles exhibit strong fidelity to nesting sites (Herholdt & Mendelsohn 1995) but a breeding pair may alternate breeding attempts between multiple nests in their breeding territory (Machange *et al.* 2005), which range in

[11] Endemic or Near-endemic (i.e. ~70% or more of population in RSA) to South Africa according to the BirdLife South Africa Checklist of Birds in South Africa, 2014.

size from 100 – 800 km^2 in South Africa (Hockey *et al*. 2005). Boshoff (1993) estimated the size of the breeding territory to be a minimum of 284 km^2 for Martial Eagles breeding on transmission towers in the Nama-Karoo (Boshoff 1993). The proposed development would fall completely within a circle with the area of 284 km^2 drawn around the nest and occupy approximately 5% of the 'minimum breeding territory'.

Martial Eagle was recorded during all four seasons in the broader project area, usually perched on pylons at or near to the active nest site. On the project site, this species was recorded during spring and summer, with a total of two flights from VP watches. All sightings of this species over the 12 month period are believed to be of the same three birds, made up of the adult breeding pair and one juvenile bird. The lack of records of this species on the project site, may indicate that the site is not favoured for foraging by this species, and it is likely that the less disturbed areas (e.g. where there is less livestock farming) to the east of the project, over the hills and in to the game farming area (e.g. Kalahari Oryx Game Reserve) are favoured. Recent research on this species (R. Van Eeden. Pers.Com) indicate that the adult female may spend the majority of her time within 3 kilometres of the nest. It is possible that the sub-adult bird seen may soon disperse, and that the adult pair will again breed at the nest site in the upcoming winter (June-August 2016) breeding season. Dispersing juvenile birds may potentially be more at risk from impacts of the proposed project. It is recommended that an effort be made to capture and equip the Martial Eagle pair nesting near the project site with GPS tracking units as soon as possible to monitor what impact the construction and operation of the solar plant might have on the foraging and activity patterns of these eagles. Understanding the movement of these eagles during all phases of project development would also be a highly beneficial contribution to the future conservation of the species not only in the immediate area but also elsewhere in the country.

The occurrence of Lappet-faced Vulture flying over the project site in autumn was surprising and it is believed to be a rare and occasional occurrence that was witnessed by the observers as the project site is on the outer edge of its range, although there are some *ad hoc* records of this species from pentads north of project site. Little is known about the movements of this *Endangered* species, but it is believed to highly nomadic with non-breeders sometimes moving >1100 km once fledged from the nest (Hockey *et al*, 2015). They usually roost singly or in pairs in trees in the evening, occasionally gathering in groups at water holes or carcasses. The observation of 7 birds, therefore may represent a group leaving or going to a feeding/drinking point. In 2004 it was believed that the species population in the Northern Cape, although low (estimated 50 pairs), was increasing slowly (Hockey et al, 2015).

5 AVIFAUNAL SENSITIVITY ZONES

5.1 High Sensitivity Zones

High sensitivity zones were related to the identified eagle nest sites in the broader study area. These included two inactive Verreaux's Eagle nests, one active Verreaux's Eagle nest and one active Martial Eagle nest (Figure 5). A circular area within a 3 km radius around each of these nests was designated as high sensitivity, as related to potential burning or collision impacts (Figure 6). It therefore recommended that the CSP Tower be constructed outside of these areas. As some areas within these buffers are already altered and disturbed (e.g. by existing transmission lines, roads and a major railway line), other project infrastructure (e.g. PV panels, pipelines and power lines) is allowed within the buffer following micrositing by an avifaunal specialist and if all the mitigations recommended are implemented. A strict no-go area (primarily to prevent impacts of disturbance and displacement impacts) for infrastructure, construction activities and construction staff, must be enforced up to 1.5 km around these nest sites.

5.2 Medium Sensitivity Zones

Medium Sensitivity Zones are areas identified on the project site that are currently important for avifauna, and/or support important species and/or support high abundances of birds at certain times. Two such types of zones were identified associated with gravel plains (which support important species such as coursers and bustards) and a 100 m radius around artificial water points (Figure 6). These areas are not sufficiently sensitive so as to preclude development and it is understood that should the project proceed these areas within the project site will be completely destroyed/removed. This has been taken into account when conducting the impact assessment for habitat destruction and disturbance.

5.3 Undetermined Sensitivity Zones

Undetermined Sensitivity Zones are all the remaining areas of the project site not buffered in Figure 6 or related to the features discussed above. These areas show no obvious avifaunal features, patterns or sensitivities and are preferred for infrastructure placement. However, considering the general avifauna of the area and broader project area, it is likely that these zones are in fact of moderate sensitivity.

6 AVIFAUNAL IMPACT ASSESSMENT

6.1 Background to Interactions between Solar Energy Facilities and Birds

South Africa receives among the highest levels of solar radiation on earth (Robbins & Burger 2009; Munzhedi *et al*. 2009) and there is huge potential for solar energy generation in the country (Fluri, 2009).

Despite its benefits of reduced toxic and carbon emissions and renewable generation, utility scale solar development can impact ecological systems and species and their habitats (Walston, *et al.* 2015). Worldwide the impacts of solar energy developments on wildlife, and particularly birds, are not well understood (Gunerhan *et al*. 2009; Lovich and Ennen 2011; Hernandez *et al*. 2014; RSPB 2011), and there are few systematic and empirically based studies that address avian fatality issues (Walston, *et al.* 2015). Unlike wind energy development, there is presently no clear pattern in the species or groups of birds impacted. Burn and collision casualties recorded to date include a wide variety of bird groups (McCary 1986, Kagan *et al*. 2014). However, Walston et al (2015) did find that Passerines were the taxonomic group most frequently found killed or injured at all six California facilities studied, with doves and pigeons also being highly impacted upon. The potential impacts also vary amongst technologies, with CSP power tower technology thought to be (and recently proving to be-Harvey and Associates, 2015) more detrimental to avifauna.

It stands to reason that the more birds that are attracted to the CSP facility or its immediate surrounds, the more likely burn and/or collision impacts could occur. Swallows, swifts and martins may be attracted to the plant infrastructure for use as roosts and/or nesting substrates. This potentially positive effect (e.g. of increased breeding success) is likely to be offset by the indirect result of these birds placing themselves at increased risk of collision or burn impacts. Furthermore there are indications that insects may for some reason (possibly influenced by the lighting used) be attracted to the vicinity of certain types of solar energy facilities (particularly CSP tower projects). This in turn may attract insectivores, including both birds and bats. Waterbirds may be attracted to solar energy facilities in mistaking the hardware for expanses of open water, and at least some of the larger, more mobile species considered prone to collision with wind turbines, may also be prone to trauma- and solar flux-based mortality (McCary 1986, Kagan *et al*. 2014). The attraction of birds to the reflective surfaces which may be mistaken for large water bodies ('the lake effect'), has been proposed as a contributing factor towards burn and collision fatalities at

solar energy facilities. This phenomenon may be possible for both the PV components and the CSP heliostat field component of the proposed project.

Another concern with CSP tower facilities surrounds the use of large evaporation ponds for the treatment of wastewater. Any open water in an arid environment in South Africa is likely to attract avifauna, putting them at more risk from the impacts of burning and collision. CSP facilities utilising wet cooling technologies require greater amounts of water for operational activities than dry cooling technologies, which may increase water demand and alter the availability of surface and groundwater sources to sustain bird habitats such as riparian vegetation.

The impacts of solar PV are primarily associated with the loss of habitat and disturbance during construction, as well as collision with the PV panels (although little evidence or studies surrounding this impact could be found). Of more concern regarding PV plants, may be the associated grid connection powerline. In South Africa, powerline impacts (primarily from collision and electrocution) on sensitive avifauna such as cranes, bustards, storks, korhaans, and vultures, are well known and documented (APLIC 1994; van Rooyen and Ledger 1999; van Rooyen 2004; van Rooyen & Smallie 2006; Shaw *et al*, 2010).

The solar guidelines (Birdlife SA, in press) report that the number of solar energy development proposals in South Africa has rapidly increased over the last five years, with more than 500 projects proposed and under review by the Department of Environmental Affairs. With almost 400 of these already having been authorised (solar guidelines-Birdlife SA in press) the main concerns with solar energy facilities are the displacement or the exclusion of nationally and/or globally threatened, rare, endemic, or range-restricted bird species from important habitats.

6.2 Identification of Potential Impacts

The following key potential impacts on avifauna, arising from the proposed project's construction and operational phases have been identified.

6.2.1 Construction Phase

6.2.1.1 Habitat destruction

Clearing activities during the construction phase will remove vegetation and therefore habitat that birds may require for breeding, foraging and roosting. Some of the impact may be temporary in the case of construction offices or laydown areas mitigation through rehabilitation of such areas is possible, however there will also be direct long-term loss of vegetation associated with the footprint of the solar arrays, power plants, power line pylons, substation, operation offices, and access roads. On the proposed project, it is assumed that in excess of 90% of the proposed project site will be stripped of all vegetation for construction. Habitat loss may effect, and be more significant for important terrestrial species such as coursers, korhaans and bustards. Raptors (e.g. Martial Eagle, Black-chested Snake-Eagle and Pale Chanting Goshawk) may also be effected to a lesser degree, through the loss of potential hunting habitat

6.2.1.2 Disturbance and displacement

Resident bird species (particularly sensitive and breeding species) may be disturbed by construction activities associated with the CSP and PV plants, which may lead to temporary or permanent displacement and/or a reduction in breeding success. At most risk in and around the Bokpoort II project site are korhaans, coursers, bustards, larks and a variety of raptors, It is noted though that due to the uniformity of the broader area, many birds (especially smaller passerines) may quite easily move off and find similar habitat nearby.

6.3 Operation Phase

6.3.1.1 Burning

The reflective surfaces of heliostats focus beams of sunlight into a small area resulting in concentrated solar flux which may burn birds. Large heliostat arrays focus solar flux on a central "power tower", exposing passing birds to the risk of being singed or burnt in the flux beams, particularly as they aggregate close to the receiver. Birds with only partially singed feathers are likely to die from predation or starvation as a result of not being able to fly. When not in full operation, certain numbers of heliostats are focussed on various points in the sky (and not on the tower) known as stand-by focal points and birds may also be burnt in the stand-by focal points of the heliostats.

Bird mortalities from burning have been recorded in the USA at the Ivanpah CSP project where mortalities of falcons, hawks, warbles and sparrows (as well as other species) have been found[12]. In a follow on detailed study at the same facility, Harvey and Associates (2015) estimated over 3500 birds to have died in a single year (many from being burnt or singed).

6.3.1.2 Collision with Reflective Structures and/or CSP Infrastructure (Excluding Power Lines)

Birds may be attracted to, and collide with, the reflective surfaces (e.g. heliostats or PV panels) which may also be mistaken for large water bodies and can cause disorientation of flying birds, resulting in injury and/or death. At the CSP plant birds may also collide with the central receiver tower. If evaporative cooling ponds are present, these bodies of water may provide artificial habitat to birds and their prey (e.g. insects), thus attracting more birds to the site which may result in a greater risk of collision with project structures. Likewise, the presence of artificial water points (e.g. livestock water points or leaking pipes/pumps) on and around the project site, may attract additional avifauna, placing them at risk of collision (or burn) impacts.

6.3.1.3 Disturbance and Displacement

Resident bird species (particularly sensitive and breeding species) may be disturbed by operational and maintenance activities associated with the solar farm and grid connection, which may lead to temporary or permanent displacement and/or a reduction in breeding success. Of particular concern is disturbance to breeding eagles (e.g. Martial Eagle) which may build nests on the new infrastructure and roosting vultures.

6.3.1.4 Collision with Power Lines

Collisions with large (132kV or above) power lines are a well-documented threat to birds in southern Africa (van Rooyen 2004; Shaw *et al.* 2010), while smaller lines pose a higher threat of electrocution but can still be responsible for collision. Collisions with overhead power lines occur when a flying bird does not see the cables, or is unable to take effective evasive action, and is killed by the impact or impact with the ground. Especially heavy-bodies birds such as bustards, cranes and waterbirds, with limited manoeuvrability are susceptible to this impact (van Rooyen 2004). Many of the collision sensitive species are also considered threatened in southern Africa. The Red Data (Taylor *et al*. 2015) species vulnerable to power line collisions are generally long living, slow reproducing species under natural conditions. Some require very specific conditions for breeding, resulting in very few successful breeding attempts, or breeding might be restricted to very small areas. These species have not evolved to cope with high adult mortality, with the results that consistent

[12] http://www.livescience.com/43458-bird-deaths-ivanpah-solar-energy-plant.html

high adult mortality over an extensive period could have a serious effect on a population's ability to sustain itself in the long or even medium term.

Birds may collide with the new over-head power lines, particularly during times of low light or poor visibility. Species that are more likely to be affected include Kori Bustard, Ludwig's Bustard, Northern Black Korhaan, Red-crested Korhaan, and Karoo Korhaan. Ludwig's Bustard is known to be particularly prone to collision (pers. Com R. Simmons, J. Smallie, M. Martins and BARESG) (Shaw *et al.* 2010). The relatively high number of records for Kori Bustard and Ludwig's Bustard during the 12 month monitoring survey, suggest that this may be a significant impact for the project if not properly considered and mitigated.

6.3.1.5 Electrocution

Birds may be electrocuted either in the substation or on the overhead powerlines. Electrocution of birds from electrical infrastructure including overhead lines is an important and well documented cause of bird mortality, especially raptors and storks (APLIC 1994; van Rooyen and Ledger 1999). Electrocution may also occur within newly constructed substations. 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). With regard to the grid connection infrastructure, overhead power line infrastructure with a capacity of 132 kV or more do not generally pose a risk of electrocution due to the large size of the clearances between the electrical infrastructure components. Electrocutions are therefore more likely for larger species whose wingspan is able to bridge the gap such as eagles or vultures. Various large raptors (such as Martial Eagle, Verreaux's Eagle and Lappet-faced Vulture), susceptible to electrocution (particularly in the absence of safe and mitigated structures) may occur in the broader project area. Electrocution is possible on electrical infrastructure within the substation particularly for species such as crows and owls which may attempt to nest on the substation infrastructure.

6.3.1.6 Water Pollution and Waste-water

Pollution of water resources used by birds may result from the operational CSP, through use of chemicals and other pollutants on the site as well as the production of wastewater (brine), which can be difficult to manage and treat. In an arid environment, artificial evaporation ponds may attract various birds that could be poisoned and/or drown. This attraction to evaporation ponds will can increase the avian activity on the site, resulting in more fatalities from collisions and/or burning.

6.3.1.7 Use of Large Amounts of Water

Certain CSP technologies, particularly those employing wet-cooling technologies, may use large amounts of water during operations. Using large amounts of water, may drain/deplete local reserves used by birds in naturally dry habitats.

6.3.1.8 Disruption of Local Bird Movement Patterns

Utility scale solar energy facilities may form a physical barrier to movement of birds across the landscape, and this may alter migration routes and increase distances travelled and energy expenditure or block movement to important areas such as hunting/foraging areas and ephemeral wetlands. This potential impact is not yet well understood, is likely to be more significant as a cumulative impact with surrounding developments, is difficult to measure and assess, and therefore mitigation measures are difficult to identify.

6.4 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 and/or existing commercial scale solar energy projects within 50 km of the project site.

6.4.1 Cumulative Impact of the proposed project and other proposed projects within a 50 km radius

Approximately 8 large solar energy projects in various stages of the EIA application process fall within this 50 km radius of the project site. Should 50 % or more of these projects be constructed the cumulative impact significance of the residual impacts of burning and collision may be High. The other impacts discussed above, are likely to have a cumulative impact ranging between Low and Medium.

In the scope of this impact study it is difficult to say with confidence at this stage what the cumulative impact of all the proposed developments will be on birds because there is no cumulative baseline to measure against. The extent of actual impacts on the region's avifauna will only become known once a solar CSP facilities are developed and operational data becomes available, and a regional population viability analysis have been conducted for key species. Furthermore, the developments considered may not all be constructed. A detailed cumulative study of solar energy facilities in the Upington/Groblershoop region should be conducted once operational data from constructed CSP facilities in the region becomes available, and is beyond the scope of this specialist study and should be commissioned by a suitable regional or national authority.

6.4.2 Cumulative Impact of the proposed project and the adjacent operational Bokpoort I project.

The Bokpoort I project, immediately adjacent to the proposed project site, is an operational 50 MW CSP facility utilising trough technology (i.e. there are no heliostats and no central receiver tower) which began operations in March 2016. No operational bird monitoring data was available for this project, and it is not known if any formal mortality monitoring is occurring and planned. It is therefore difficult to assess cumulative impacts, in the absence of knowing the impact of the Bokpoort 1 facility. However, it is believed that the impacts of this technology type on avifauna is likely to be less than that of projects utilising CSP tower technologies, as burning or singing of birds is highly unlikely. Mortalities from collision are possible and the cumulative significance of this impact and those of habitat destruction and disturbance are likely to be are likely to be only slightly higher than those ratings for the proposed project.

6.5 Impact Assessment and Mitigations

Considering all the bird baseline data (including the results of 12 months of seasonal monitoring), resulted in the identification of a set of focal species. The focal species for the Impact assessment were determined to be: **Martial Eagle, Verreaux's Eagle, Lappet**-faced Vulture, Cape Eagle-Owl, Lanner Falcon, Pygmy Falcon, Pale-chanting Goshawk, Greater Kestrel, **Kori Bustard, Ludwig's Bustard, Northern Black Korhaan, Burchell's Courser,** Eastern Clapper Lark, Fawn-coloured Lark, Black-eared Sparrowlark, Black-headed Canary, Sociable Weaver, Namaqua Sandgrouse, Rock Martin, Barn Swallow, and Namaqua Dove. By considering focal species we are not ignoring other birds, as in most cases these focal species serve as surrogates for other species, examples being Martial Eagle for Booted Eagle and Northern Black Korhaan for Karoo Korhaan.

A significance rating and impact assessment (considering the baseline bird data) has been done for each impact using set criteria (Appendix I) and impact tables in the following sections below. The impact tables include essential mitigation measures for each of the significance ('With Mitigation') is given for each impact, assuming correct implementation of the mitigations.

6.5.1 Construction Phase

6.5.1.1 Habitat Destruction

Potential Impact: The removal and/or destruction and/or alteration of habitat used by birds, may impact on the foraging and/or breeding success of certain species, and will lead to numerous birds being displaced from the projects site, and needing to find suitable available habitat elsewhere.							
	Magnitude	Duration	Scale	Probability	Significance	Status	Confidence
Without Mitigation	8	4	2	5	70 (Moderate)	Negative	Medium
With Mitigation	8	4	1	5	65 (Moderate)	Negative	Medium
Can the impact be reversed?			Partially (If suitably re-habilitated after decommissioning)				
Will impact cause irreplaceable loss or resources?			Possibly				
Can impact be avoided, managed or mitigated?			Unlikely. The entire project site is likely to be disturbed and cleared of vegetation. The mitigation measures below may help to keep the impact to a practical minimum.				

Required mitigation measures to reduce residual risk or enhance opportunities:

- 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
- High traffic areas and buildings such as offices, batching plants, storage areas etc. should, where possible be situated in areas that are already disturbed;
- 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;
- No off-road driving;
- Environmental Control Officer (ECO) to oversee activities and ensure that the 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 CEMP.

6.5.1.2 Disturbance and Displacement

Potential Impact: Birds are disturbed and displaced from the project site and surrounding areas due to construction activities and associated noise etc. Particularly at risk are sensitive species breeding on and around the site or regularly utilizing the project site for foraging/hunting e.g. eagles, korhaans, coursers and bustards.							
	Magnitude	Duration	Scale	Probability	Significance	Status	Confidence
Without Mitigation	8	2	2	4	48 (Moderate)	Negative	Medium
With Mitigation	6	2	2	3	30 (Moderate)	Negative	Medium
Can the impact be reversed?			Yes				
Will impact cause irreplaceable loss or resources?			No				

Can impact be avoided, managed or mitigated?	Partially

Required mitigation measures to reduce residual risk or enhance opportunities:

- 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.
- Environmental Control Officer (ECO) to oversee activities and ensure that the site specific construction environmental management plan (CEMP) is implemented and enforced;
- The appointed 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.
- Prior to construction, an avifaunal specialist should conduct a site walkthrough, covering the final road, pipeline and power line routes as well as the CSP plant layout, to identify any nests/breeding/roosting activity of sensitive species, as well as any additional sensitive habitats. The results of which may inform the final construction schedule in close proximity to that specific area, including abbreviating construction time, scheduling activities around avian breeding and/or movement schedules, and lowering levels of associated noise.
- No construction activities or staff are permitted within 1.5 km of the identified Martial Eagle nest (Figure 5).
- A construction phase bird monitoring programme must be implemented by a bird specialist, to document potential impacts on key species such as korhaans, bustards and eagles, and must include the ongoing monitoring of the active Verreaux's Eagle and Martial eagle nest sites.

6.5.2 Operational Phase

6.5.2.1 Disturbance and Displacement

Potential Impact: Birds are disturbed and displaced from the project site and surrounding areas, or from the grid connection servitude and surrounding areas, due ongoing operational and maintenance activities. Particularly at risk are sensitive species breeding or foraging/hunting in close proximity to the activities, for example raptors that may nest on the new powerline tower being disturbed by power line and servitude maintenance.

	Magnitude	Duration	Scale	Probability	Significance	Status	Confidence
Without Mitigation	8	4	2	4	56 (Moderate)	Negative	Medium
With Mitigation	6	4	2	2	24 (Low)	Negative	Medium

Can the impact be reversed?	Yes
Will impact cause irreplaceable loss or resources?	No
Can impact be avoided, managed or mitigated?	Partially

Required mitigation measures to reduce residual risk or enhance opportunities:

- 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 operational 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 2 km of the operational facility (or the grid connection servitude), the nest/breeding site must not be disturbed and the avifaunal specialist must be contacted for further instruction.

- The on-site operational facilities manager (or a suitably appointed Environmental Manager) must conduct inspections every two months of the grid connection line, and all existing transmission line pylons within 2 km of the project site boundary to locate possible nesting raptors. Any such nests must not be disturbed and should be reported to the avifaunal specialist for further instruction.
- Operational phase bird monitoring, in line with the solar guidelines, must be implemented.
- No operational activities or staff are permitted within 1.5 km of the identified Martial Eagle nest (Fig 5)

6.5.2.2 Burning

Potential Impact: Large heliostat arrays focus solar flux on a central "power tower", exposing passing birds to the risk of being singed or burnt in the flux beams, particularly as they aggregate close to the receiver. Birds may be burnt in the stand-by focal points

	Magnitude	Duration	Scale	Probability	Significance	Status	Confidence
Without Mitigation	10	4	3	5	85 (High)	Negative	Low
With Mitigation	8	4	2	5	70 (Moderate)	Negative	Low

Can the impact be reversed?	No
Will impact cause irreplaceable loss or resources?	Yes
Can impact be avoided, managed or mitigated?	Partially, although our confidence in the effectiveness of available mitigations is low.

Required mitigation measures to reduce residual risk or enhance opportunities:

- The occurrence and intensity of standby focal points should be kept to a minimum by careful focusing of heliostats when not in use, for example in a 'pancacke' stand-by pattern.
- Attractants to birds, such as foraging and perching opportunities should be limited in the immediate vicinity of the facility.
- All artificial water points (e.g. livestock water points and wind pumps) on the project site and within 500 m from the boundary of the project site, must be moved or shut down (if not already removed from the project site during construction) so that birds are not attracted to the project site and immediate surrounding areas.
- All water related infrastructure (e.g. pipes, pumps, reservoirs, toilets, taps etc.) must be regularly (twice weekly) checked for leaks, and repaired immediately.
- Any waste water treatment or evaporation ponds must either be entirely covered, or must be located at least 1 km away from the outer rim of the CSP heliostat field.
- The CSP central receiver tower must not be constructed within 3 km of the identified Martial Eagle nest (Figure 6).
- Develop and implement an operational monitoring programme for birds in line with applicable solar guidelines, which must include searching for mortalities for at least the first two years of operations.
- Frequent and regular review of operational phase monitoring data and results by an avifaunal specialist.
- 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 burning risk.
    - Various approaches to standby aiming of heliostats, which could significantly reduce flux levels. For example, (Walston, *et al.* 2015) found that various approaches to standby aiming could significantly reduce flux levels and their impact on avian fatality. One approach could be the 'pancake' standby where no more than 4 mirrors focussing on a single point.

6.5.2.3 Collision with Reflective Structures and/or CSP Infrastructure (Excluding Power Lines)

Potential Impact: Birds collide with heliostats and/or the PV panels and/or the central receiver tower. Birds may be attracted to the reflective surfaces which may be mistaken for large water bodies and can cause disorientation of flying birds, resulting in injury and/or death.							
	Magnitude	Duration	Scale	Probability	Significance	Status	Confidence
Without Mitigation	8	4	2	5	70 (Moderate)	Negative	Medium
With Mitigation	7	4	2	4	52 (Moderate)	Negative	Low
Can the impact be reversed?			No				
Will impact cause irreplaceable loss or resources?			Yes				
Can impact be avoided, managed or mitigated?			Partially.				

Required mitigation measures to reduce residual risk or enhance opportunities:

- To limit bird traffic across the site, perch able structures should be avoided where possible.
- All artificial water points (e.g. livestock water points and wind pumps) on the project site and within 500 m from the boundary of the project site, must be moved or shut down (if not already removed from the project site during construction) so that birds are not attracted to the project site and immediate surrounding areas.
- All water related infrastructure (e.g. pipes, pumps, reservoirs, toilets, taps etc.) must be regularly (twice weekly) checked for leaks, and repaired immediately.
- Any waste water treatment or evaporation ponds must either be entirely covered, or must be located at least 1 km away from the outer rim of the CSP heliostat field.
- 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) and where possible, lighting should be intermittent or flashing-beam lights.
- Careful selection of and modifications to solar facility equipment should be made where possible. For instance, white borders could be applied to PV panels to reduce the resemblance that arrays have of waterbodies.
- Develop and implement an operational monitoring programme for birds in line with applicable solar guidelines, which must include searching for mortalities.
- Frequent and regular review of operational phase monitoring data and results by an avifaunal specialist.
- 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, which may include the use of rotating/flashing mirrors, or sound deterrents.

6.5.2.4 Collision with powerlines

Potential Impact: Birds collide with the overhead power lines.							
	Magnitude	Duration	Scale	Probability	Significance	Status	Confidence
Without Mitigation	10	4	4	5	90 (High)	Negative	Medium
With Mitigation	8	4	2	3	42 (Moderate)	Negative	Medium
Can the impact be reversed?			No				
Will impact cause irreplaceable loss or resources?			Yes				

Can impact be avoided, managed or mitigated?	Yes

Required mitigation measures to reduce residual risk or enhance opportunities:

- Where possible, power lines/cables on the project site should be underground.
- Where possible, the routing of power line infrastructure should avoid Medium or High Sensitivity zones (Figure 6).
- Where possible, grid connection infrastructure should follow existing servitudes such as existing power lines, roads and fences.
- An avifaunal specialist must conduct a site walk through of the final Grid Connection route and pylon positions prior to construction to determine if, and where, bird flight diverters (BFDs) are required.
- Install bird flight diverters as per the instructions of the specialist following the site walkthrough, which may include the need for modified BFDs fitted with solar powered LED lights on certain spans.
- The operational monitoring programme for the associated CSP site must be in line with applicable monitoring guidelines and must include regular (at least monthly) monitoring of the grid connection power line for collision (and electrocution) mortalities. Any mortalities should be reported to the Endangered Wildlife Trust (EWT).

6.5.2.5 Electrocution

Potential Impact:							
	Magnitude	Duration	Scale	Probability	Significance	Status	Confidence
Without Mitigation	10	4	4	4	72 (Moderate)	Negative	Medium
With Mitigation	6	4	2	2	24 (Low)	Negative	High
Can the impact be reversed?			No				
Will impact cause irreplaceable loss or resources?			Yes				
Can impact be avoided, managed or mitigated?			Yes				

Required mitigation measures to reduce residual risk or enhance opportunities:

- Any new power line/s must be of a design that minimizes electrocution risk by using adequately insulated 'bird friendly' monopole structures, with clearances between live components of 2 m or greater and which provide a safe bird perch. The structures to be constructed must be approved by the Endangered Wildlife Trust's (EWT) Wildlife and Energy Programme or a suitably qualified bird specialist.
- The operational monitoring programme for the associated WEF site must be in line with applicable guidelines and must include regular monitoring of the grid connection power line and all new associated substations for electrocution (and collision) mortalities. Any mortalities should be reported to the EWT.

6.5.2.6 Water Pollution and Waste-water

Potential Impact: Pollution of water resources used by birds. Production of wastewater (brine), which can be difficult to manage and treat. Artificial evaporation ponds attract waterbirds, which could be poisoned and/or drown.							
	Magnitude	Duration	Scale	Probability	Significance	Status	Confidence
Without Mitigation	6	4	3	3	39 (Moderate)	Negative	Low
With Mitigation	4	4	2	2	20 (Low)	Negative	Low
Can the impact be reversed?			Possibly.				
Will impact cause irreplaceable loss or resources?			Unlikely.				
Can impact be avoided, managed or mitigated?			Partially.				

Required mitigation measures to reduce residual risk or enhance opportunities: • Ensure that birds do not get in contact with evaporation ponds i.e. ponds should be covered with wire mesh or netting to reduce the possibilities of, attracting, drowning, or poisoning birds. • All cleaning products used on the site should be environmentally friendly and bio-degradable. • The OEMP must include site specific measures for the effective management and treatment of waste water.

6.5.2.7 Excessive Use of Water

Potential Impact: Excessive use of water, which may drain local reserves used by birds in naturally dry habitats.							
	Magnitude	Duration	Scale	Probability	Significance	Status	Confidence
Without Mitigation	6	4	3	3	39 (Moderate)	Negative	Low
With Mitigation	4	4	3	2	22 (Low)	Negative	Low
Can the impact be reversed?			No				
Will impact cause irreplaceable loss or resources?			Possibly.				
Can impact be avoided, managed or mitigated?			Unknown				
Required mitigation measures to reduce residual risk or enhance opportunities: • Adopt dry cooling technologies for the CSP plant.							

6.5.2.8 Disruption of Bird Movement Patterns

Potential Impact:							
	Magnitude	Duration	Scale	Probability	Significance	Status	Confidence
Without Mitigation	6	4	3	3	39 (Moderate)	Negative	Low
With Mitigation	5	4	3	3	36 (Moderate)	Negative	Low
Can the impact be reversed?			Unlikely				
Will impact cause irreplaceable loss or resources?			No				
Can impact be avoided, managed or mitigated?			No				
Required mitigation measures to reduce residual risk or enhance opportunities: • External lighting to be of an intermittent and coloured nature rather than constant white light to reduce the potential impact on the movement patterns of nocturnal species.							

7 CONCLUSION

Based on a thorough desk based study and four seasonal site surveys conducted over a 12 month period, it can be concluded that the project site has a moderate sensitivity and the broader project area has a moderate to high sensitivity in terms of avifauna.

The species of most concern are the *Endangered* Martial Eagle and the *Endangered* Ludwig's Bustard. It was noted though that former species was rarely recorded flying over the project site in the surveys conducted and in fact, the abundance and flight activity levels of all raptors and priority species recorded on the project site was relatively low. The latter is believed to be less at risk from burning impacts, and more at risk from collisions

with powerlines and disturbance and displacement impacts. Other red-data species of concern were the Lanner Falcon, Burchell's and Double-banded Coursers and Kori Bustard.

Although a relatively diverse number of species and a high number of red-data species were recorded by monitoring, in most cases the frequency of records and the activity (especially flight activity) of these species on the project site was low.

Commercial scale solar farms, and particularly CSP developments, are relatively new in South Africa and little information therefore exists on the potential impacts of these technologies on South African avifauna. Some information is available internationally which shows that the main potential impacts may include: burning; collision; electrocution; disturbance and displacement; habitat destruction; water pollution; and excessive use of water. Impacts of associated infrastructure (e.g. the grid connection power lines) is however well understood.

The most significant potential impacts to date are burning and collision with reflective structures and/or CSP infrastructure which were both rated (after the application of mitigation) Medium. Cumulatively, these impacts are likely to have a high significance rating.

Generally, when viewed as a whole, and considering the lack of confirmed impacts of CSP projects on birds in South Africa, the potential important contribution that CSP power may have on slowing climate change, 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 construction and operational phase monitoring) and proposed mitigations in this report being implemented.

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APPENDIX I: IMPACT ASSESMENT METHODOLOGY

The significance of the identified impacts will be determined using the approach outlined below (terminology from the Department of Environmental Affairs and Tourism Guideline document on EIA Regulations, April 1998). This approach incorporates two aspects for assessing the potential significance of impacts, namely occurrence and severity, which are further sub-divided as follows:

Occurrence		**Severity**	
Probability of occurrence	Duration of occurrence	Scale / extent of impact	Magnitude (severity) of impact

To assess each of these factors for each impact, the following four ranking scales are used:

Probability	**Duration**
5 - Definite/don't know	5 - Permanent
4 - Highly probable	4 - Long-term
3 - Medium probability	3 - Medium-term (8-15 years)
2 - Low probability	2 - Short-term (0-7 years) (impact ceases after the operational life of the activity)
1 - Improbable	1 – Immediate
0 - None	
Scale	Magnitude
5 - International	10 - Very high/don't know
4 - National	8 - High
3 - Regional	6 - Moderate
2 - Local	4 - Low
1 - Site only	2 - Minor
0 - None	

Once these factors are ranked for each impact, the significance of the two aspects, occurrence and severity, is assessed using the following formula:
SP (significance points) = (magnitude + duration + scale) x probability

The maximum value is 100 significance points (SP). The impact significance will then be rated as follows:

SP >75	**Indicates high environmental significance**	**An impact which could influence the decision about whether or not to proceed with the project regardless of any possible mitigation.**
SP 30 – 75	Indicates moderate environmental significance	An impact or benefit which is sufficiently important to require management and which could have an influence on the decision unless it is mitigated.
SP <30	Indicates low environmental significance	Impacts with little real effect and which should not have an influence on or require modification of the project design.
+	Positive impact	An impact that constitutes an improvement over pre-project conditions

APPENDIX II: WALKED TRANSECT SURVEY DETAILS

Ref*	Transect Co-ordinates (Start)		Transect Co-ordinates (Finish)		Winter Survey Details			Spring Survey Details			Summer Survey Details			Autumn Survey Details		
	South	East	South	East	Date	Start Time	End Time	Date	Start Time	End Time	Date	Start Time	End Time	Date	Start Time	End Time
WT1.1	-28.68096°	22.02358°	-28.68990°	22.02354°	09/06/2015	11:38	12:08	15/09/2015	15:39	16:08	09/12/2015	07:45	08:24	02/04/2016	09:14	10:02
WT1.2	-28.68096°	22.02358°	-28.68990°	22.02354°	11/06/2015	14:30	14:56	21/09/2015	08:02	08:32	13/12/2015	07:08	07:45	03/04/2016	17:06	17:37
WT2.1	-28.70532°	21.99888°	-28.71391°	21.99553°	06/06/2015	07:55	08:33	16/09/2015	16:33	17:02	10/12/2015	05:41	06:11	02/04/2016	16:50	17:30
WT2.2	-28.70532°	21.99888°	-28.71391°	21.99553°	11/06/2015	10:19	10:43	17/09/2015	07:18	07:46	14/12/2015	06:58	07:21	04/04/2016	15:25	16:02
WT3.1	-28.70505°	22.01497°	-28.70036°	22.00623°	10/06/2015	14:05	14:46	15/09/2015	11:18	11:57	08/12/2015	06:08	06:50	03/04/2016	09:10	09:58
WT3.2	-28.70505°	22.01497°	-28.70036°	22.00623°	11/06/2015	09:06	09:45	16/09/2015	07:47	08:22	14/12/2015	05:45	06:23	04/04/2016	16:43	17:21
CWT1.1	-28.75565°	21.95405°	-28.74846°	21.94785°	07/06/2015	08:43	09:26	17/09/2015	15:26	15:48	10/12/2015	08:08	08:37	05/04/2016	08:24	09:09
CWT1.2	-28.75565°	21.95405°	-28.74846°	21.94785°	10/06/2015	07:55	08:26	18/09/2015	07:14	07:52	11/12/2015	05:26	05:53	06/04/2016	09:02	09:44
CWT2.1	-28.77405°	21.93708°	-28.77062°	21.92764°	09/06/2015	14:47	15:17	19/09/2015	15:48	16:14	10/12/2015	07:03	07:28	05/04/2016	15:50	16:29
CWT2.2	-28.77405°	21.93708°	-28.77062°	21.92764°	11/06/2015	07:53	08:25	20/09/2015	07:18	07:48	13/12/2015	05:30	05:52	06/04/2016	07:51	08:28

** Transects are named according to location and visit within the season; i.e. WT2.1 is transect location two, first visit; WT2.2 is transect location two, second visit.*

APPENDIX III: DRIVEN TRANSECT SURVEY DETAILS

Ref*	Length (km)	Transect Co-ordinates (Start)		Transect Co-ordinates (Finish)		Winter Survey			Spring Survey			Summer Survey			Autumn Survey		
		South	East	South	East	Date	Start Time	End Time	Date	Start Time	End Time	Date	Start Time	End Time	Date	Start Time	End Time
DT1.1	10.3	-28.739388°	21.999576°	-28.689782°	22.078781°	03/06/15	09:03	09:49	14/09/15	12:53	13:23	07/12/15	12:38	13:00	01/04/16	12:33	13:15
DT1.2	10.3	-28.739388°	21.999576°	-28.689782°	22.078781°	08/06/15	09:05	09:32	18/09/15	15:46	16:15	12/12/15	13:47	14:04	04/04/16	07:39	08:18
DT2.1	10.6	-28.699189°	22.052513°	-28.671372°	22.013056°	04/06/15	08:14	09:05	15/09/15	16:40	17:29	08/12/15	11:11	12:19	02/04/16	07:33	08:52
DT2.2	10.6	-28.699189°	22.052513°	-28.671372°	22.013056°	11/06/15	12:00	12:47	16/09/15	12:19	13:16	09/12/15	06:21	07:21	03/04/16	07:58	08:47

Ref*	Length (km)	Transect Co-ordinates (Start)		Transect Co-ordinates (Finish)		Winter Survey			Spring Survey			Summer Survey			Autumn Survey		
		South	East	South	East	Date	Start Time	End Time	Date	Start Time	End Time	Date	Start Time	End Time	Date	Start Time	End Time
DT3.1	5.9	-28.731022°	22.005815°	-28.682639°	22.002591°	10/06/15	13:22	13:50	15/09/15	07:20	07:51	10/12/15	14:17	14:33	02/04/16	16:59	17:24
DT3.2	5.9	-28.731022°	22.005815°	-28.682639°	22.002591°	11/06/15	11:18	11:52	18/09/15	11:36	12:05	11/12/15	15:41	15:57	04/04/16	08:46	09:13
CDT1.1	4.65	-28.778240°	21.933382°	-28.750492°	21.962642°	07/06/15	08:15	08:33	14/09/15	14:18	14:35	12/12/15	09:23	09:59	05/04/16	06:48	07:19
CDT1.2	4.65	-28.778240°	21.933382°	-28.750492°	21.962642°	09/06/15	13:59	14:16	17/09/15	06:46	07:05	13/12/15	11:13	11:30	06/04/16	06:51	07:13
CDT2.1	2.55	-28.735274°	21.965228°	-28.733288°	21.944551°	07/06/15	13:06	13:22	17/09/15	11:29	11:44	13/12/15	10:44	11:01	05/04/16	07:30	08:00
CDT2.2	2.55	-28.735274°	21.965228°	-28.733288°	21.944551°	10/06/15	12:45	13:01	20/09/15	12:07	12:22	14/12/15	08:08	08:20	06/04/16	07:16	07:29

** Transects are named according to location and visit within the season; i.e. DT1.1 is transect location one, first visit; DT1.2 is transect location one, second visit*

APPENDIX IV: CUMULATIVE SPECIES LIST

Common Name	Red List Status (Taylor 2015)	Endemic*	Priority species score (Retief et al. 2011)	Area Recorded															
				Winter				Spring				Summer				Autumn			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Barbet, Acacia Pied				1	1	1		1	1	1	1	1	1	1	1	1	1	1	
Barbet, Crested											1				1				1
Batis, Pririt								1	1	1		1	1	1	1	1	1	1	
Bee-eater, European												1	1	1	1				
Bee-eater, Swallow-tailed											1								1
Bee-eater, White-fronted											1								1
Bishop, Southern Red								1	1	1					1	1		1	1
Bokmakierie				1	1	1		1	1	1	1	1	1	1	1	1	1	1	
Bulbul, African Red-eyed				1	1	1	1	1	1	1	1	1	1	1	1				1
Bunting, Cape				1				1			1	1	1						
Bunting, Cinnamon-breasted				1															
Bunting, Golden-breasted								1	1										
Bunting, Lark-like				1	1	1	1	1	1	1		1	1	1		1	1	1	

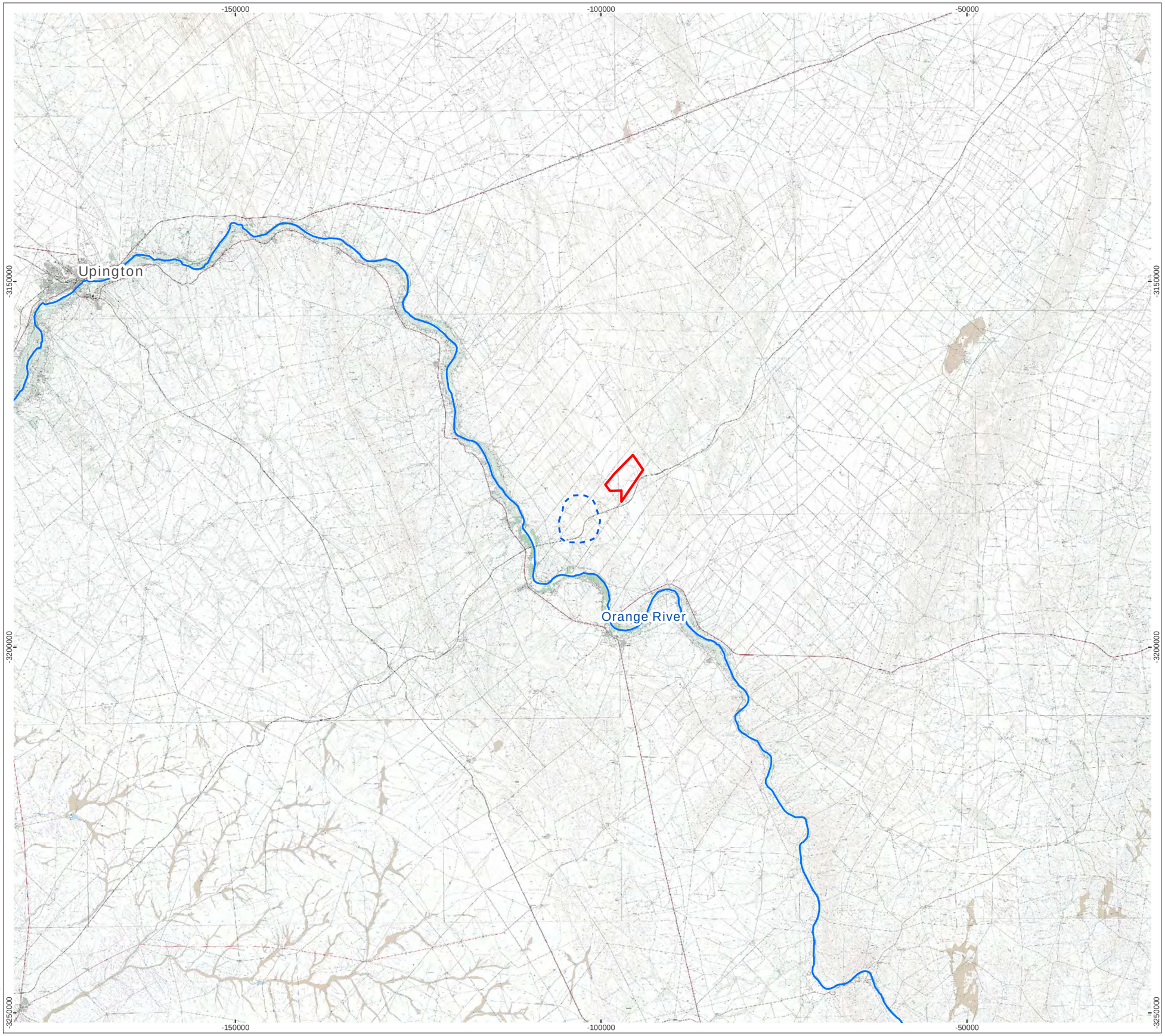
Common Name	Red List Status (Taylor 2015)	Endemic*	Priority species score (Retief et al. 2011)	Area Recorded															
				Winter				Spring				Summer				Autumn			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Bustard, Kori	NT		260	1	1	1		1	1	1		1	1		1	1	1		
Bustard, Ludwig's	EN		320	1	1											1			1
Buzzard, Jackal		(*)	250													1	1		
Canary, Black-headed		(*)		1															
Canary, Black-throated				1	1			1	1			1	1	1					
Canary, White-throated				1	1							1	1	1					
Canary, Yellow				1	1	1		1	1	1		1	1	1	1	1	1	1	
Chat, Ant-eating				1	1	1		1	1	1		1	1	1	1	1	1	1	
Chat, Familiar				1	1		1	1	1		1				1	1	1		1
Chat, Sickle-winged		(*)		1	1														
Cisticola, Grey-backed							1	1											
Cisticola, Levaillant's															1				
Cormorant, Reed							1				1				1				
Cormorant, White-breasted							1				1				1	1			
Coucal, Burchell's															1				
Courser, Burchell's	VU		210					1	1			1	1						
Courser, Double-banded	NT		204					1	1			1	1						
Crombec, Long-billed				1	1			1	1	1		1	1	1	1				
Crow, Pied				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Cuckoo, Diederik																			
Cuckoo, Jacobin												1	1		1				
Darter, African							1				1				1	1		1	1
Dove, Cape Turtle				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Dove, Laughing				1	1	1		1	1	1	1	1	1	1		1	1	1	1
Dove, Namaqua				1	1	1	1	1	1	1		1	1	1	1	1	1	1	1
Dove, Rock															1				
Duck, African Black							1				1				1				1
Eagle, African Fish			290	1			1			1	1				1	1	1		1
Eagle, Black-chested Snake			230												1				
Eagle, Booted			230					1	1										

Common Name	Red List Status (Taylor 2015)	Endemic*	Priority species score (Retief et al. 2011)	Area Recorded															
				Winter				Spring				Summer				Autumn			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Eagle, Martial	EN		350	1		1		1	1			1	1			1			
Eagle, Verreauxs'	VU		360	1				1				1	1		1	1	1		
Egret, Little							1				1				1				1
Egret, Western Cattle							1								1	1			1
Eremomela, Yellow-bellied				1	1	1		1	1	1		1	1	1		1	1	1	
Falcon, Lanner	VU		300									1	1			1	1	1	
Falcon, Pygmy				1								1	1	1					
Finch, Red-headed				1				1	1			1	1	1				1	
Finch, Scaly-feathered				1	1	1	1	1	1	1		1	1	1	1	1	1	1	
Fiscal, Common				1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
Flycatcher, Chat																1	1		
Flycatcher, Fiscal		(*)					1	1	1	1	1				1				
Goose, Egyptian							1	1			1				1	1	1		1
Goose, Spur-winged							1								1				
Goshawk, Pale Chanting			200	1	1			1	1			1	1	1	1	1	1		
Grebe, Little							1												
Guineafowl, Helmeted															1				
Hawk, African Harrier-			190													1			1
Heron, Black-headed							1								1				
Heron, Goliath							1				1				1				1
Heron, Grey							1				1				1				
Hoopoe, African											1				1				
Hornbill, African Grey				1	1														
Hornbill, Southern Yellow-billed								1	1										
Ibis, African Sacred							1				1				1				
Ibis, Hadeda							1	1	1	1	1	1	1	1	1	1	1		1
Kestrel, Greater			174													1	1		
Kestrel, Rock				1								1	1	1					
Kingfisher, Giant							1				1				1	1			1

Common Name	Red List Status (Taylor 2015)	Endemic*	Priority species score (Retief et al. 2011)	Area Recorded															
				Winter				Spring				Summer				Autumn			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Kingfisher, Malachite							1									1			1
Kite, Black-shouldered			174				1												
Kite, Yellow-billed															1				
Korhaan, Karoo	NT		240	1		1								1	1				
Korhaan, Northern Black			180	1	1	1		1	1	1		1	1	1		1	1	1	
Korhaan, Red-crested				1	1	1		1	1	1		1	1	1	1				
Lapwing, Blacksmith											1				1				
Lapwing, Crowned				1	1			1	1							1	1	1	
Lark, Black-eared Sparrow-		(*)						1	1										
Lark, Eastern Clapper				1	1	1		1	1	1		1	1	1		1	1	1	
Lark, Fawn-coloured				1	1	1		1	1	1		1	1	1		1	1	1	
Lark, Grey-backed Sparrow				1	1			1	1	1		1	1	1		1	1	1	
Lark, Sabota				1	1	1													
Lark, Spike-heeled								1	1	1		1	1	1		1	1		
Lark, Stark's												1	1	1					
Martin, Rock				1	1	1	1	1	1	1		1	1	1	1			1	1
Mousebird, Red-faced				1	1	1		1	1	1	1	1	1	1	1	1	1	1	
Mousebird, White-backed				1	1	1	1	1	1	1		1	1	1	1	1	1		
Owl, Cape Eagle-			250					1	1										
Owlet, Pearl-spotted							1								1				1
Penduline-tit, Cape								1	1										
Pigeon, Speckled							1	1	1	1	1	1	1	1	1	1	1		1
Pipit, African				1	1			1	1										
Plover, Three-banded											1								
Prinia, Black-chested				1	1	1		1	1	1		1	1	1	1	1	1	1	
Quail-finch, African																		1	
Quelea, Red-billed				1	1	1		1	1	1								1	
Robin, Kalahari Scrub				1	1			1	1	1		1	1	1	1	1	1	1	
Robin, Karoo Scrub										1	1								
Robin-chat, Cape							1								1				1

Common Name	Red List Status (Taylor 2015)	Endemic*	Priority species score (Retief et al. 2011)	Area Recorded															
				Winter				Spring				Summer				Autumn			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Sandgrouse, Namaqua				1	1	1	1	1	1	1		1	1	1		1	1	1	
Scimitarbill, Common				1	1			1	1	1		1	1	1					
Shelduck, South African											1								
Shrike, Crimson-breasted				1								1	1						
Shrike, Lesser Grey																1	1		
Shrike, Red-backed																1	1	1	
Sparrow, Cape							1	1	1		1				1				
Sparrow, Great							1								1				
Sparrow, House											1				1				1
Sparrow-weaver, White-browed				1	1	1		1	1	1		1	1	1				1	
Starling, Cape Glossy										1	1				1				1
Starling, Pale-winged				1				1											
Starling, Wattled																			
Sunbird, Dusky				1	1	1		1	1	1		1	1	1		1	1	1	
Swallow, Barn												1	1	1	1	1	1		
Swallow, White-throated								1	1	1	1					1	1	1	
Swift, Alpine																		1	1
Swift, Bradfield's											1								
Swift, Little				1	1			1	1	1	1	1	1	1	1	1	1		1
Swift, White-rumped																		1	
Tchagra, Brown-crowned												1	1						
Thrush, Karoo		(*)									1				1				
Thrush, Olive																			1
Thrush, Short-toed Rock				1												1			
Tinkerbird, Red-fronted																1	1		
Tit, Ashy				1	1	1		1	1	1		1	1	1	1				
Tit-Babbler, Chestnut-vented				1	1	1		1	1	1		1	1	1	1	1	1	1	
Vulture, Lappet-faced	EN, VU		310													1	1		
Wagtail, African Pied											1				1				

Common Name	Red List Status (Taylor 2015)	Endemic*	Priority species score (Retief et al. 2011)	Area Recorded															
				Winter				Spring				Summer				Autumn			
				Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley	Broader Project Area	Project Site	Control Site	Orange River Valley
Wagtail, Cape						1	1				1								
Warbler, African Reed																1			
Warbler, Namaqua		(*)					1												
Warbler, Rufous-eared				1	1	1		1	1	1		1	1	1					
Waxbill, Common											1	1	1						
Waxbill, Violet-eared				1	1	1						1	1	1				1	
Weaver, Cape		(*)																	1
Weaver, Sociable				1	1	1		1	1	1		1	1	1	1			1	
Weaver, Southern Masked				1	1	1	1	1	1	1	1				1				
Wheatear, Capped				1	1							1	1			1	1	1	
Wheatear, Mountain				1															
White-eye, Orange River				1	1		1	1	1	1	1	1	1		1	1			1
Whydah, Shaft-tailed																		1	
Woodpecker, Cardinal								1	1		1				1				



Basemapping from the Chief Directorate National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

Project Site

Control Site

Watercourse

1:500,000 Scale @ A3

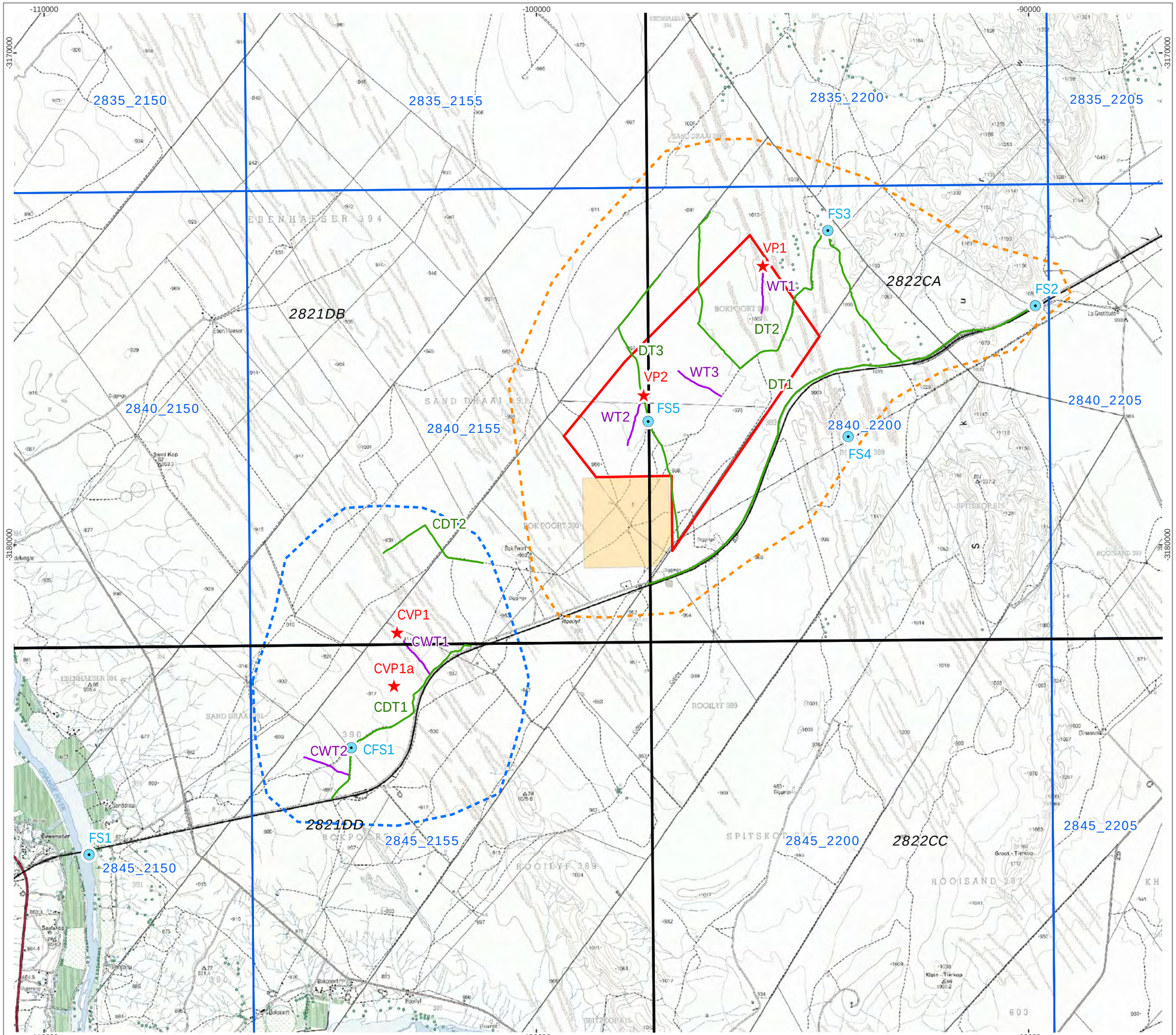
N

0 10 20 km

Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/017 Date: 10/05/2016

Project Site and
Control Site Locations
Figure 1

Bokpoort II Solar Farm
Avifaunal Impact Assessment
Report



Basemapping from the Chief Directorate National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

- Project Site
- Control Site
- VP Location
- Focal Site
- Walked Transect
- Driven Transect
- Broader Project Area
- Bokpoort I Area
- SABAAP 1 Quarter Degree Squares
- SABAAP2 Pentads

1:75,000 Scale @ A3

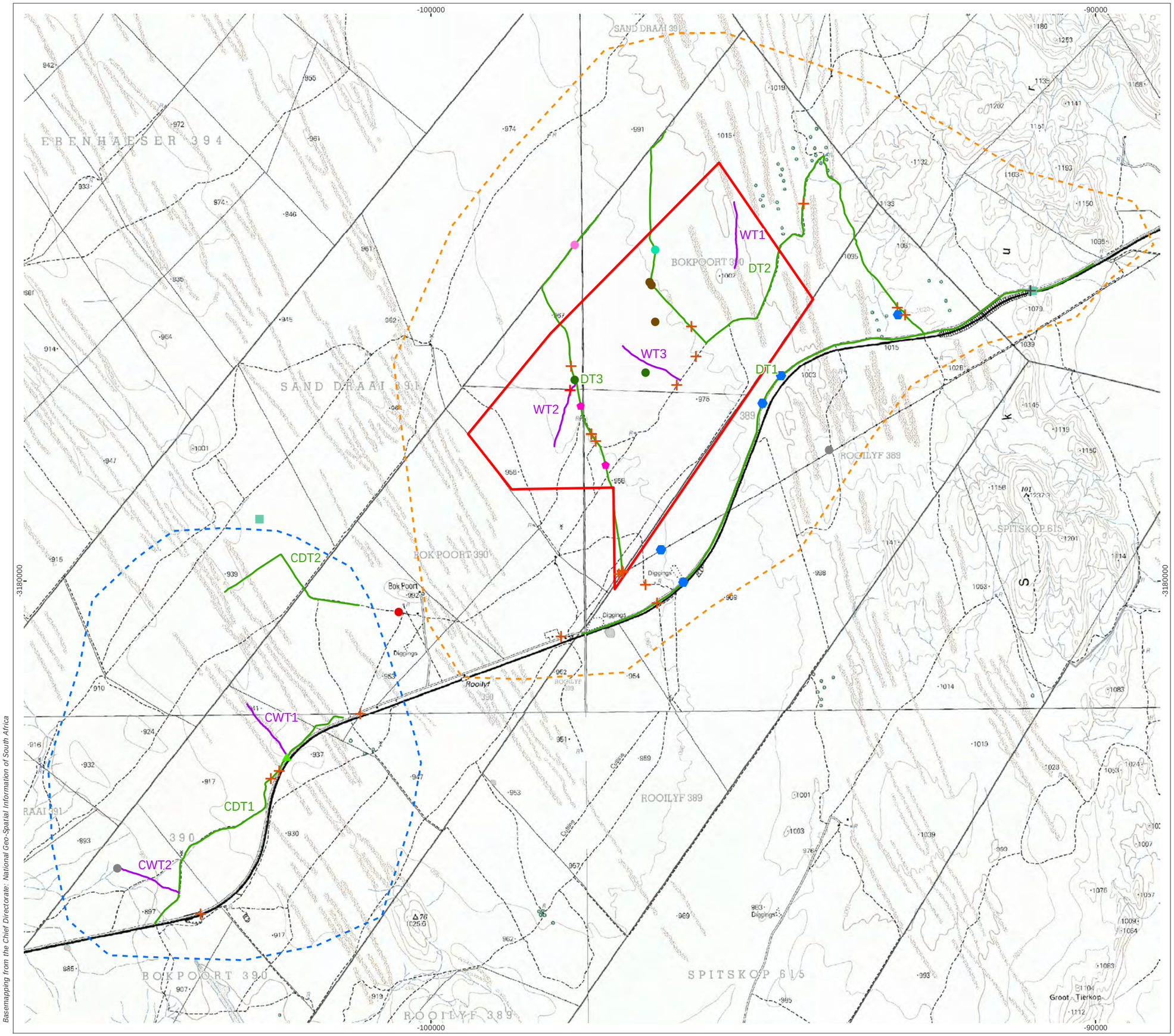
N

0 1.5 3 km

Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/018 Date: 10/05/2016

Vantage Point, Focal Site, Driven and Walked Transect Locations
Figure 2

Bokpoort II Solar Farm
Avifaunal Impact Assessment Report



Basemapping from the Chief Directorate: National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

- Project Site
- Control Site
- Broader Project Area
- Walked Transect
- Driven Transect
- African Fish Eagle
- Burchells Courser
- Cape Eagle Owl
- Crowned Lapwing
- Double-banded Courser
- Egyptian Goose
- Grey Hornbill
- Lanner Falcon
- Martial Eagle
- Pale Chanting Goshawk
- Pygmy Falcon
- Rock Kestrel
- Verreaux's Eagle

1:55,000 Scale @ A3

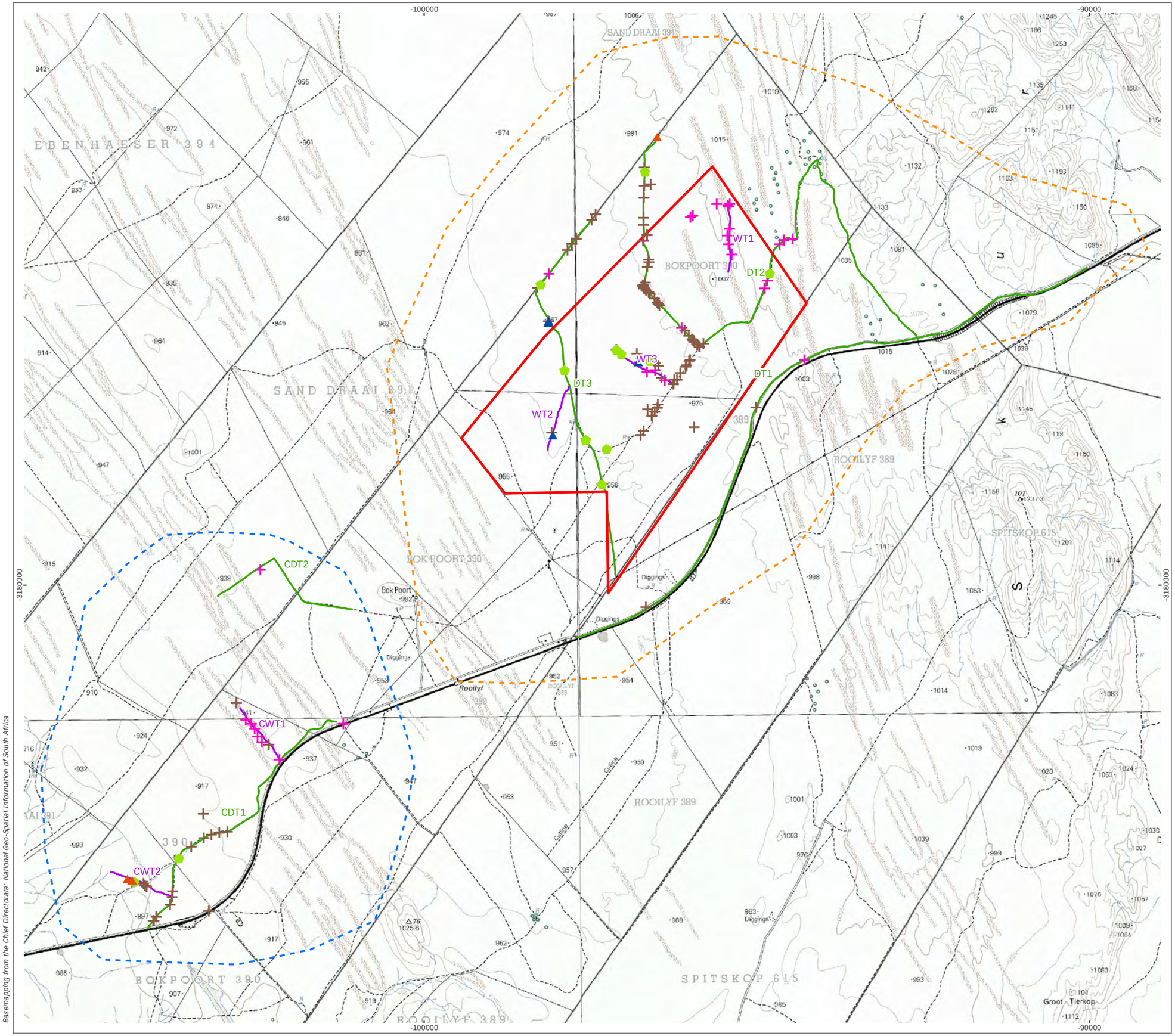
N

0 1 2 km

Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/019 Date: 11/05/2016

Selected Transect and Incidental Target Species Records
Figure 3a

Bokpoort II Solar Farm
Avifaunal Impact Assessment Report



Basemapping from the Chief Directorate: National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

- Project Site
- Control Site
- Broader Project Area
- Walked Transect
- Driven Transect
- Karoo Korhaan
- Kori Bustard
- Ludwig's Bustard
- Northern Black Korhaan
- Red-crested Korhaan

1:55,000 Scale @ A3

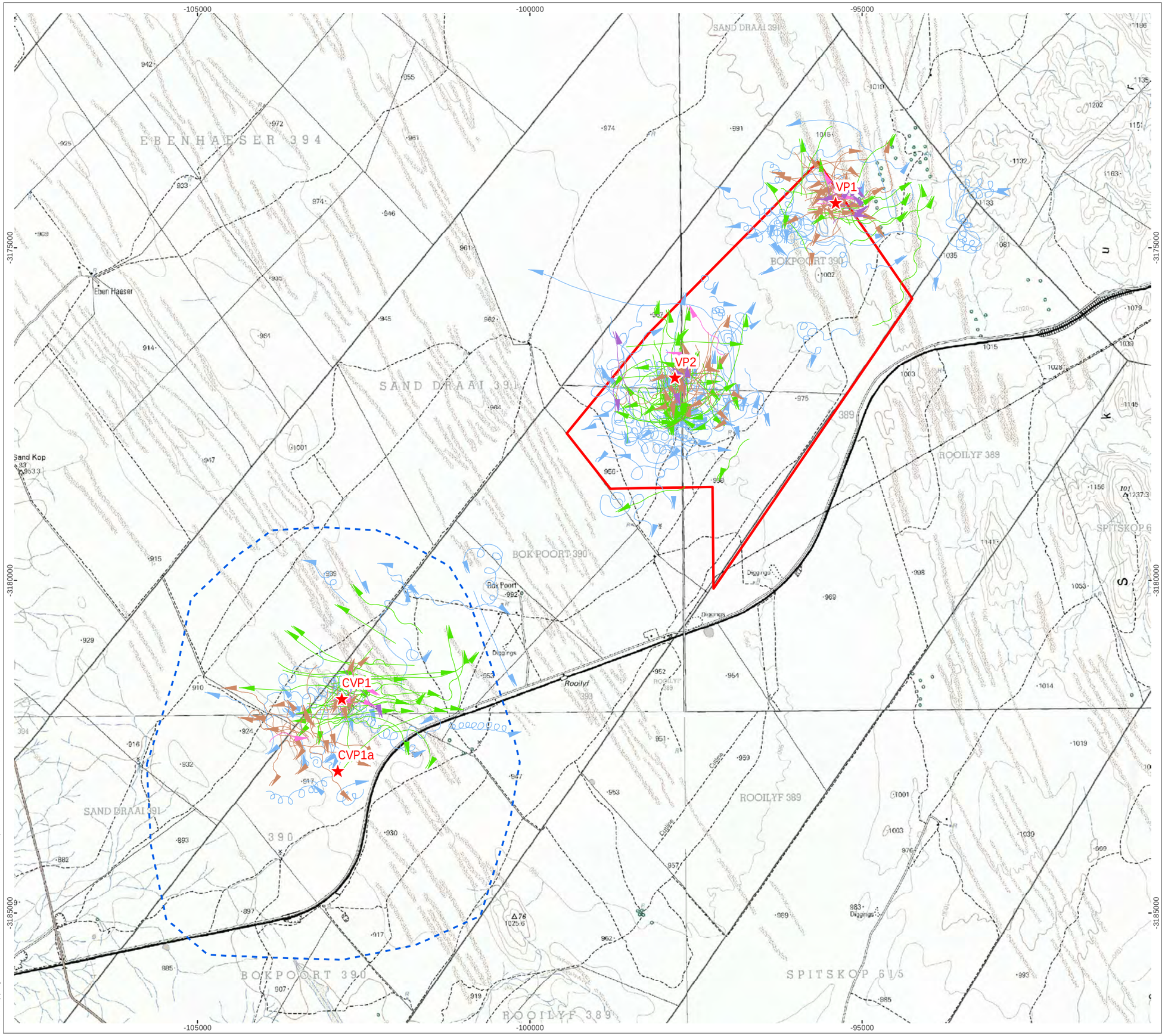
N

0 1 2 km

Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/025 Date: 11/05/2016

Transect and Incidental Records of Korhaans and Bustards
Figure 3b

Bokpoort II Solar Farm
Avifaunal Impact Assessment Report



Basemapping from the Chief Directorate National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

- Project Site
- Control Site
- VP Location
- Cape Turtle Dove Flight
- Laughing Dove Flight
- Namaqua Dove Flight
- Namaqua Sandgrouse Flight (winter season only)
- Pied Crow Flight

1:55,000 Scale @ A3

N

0 1 2 km

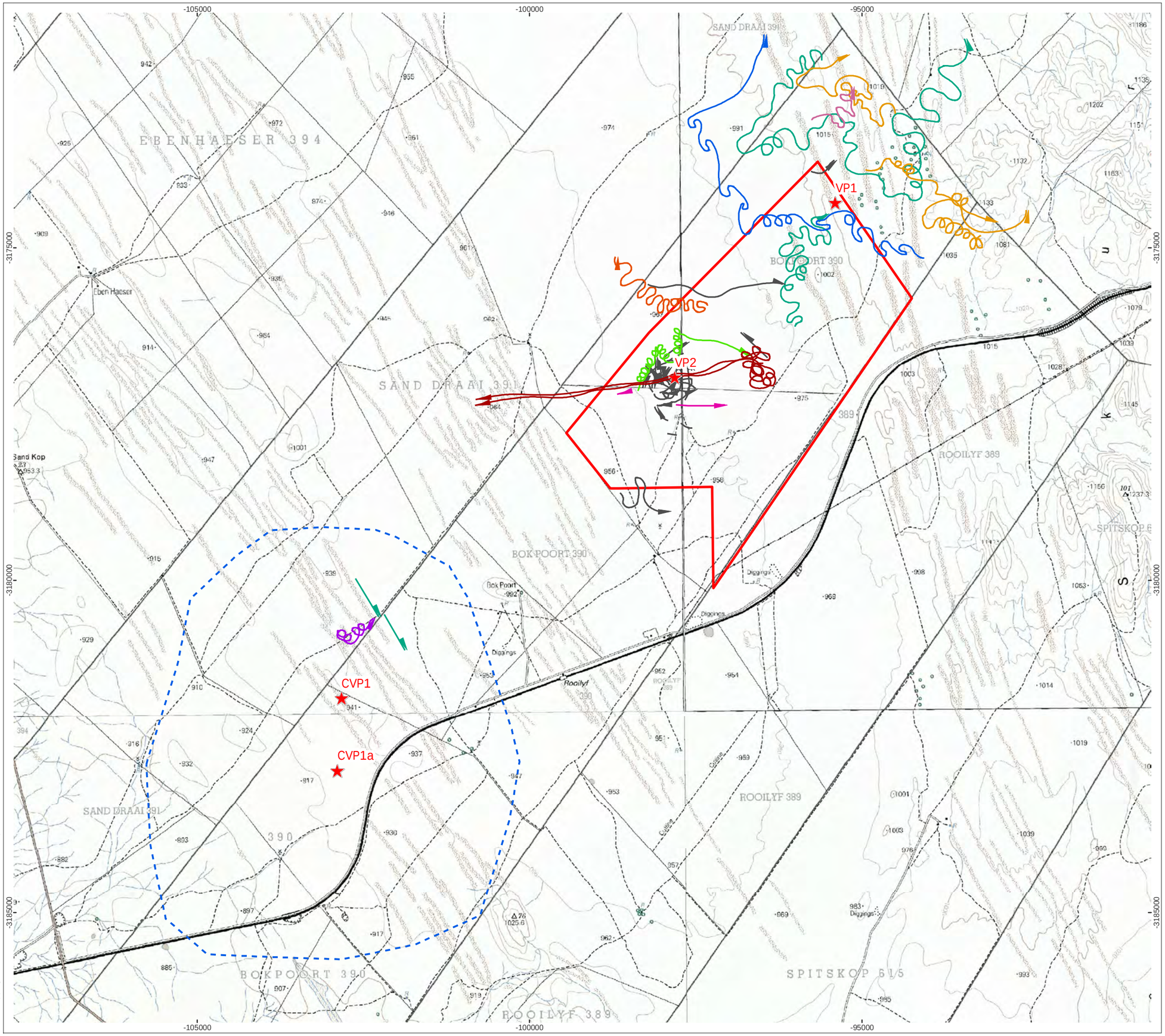
Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/020 Date: 11/05/2016

Crow, Dove and Sandgrouse Flights
Figure 4a

Bokpoort II Solar Farm
Avifaunal Impact Assessment
Report

ACWA POWER

ARCUS



- Project Site
- Control Site
- VP Location
- Booted Eagle Flight
- Greater Kestrel Flight
- Jackal Buzzard Flight
- Large Raptor Flight
- Lanner Falcon Flight
- Lappet-faced Vulture Flight
- Martial Eagle Flight
- Pale Chanting Goshawk Flight
- Unidentified falcon Flight
- Verreaux's Eagle Flight

1:55,000 Scale @ A3

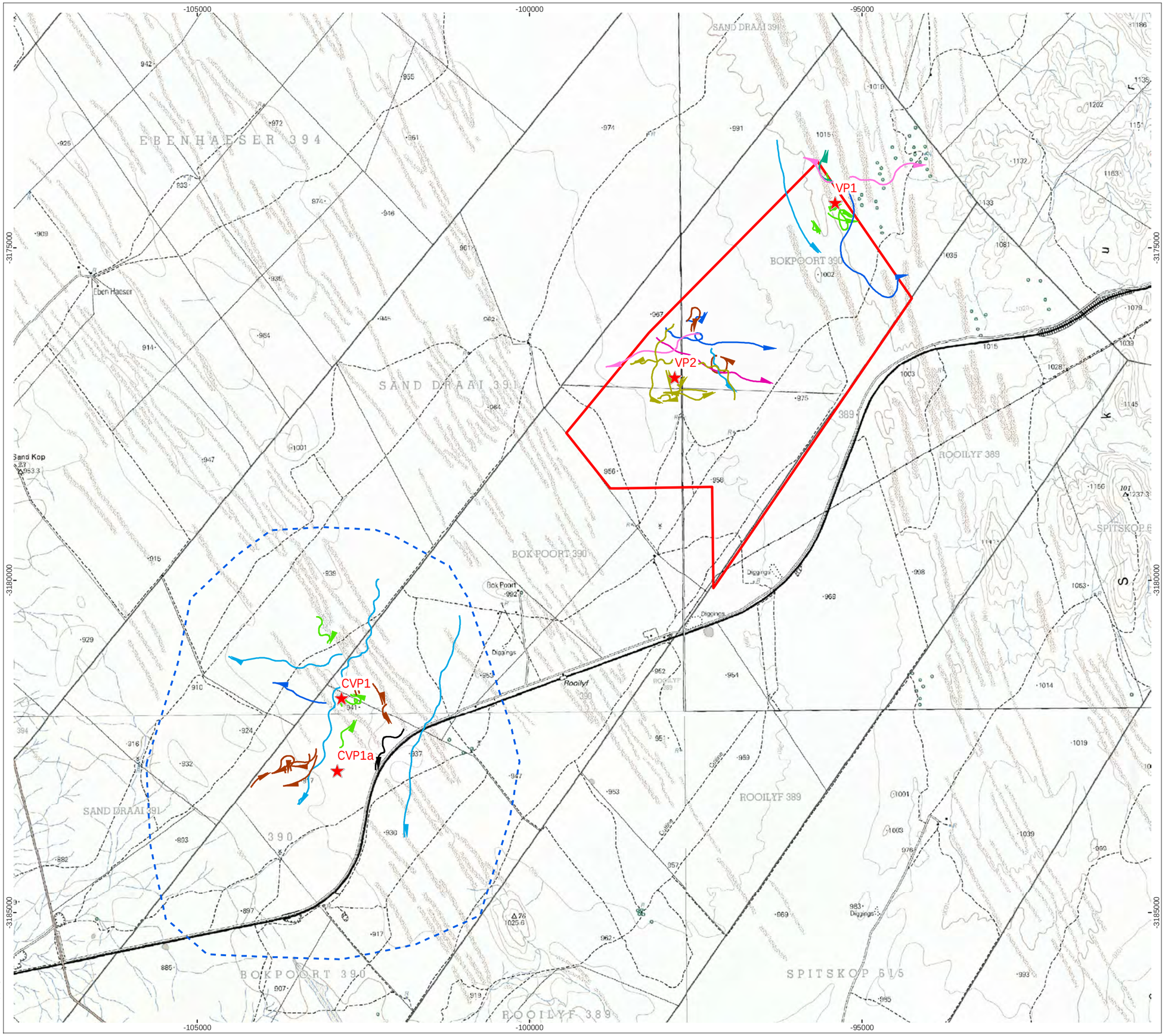
N

0 1 2 km

Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/021
	Date: 10/05/2016

Raptor Flights
Figure 4b

Bokpoort II Solar Farm
Avifaunal Impact Assessment
Report



Basemapping from the Chief Directorate National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

- Project Site
- Control Site
- VP Location
- Crowned Lapwing Flight
- Eastern Clapper Lark Flight (winter season only)
- Hadeda Ibis Flight
- Kori Bustard Flight
- Ludwig's Bustard Flight
- Northern Black Korhaan Flight
- Southern Yellow-billed Hornbill Flight
- Speckled Pigeon Flight
- Unidentified Species Flight

1:55,000 Scale @ A3

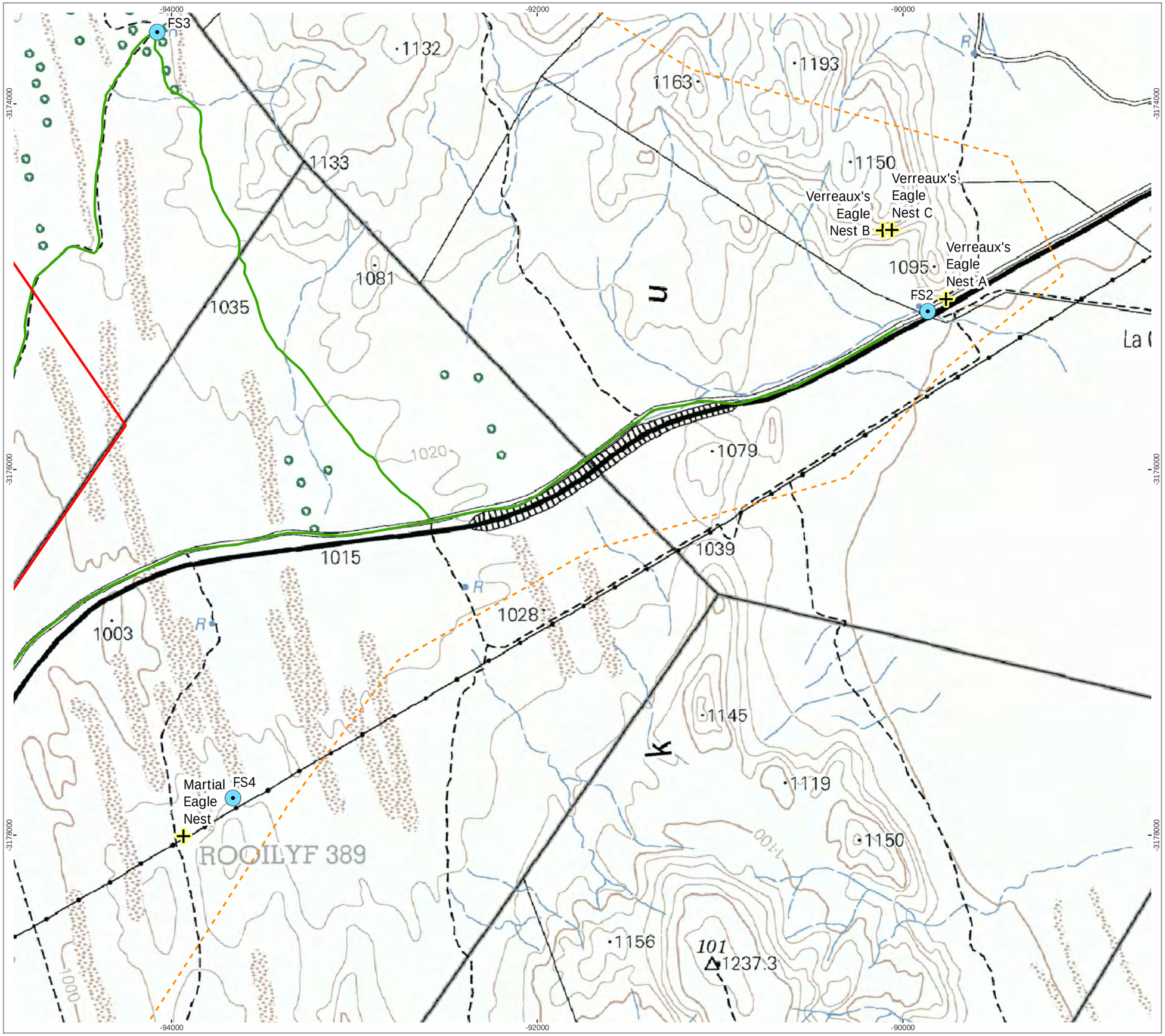
N

0 1 2 km

Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/022
	Date: 11/05/2016

Other Target Species Flights
Figure 4c

Bokpoort II Solar Farm
Avifaunal Impact Assessment
Report

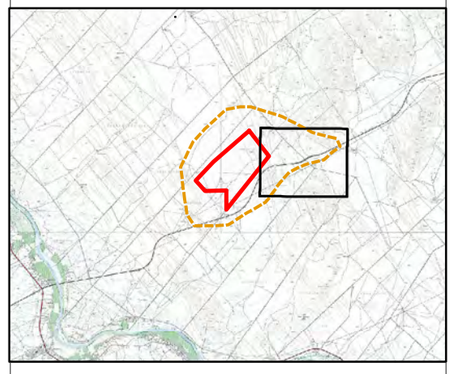


Basemapping from the Chief Directorate National Geo-Spatial Information of South Africa.

ACWA POWER

ARCUS

- Project Site
- Broader Project Area
- Driven Transect
- Focal Site
- Nest Site



1:20,000 Scale @ A3

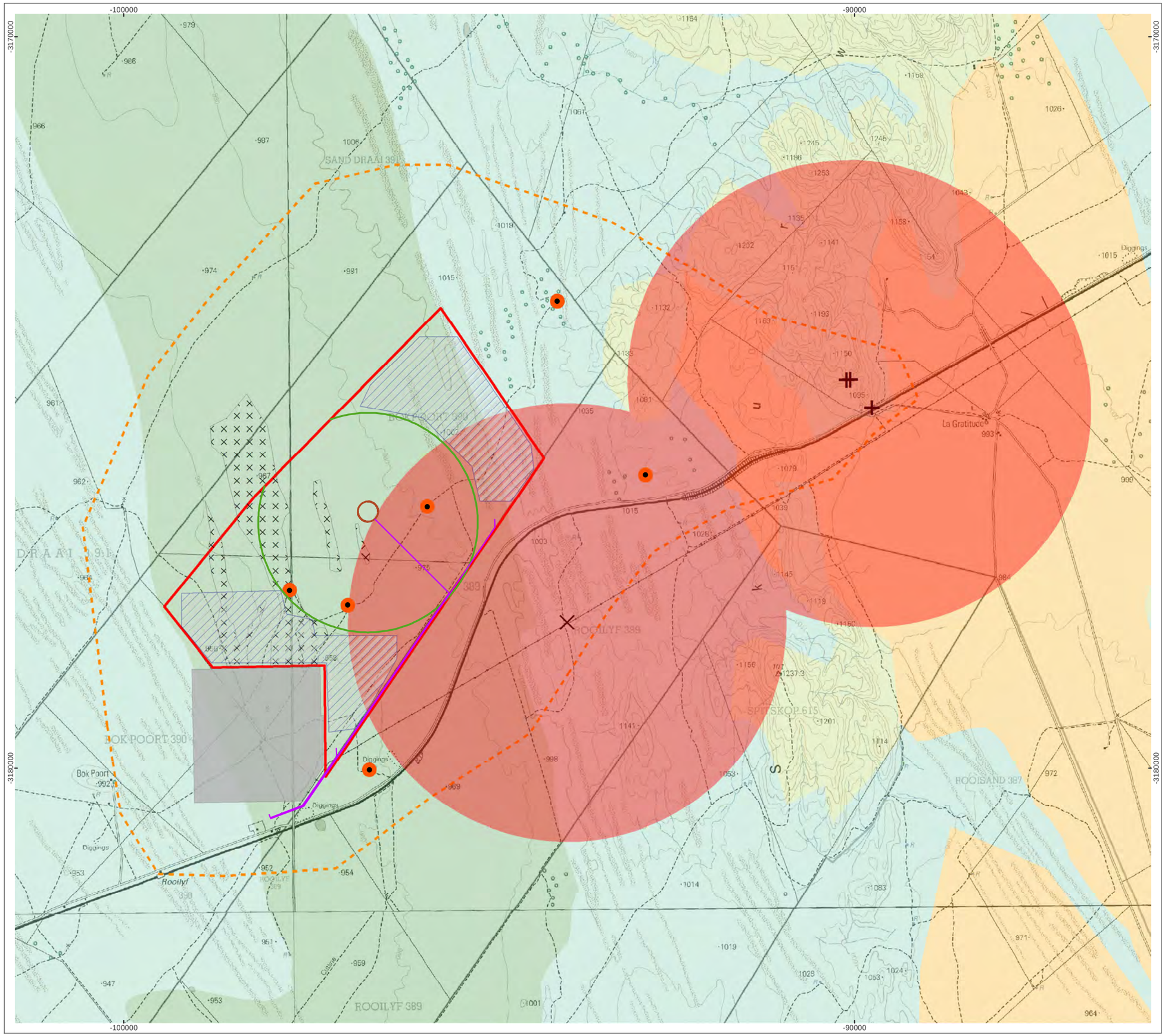
N

0 0.5 1 km

Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/023 Date: 10/05/2016

Eagle Nest Sites
Figure 5

Bokpoort II Solar Farm
Avifaunal Impact Assessment
Report



Basemapping from the Chief Directorate National Geo-Spatial Information of South Africa

ACWA POWER

ARCUS

- Project Site
- Broader Project Area
- Bokpoort I Area
- Grid Connection Power Line
- CSP Tower Area
- Heliostat Field Area
- Approximate PV Area
- Martial Eagle Nest
- Verreaux's Eagle Nest
- Water Points

Sensitivity Zones

- Gravel Plains (Medium Sensitivity)
- 100 m Water Point Buffer (Medium Sensitivity)
- 3 km Nest Buffer (High Sensitivity)

Vegetation Types

- Gordonia Duneveld
- Kalahari Karroid Shrubland
- Koranna-Langeberg Mountain Bushveld
- Olifantshoek Plains Thornveld

1:50,000 Scale @ A3

N

0 1 2 km

Produced: JA Reviewed: SC Approved: AP	Ref: 2059/REP/024 Date: 12/05/2016

Avifaunal Sensitivity Map
Figure 6

Bokpoort II Solar Farm
Avifaunal Impact Assessment Report

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	**14/12/16/3/3/2/881**
NEAS Reference Number:	DEAT/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, 2010; and

(2) National Environmental Management Act: Waste Act, 2008 (Act No. 59 of 2008) and Government Notice 718, 2009

PROJECT TITLE

Proposed 75 MW Photovoltaic Development (PV1) on the Remaining Extent of the Farm Bokpoort 390 near Groblershoop in the !Kheis Local Municipalitly, Northern Cape.

Specialist:	Arcus Consulting		
Contact person:	Andrew Pearson		
Postal address:	Office 220, Cube Workspace, Cnr Long St and Hans Strijdom, Cape Town.		
Postal code:	8001	Cell:	0725580080
Telephone:	0214121529	Fax:	
E-mail:	andrewp@arcusconsulting.co.za		
Professional affiliation(s) (if any)	SACNASP		
Project Consultant:	**Golder Associated Africa (Pty) Ltd**		
Contact person:	**Marié Schlechter**		
Postal address:	**P.O. Box 6001, Halfway House**		
Postal code:	**1685**	Cell:	**082 320 8150**
Telephone:	**011 254 4800**	Fax:	**086 582 1561**
E-mail:	**mschlechter@golder.co.za**		

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 71 and is punishable in terms of section 24F of the Act.

Signature of the specialist:

Arcus Consulting
Name of company (if applicable):

24/05/2016
Date: