APPENDIX H

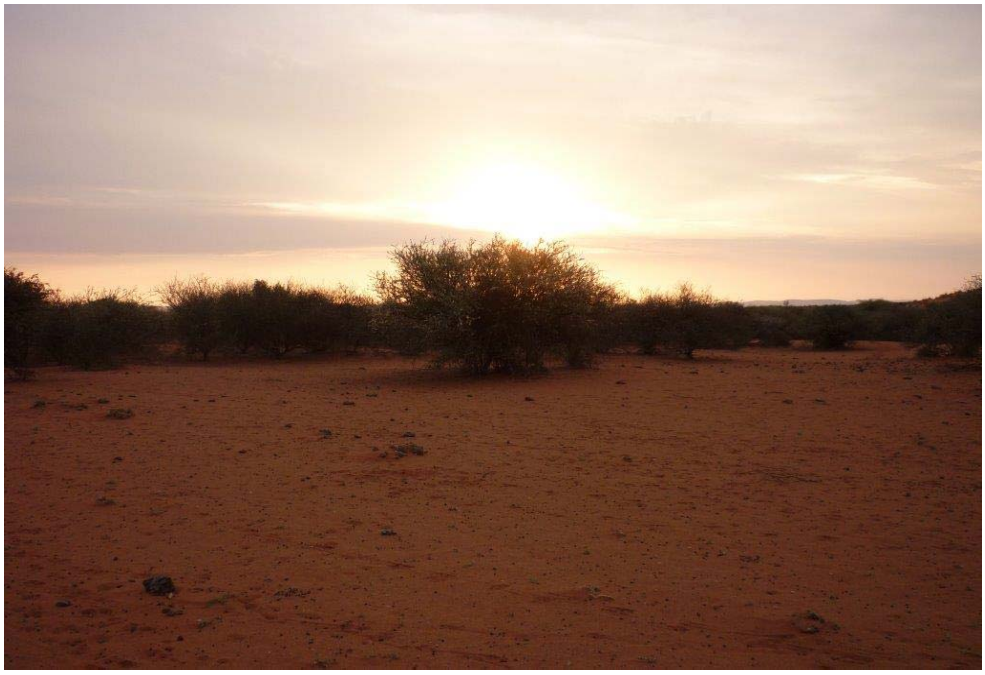
Bat Assessment

May 2016

ACWA POWER AFRICA HOLDINGS (PTY) LTD

Bat Impact Assessment: Proposed Photovoltaic 1 (PV1) Solar Development (Bokpoort II Project) on the Remaining Extent of Farm Bokpoort 390, Northern Cape

Submitted to:
ACWA Power Africa Holdings (Pty) Ltd.



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REPORT

Golder Associates

Executive Summary

The proposed Bokpoort II development consists of a solar energy facility (Bokpoort II) on the north-eastern portion of the Remaining Extent (RE) of the Farm Bokpoort 390, which is 20 km northwest of the town of Groblershoop within the !Kheis Local Municipality in the ZF Mgcawu District Municipality, Northern Cape Province. The total Bokpoort II project area designated for the development is approximately 1 500 ha. The Study Area for this biodiversity impact assessment was defined as the area where the Bokpoort II project will be developed, as well as the route of the proposed pipeline to the water abstraction point.

The proposed Bokpoort II project will consist of three (3) applications for environmental authorisation, each having a Scoping Report and an Environmental Impact Assessment Report. ACWA Power is applying for environmental authorisation for two (2) 75 Mega Watt (MW) photovoltaic (PV) facilities and one (1) 150 MW Concentrated Solar Power (CSP) Tower facility. The combined power generation capacity of the entire Bokpoort II solar development will be 300 MW. Each of the solar technologies will have separate associated infrastructure that will not overlap in footprint.

This report assesses the potential impacts on bats associated with the proposed 75 MW **PV1** facility (the Project).

The Study Area largely comprises arid grassland, with an area of rocky outcrop at the north-eastern extent of the boundary, whilst the proposed water pipeline will be laid in the existing pipeline servitude along the existing railway line and access road corridor; at this stage no additional natural vegetation clearance for the proposed pipeline is anticipated. As the pipeline approaches the Orange River, it diverts south along an existing access track, finally crossing approximately 200 m of agricultural cultivation and riparian fringe vegetation, to the proposed water abstraction point.

The development of the proposed 75 MW PV facility will cause land cover changes through vegetation clearance, the effects of which may impact bat species through direct loss/injury, and reductions in the extent of bat foraging and roosting habitat. Night-time site lighting over the course of the operation of the Project will result in increased sensory disturbance to bats, reducing the area of foraging habitat available to them. The PV facility may have additional effects on bat and insect fauna through changes in insect foraging patterns, and potential collision risks to foraging or drinking bats.

It is therefore crucial that the mitigation hierarchy is followed and all efforts to avoid impacts on bats within the project's area of influence are made. Where avoidance of impacts is impossible, application of the recommended mitigation measures is critical in reducing the significance of predicted project impacts. Appropriate surface and storm water management is essential for the prevention of serious pollution of aquatic ecosystems - which are a water source for bats - downstream of the Project footprint. The implementation of an ongoing acoustic monitoring programme to detect changes in bat activity that may be associated with the presence of the PV1 development is recommended, as is monthly monitoring for carcasses to establish the frequency of any bat fatalities through collision with the PV facilities solar panels.

Provided that the recommended mitigation measures are incorporated into the Bokpoort II Environmental Management Plan, and are enacted and reported upon to the relevant authority throughout the lifetime of the project, the environmental significance of predicted impacts on bat species can be reduced to environmentally acceptable levels.

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1.0 INTRODUCTION

ACWA Power Africa Holdings (Pty) Ltd. (the Client) intends to develop a solar energy facility (Bokpoort II) on the north-eastern portion of the Remaining Extent (RE) of the Farm Bokpoort 390, which is 20 km northwest of the town of Groblershoop within the !Kheis Local Municipality in the ZF Mgcawu District Municipality, Northern Cape Province. The total Bokpoort II project area designated for the development is approximately 1 500 ha. The Orange River is located approximately 12 km south-west of the site; water for the proposed Bokpoort II project site will be pumped from the Orange River to the facility via an underground pipeline. The proposed Bokpoort II project site will also have a new water abstraction point. The abstraction point will be in close proximity to the existing Bokpoort I point. The new pipeline will run parallel to the existing Bokpoort I pipeline, within the existing pipeline servitude.

The proposed Bokpoort II project will consist of three (3) applications for environmental authorisation, each having a Scoping Report and an Environmental Impact Assessment Report. ACWA Power is applying for environmental authorisation for two (2) 75 Mega Watt (MW) photovoltaic (PV) facilities and one (1) 150 MW Concentrated Solar Power (CSP) Tower facility. The combined power generation capacity of the entire Bokpoort II solar development will be 300 MW. Each of the solar technologies will have separate associated infrastructure that will not overlap in footprint.

This report presents an assessment of the potential impacts associated with the proposed 75 MW **PV1** facility (hereafter referred to as 'the Project'), as they relate to bats (*Chiroptera*), and sets out recommendations for their avoidance and reduction, where necessary. The impact assessment was conducted with reference to the specific bat baseline data gathering fieldwork completed in September 2015 by Golder Associates Africa, in liaison with specialist subcontractors Animalia Consulting.

1.1 Bats and PV Facilities

The potential effects of PV Solar developments on bats are poorly understood. Limited evidence suggests that bats may collide with solar panels associated with CSP towers due to mistaking them for a water source (Greif & Siemers, 2010); however this evidence was deduced from laboratory experiments where no actual water source alternative was provided - bats are likely to behave differently under natural conditions where actual water sources are available. The displacement or the exclusion of species, particularly threatened, endemic and range-restricted species, from important habitats (e.g. bat roosts) is potentially the most significant impact (Smit, 2013) solar energy facilities can have on bats. Bats may be further displaced from preferred roosting, foraging or commuting habitat as a result of Project site security lighting at night-time.

In addition, CSP towers associated with PV systems may present a collision risk to flying bats. CSP towers are thought to pose a risk of burning flying birds when in the vicinity of the central receiver or when entering the standby focal points (Smit, 2013); although this risk is likely to be much reduced for bats which fly at night, bats may be attracted to the towers for territorial or roosting purposes at night time. If towers are still at high temperatures during the night, this may present a burn risk to bats.

2.0 TERMS OF REFERENCE

The Terms of Reference for the bat impact assessment, as reflected in the Scoping Report (Golder Associates 2015), include:

- Any specific identified sensitivities of the site related to the Project and its associated structures and infrastructures will be reported. This will include identification of any areas to be avoided, including buffers;
- The biodiversity impact assessment will include an assessment of the impact of the proposed Project - in particular the potential negative impact of the proposed CSP Tower facility - on avifauna, which will be done in accordance with the Guidelines to Minimise the Impact on Birds of Solar Facilities and Associated Infrastructure in South Africa released by BirdLife in 2014. ***Please note that the bird study is provided as a separate study report (ARCUS, 2016) and this report addresses bats only***; and

- A Biodiversity Management Plan will be included in the Environmental and Social Management Systems.

2.1 Objectives

The aim of this assessment was to collect baseline data of sufficient scope that could be used to characterise the baseline conditions of the area and assess how the Project could affect bat species that may be present. This was undertaken in consideration of South Africa's national legislation and policy pertaining to biodiversity (ref. section 4.1 of Biodiversity Impact Assessment Report) and with reference to the IFC Performance Standard 6 (ref. section 4.3 of Biodiversity Impact Assessment Report), which seeks to protect biodiversity (including bat species) from the adverse impacts of project activities and support biodiversity conservation. Subsequently, the objectives of this study were to:

- Establish whether the habitats within the Project area of influence were suitable to support significant populations of foraging and/or roosting bat species;
- Characterise the ecological integrity of such habitats and as such their capacity to support foraging and/or roosting bats in the Project's area of influence;
- Identify any bat species of concern that could trigger critical habitat (as defined by IFC PS6);
- Identify and describe potential sources of risk and impact associated with the development that could affect bat species within the Project's area of influence;
- Identify the potential direct, indirect and cumulative effects on bats associated with the Project;
- Recommend suitable mitigation measures where applicable; and
- Develop a monitoring programme and management/action plan for any bat species predicted to be significantly affected by the Project's development.

3.0 APPROACH AND METHODS

This section presents the approach and methods used to characterise bat diversity and abundance within the Study Area, and the importance of habitats within the Study Area for bats.

3.1 Approach

The Department of Environmental Affairs (DEA) requested that 12 months of pre-construction monitoring of bat activity within the Project site be conducted. In the absence of specific guidance for potential impacts of solar power installations on bats, a year-long period of pre-construction monitoring is typically recommended in general accordance with accepted best practise for wind power installations (Sowler & Stoffberg, 2014). However, the bat fauna for this region of the Northern Cape is impoverished with just five ubiquitous species expected. In addition, the arid condition on the site, distance from perennial water sources and limited roosting opportunities reduce the potential importance of the site for bat species. Therefore, the approach to the study consisted of a site visit by a bat specialist to assess habitat suitability for bats and conduct a roost search of the rocky outcrops in order to make a determination as to the baseline suitability of the Project site for roosting/foraging bats to inform the assessment of potential impacts on bats. This was undertaken with a proviso that 12 months of post-construction monitoring be undertaken at a later stage in order to better understand the potential effects, if any, of CSP towers on flying bats.

3.2 Study Area

The primary effect on bats arising from the Project will be loss in extent of potential foraging and roosting habitat due to site clearance and groundworks. These works are unlikely to be limited to the exact footprint of PV1 in isolation, therefore impacts are considered as occurring within the extent of the Bokpoort II boundary.

The Study Area for this impact assessment was therefore defined as the area where the Bokpoort II project will be developed, as well as the route of the proposed pipeline to the water abstraction point (Figure 1).

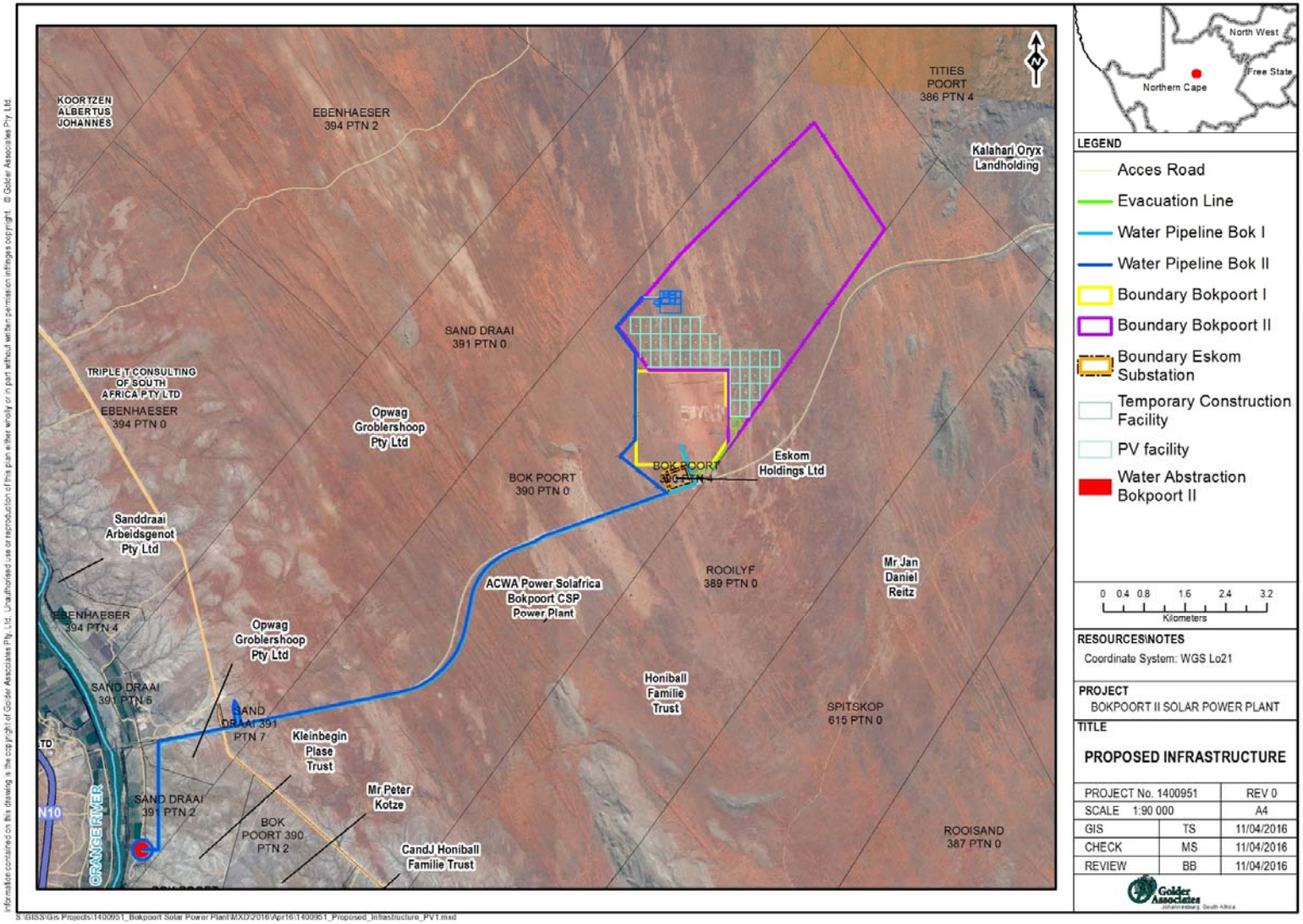

Figure 1: Study area

3.3 Desktop Review

A comprehensive literature review of available information on bat presence and diversity within the Study Area and general region was conducted. Reviewed data included biodiversity baseline data gathered within the Study Area for aspects of the Bokpoort I development (RHDV, 2014a; RHDV, 2014b; BEC, 2010). Other information that was reviewed included IUCN Red Data lists for bat species present in the Northern Cape, bat species distribution maps for South Africa (Monadjem *et al.,* 2010), and any other available information on bat presence in these areas.

Sensitive bat species and bat-supporting habitats, as well existing threats to such species were identified through review of background biodiversity and environmental reports relating to the site, available published literature, consideration of South Africa's national and Northern Cape's provincial biodiversity legislation and policies as they pertain to bats, Non-Governmental Organisation (NGO) opinion and guidance documentation (Sowler & Stoffberg, 2014), and through application of the expertise of the bat survey and impact assessment team.

3.4 Baseline Bat Data Gathering

A site visit was conducted from 21/09/2015 – 23/09/2015 to assess the current extent of use of the Study Area by bat fauna.

Bat Habitat Suitability Assessment

Habitats within the Study Area were examined for the presence of features with bat roosting potential, such as rocky outcrops, cave systems, and mature and decaying trees. Daytime surveys of the Study Area also focussed on the identification of areas with good foraging potential for bats, including natural habitats with diverse structure/topography, and water sources e.g. riparian areas.

Active Monitoring

Active monitoring was carried out with the use of a mobile bat detector. The bat detector was mounted on a vehicle and transects were driven within the vicinity of the study area. Transect routes were selected based on availability and accessibility of roads, with the aim of covering different habitats on site. A SM2BAT+ bat detector was used for this monitoring technique.

The detector was set to operate in continuous trigger mode during the active monitoring. Trigger mode is the setting for a bat detector in which any frequency which exceeds 16 KHz and 18 dB will trigger the detector to record for the duration of the sound and 500 m after the sound has ceased, this latter period is known as a trigger window. All signals are recorded in WAC0 lossless compression format. Weatherproof ultrasound SMXU1 microphones were used.

3.5 Impact Assessment

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 probability of 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

Probability	Duration
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	Significance	Description
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.

4.0 BAT BASELINE ENVIRONMENT

4.1 Bat Species Confirmed in the Study Area

Three bat species were confirmed via active monitoring conducted in 2015: *Sauromys petrophilus, Neoromicia capensis* and *Tadarida aegyptiaca*. In addition, some unidentified species were also detected. No bat species were found roosting within the Project area during the site visit. The confirmed species as well as species expected to occur within the region, based on the desktop review of available data, are described in Table 1.

Table 1: Bat species confirmed and potentially occurring within the Study Area (Monadjem *et al*., 2010; Friedman & Daly, 2004)

Species	Common Name	Likelihood of occurrence	Conservation Status (Regional)	Likely habitat use in Study Area
Cistugo seabrae	Angolan wing-gland bat	Possible	Near threatened	It is restricted to the arid western parts of southern Africa, typically in desert and semi-desert conditions. Not a common bat.
Eptesicus hottentotus	Long-tailed serotine	Possible	Least concern	It is a crevice dweller roosting in rock crevices, expansion joints in bridges and road culverts.
Miniopterus natalensis	Natal long-fingered bat	Possible	Near threatened	As an obligate cave-rooster, this species is not expected to roost on site. It may be present within the Study Area for foraging.
Neoromicia capensis	Cape serotine	**Confirmed**	Least concern	Roosts under the bark of trees, and inside the roofs of buildings. The nearby Olifantshoek Plains Thornveld may offer such roosting space.
Nycteris thebaica	Egyptian slit-faced bat	Possible	Least concern	Could potentially roost on site in aardvark burrows or culverts under roads.
Rhinolophus clivosus	Geoffroy's horseshoe bat	Possible	Near threatened	As an obligate cave-rooster, this species is not expected to roost on site. It may be present within the Study Area for foraging.
Rhinolophus darling	Darling's horseshoe bat	Possible	Near threatened	This species roosts in caves/mine adits and is therefore not expected to be roosting within the Project area; however it may roost in the vicinity of the Project area and use the Study Area for foraging.
Rhinolophus denti	Dent's horseshoe bat	Possible	Near threatened	This species roosts in caves/mine adits and is therefore not expected to be roosting within the Project area; however it may roost in the vicinity of the Project area and use the Study Area for foraging.
Sauromys petrophilus	Roberts's flat-headed bat	**Confirmed**	Least concern	Roosts in narrow cracks and under slabs of exfoliating rock. Closely associated with rocky habitats. May be roosting in the Koranna-Langeberg Mountain Bushveld rocky outcrops adjacent to the northern extent of the site.
Tadarida aegyptiaca	Egyptian free-tailed bat	**Confirmed**	Least concern	Roost during the day, rock crevices, under exfoliating rocks. May be roosting in the Koranna-Langeberg Mountain Bushveld adjacent to the northern extent of the site.

4.2 Bat Activity Patterns within the Study Area

The bat activity calls recorded during the transects were grouped by the Free-tailed family Molossidae (Molossids) and the Plain-faced bats family Vespertilionidae (Vespers) – species within these family groups have relatively similar foraging and roosting habitat preferences.

Vesper bats were more abundant than Molossids overall. Both groups were more active and numerous in the northern parts of the study area(Figure 2) which is closer to the Koranna-Langeberg Mountain Bushveld and Olifantshoek Plains Thornveld vegetation units, indicating that these areas may have greater foraging/roosting habitat opportunities for bats than those other vegetation types within the Study Area.

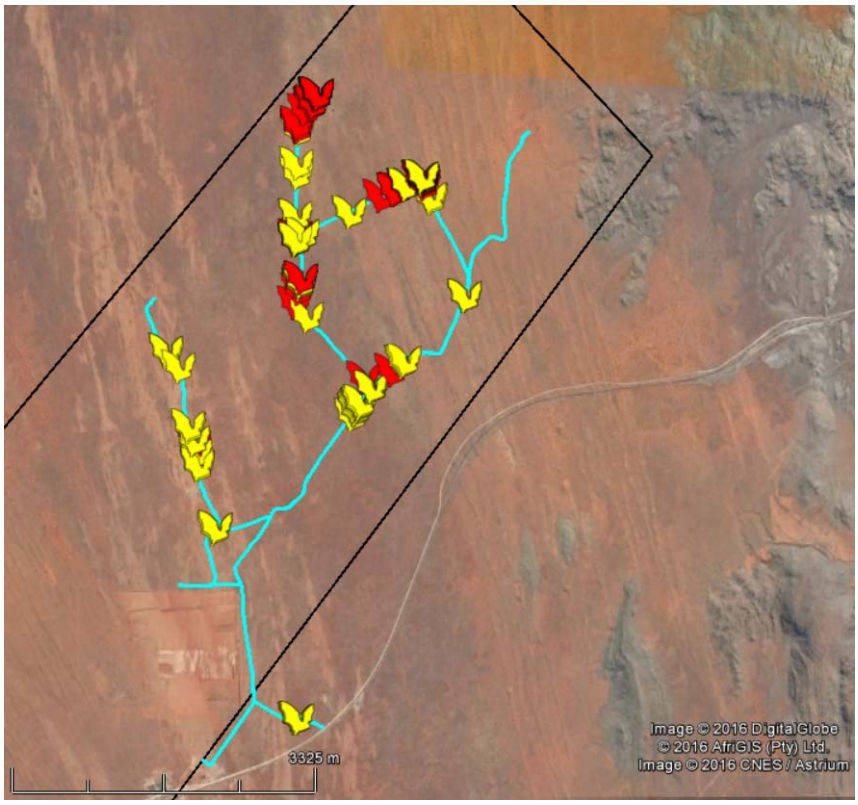

Figure 2: Bat passes detected during active monitoring transect - Molossids denoted by red icon, Vespers by yellow icon

4.3 Sensitivity of bat habitat to development

Based on the results of the active sampling and habitat suitability assessment, specific regions that have importance for foraging and roosting bats were mapped based on the presence of natural habitat features capable of providing bat roosts as well as foraging habitat; such features include rocky outcrops in the northern region of the Study Area, the variety vegetation types and presence of riparian/water drainage habitat which are used as indicators of probable foraging areas; and the presence of several water tanks in the footprint and the Orange River at the southern extent of the Study Area, which are important sources of drinking water and provide habitat that host insect prey for bats. The areas identified as most sensitive to development as a factor of loss of important bat foraging and roosting habitats, plus a 1 km high sensitivity buffer, are shown on Figure 3.

4.4 Bat species of conservation importance

All bat species confirmed during surveys are of Least Concern in terms of conservation status. One species of conservation importance, Angolan wing-gland bat (*Cistugo seabrae* – Near Threatened) was not confirmed but does have potential to occur within the Study Area based on its known distribution and foraging habitat preference - its preferred foraging habitat is thought to be riverine vegetation (Monadjem *et al.,* 2010). Few records of roosting habitat are known, although it may use buildings.

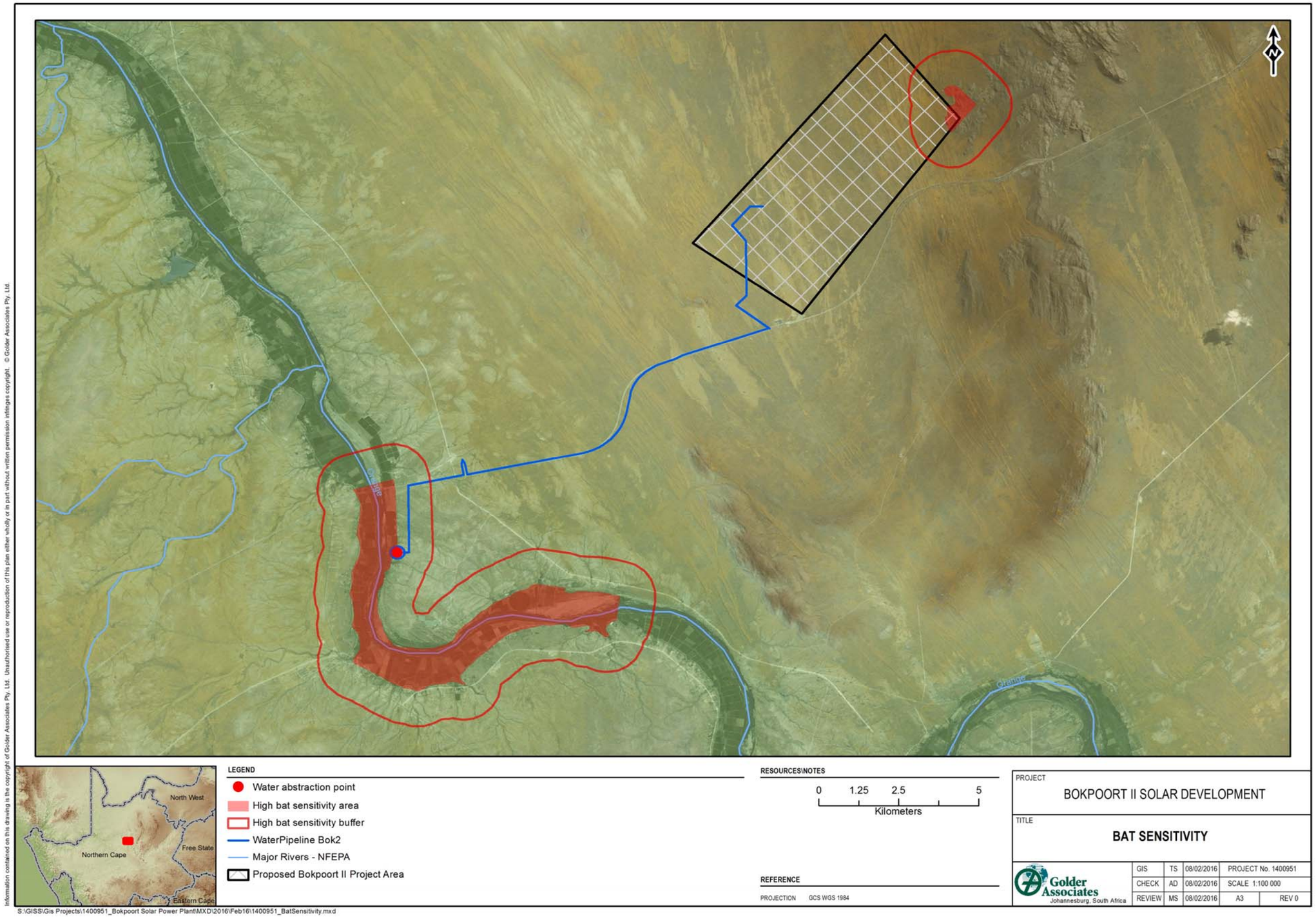

Figure 3: Sensitive bat foraging and roosting habitat within the Study area

5.0 BAT IMPACT ASSESSMENT

5.1 Potential Impacts of the PV facility on bat species

Potential impacts of the Project on bat species were identified, based on review of available information on the effects of PV facilities on fauna, and South African guidance on assessment of potential impacts of wind energy facilities on bats (Sowler *et al*., 2014), from which relevant information was distilled and applied to this assessment. The predicted impacts on bats for the construction, operational and closure phases of this Project are outlined in the following sections.

5.1.1 Identified Impacts for the Construction Phase

The main impact on bats during the construction phase arises from changes in land cover due to the proposed construction of the Project and all associated infrastructure, resulting in direct impacts on the extent and composition of vegetation communities and associated extent of provisioning of foraging and roosting grounds to local bat populations. Specific project impacts on bats that are anticipated include:

- Direct loss/disturbance of bat species;
- Reduction in extent of foraging and roosting habitat for bats; and
- Soil erosion and sediment loading of surface water runoff which could affect drinking water quality at the Orange River.

5.1.2 Identified Impacts for the Operational Phase

Predicted impacts on bats during the operational phase of the Project chiefly relate to the unknown/uncertain risks posed by PV infrastructure, and contamination risks for the Orange River. The specific operational impacts that are anticipated include:

- Disturbance of typical bat foraging patterns caused by ongoing operation and maintenance activities at the facility (e.g. security lighting at night);
- Reflective surfaces (solar panels) may pose a collision risk to flying bats;
- Solar panels may attract foraging insect species, further exacerbating the collision risk to bats; and
- Water abstraction at the Orange River and effects on quantity and quality of water and riparian habitat downstream that constitute bat foraging and drinking habitat.

5.1.3 Identified Impacts for the Decommissioning/Closure Phase

Predicted impacts on bats during the decommissioning and closure phase of the Project include the following:

- Contamination of surface water and aquatic ecosystems which bats use as water sources.

5.2 Impact Assessment for Project Phases

The Project components and activities potentially affecting bats are broken down by Phase and assessed individually as follows.

5.2.1 Construction Phase Impacts

Predicted impacts on bats during the construction phase of the Project relate to vegetation clearance within the Bokpoort II boundary, resulting in direct effects on bat species and habitats, and indirect effects on ecosystem integrity due to dust and sediment contamination of surface water systems. The impact assessment matrix summarises construction-phase related impacts to bats (Table 2); specific impacts are discussed in the paragraphs that follow.

Direct Loss/disturbance of bat species

Site clearance prior to construction could result in direct impacts including mortality and injury of bat species that may be roosting in the rocky outcrop habitat, and potentially in woody vegetation in the Koranna-Langeberg mountain bushveld vegetation type in the northern region of the Study Area.

This is considered to be an impact of moderate significance – although confirmed bat species within the Study Area may not be of conservation concern, they contribute to the overall regional biodiversity and ecological integrity of the Study Area. Angolan wing-gland bat (*C. seabrae*) is potentially present, however it is thought to roost in buildings (Monadjem *et al.,* 2010); therefore the risk of direct loss/disturbance of individuals of this species is considered low.

Nevertheless, provided that the recommended mitigation measures (ref. section 6.0) are put in place, the predicted impact can be reduced to one of **low** significance.

Reduction in extent of roosting habitat for bats

Prime foraging and roosting habitat for bats coincide with the ecosystems of conservation concern identified within the Study Area in the biodiversity baseline assessment, that is, the rocky outcrop in the northern section of the Study Area and the riparian vegetation (Lower Gariep Alluvial vegetation).

The rocky outcrop in the northern corner of the Study Area constitutes prime roosting habitat for crevice-roosting bats. Reduction in the extent of this habitat is considered to potentially be of moderate significance due to its support of roosting bat species. However, assuming that the application of recommended mitigation measures is adhered to i.e. the rocky outcrop area is avoided and not levelled for the Project, the predicted effects can be reduced to **low** significance.

Reduction in extent of foraging habitat for bats

The loss of natural vegetation within the main Project footprint during site clearance will result in a reduction of available foraging habitat for bats, albeit relatively low value foraging habitat by comparison with the high-value riparian foraging habitat associated with the Orange River. The importance of this riparian habitat also lies in the provision of a drinking water source in the context of an otherwise arid landscape. Some riparian vegetation is expected to be lost as a result of site clearance for the construction of the new abstraction point; this is expected to be localised and minimal.

The predicted reduction in extent of the vegetation types providing foraging habitat within the Study Area is considered to be of **moderate** significance in the context of the availability of vast areas of similar habitat in the surrounding area. However, the application of mitigation measures is recommended in order to ameliorate potential effects on bat species to **low** significance.

Sediment loading of surface water runoff

Sediment is expected to be generated during construction activities and earthworks, particularly those associated with the construction of the new abstraction point; sediment loading of surface water systems ecosystems can also affect the quality of riparian and wetland habitats through changes in water chemistry as a result of sedimentation and potentially embedded pollutants from heavy machinery etc. Changes in water quality in the Orange River have the potential to affect bats which rely on this as a water source in an otherwise generally arid landscape. The impact significance is predicted to be **moderate** prior to mitigation, due to the limited extent and duration of predicted effects which would be greatest during seasonal rains.

With the application of recommended mitigation measures (section 6.0), the duration, extent and probability of impact can all be reduced; reducing the resulting impact to one of **low** environmental significance post-mitigation.

Table 2: Bat impact rating - Construction Phase

Aspect	Impact	Rating – Pre mitigation				Total Rating	Significance Points	Rating – Post mitigation				Total Rating	Significance Points
		Magnitude	Duration	Scale	Probability			Magnitude	Duration	Extent	Probability		
Vegetation clearance in advance of construction works	Direct loss/ disturbance of bat species	8	4	1	5	65	Moderate	8	4	1	2	26	Low
	Reduction in extent of roosting habitat	6	5	1	5	60	Moderate	4	2	0	2	12	Low
	Reduction in extent of foraging habitat	4	4	1	5	45	Moderate	2	4	1	2	14	Low
Soil erosion and dust and sediment generation from earthworks and vehicles	Contamination of surface water ecosystems	4	2	2	5	40	Moderate	4	1	2	2	14	Low

5.2.2 Operation Phase Impacts

Predicted operational phase impacts relate to disturbance of typical bat foraging patterns caused by ongoing operation and maintenance activities at the facility (e.g. security lighting at night) as a result of the presence of site lighting, the potential collision risks to bats presented by the solar panel surface, and contamination risks for the Orange River. The impact assessment matrix summarises operation phase-related impacts to bats (Table 3); specific impacts are discussed in the paragraphs that follow.

Disturbance of normal bat foraging/commuting patterns

Based on observations of the Bokpoort I facility made during the field work conducted in September 2015, the Bokpoort II facility will be well-lit at night. This is expected to cause disturbance to bat species in surrounding areas. The disturbance may deter some species of bats from foraging in the area, it may also attract other bat species that actively hunt insects around lights. The magnitude of the effects is expected to be moderate given the extent of lighting observed at the existing facility. The predicted impact is thus considered to be of moderate significance prior to mitigation.

Once the recommended mitigation measures are applied, the magnitude of effects on bats and the probability of effects on other faunal species can be reduced, reducing the significance of the overall impact to **low.**

Collision Risks associated with the PV solar panels

Limited evidence suggests that bats may collide with solar panels due to mistaking them for a water source (Greif & Siemers, 2010); however this evidence was deduced from laboratory experiments where no actual water source alternative was provided, and bats are likely to behave differently under natural conditions where actual water sources are available.

The area identified as potentially sensitive bat foraging habitat (the Orange River and associated riparian vegetation) is located approximately 13 km from the location of the proposed PV facility; this is also the primary drinking source for bats within the Study Area. Therefore, the probability of bats mistaking the solar panels for their normal drinking source is considered low, as bats are long-lived creatures of habit that specifically commute to known drinking sources, particularly in arid areas such as the Study Area. The magnitude is assessed as low, as the number of bats may fatally collide with the panels is expected to be very low, given the low levels of activity recorded on site. The significance of the predicted impact is considered **low** before mitigation.

Once the recommended mitigation measures are applied, the magnitude of effects on bats can be further reduced, and the significance of the overall impact remains **low.**

Water abstraction at the Orange River and effects on quantity and quality of water and riparian habitat downstream that constitute bat foraging and drinking habitat

The amount of water being abstracted from the Orange River is negligible by comparison to the available water resource (Ref. Chapter 9.0, Surface Water Baseline and Impact Assessment Report, 2016). Water abstraction in itself is not expected to significantly contribute to any negative effects on water quality within the Orange River during operation, therefore drinking water for bats is expected to be unaffected. However, some changes in the river flow patterns (e.g. scour of substrate around the abstraction point) may have a limited effect on habitat availability for invertebrates in the immediate area of the abstraction point, which could lead to localised reductions in prey fauna for foraging bats. These potential impacts are considered to be of low magnitude and will occur at a site scale only, however it is definite so it is therefore considered to be of moderate environmental significance prior to mitigation. Providing that the specific mitigation measures outlined in the surface water assessment (Ref. Chapter 9.0, Surface Water Baseline and Impact Assessment Report, 2016) are adhered to, the impact post-mitigation is considered to be of **low** environmental significance.

Table 3: Bat Impact Rating - Operational Phase

Aspect	Impact	Rating – Pre mitigation				Total Rating	Significance Points	Rating – Post mitigation				Total Rating	Significance Points
		Magnitude	Duration	Scale	Probability			Magnitude	Duration	Extent	Probability		
Site lighting and maintenance	Disturbance of foraging bats	6	4	2	5	60	Moderate	4	4	2	2	24	Low
PV solar panels	Injury and mortality of bats as a result of collision with solar panels	4	4	2	2	20	Low	2	4	2	2	16	Low
Water abstraction	Reduction in quantity of water available downstream of the abstraction point in the Orange River system, and effects on invertebrate habitat availability (hence bat foraging opportunities)	2	4	1	5	35	Moderate	1	4	1	5	30	Low

5.2.3 Closure/Decommissioning Phase Impacts

Predicted impacts on bats during the decommissioning and closure phase of the project relate to contamination of surface water and aquatic ecosystems which bats use as water sources.

Contamination of surface water and aquatic ecosystems used as water sources by bats

Impacts on aquatic ecosystems during the decommissioning and closure period are mostly associated with soil erosion and sediment loading of surface water runoff and subsequently aquatic ecosystems, incorrect disposal of hazardous waste and possible surface water pollution due to the leaching of contaminants. Provided the approved design principles and rehabilitation program are implemented, no significant impacts on aquatic ecosystems and therefore drinking water quality for bats are expected after closure phase of the site thereby reducing the ranking to **low.**

Table 4: Bat Impact Rating: Decommissioning and Closure Phase

Aspect	Impact	Rating – Pre mitigation						Rating – Post mitigation					
		Magnitude	Duration	Extent	*Probability*	Total Rating	Significance Points	Magnitude	Duration	Extent	*Probability*	Total Rating	Significance Points
Removal of infrastructure ground works for rehabilitation	Transportation of sediment from newly rehabilitated areas during intense rainfall events into surface water bodies may contaminate water sources for bats	8	5	3	5	80	High	6	5	3	1	14	Low

6.0 MITIGATION MEASURES

Mitigation measures to avoid/minimise effects on bats and their habitats, and restore affected areas are presented in the sections that follow.

6.1 Construction Phase Mitigation Measures

- New areas of surface disturbance and associated vegetation clearance should be minimised wherever possible. Areas proposed for vegetation clearance should be clearly marked and no heavy vehicles should travel beyond the marked works zone;
- The area of rocky outcrop in the north-eastern extent of the Project area and the associated high sensitivity buffer (Figure 3) should be avoided – no clearance or levelling works should take place in this area and a buffer between it and the cleared area should be retained;
- The retention of a 250 m buffer zone between the edge of the proposed infrastructure footprint and the outer boundary (security fence) of the PV1 facility, within which the existing vegetation is retained, is recommended. This will reduce disturbance associated with construction activity (presence of people and heavy machinery, disturbance of faunal species of conservation concern), and will also contribute to the conservation of natural vegetation and bat foraging habitat within the project boundary;
- Targeted searches for less mobile species of conservation concern with high probability of occurring within the Project footprint (i.e. roosting bats) should be conducted immediately prior to commencement of clearance activities to allow relocation to take place where necessary, and avoid mortalities of these species; and

- An Environmental Control Officer should be employed by ACWA Power in order to supervise clearance and construction works and stop works where necessary (e.g. a bat roost is discovered) so that the appropriate conservation measures can be undertaken.

6.2 Operational Phase Mitigation Measures

- Site lighting options such as directional shading to prevent excessive light spillage and the use of light bulbs that are not as attractive to insects (e.g. LED bulbs) should be investigated and applied where feasible;
- An adaptive management approach to lighting should be used in tandem with the monthly bat monitoring results to determine the most beneficial lighting regime for bats and the operation of the facility;
- Continuous monitoring of bat activity should be undertaken using remote passive detectors should be undertaken at the Project to better understand any changes in bat activity that may be induced by the Project;
- In addition, monthly ground searches for bat carcases should be undertaken at the same frequency to quantify the level of mortality (if any) as a result of potential collisions with the solar panels. This data should be made available to the relevant statutory department to facilitate assessment of future solar developments in the region;
- Effective diversion of storm water and maintenance of the storm water management system should remain ongoing throughout the lifespan of the Project. The surface drainage management plan for the project should be strictly adhered to. Annual monitoring of the Orange River upstream and downstream of the abstraction point should remain ongoing throughout the lifespan of the Project; and
- Native species planting should be put in place around the Site boundary and in any areas which have exposed soils to aid in the reduction of soil erosion and additional loss of vegetation beyond the footprint of cleared areas.

6.3 Closure/Decommissioning Phase Mitigation Measures

- Ongoing annual monitoring of river and stream aquatic health through sampling of amphibian, fish and aquatic macroinvertebrate communities, upstream and downstream of the abstraction point, during rehabilitation works and post-closure is required to ensure that the works (e.g. soil moving works) do not impact the downstream aquatic environment; and
- Restoration/rehabilitation of the Project footprint must include consideration of compatible measures for biodiversity enhancement. Such measures should include planting of native species vegetation and demarcation of rehabilitated areas as conservation areas only i.e. no livestock grazing should take place in these areas, and installation of artificial bat roosts in suitable locations.

7.0 CUMULATIVE IMPACTS

The Project is located adjacent to the existing Bokpoort I development, and the proposed PV2 and CSP Tower also proposed for the Bokpoort II facility.

In addition, the proposed SolAfrica Sand Draai 75 MW PV Project is situated on the farm directly adjacent to the Project (No. 19, Figure 4), and the proposed Kheis Solar Park 1 PV project (No. 14, Figure 4) is located in similar habitat approximately 20 km north of the Project.

Potential impacts of the Bokpoort Solar PV1 Project that may contribute to the cumulative effects of other proposed and permitted solar developments in the region include reduction in the area of potential foraging and roosting habitat for bats. The most sensitive foraging habitat for bats is the riparian vegetation along the banks of the Orange River. The new abstraction point will be constructed in the close vicinity of the existing abstraction point, and the pipeline will be laid in the already-cleared Bokpoort I pipeline servitude. Therefore the Project is not expected to significantly contribute to impacts on bat foraging habitat in this regard.

Large areas of solar panels in adjacent developments are thought to have the potential to cause interference in normal aquatic insect distribution that may potentially contribute to rapid population declines or collapse (Horvath *et al.,* 2010).

This could affect the foraging potential of sensitive foraging habitats for bats. However, the Orange River presents a vastly larger and more obvious water source than the proposed panels, therefore the likelihood of the panels attracting significant quantities of aquatic insects and consequent effects on aquatic insect populations and bat foraging opportunities is considered unlikely.

Uncertainties regarding the potential PV1 facility effects on bat activity patterns should be investigated through the implementation of an operational monitoring programme to gather data on bat activity levels in the vicinity of the solar panels and document any mortalities, and/or significant changes in bat diversity and activity patterns. These studies would establish the actual magnitude of effects post-mitigation and could demonstrate whether mitigation measures were effective, and whether the Project would contribute to cumulative effects on bats in combination with other photovoltaic solar developments, as well as determine whether further conservation actions are necessary.

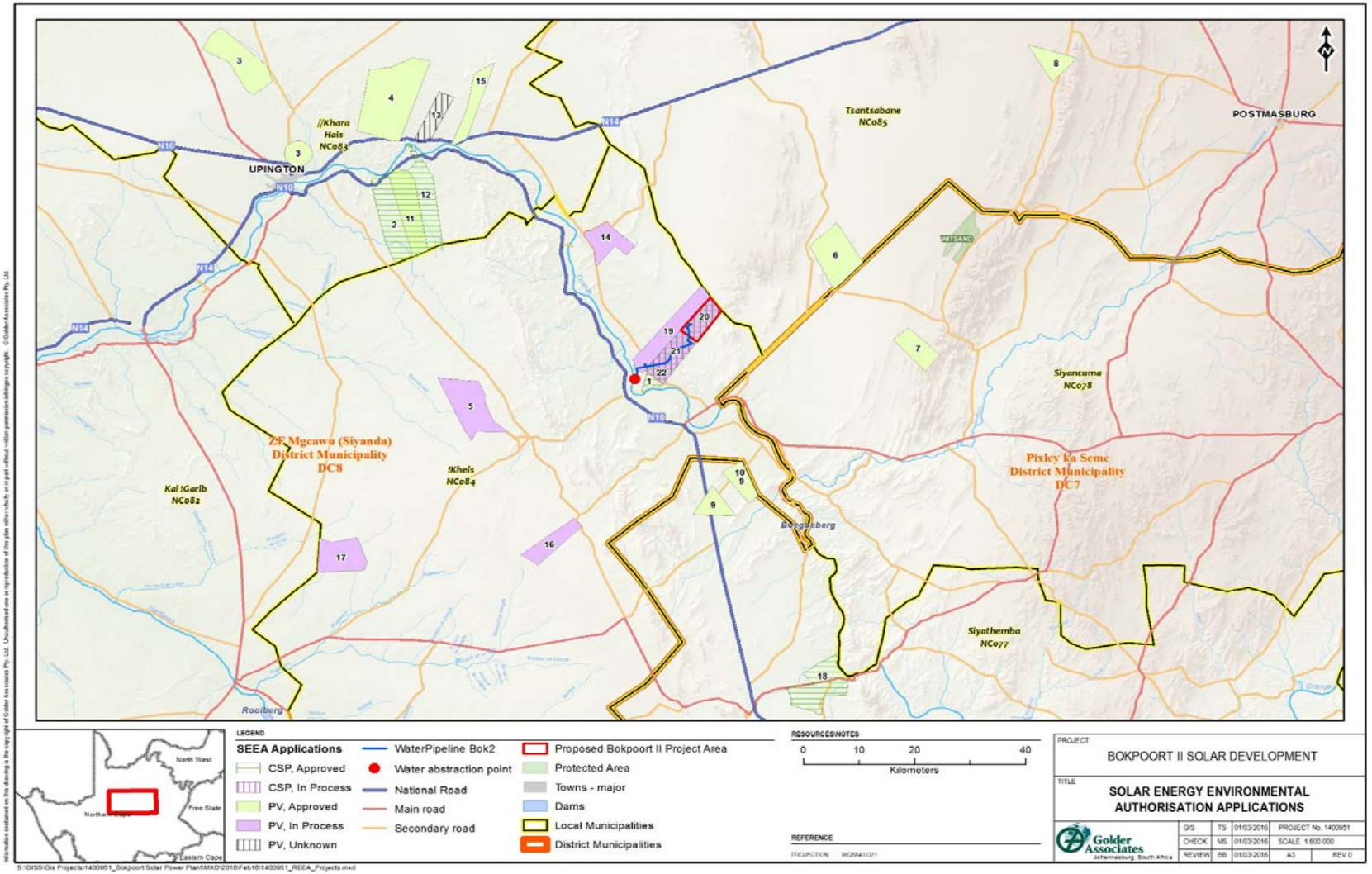

Figure 4: Approved and proposed solar projects that, together with this Project, could contribute to cumulative effects

8.0 REFERENCES

Friedmann, Y. & Daly, B. (2004). Red Data Book of the Mammals of South Africa: A Conservation Assessment. CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust, South Africa.

Greif, S., & Siemers, B. (2010). Innate recognition of water bodies in echolocating bats. *Nature Communications, 2*(1), 107.

Monadjem, A., Taylor, P.J., Cotterill, F.P.D., & Schoeman, M.C. (2010). Bats of Southern and Central Africa: A Biogeographic and Taxonomic Synthesis. Wits University Press.

Smit, H. (2013). *Guidelines to minimise the impact on birds of Solar Facilities and Associated Infrastructure in South Africa.* BirdLife South Africa.

Sowler, S., & Stoffberg, S. (2014). *South African Good Practise Guidelines for Surveying Bats at Wind Energy Facility Developments - Pre-construction.* Distributed by and produced in cooperation with the Wildlife & Energy Programme of the Endangered Wildlife Trust and the South African Bat Assessment Advisory Panel: Third Edition.

GOLDER ASSOCIATES AFRICA (PTY) LTD.

Aisling Dower M.Sc.Pr.Sci.Nat.
Terrestrial Ecologist

Warren Aken M.Sc.
Biodiversity Services

AD/WA/jep

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APPENDIX A

Document Limitations

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Golder Associates

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:	Aisling Dower		
Contact person:	Golder Associates Africa (Pty) Ltd		
Postal address:	P.O. Box 6001, Halfway House		
Postal code:	1685	Cell:	079 4650504
Telephone:	011 254 4800	Fax:	086 582 1561
E-mail:	adower@golder.com		
Professional affiliation(s) (if any)	Pr. Sci. Nat.		

Project Consultant:	Golder Associated Africa (Pty) Ltd		
Contact person:	Marié Schlechter		
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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, Aisling Dower , 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:

Golder Associates Africa Pty Ltd

Name of company (if applicable):

18 April 2016

Date:

Independent Peer Review for the Proposed 75 MW Photovoltaic (PV1) Solar Power Development on the Remaining extent of Farm Bokpoort 390 - DEA Reference Number: 14/12/16/3/3/2/881

On behalf of

GOLDER ASSOCIATES AFRICA (PTY) LTD

May 2016

Prepared By:

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TABLE OF CONTENTS

1 INTRODUCTION

ACWA Power Africa Holdings (Pty) Ltd is proposing to establish a solar power facility (Bokpoort II) on the north-eastern portion of the Remaining Extent of the Farm Bokpoort 390, which is 20 km north-west of the town of Groblershoop within the !Kheis Local Municipality in the ZF Mgcawu District Municipality, Northern Cape Province. The proposed development has three parts each of which constitutes an independent project subject to their own environmental impact assessment process and standalone specialist study.

Golder Associates Africa (Pty) Ltd ('Golder') is leading the environmental impact assessment for the project and also carried out the bat impact assessment. Golder were consequently asked by the Department of Environmental Affairs to provide a third-party independent review of the bat specialist work completed. This document presents a review of the following report:

Bat Impact Assessment: Proposed 75 MW Photovoltaic (PV1) Solar Development on the Remaining Extent of Farm Bokpoort 390, Northern Cape; Golder Report No: 1400951-302664-22; DEA Reference Number: 14/12/16/3/3/2/881.

2 SCOPE OF WORK

The review is intended to focus on the work completed with the aim of expressing an independent opinion on the appropriateness and adequacy of the specialist bat study conducted by Golder. Particular attention was given towards:

- The appropriateness of the approach and methodology to the assessment
- The appropriateness of the baseline and identification of key issues to be assessed
- The appropriateness of the impact assessment and mitigation proposed

3 INDEPENDENT REVIEW

3.1 Appropriateness of the approach and methodology to the assessment

The approach to the assessment was sufficient to meet its objectives, which were themselves appropriate for a solar facility in South Africa. The justification for not undertaking extensive acoustic monitoring is acceptable given the type and location of the development (and given that the potential impacts are currently largely unknown). The assessment did not aim to collect extensive acoustic data because this will be undertaken during the operational phase of the facility. It must be ensured that this does take place.

3.2 Appropriateness of the baseline and identification of key issues to be assessed

The assessment was sufficient to characterise the baseline environment in terms of bat habitats. In terms of bat species presence and diversity, the baseline would have benefited from a longer period of acoustic data collection but this was justifiably not a primary objective of the assessment. Despite this, the baseline environment was still not fully characterised in terms of which species are likely to occur in the region. The Bat Impact Assessment reports that five bat species are expected for this region of the Northern Cape. However, five additional species (Table 1) are known to occur at several sites within the region[1]. These species may also be impacted by the development.

The identification of the key issues for each phase of the development (i.e. construction, operational and decommissioning) did capture the likely potential impacts the

[1] ACR 2015. African Chiroptera Report. 2015. AfricanBats, Pretoria. i - xix, 1 - 7001 pp.

development may have on bats given our current understanding of the impacts of solar facilities on bats.

Table 1: Additional bat species occurring in the broader region surrounding the Bokpoort II Solar Power Facility

Common Name	Scientific Name	Conservation Status	
		Local[2]	International[3]
Egyptian slit-faced bat	*Nycteris thebaica*	Least Concern	Least Concern
Darling's horseshoe bat	*Rhinolophus darlingi*	Near Threatened	Least Concern
Dent's horseshoe bat	*Rhinolophus denti*	Near Threatened	Least Concern
Geoffroy's horseshoe bat	*Rhinolophus clivosus*	Near Threatened	Least Concern
Natal long-fingered bat	*Miniopterus natalensis*	Near Threatened	Least Concern

3.3 Appropriateness of the impact assessment and mitigation proposed

The rating of impacts during the construction and decommissioning phases are acceptable given the baseline environment (even with the additional five species not accounted for in the assessment) and nature of the impacts. The mitigation measures proposed during these two phases are also appropriate. However, it is slightly unclear what the extent of the buffer zone is around the rocky outcrops in the north-eastern extent of the site (*see first bullet point on page 13*). This should be made explicitly clear on this page. It is also not clear if bats were found roosting in these outcrops during the site visit.

Regarding the operational phase, the rating of the impact of water abstraction on bats, and the relevant mitigation, is appropriate. The characterisations of the other potential impacts during this phase, specifically relating to site lighting and collision risks of bats with solar panels, are however incomplete.

It is asserted that high-flying bat species may be less sensitive to light disturbance compared to clutter-foraging species but no evidence is given to support this. Some high-flying bat species, such as those in the genus *Otomops* and *Tadarida*, are known to actively hunt insects around lights[4]. The latter species is present on the site as it was recorded during the acoustic monitoring. Related to this, the assessment also states that lighting would deter bats from flying in the area and hence reduce the risk of bats colliding with solar panels. However, many bats actively forage around lighting[5] and could be attracted to the area including *Tadarida aegyptiaca, Eptesicus hottentotus* and *Neoromicia capensis* which are present on the site. However, this may not necessarily increase collision risk as currently bat collisions with solar panels are poorly understood. This additional information would therefore not change the significance ratings for either impact before or after mitigation, nor require any additional mitigation not already presented, but it is important that the assessment acknowledges that the lighting could increase bat activity at the site for some bat species.

Some aspects of the mitigation proposed for the operational phase need further clarification. For example, it is asserted that the solar panels should remain lit at night to preclude the possibility of bats colliding with them at night. However, no evidence is presented that this could be an effective strategy. On the contrary, it could be more

[2] Monadjem, A., Taylor, P.J., Cotterill, F.P.D., Schoeman, M.C. (2010) Bats of Southern and Central Africa: A Biogeographic and Taxonomic Synthesis. Wits University Press, Johannesburg.

[3] IUNC Redlist Version 3.1 (2008) Accessed 28/04/2016.

[4] Fenton, M.B., Jacobs, D.S., Richardson, E.J., Taylor, P.J., White, W. (2004) Individual signatures in the frequency-modulated sweep calls of African large-eared, free-tailed bats *Otomops martiensseni* (Chiroptera: Molossidae). Journal of Zoology 262, 11-19.

[5] Stone, E.L., Harris, S., Jones, G. (2015) Impacts of artificial lighting on bats: a review of challenges and solutions. Mammalian Biology 80, 213-219.

beneficial to reduce excessive and/or unnecessary lighting as much as possible. The lighting regime required for the facility must therefore be investigated further. An adaptive management approach should be used to better understand the impacts of lighting on bats at the facility and to determine the most mutually beneficial lighting regime for the operation of the facility and for bats. This could include adjusting the duration, timing and intensity of the lighting regime[6].

Finally, it is proposed that mutli-seasonal (but preferably monthly) monitoring of bat and insect activity is undertaken at the facility during operation. It should be made clear that multi-seasonal monitoring is insufficient and that monthly monitoring for carcasses and continuous acoustic monitoring for bat activity should be required.

4 CONCLUSION

It is my specialist opinion that the bat impact assessment carried out by Golder is generally sufficient for a solar power facility in South Africa where the impacts of these facilities are currently unknown/unclear. An adaptive approach is presented which includes the monitoring of bat and insect activity during operation and it must be ensured that this is carried out according to the time frames specified in the assessment and in this review. Acknowledgement should also be given to the additional five bat species (Table 1) that may be impacted by the development. The addition of these species to the baseline does not however warrant changing the impact assessments in either phase but is necessary to more accurately define the baseline environment against which to measure potential impacts. Finally, further investigation is needed into the appropriate lighting regime for the facility to achieve a balance between operation of the facility and light disturbance to bats.

[6] Stone, E.L., Harris, S., Jones, G. (2015) Impacts of artificial lighting on bats: a review of challenges and solutions. Mammalian Biology 80, 213-219.

Appendix 1

CURRICULUM VITAE

Jonathan Aronson Pr.Sci.Nat

Ecology Specialist

Email:JonathanA@arcusconsulting.co.uk Tel: +27 (0) 790 988 595

Specialisms

- Environmental Impact Assessments (EIA) at wind energy developments for bats
- Data analysis and statistical assessment of ecological data
- Eight years of research experience on South African Bats

Summary of Experience

Research and extensive field surveys on insects, baboons, freshwater systems, savannah ecology, birds and bats have all contributed to Jonathan's experience as an ecologist. He combines this knowledge with key skills in quantitative data analysis, GIS and scientific writing to provide input into the ecology work at Arcus Consultancy.

Jonathan has 8 years of experience studying and researching bats and has presented at the International Bat Research Conference and local bat workshops. He has been at the forefront of bats and wind energy research in South Africa. He has contributed to the Good Practise Guidelines for Surveying Bats at Wind Energy Facilities in South Africa, is the lead author on the operational monitoring guidelines for bats and is a member of the South African Bat Assessment Advisory Panel (SABAAP). He has experience managing wind energy facility projects including developing survey strategies, implementing field surveys, data analysis and report writing. He has provided input to Environmental Impact Assessments (EIA) and post-construction Environmental Management Plans (EMP) for bats.

Professional History

2013 to present - Ecology Specialist, Arcus Consultancy Services Ltd, Cape Town
2011 to 2013 - Director, Gaia Environmental Services Pty (Ltd), Cape Town
2008 to 2008 - Research Assistant, Percy Fitzpatrick Inst. of African Ornithology, Cape Town

Qualifications and Professional Interests

- **University of Cape Town, 2009-2010**
  Msc Zoology
- **University of Cape Town, 2007**
  BSc (Hons) Freshwater Biology
- **University of Cape Town, 2003-2006**
  BSc Zoology
- Member of Society for Conservation Biology (2011 to present)
- South African Bat Assessment Advisory Panel (2013 to present)
- Professional Natural Scientist (Ecological Science) – SACNASP Registration #400238/14

Project Experience

- Gouda Wind Farm. 12 months of operational monitoring for bats including activity and fatality surveys (Blue Falcon).
- Touws River North and South Wind Energy Facilities. 12 months pre-construction bat monitoring study (Mainstream Renewable Power South Africa).
- Komsberg East and West Wind Energy Facilities. 12 months pre-construction bat monitoring study (African Clean Energy Developments – ACED)
- Hopefield Wind Farm. 12 months of operational monitoring for bats including activity and fatality surveys. (Umoya Energy)
- Oyster Bay Wind Energy Facility. Reviewing a pre-construction bat monitoring study and providing input into a stand-alone study. (RES Southern Africa).
- Elliot Wind Energy Facility. Pre-construction bat monitoring study. (Rainmaker).
- Pofadder Wind Energy Facility. 12 months pre-construction bat monitoring study (Mainstream Renewable Power South Africa).
- Spitskop West Wind Energy Facility. 12 months pre-construction bat monitoring study (RES Southern Africa/Gestamp).
- Spitskop East Wind Energy Facility. Analysis of 12 months of pre-construction bat monitoring data (RES Southern Africa).
- Patryshoogte Wind Energy Facility. Pre-construction bat monitoring study (RES Southern Africa).

- Swartberg Wind Energy Facility. 12 months pre-construction monitoring and surveys for the presence of bats roosting in farm buildings (CSIR).
- Darling National Demonstration Wind Farm Project. Designed and implemented a pilot research project investigating bat fatality at this facility in the Western Cape which resulted in the publication of a research paper.
- Clover Valley and Groene Kloof Wing Energy Facility. Arcus staff undertook 12 months of pre-construction bat monitoring which included acoustic surveys and mist-netting to catch bats. (Western Wind Energy).
- Killean Wind Farm. Bat acoustic surveys including a driven transect and commissioning of bat detectors for this proposed site in Scotland, UK. (Renewable Energy Systems Ltd).
- Spitskopvlakte Wind Energy Project. Arcus staff assisted with the implementation of a survey of bat activity on this site located near Laingsburg in the Western Cape. This work included acoustic monitoring at several locations including monitoring at height.

Publications

- **Aronson, J.B.** and Sowler, S. (2016). Mitigation Guidance for Bats at Wind Energy Facilities in South Africa.
- **Aronson, J.B.**, Richardson, E.K., MacEwan, K., Jacobs, D., Marais, W., Aiken, S., Taylor, P., Sowler, S. and Hein, C. (2014). South African Good Practise Guidelines for Operational Monitoring for Bats at Wind Energy Facilities (1st Edition).
- Sowler, S. and S. Stoffberg (2014). South African Good Practise Guidelines for Surveying Bats in Wind Energy Facility Developments - Pre-Construction (3rd Edition). Kath Potgieter, K., MacEwan, K., Lötter, C., Marais, M., **Aronson, J.B**., Jordaan, S., Jacobs, D.S, Richardson, K., Taylor, P., Avni, J., Diamond, M., Cohen, L., Dippenaar, S., Pierce, M., Power, J. and Ramalho, R (eds).
- **Aronson, J.B.**, Thomas, A. and Jordaan, S. 2013. Bat fatality at a Wind Energy Facility in the Western Cape, South Africa. *African Bat Conservation News* 31: 9-12.

Workshops and Courses

- Endangered Wildlife Trust (EWT), BirdLife South Africa, BioInsight, The Use of Detection Dogs on Biodiversity and Conservation Studies, Kirstenbosch Botanical Gardens, Cape Town, 1 July 2015.
- Endangered Wildlife Trust (EWT) Bats and Wind Energy Training Course, Highover, 22 – 23 October 2013.
- Ecological Networks Course, Kirstenbosch Botanical Gardens, Cape Town, 22 – 23 July 2013.
- Social and Economic Network Analysis, online via Stanford University, 2013.
- Social Network Analysis, online via University of Michigan, 2013
- Introduction to Complexity Science, online via Santa Fe Institute, 2013.
- Introduction to Spatial Analysis using R, Kirstenbosch Botanical Gardens, Cape Town, 7 – 8 May 2013.
- Google Geo Tools for Conservation, University of Cape Town, 7 – 8 February 2013.
- Endangered Wildlife Trust (EWT) Bats and Wind Energy Training Course, Greyton, 22 – 26 January 2012
- Statistical Modelling Workshop for Biologists, University of Cape Town, 7 – 10 September 2010.
- ESRI Virtual Campus Online GIS Courses, 2010.
- WAYS/ScholarShip Information Technolgoy Workshop: Remote Sensing and GIS, V&A Waterfront, Cape Town, 29 Feb – 02 Mar 2009.

TECHNICAL MEMORANDUM

DATE 13 May 2016 **PROJECT No.** 1400951

TO Marie Schlechter

CC Brent Baxter, ARCUS Consultancy Services,

FROM Aisling Dower **EMAIL** adower@golder.com

INDEPENDENT PEER REVIEW FOR THE PROPOSED 75 MW PHOTOVOLTAIC (PV1) SOLAR POWER DEVELOPMENT ON THE REMAINING EXTENT OF FARM BOKPOORT 390 - DEA REFERENCE NUMBER: 14/12/16/3/3/2/881

Dear Marie

The comments contained in the peer review document dated May 2016 have now been addressed in the Bat Impact Assessment: Proposed Photovoltaic 1 (PV1) Solar Development (Bokpoort II Project) on the Remaining Extent of Farm Bokpoort 390, Northern Cape report. The responses are summarised in Table 1 below.

Table 1: Responses to peer review comments received for ecosystem service review and impact assessment

Comment Reference No.	Response
3.1	Acknowledged. No action required.
3.2	See updated Table 1 in Section 4.1. Initially the table only addressed species that might roost on site. The inclusion of cave/cavity roosting species which may use the site for foraging has been included as recommended.
3.3	The extent of the buffer around the rocky outcrop has been clarified. See page 13.
	Characterisation of potential impacts of site lighting has been updated.
	Proposed mitigation measures have been revised.
	The option for multi-seasonal bat monitoring has been removed; monitoring must be conducted monthly.

If you have any questions please do not hesitate to contact me.

Kind regards,

Aisling Dower
Terrestrial Ecologist

\\joh1-s-fs1\gaadata\projects\1400951 - acwaeia-bokpoortncape\6.1 deliverables\specialist studies\biodiversity\bat reports may 2016\160516_response memo_bats.docx