Postal address: 710 Penge Street
Faerie Glen, 0043, Pretoria
Gauteng, South Africa
Mobile: +27 (0) 79 313 3479
E-mail: info@iws-sa.co.za
Website: www.iws-sa.co.za

Attention: Annelize Erasmus
LANDSCAPE DYNAMICS
91 Wenning Street, Groenkloof, Pretoria, 0181
PO Box 947, Groenkloof, Pretoria, 0027
Tel: + 27 82 566 4530

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Dear Annelize

BAT SCREENING ASSESSMENT FOR THE MERCURY SOLAR PV CLUSTER NEAR VILJOENSKROON IN THE FREE STATE

1. Introduction

As requested by Landscape Dynamics, presented herein is a brief desktop bat screening assessment for the proposed Mercury Solar PV (photovoltaic) cluster near the town of Viljoenskroon in the Free State. The Zaaiplaats PV1, Kleinfontein PV1 and Vlakfontein PV1 projects comprise the northern Mercury Solar PV cluster, and the Horah PV1 and Ratpan PV1 projects comprise the southern Mercury Solar PV cluster (**Figure 1)**. As detailed bat surveys, monitoring, and impact assessments are currently not required for proposed solar developments in South Africa, this desktop bat screening assessment serves to inform on the potential impact of the Mercury Solar PV cluster on bats in the region. No guidelines currently exist for bats on solar farms. As such, IWS has used their previous experience on similar developments and consulted peer-reviewed publications related to bats and solar farms, and the South African guidelines on bats and wind farms, to inform this desktop assessment. The Mercury Solar PV cluster is proposed on land that is mostly transformed or disturbed (cultivated, fallow, or invaded by exotic trees). These habitat types and the nature of solar farm infrastructure is likely to have a more limited impact on bats, than that of wind farms and certain other types of development.

2. Methodology

Not much information about the proposed cluster was available, and only a desktop investigation was performed, which was based on consideration/consultation/review of:

- Available aerial imagery for the site and surrounds (Google Earth 2022).
- The reports and spatial sensitivity layers of the aquatic specialist (BlueScience 2022) and the floral and faunal specialists (EnviroGuard 2022) who were appointed for the Mercury Solar PV cluster.
- Long-term bat monitoring performed by IWS at other sites in the Highveld Grasslands ecoregion (Olson *et al.* 2001; Dinerstein *et al.* 2017).
- Regional bat species records provided by the African Chiroptera Report (ACR 2021), Monadjem *et al.* (2020) and MammalMAP (FIAO 2022).

Figure 1 Project sites comprising the proposed Mercury Solar PV cluster

- Known major bat roosts in the region such as those known to IWS from other projects and those included in and/or published e.g. in Pretorius *et al.* (2020).
- Predicted migration routes of the Natal Long-fingered Bat (*Miniopterus natalensis*) in South Africa as reported by Pretorius *et al*. (2020).
- The current regional and global Red List status of potentially occurring bat species (Child *et al*. 2016; IUCN 2021-3).
- Peer-reviewed scientific publications and other reliable literature, such as the published account of potential ecological impacts of photovoltaic solar panels (Taylor *et al.* 2019).
- Peer-reviewed scientific publications and other reliable literature, such as the published account of bat activity levels in different South African ecoregions by MacEwan *et al.* (2020b).

3. Bat Considerations

3.1 Low Bat Species Richness

Based on available bat occurrence records in the region (ACR 2021; FIAO 2022), eight bat species have been recorded in the region, all of which are listed as Least Concern (Child *et al.* 2016; IUCN 2022) (**Table 1**). None of the listed species are endemic to South Africa, nor do any have any special protection associated with them.

3.2 Low Bat Activity

According to MacEwan *et al*. (2020b), bat activity in the Highveld Grasslands ecoregion is considered low. On average, approximately 2 bat passes per hour (range: 1-7) was recorded by IWS at grassland sites in the southern extremity of this ecoregion. One migratory bat species, *viz.* the Natal Long-fingered Bat (*M. natalensis*) is highly likely to occur in the study region. Given the infrastructure associated with the cluster, and that this would not intercept a known or predicted migratory pathway of *M. natalensis* (Pretorius *et al.* 2020), these bats should not be at any higher risk of fatality from the proposed development than other bat species. The proposed development is also unlikely to pose a risk to the migratory Temminck's Myotis (*Myotis tricolor*), which was rated with a Low likelihood of occurrence.

3.3 Limited Bat Roosting Habitat

Two important bats roosts known to IWS in the region, namely the Venterskroon and Rooipoort caves, are situated within 40 km north-east of the cluster site. Six of the eight regionally occurring bat species have been recorded in the vicinity of the Venterskroon Cave (ACR 2021). No bat information for Rooipoort Cave appears to be available (Gauteng and Northern Regions Bat Interest Group, pers. comm. March 2022). While the proposed cluster would not infringe on a protective 20 km buffer around these caves (based on the buffer recommendations of MacEwan *et al.* 2020a – albeit for wind energy developments), it is important to consider that destruction of habitat surrounding major roosts can severely impact the associated bat population(s).

Many anthropogenic structures such as buildings provide suitable habitat for bats. Although roosts such as trees and caves are generally preferred by bats, many bat species including the Cape Serotine (*Laephotis capensis*) and the Yellow House Bat (*Scotophilus dinganii*), which likely occur in the area (**Table 1**), have adapted to dwelling within roof spaces. Therefore, all buildings (including ruins) should be regarded as conservation important or sensitive for bats. The same applies to indigenous and exotic trees, which could support roosting of the potentially occurring Molossid or free-tailed bats (Lopez-Baucells 2017).

Table 1 List of known and potentially occurring bat species in the region where the Mercury Solar PV cluster is situated

FAMILY	SPECIES	COMMON NAME	LIKELIHOOD OF OCCURRENCE[1,2,3,4]	RED LIST STATUS		SPECIES OF CONSERVATION CONCERN[4, 5]
				Global[4]	National[5]	
MOLOSSIDAE	*Tadarida aegyptiaca*	Egyptian Free-tailed Bat	High	LC (U)	LC	
VESPERTILIONIDAE	*Laeophotis capensis*	Cape Serotine Bat	High	LC (S)	LC	
MINIOPTERIDAE	*Miniopterus natalensis*	Natal Long-fingered Bat	High	LC (U)	LC	Migratory
RHINOLOPHIDAE	*Rhinolophus clivosus*	Geoffroy's Horseshoe Bat	High	LC (S)	LC	
VESPERTILIONIDAE	*Scotophilus dinganii*	Yellow House Bat	High	LC (U)	LC	
NYCTERIDAE	*Nycteris thebaica*	Egyptian Slit-faced Bat	Medium	LC (U)	LC	
VESPERTILIONIDAE	*Myotis tricolor*	Temminck's Myotis	Low	LC (U)	LC	Migratory
MOLOSSIDAE	*Sauromys petrophilus*	Roberts' Flat Headed Bat	Low	LC (S)	LC	

Status: D: Decreasing; LC: Least Concern; S: Stable; U: Unknown.

Source: [1]African Chiroptera Report (2021); [2]Monadjem *et al.* (2020); [3]FIAO (2022); [4]IUCN (2021-1); [5]Child *et al.* (2016); [6]MacEwan *et al.* (2020a)

3.4 Bat Foraging Habitats

Of the eight bat species known to occur in the area, two are clutter foragers, four are clutter-edge foragers, and two are open-air foragers (Monadjem *et al.* 2010). Indigenous and exotic trees and tree clumps represent important foraging habitat especially for clutter and clutter-edge foraging species such as the Cape Serotine Bat (*Laephotis capensis*) and the Geoffroy's Horseshoe Bat (*Rhinolophus clivosus*). To preserve the availability of foraging habitat and prey for these bats, indigenous trees should remain undisturbed.

Considering that the cluster site largely comprises cultivated fields and disturbed fallow and/or pasture fields, construction and operation will most likely impact the availability of crop pest and other insect prey for aerial-foraging species such as the Egyptian Free-tailed Bat (*Tadarida aegyptiaca*). A growing number of studies (Noer *et al.* 2012; Taylor *et al.* 2013; Mtsetfwa *et al.* 2018; MacEwan *et al.* 2020b) indicate that bat activity in southern Africa can be highly concentrated over cultivated fields where there is a high abundance of insect pests. This can be a concern for wind energy developments, but for solar developments, disturbance of terrestrial habitats is a greater concern.

Surface water resources (whether natural or artificial, or perennial or non-perennial) provide bats with essential drinking water, a concentrated availability of insect prey, possible roosting trees, as well as landmarks and corridors for movement (Serra-Cobo *et al*. 2000; Salata 2012; Sirami *et al*. 2013). For these reasons, all surface water resources should be treated with high conservation importance for bats.

3.5 Important Bat Ecosystem Services

The Free State province is a major producer of South Africa's maize, sorghum, potatoes, wheat, soy beans, groundnuts, sunflowers, and wool (FDC 2022). Insectivorous bats often feed on insects and arthropods that are considered agricultural pests or disease-carriers (Kunz *et al.* 2011). Along with pest control, bats are responsible for pollination and seed dispersal in many environments. Bats, therefore, provide useful ecosystem services to areas of anthropogenic and biodiversity importance (Kunz *et al.* 2011). In South Africa, several studies have focused on the economic benefit bats have in agricultural environments (Marais 2010; Taylor *et al.* 2017), highlighting the importance of these animals in areas such as Viljoenskroon and surrounds.

4. Bat Sensitive Areas

The Venterskroon and Rooipoort caves were rated with High sensitivity and assigned 0-20 km High sensitive (no-go) buffers as these caves provide important roosting habitat for several bat species. However, the proposed Mercury Solar PV cluster site does not infringe on these buffers and, therefore, is not expected to have a significant impact on the bats that utilize these caves.

Described in **Table 2** and depicted in **Figure 2 – Figure 7** is the relative conservation importance or "sensitivity" for bats of the different local natural and artificial habitats, and buffers where these are considered necessary.

Areas rated with High conservation importance for bats include:

- Each "watercourse wetland corridor" mapped by BlueScience (2022), which include the remaining uncultivated extent of onsite seasonal streams, headwater seeps, and a 100 m buffer around these, as well as associated wetland vegetation mapped as "vegetation unit 5" by EnviroGuard (2022). Along these corridors bat movement and foraging will potentially be concentrated.

- Wetland "depression clusters" with or without a 100 m buffer as mapped by BlueScience (2022), as well as associated wetland vegetation mapped as "vegetation unit 2" by EnviroGuard (2022). At these wetland clusters, bat foraging will potentially be concentrated.
- Water reservoirs, which likely provide important sources of open drinking water for bats, and a 50 m buffer around these.
- Buildings (including ruins with rooves), which may provide roosting habitat for bats, and a 50 m buffer around these.

Areas rated with Medium conservation importance for bats include:

- Tree clumps, mapped by IWS and/or as "vegetation unit 3" by EnviroGuard (2022), which may provide roosting and foraging habitat for bats.

Areas rated with Low-Medium conservation importance for bats include:

- Small, scattered wetlands, disturbed by cultivation - mapped by BlueScience (2022).
- Weed-dominated grassy fallow fields mapped as "vegetation unit 1," "vegetation unit 6," and "vegetation unit 7" by EnviroGuard (2022) where, relative to cultivated fields, a slightly greater diversity of plants may support a greater diversity of insect prey for bats.

Remaining areas, which mainly comprise cultivated fields, were rated with Low sensitivity.

The bat sensitivity maps should be interpreted as follows. All High sensitive (red) areas should be avoided. Specifically, there must be no terrestrial disturbance of High sensitive areas from development of infrastructure. Where possible, the development of aerial infrastructure (e.g. overhead power lines) should preferably avoid High sensitive areas. Buffers around buildings (including ruins) may only be dropped, and buildings (including ruins) may only be demolished, if and where an ecological or bat specialist has confirmed that these do not support roosting bats. Where a ruin or other building with roosting bats will be demolished, a bat specialist will need to be consulted to advise on means of humanely evicting the bats prior to demolition. In Medium sensitive (orange) areas and elsewhere onsite, indigenous trees (if/where any) should remain undisturbed. In Low-Medium (yellow) sensitive areas, disturbances should be minimized where possible, and vegetation should be allowed to re-establish. Where Low sensitive (clear) areas are not developed, vegetation should be allowed to re-establish.

Table 2 Relative sensitivity/conservation importance of different local habitat features and buffers for bats

HIGH
Each "watercourse wetland corridor" mapped by BlueScience (2022), which include the remaining uncultivated extent of onsite seasonal streams, headwater seeps, and a 100 m buffer around these, as well as associated wetland vegetation mapped as "vegetation unit 5" by EnviroGuard (2022).
Wetland "depression clusters" with or without a 100 m buffer as mapped by BlueScience (2022), as well as associated wetland vegetation mapped as "vegetation unit 2" by EnviroGuard (2022).
Water reservoirs, and a 50 m buffer around these.
Buildings (including ruins), and a 50 m buffer around these
MEDIUM
Tree clumps
LOW-MEDIUM
Small, scattered wetlands, disturbed by cultivation - mapped by BlueScience (2022)
Weed-dominated grassy fallow fields mapped as "vegetation unit 1," "vegetation unit 6," and "vegetation unit 7" by EnviroGuard (2022)
LOW
Cultivated fields and other remaining disturbed areas

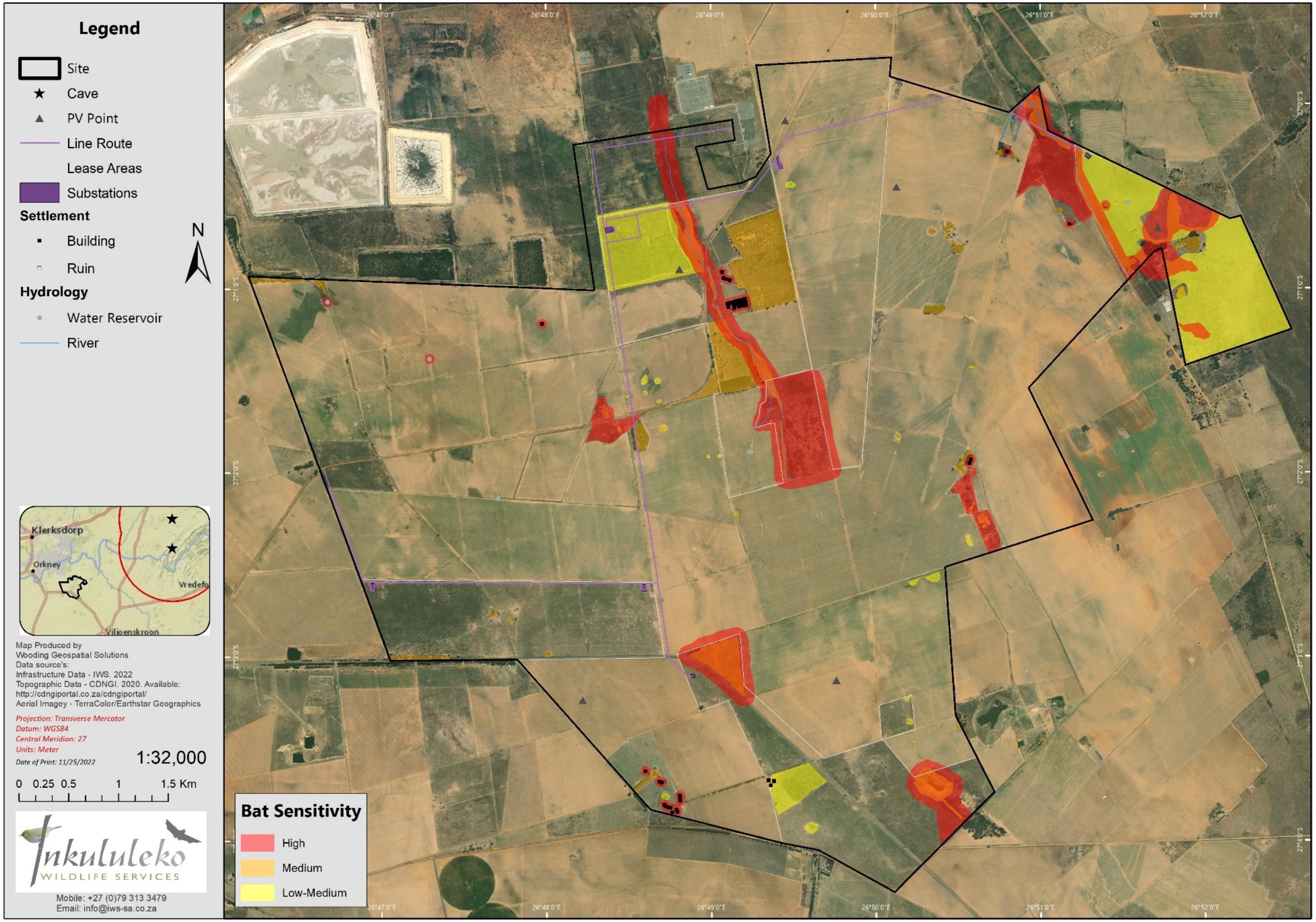

Figure 2 Overall bat sensitivity map for the Mercury Solar PV cluster site

Figure 3 Bat sensitivity map for the Zaaiplaats PV1 project site

Figure 4 **Bat sensitivity map for the Kleinfontein PV1 project site**

Figure 5 **Bat sensitivity map for the Vlakfontein PV1 project site**

Figure 6 Bat sensitivity map for the Hormah PV1 project site

Figure 7 Bat sensitivity map for the Ratpan PV1 project site

5. Potential Impacts on Bats

The potential impacts on bats described here, apply to each of the five projects (i.e. Zaaiplaats PV1, Kleinfontein PV1, Vlakfontein PV1, Hormah PV1, and Ratpan PV1) comprising the Mercury Solar PV cluster.

1.1 Destruction or Disturbance of Bat Roosts

During construction, operation, and decommissioning of the proposed infrastructure, bat roosts (roosting bats and/or roost sites) in buildings (including ruins), trees, and elsewhere could be disturbed or destroyed (e.g. from demolition activities, vegetation clearing, excavation works, and noise) if overlooked and/or not adequately avoided. To avoid or minimize the probability of this impact, **all buildings (including ruins) and their High sensitive buffers should be avoided. In Medium sensitive areas and elsewhere onsite, indigenous trees should remain undisturbed. Buffers around buildings (including ruins) may only be dropped, and buildings and ruins may only be demolished, if a bat specialist has confirmed that these do not support roosting bats. This will require a bat specialist to undertake a site walkthrough prior to construction. If a few bats are found roosting in a building, ruin, tree, or other feature, the bat specialist must advise on humane eviction of the bats.**

1.2 Destruction or Disturbance of Bat Foraging Habitat

During construction and operation of the proposed infrastructure, bat foraging habitat including cultivated fields, weed-dominated grassy vegetation, trees, wetlands, and the seasonal streams will or may be destroyed or disturbed (e.g. from vegetation clearing, excavation works, construction of permanent infrastructure, and light pollution). To minimize the severity and extent of this impact, **all High sensitive areas (especially the buffered uncultivated streams and wetlands) should be avoided. In Medium sensitive areas and elsewhere onsite, indigenous trees should remain undisturbed. In Low-Medium sensitive areas the infrastructure footprint should be minimized, and disturbed areas should be rehabilitated. Light pollution should be minimized throughout the development footprint.**

1.3 Displacement of Bats from Habitat

Bats can potentially be impacted by the indirect effects of solar mirrors, transmission and distribution lines, power line utility poles, and associated infrastructure. The impacts may include the introduction of barriers to movement, habitat fragmentation, site avoidance/abandonment, disturbance, loss of population vigour, behavioural modification, creation of sub-optimal or marginal habitats, loss of refugia, and competition for resources (Manville 2013, Manville 2016). To reduce the severity and extent of this impact, **all High sensitive areas (including the buffered uncultivated streams and wetlands, buildings including ruins, and indigenous trees) should be avoided. In Low-Medium sensitive areas the infrastructure footprint should be minimized, disturbed areas should be rehabilitated. Light pollution should be minimized throughout the development footprint.**

1.4 Bat Collisions with Infrastructure

In terms of fatal impacts on bats, solar farms are generally regarded as having relatively low impacts. According to literature, photovoltaic solar panels such as the ones proposed for the Mercury Solar PV cluster, can be confused for water sources by bats (Taylor *et al.* 2019). While this is somewhat concerning in areas where alternative water sources are not available, there is no evidence to suggest that this mistake results in bat fatalities, as bats seem to merely land on the panels for a short period of time, and then fly off once they realise the panels are not bodies of water (Taylor *et al.* 2019). The polarised light reflected off PV cells may result in the congregation of insects, which may attract insectivorous bats using the PV fields and evaporation ponds for foraging (Murphy-Mariscal 2018; Visser *et al.* 2019). Frugivorous bats may be impacted by power line collisions due to their larger size relative to the smaller insectivorous bats (Tella *et al.* 2020). However, as there are no known records of fruit bats in the immediate vicinity of the site (ACR 2020; FAIO 2022), this is a minor concern for the Mercury Solar PV cluster. **To reduce the probability of this impact, the infrastructure footprint should be minimized. Consideration should be given to burying power lines and other infrastructure where possible – provided this will not cause disturbance of streams, wetlands, and/or indigenous trees (if/where these occur).**

6. Conclusion

In IWS' opinion, the proposed Mercury Solar PV cluster will not cause significant impact to bat populations in the area. Although very little literature exists on the impacts of solar farms on bats, IWS believes that any impacts to bats due to construction, operation, and decommissioning of the proposed infrastructure will be relatively low. Provided that all High sensitive areas are avoided during construction and operation of the facility, IWS regards the development of the Mercury Solar PV cluster as feasible from a bat impact perspective.

We trust that our opinion and comments will be helpful. If needed, we will gladly discuss these issues further.

Kind regards

Dr Caroline Lötter, Pr. Nat. Sci.

Inkululeko Wildlife Services (Pty) Ltd

Dominique Greeff

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