Appendix G.8

BATS ASSESSMENT

Bat Scoping Report for the proposed Verkykerskop Wind Energy Facility Cluster, Free State

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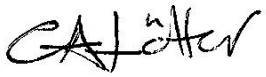
Declaration of Independence

Inkululeko Wildlife Services (Pty) Ltd is an independent consultancy. Inkululeko Wildlife Services has no legal or financial connection with the developer except for having fulfilled the tasks required for this assessment. Remuneration to Inkululeko Wildlife Services (Pty) Ltd for conducting this assessment is not linked to the authorisation of the project by the competent authority. In addition, Inkululeko Wildlife Services (Pty) Ltd has no interest or connection to any secondary or future development associated with the approval of this project. This report was jointly compiled by Dr Jarryd Alexander and Dr Caroline Lötter, who is registered with the South African Council for Natural Scientific Professions (SACNASP). The mapping was performed by Dominique Greeff.

Signed for Inkululeko Wildlife Services (Pty) Ltd by:



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Executive Summary

Presented in this report is a Bat Scoping Assessment for Mulilo Renewable Project Developments' (Mulilo's) proposed Verkykerskop Wind Energy Facility (WEF) Cluster in the Free State Province, South Africa. The Assessment was based on a desktop review, and two brief site visits conducted by Inkululeko Wildlife Services (Pty) Ltd (IWS) team members. Long-term passive acoustic monitoring of bat activity in the Verkykerskop WEF Cluster site commenced in June 2023 and ended in July 2024, and the results from this will be presented in a Bat Monitoring and Impact Assessment Report for each proposed WEF, to follow. It should be noted, however, that in this revised Scoping Report, the bat sensitivity map is based on the desktop and infield findings from the full pre-construction bat monitoring study.

Of 14 bat species that are listed for the study area, 12 species have a High to Medium occurrence potential, and two species have a Low occurrence potential. Among the 12 species most likely to occur, five have a High fatality risk of collision with turbines, and one a Medium–High fatality risk. Five species are regarded as Species of Conservation Concern (SCC). Of these, the Natal Long-fingered Bat (*Miniopterus natalensis*) has a High occurrence potential and a High fatality risk, and the Lesser Long-fingered Bat (*M. fraterculus*) has a Medium occurrence potential and a High fatality risk. Lesueur's Wing-gland Bat (*Cistugo lesueuri*) has a High occurrence potential but Low fatality risk and the two remaining SCC have a Low occurrence potential or Low fatality risk.

The bat sensitivity map for the WEF Cluster site was compiled based on landcover and potential bat important features such as buildings, and comprises High, Medium–High, Medium, and Low sensitive areas. High sensitive areas include: i) buildings with confirmed roosts, and a 500 m buffer around these; ii) buildings with potential roosts, and a 200 m buffer around these; iii) significant rocky terrain including cliff faces, overhangs, cavities, crevices, and/or exfoliating rock, and a 200 m buffer extending downslope from these; and iv) natural and artificial hydrological features, and a 500 m buffer around the large dam and river onsite, and a 200 m buffer around all other hydrological features. Medium–High sensitive areas include dense patches of indigenous and exotic woody vegetation, and a 200m buffer around these. Medium Bat Sensitive Areas include two monitoring locations where possible cave roosts are suspected based on the high levels of activity of certain cavity- and crevice-roosting bat species that were recorded at these two stations. Remaining areas have Low sensitivity.

In addition to the identified local sensitivities, according to the spatial data and other information sources that were consulted by IWS, seven protected areas are situated within only 10 km of the proposed Verkykerskop WEF Cluster site. Bats which should be conserved within these protected areas could potentially be impacted in various ways by the proposed Verkykerskop WEF Cluster and, therefore, a 0-2.5 km High and 2.5-5 km Medium sensitivity buffer has been assigned around each of the seven closest protected areas.

High sensitive areas are No-Go areas for turbines and other non-linear infrastructure. Medium–High sensitive areas represent No-Go areas for turbine towers but which may, however, be encroached by turbine blades and other infrastructure.. In Medium Sensitive Areas, bat fatality mitigation is required (as prescribed in the IWS Bat Monitoring and Impact Assessment Report for each WEF).

Potential impacts on bat species, habitats, and ecosystems services from wind energy development in the Verkykerskop WEF Cluster site have been identified, and basic measures to mitigate these have been recommended. Potential impacts include: i) roost disturbance or destruction; ii) destruction, degradation, and fragmentation of and displacement from foraging habitat; iii) bat fatalities from collision and barotrauma, and population declines; and iv) decline or loss of bat ecosystem services. There is potential cumulative impact on bats from increasing anthropogenic activities in the region including commercial crop cultivation (involving e.g., pesticide spraying), burning, urban settlement (involving e.g., persecution of bats in rooves and light pollution), and energy development. Without considerable mitigation (primarily, pre-construction avoidance of High sensitive areas, and secondarily, operational management of bat fatalities below the cluster's WEF fatality threshold), the proposed Verkykerskop project could have an appreciable adverse impact on certain bat populations that are meant to be conserved by the various protected areas in the surrounding region.

For the proposed Verkykerskop WEF Cluster, based on this Bat Scoping Assessment IWS advises the following:

- Ensure that the layout of each proposed WEF will avoid all High sensitive areas, and Medium-High sensitive areas where possible.
- Plan to construct infrastructure in already-transformed areas such as extraction pits and quarries, cultivated, fallow, and old fields, and eroded and barren areas (unless containing water sources).
- Plan to minimize the turbine Area of Influence i.e., the minimum convex polygon for all turbines comprising each WEF.
- Plan to minimize the total number of turbines, and the total rotor swept area of each WEF.
- Plan to maximize the lowest reach of the turbine blades.
- Minimize the extent (total area) of the proposed road network for all WEFs. Plan to use and upgrade existing roads and tracks so far as possible.
- Plan to minimize artificial lighting on site.
- Plan to effectively rehabilitate all disturbed areas.
- Carefully consider the full findings and recommendations in the Bat Monitoring and Impact Assessment for each WEF, which will be submitted in due course.

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1. Introduction

Mulilo Renewable Project Developments (Mulilo) proposes to develop the Verkykerskop Wind Energy Facility (WEF) Cluster, in the Free State, South Africa (**Figure 1**). Inkululeko Wildlife Services (IWS) was appointed by Mulilo to undertake 12 months of pre-construction bat monitoring and impact assessment as per the current South African guidelines on bat monitoring for the project (MacEwan *et al*. 2020a).

Presented in this report is a Bat Scoping Assessment for the proposed Verkykerskop WEF Cluster. The Scoping Assessment was based on a desktop review and two brief site visits conducted by IWS team members. Long-term passive acoustic monitoring of bat activity in the Verkykerskop WEF Cluster site commenced in June 2023 and ended in July 2024. Equipment for eight bat monitoring stations (referred to as VK1 to VK8) was installed by IWS on the two onsite 100 m and 92 m meteorological (met.) masts and six 10 m masts (**Figure 1**). The details of the passive monitoring are not provided in this report but will be provided in a Bat Monitoring and Impact Assessment Report for each WEF to follow.

This Report includes some initial findings for the WEF Cluster, including a preliminary bat species list, and comments on potential impacts of wind energy development on local bat species, habitats, and ecosystem services. It should be noted, however, that in this revised Scoping Report, the bat sensitivity map is based on the desktop and infield findings from the full pre-construction bat monitoring study.

2. Site Description

The Verkykerskop WEF Cluster site is approximately 19 506 ha in extent and is situated in the Free State Province roughly 35 km south-west of Newcastle and 65 km north-east of Harrismith, almost adjacent to the border of KwaZulu-Natal. The primary vegetation type is the Near Threatened Eastern Free State Sandy Grassland, followed by Low Escarpment Moist Grassland in the east, some Basotho Montane Shrubland in the south-east, and Southern Mistbelt Forest occurring in a single landowner's property in the far east of the site (Mucina and Rutherford 2006). Various hydrological features are present in the site including rivers, dams, pans, and herbaceous wetlands (**Figure 1**). Commercial crop (mainly maize) cultivation and livestock (mainly cattle) farming are the predominant forms of land-use.

Presently, the Verkykerskop Cluster project is proposed to comprise up to 170 NORDEX 5.9 MW turbines (with a hub height of 140 m and total rotor diameter distance of 200 m) distributed as follows: 55 (Groothoek – 6 170 ha), 55 (Kromhoff – 7 269 ha), and 60 (Normandien – 6 067 ha).

3. Legislation and Guidelines

3.1 International agreements

Convention on Biological Diversity (CBD)

It is recognised by the CBD that biological diversity is about more than plants, animals and micro-organisms and their ecosystems – it is about people and our need for food security, medicines, fresh air, clean water, shelter, and a healthy environment in which to live. It is an international convention signed by 150 leaders at the Rio 1992 Earth Summit. South Africa is a signatory. An important principle encompassed by the CBD is the precautionary principle which essentially states that where serious threats to the environment exist, lack of full scientific certainty should not be used as a reason for delaying management of these risks. The burden of proof that an impact will not occur lies with the proponent of the activity posing the threat.

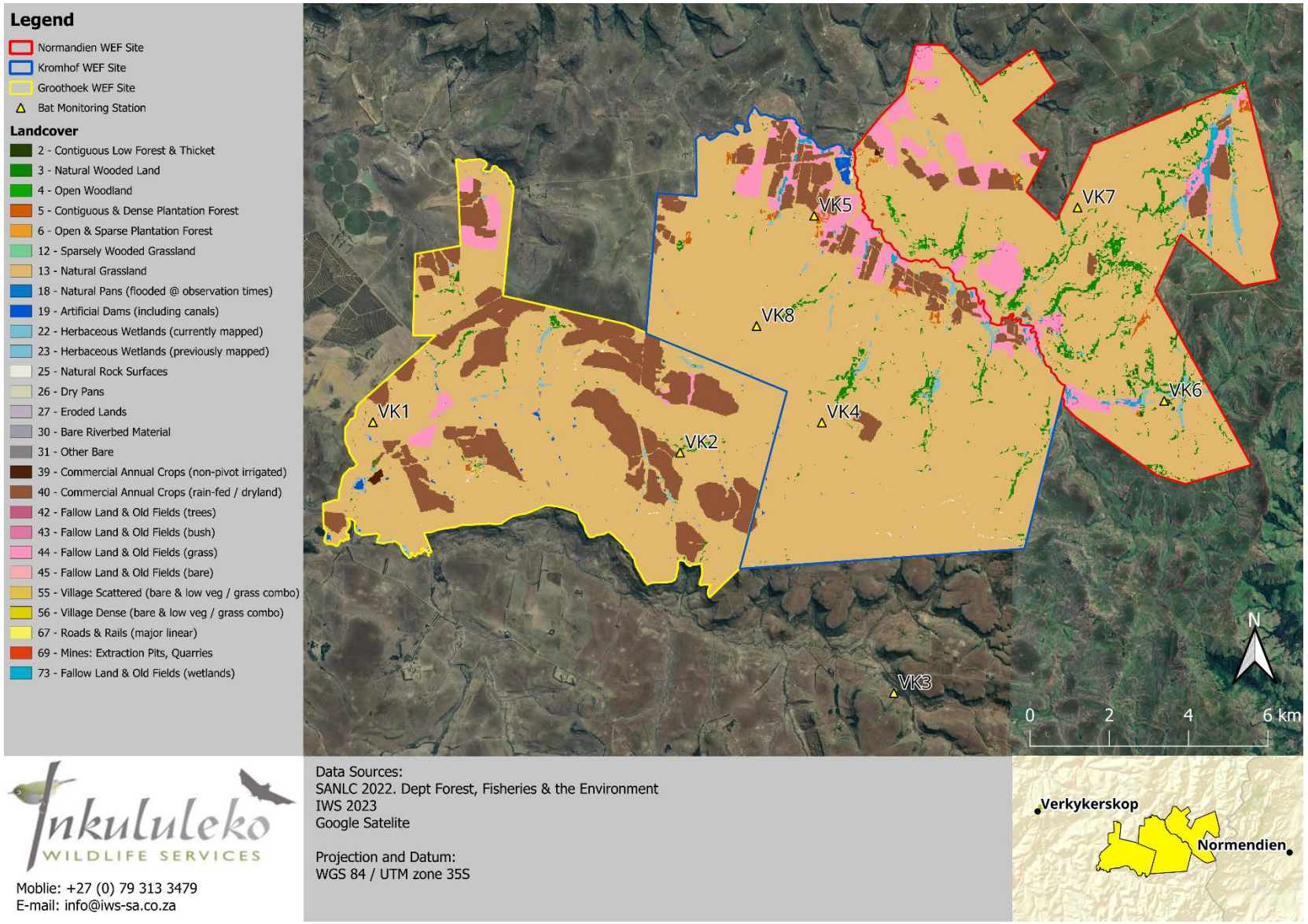

Figure 1 **National landcover in the proposed Verkykerskop wind energy facility cluster site, and the locations of the eight onsite bat monitoring stations (VK1-VK8)**

(Bonn) Convention on the Conservation of Migratory Species (CMS) of Wild Animals

The CMS Convention, signed in 1979, serves to conserve terrestrial, marine and aerial migratory species throughout their range. South Africa is a party to this Convention, which affords protection to various migratory animals. These include a broad spectrum of taxa including certain bat species such as the migratory and regionally occurring Natal Long-fingered Bat (*Miniopterus natalensis*), Lesser Long-fingered Bat (*Miniopterus fraterculus*), and Temminck's Myotis (*Myotis tricolor*).

3.2 National legislation and policies

National Environmental Management: Biodiversity Act (NEM:BA)

NEM:BA (Act 10 of 2004) provides, inter alia, for the management and conservation of South Africa's biodiversity within the framework of the National Environmental Management Act (Act 107 of 1998); the protection of species and ecosystems that warrant protection; and the fair and equitable sharing of benefits arising from bioprospecting involving indigenous biological resources. Under NEM:BA, the Threatened Or Protected Species (TOPS) Regulations provide for the listing and protection of national Threatened Or Protected Species. Presently no bat species is listed as a Threatened of Protected Species under NEM:BA.

National Environmental Management: Protected Areas Act (NEM:PAA)

NEM:PAA (Act 57 of 2003) – as amended - provides, inter alia, for: the conservation and protection of ecologically viable areas in South Africa that characterise the country's biological diversity and natural land and seascapes; declaration and categorisation of different kinds of protected areas (including national, provincial, and local protected areas); management authorities, plans, monitoring and restrictions in respect of protected areas; intergovernmental co-operation and public consultation in matters concerning or related to protected areas; and also offences, and penalties for contravention of the Act.

National Strategy on Buffer Zones for National Parks

This policy (published in Government Gazette 35020 on 8 February 2012) sets out the South African government's national strategy on the establishment and management of buffer zones around national parks so these may better meet their objectives. Guiding principles of this policy include: the intrinsic value of all life forms; the duty of care of all people and organizations to avoid negative impacts on biodiversity; and the precautionary principle. The number one objective of a buffer zone, according to this policy, is to "Ensure the persistence of important species and ecological processes." According to this policy "Buffer zones must be established around all national parks." Furthermore, it is stated that **"**Development outside a national park, and in its buffer zone, depending on its type may be controlled at any one of the three spheres of government. All development in the buffer zone which may have a negative impact on the national park will be strictly controlled."

3.3 Provincial legislation

Free State Nature Conservation Ordinance 8 of 1969

This Ordinance, assigned to the Free State Department of Small Business Development, Tourism, and Environmental Affairs (DESTEA) on 17 June 1994 states that all species in the region, other than specifically listed invasive species should be protected and may only be removed, traded, hunted, or otherwise impacted by individuals in possession of a valid permit. National and private protected areas are to be treated in the same regard and may not be impacted in any way unless an activity has been formally permitted.

3.4 Best practice guidance

South African best practice guidelines for pre-construction bat monitoring at WEFs

The document by MacEwan *et al.* (2020a) provides technical guidance on bat monitoring for proposed wind farms in South Africa. It is principally directed at ecological consultants and environmental impact assessment practitioners to ensure that pre-construction bat studies are sufficiently comprehensive for the evaluation of wind farm applications by authorities. The document includes, inter alia, a synopsis of wind farm impacts on bats, an outline of the minimum requirements for pre-construction bat studies, and methodological considerations for planning and executing these studies. Guidance which applies to the present Scoping Assessment includes, but is not limited to, the need to: i) collate information on known significant bat roosts, potentially occurring conservation important bat species, and bat-important landscape features, including protected areas within 100 km of a proposed WEF site; and ii) early identification of applicable legislation and policies, important issues, sensitivities, and risks to be addressed during the impact assessment phase, and potential impacts and mitigation options to be considered for future project phases

4. IWS Team

Inkululeko Wildlife Services has conducted bat (and bird) monitoring and impact assessments for over 60 (pre-construction and operational) wind farm developments in South Africa, Zambia, Namibia, and Malawi. Inkululeko Wildlife Services team members were involved with the bat sensitivity analysis of the Strategic Environmental Assessment for South Africa's Renewable Energy Development Zones (REDZs), and have performed numerous specialist bat assessments for mines, power lines, the Square Kilometre Array, and other developments, and for caves and protected areas.

Key IWS personnel are as follows.

Dr Caroline Lötter

Caroline, the Managing Director at IWS, has worked on multiple long-term bat monitoring and impact assessment studies for wind energy developments in South Africa. Caroline has also performed numerous impact assessments on vertebrate and invertebrate fauna, as well as bat cave surveys for a broad spectrum of other developments throughout South Africa. Caroline is SACNASP-accredited as a Professional Natural Scientist in the field of Zoology and obtained a PhD in Zoology on the conservation biology of the rare giant bullfrog (*Pyxicephalus adspersus*). Caroline currently sits on the panel of the South African Bat Assessment Association (SABAA) and the Executive Committee of the Gauteng and Northern Regions Bat Interest Group (GNorBIG). Caroline is a co-author of the current South African best practice guidelines for pre-construction bat monitoring studies at wind farm developments (MacEwan *et al*. 2020a), and a peer-reviewed article on bat activity and its implications for wind farm development in South Africa (MacEwan *et al*. 2020b). She is also a member of the Zoological Society of Southern Africa and the Herpetological Association of Africa.

Trevor Morgan

Trevor has worked with the IWS Directors for more than 10 years as the Senior Technical Specialist on all the various bat monitoring projects. He has served as an active member on the Executive Committee of the GNorBIG for several years. His knowledge on South African bats is extensive and he has over a decade of experience with bat detectors, their related software, mist-netting, and harp-trapping. By trade, Trevor is an electrician and an inventor, and has constructed his own harp trap and heterodyne bat detector. Trevor's considerable field-based involvement in all long-term bat monitoring and several bird monitoring studies has been invaluable. Trevor is also a co-author on the MacEwan *et al*. (2020b) article on bat activity and its implications for wind farm development in South Africa.

Dominique Greeff

Dominique is a Junior Zoological Consultant at IWS. Dominique holds a MSc in Ecology and Environmental Conservation from the University of the Witwatersrand. She has extensive terrestrial field work experience working with various animal species within South Africa, including African elephants, sungazer lizards, and edible bullfrogs, and is certified in snake handling, working at heights, and basic first aid. In addition to her work within the country, Dominique has spent nearly 2 years focused on bat research and conservation in Malawi, and has extensive experience with mist-netting, harp-trapping, radiotracking, hand-netting, and identification of many African bat species.

Dr Jarryd Alexander

Jarryd has a broad and detailed knowledge of biodiversity, ecosystem health and functioning, and conservation management. Since 2013 Jarryd has been designing, implementing, analysing, and reporting scientific research, which has all gone on to be published. During his time completing his PhD in ecological sciences Jarryd provided specialist consulting on environmental health; pre- and post-development, with specific focus on terrestrial- and avifauna but also including bats and herpetofauna. Jarryd has also been contracted as a specialist avifaunal consultant for several environmental assessments post completing his PhD. In 2019 Jarryd joined the Mabula Ground Hornbill Project as the research manager where his focus was to manage the research outputs of the organisation and the national monitoring of the Endangered Southern Ground-hornbill. His work led to effective conservation action plans being developed and implemented for the species. During his time with the project, he was also involved as a specialist for species specific assessments at wind energy sites. In 2022 Jarryd joined IWS as a senior zoologist, with specific focus on avifauna and bats

5. Methodology

5.1 Desktop review

A desktop review involved (but was not limited to) consultation and consideration of: the latest bat species records and distribution maps for the region provided by Monadjem *et al.* (2020), the African Chiroptera Report (2022), and MammalMAP (FAIO 2023); and the current South African and global Red List status of the listed bat species (Child *et al.* 2016; IUCN 2024-1).

5.2 Fieldwork

The Verkykerskop WEF Cluster site was briefly visited during 15–19 May 2023 and 31 May–2 June 2023, when IWS installed passive acoustic bat monitoring equipment on the two onsite met. masts and six 10 m masts (**Figure 1**). As the objective of these site visits was installation of the equipment, additional bat survey work was limited to visual observation of habitats.

5.3 Sensitivity mapping

Bat sensitivity mapping conducted by IWS for the Cluster site was based on the desktop and infield findings from the pre-construction bat monitoring study, and specifically took into consideration, within the study area (where present):

- Known significant bat roosts in the region (IWS unpubl. data).
- Local buildings with confirmed or potential bat roosts (CDNGI 2020; IWS unpubl. data).
- South African National Land-cover data (SANLC 2022).
- Significant rocky terrain including cliff faces, overhangs, cavities, crevices, and/or exfoliating rock.Natural and artificial hydrological features including rivers, dams, pans, and certain herbaceous wetlands.
- Statutory and private protected and conservation areas (SAPAD 2022; SACAD 2022).

Buffering of buildings and certain land-cover classes, was based on recommendations in the South African guidelines on bat monitoring for proposed wind farms (MacEwan *et al*. 2020a), and our professsional judgement.

5.4 Potential impacts and basic recommended mitigation

Potential impacts on bat species, habitats, and ecosystems services, from wind energy development in the Verkykerskop WEF Cluster site were identified, and basic measures to mitigate these have been recommended. A detailed assessment of these impacts, along with comprehensive mitigation recommendations, will be provided in the Bat Monitoring and Impact Assessment Report for each WEF in the context of the full pre-construction bat monitoring results and the proposed infrastructure layout and details of each WEF.

5.5 Limitations

- This Scoping Report is based on desktop review work and a visual appraisal of major habitat types during two brief site visits, except for the sensitivity map, which is based on the desktop and infield findings from the full pre-construction bat monitoring study. The details and findings of the latter will be provided in a Bat Monitoring and Impact Assessment Report for each WEF to follow.
- It should be noted that not all cave and (especially old) mine tunnel locations are necessarily known in the region.
- Information on bat migration in South Africa is limited.

6. Results and Discussion

6.1 Potentially occurring bat species

Bat species which potentially occur in the study area are listed in **Table 1**, together with their current Red List status, and turbine fatality risk (as given in MacEwan *et al.* 2020a). Of 14 bat species that are listed for the study area, 12 species have a High to Medium occurrence potential, and two species have a Low occurrence potential. Among the 12 species most likely to occur, five have a High fatality risk of collision with turbines, and one a Medium–High fatality risk.

The widespread but High-Risk, aerial-feeding Egyptian Free-tailed Bat (*Tadarida aegyptiaca*) and Cape Serotine (*Laephotis capensis*) and migratory Natal Long-fingered Bat (*Miniopterus natalensis*), as well as the widespread but Low-Risk Egyptian Slit-face Bat (*Nycteris thebaica*), almost certainly occur in the study area. The endemic Low-Risk Lesueur's Wing-gland Bat (*Cistugo leseueri*) was also rated with a High potential occurrence considering that this species favours broken terrain in high-altitude montane grasslands, and that there are multiple records of this species in the broader region.

The regionally common, cavity-roosting Geoffroy's Horseshoe Bat (*Rhinolophus acrotis*) and Temminck's Myotis (*Myotis tricolor*), and the Mauritian Tomb Bat (*Taphozous mauritianus*) were rated with a Moderate-High potential occurrence. The rare De Winton's Long-eared Bat (*Laephotis wintoni*) which also is associated with high altitude montane grasslands; was rated with a Medium–High potential occurrence. The aerial-foraging Mauritian Tomb Bat has a High fatality risk, but the other three lower-flying species have a Low fatality risk.

The Long-tailed Serotine (*Cnephaeus hottentotus*), which is widely but sparsely distributed, and which requires rocky outcrops for roosting; the endemic, rare, cavity-roosting Swinny's Horseshoe Bat (*Rhinolophus swinnyi*), which is associated with Afromontane forest; and the Lesser Long-fingered Bat (*Minioptersus fraterculus*), which is endemic to South Africa and Eswatini where it inhabits montane grasslands of the escarpment, were all rated with a Medium potential occurrence.

Two fruit bat species were rated with a Low potential occurrence.

Of the 14 listed species; the following five species are regarded by IWS as Species of Conservation Concern (SCC):

- Lesueur's Wing-gland Bat: Endemic to South Africa and Lesotho. Currently not Red Listed but experiencing a global population decline (IUCN 2024-1).
- Natal Long-fingered Bat: Known to roost in large numbers (sometimes hundreds or thousands of individuals) and to migrate hundreds of kilometres (Miller-Butterworth *et al.* 2003; Kearney *et al.* 2016; MacEwan *et al.* 2016).
- Lesser Long-fingered Bat: Endemic to South Africa and Eswatini where the core of its distribution is in the montane grasslands of the escarpment. Cave-dependent and migratory; this species congregates in far smaller numbers than the Natal Long-fingered Bat (Monadjem *et al.* 2020).
- Swinny's Horseshoe Bat: A rare species endemic to South Africa, where it appears to be associated with temperate Afromontane forest (Monadjem *et al.* 2020). Regionally, the red-list status was updated to Vulnerable for this species (Child *et al.,* 2016).
- African Straw-coloured Fruit Bat: Globally and nationally Near Threatened. Known to roost in large numbers and migrate hundreds of kilometres (Monadjem *et al*. 2020). Records in the study region are most likely representative of vagrant individuals, however.

Of these, the Natal Long-fingered Bat has a High occurrence potential and a High fatality risk, and the Lesser Long-fingered Bat has a Medium occurrence potential and a High fatality risk. Lesueur's Wing-gland Bat has a High occurrence potential but Low fatality risk and the two remaining SCC have a Low occurrence potential or Low fatality risk.

The nearest known major bat roost is ~103 km north-east of the Verkykerskop WEF site, in old mine tunnels referred to as Yzermyn (**Figure 3**). Here, sizeable populations of the migratory Natal Long-fingered Bat, Geoffroy's Horseshoe Bat, Temminck's Myotis, and the regionally Vulnerable (Child *et al.* 2016) Swinny's Horseshoe Bat have been recorded (NSS 2013). Given the distance from the Yzermyn tunnels, the proposed Verkykerskop WEF Cluster is not expected to have a major impact on bats from that roost site.

Table 1 Potentially occurring bat species in the proposed Verkykerskop wind farm cluster site

FAMILY	SPECIES	COMMON NAME	OCCURRENCE POTENTIAL[1,2,3,4]	RED LIST STATUS		SPECIES OF CONSERVATION CONCERN[2,5]	TURBINE FATALITY RISK[7]
				Global[5]	Regional[6]		
MOLOSSIDAE	*Tadarida aegyptiaca*	Egyptian Free-tailed Bat	High	LC (U)	LC	-	High
VESPERTILIONIDAE	*Laephotis capensis*	Cape Serotine	High	LC (S)	LC	-	High
MINIOPTERIDAE	*Miniopterus natalensis*	Natal Long-fingered Bat	High	LC (U)	LC	**Migratory**	High
NYCTERIDAE	*Nycteris thebaica*	Egyptian Slit-faced Bat	High	LC (U)	LC	-	Low
VESPERTILIONIDAE	*Cistugo lesueuri*	Lesueur's Wing-gland Bat	High	LC (D)	LC	**Near-endemic**	Low
EMBALLONURIDAE	*Taphozous mauritianus*	Mauritian Tomb Bat	Medium–High	LC (U)	LC	-	High
VESPERTILIONIDAE	*Myotis tricolor*	Temminck's Myotis	Medium–High	LC (U)	LC	**Migratory**	Medium–High
RHINOLOPHIDAE	*Rhinolophus acrotis*	Geoffroy's Horseshoe Bat	Medium–High	LC (U)	LC	-	Low
VESPERTILIONIDAE	*Laephotis wintoni*	De Winton's Long-eared Bat	Medium–High	LC (U)	VU	-	Low
MINIOPTERIDAE	*Miniopterus fraterculus*	Lesser Long-fingered Bat	Medium	LC (U)	LC	**Near-endemic; Migratory**	High
VESPERTILIONIDAE	*Cnephaeus hottentotus*	Long-tailed Serotine	Medium	LC (U)	LC	-	Medium
RHINOLOPHIDAE	*Rhinolophus swinnyi*	Swinnys' Horseshoe Bat	Medium	LC (D)	VU	**Endemic**	Low
PTEROPODIDAE	*Epomophorus wahlbergi*	Wahlberg's Epauletted Fruit Bat	Low	LC (S)	LC	-	High
PTEROPODIDAE	*Eidolon helvum*	African Straw-coloured Fruit Bat	Low	NT (D)	LC	**Migratory**	High

Status: D: Decreasing; EN: Endangered; LC: Least Concern; NT: Near Threatened; S: Stable; U: Unknown; VU: Vulnerable.

Source: [1]Monadjem *et al.* (2020); [2]African Chiroptera Report (2022); [3]FIAO (2023); [4]IWS (unpubl. data); [5]IUCN (2024-1); [6]Child *et al.* (2016); [7]MacEwan *et al.* (2020a)

6.2 Preliminary Bat Sensitivity Mapping

Described in **Table 2** and shown in **Figure 2**, is the relative sensitivity (i.e., the conservation importance for bats) of the different local land-cover classes and features, and the recommended buffers around these, as recommended in the South African guidelines on bat monitoring for proposed wind farms (MacEwan *et al.* 2020a) and based on our professional judgement.

High Bat Sensitive Areas include:

- Confirmed roosts with a 500 m buffer around these, based on evidence of bat roosting activity and suitable roosting habitat for certain cavity/roof-roosting bat species in identified buildings onsite, and the minimum 500 m buffer recommendation in the MacEwan *et al*. (2020a) guidelines for a small roost of Least Concern bats and/or Low fatality risk bats.
- Potential roosts with a 200 m buffer around these, based on the possibility that occupied and abandoned dwellings may provide suitable roosting habitat for certain cavity/roof-roosting bat species, and the minimum 200 m buffer recommendation in the MacEwan *et al*. (2020a) guidelines for any potentially important bat features.
- Significant natural rocky terrain including cliff faces, overhangs, cavities, crevices, and/or exfoliating rock, and a 200 m buffer extending downslope from these, based on: i) the possibility that these may provide roosting habitat for the cave-, cavity-, and crevice-roosting bat species that have been listed for the study area; ii) the minimum 200 m buffer recommendation in the MacEwan *et al.* (2020a) guidelines for any potentially important bat features; and iii) the generally higher levels of bat activity recorded by IWS at monitoring stations at lower elevations, compared to those at higher elevations.
- Natural and artificial hydrological features including rivers, dams, pans, and certain herbaceous wetlands, and a 500 m buffer around the large dam and river onsite, and 200 m buffer around all other hydrological features, based on: i) the known importance of surface water resources for bats (Serra-Cobo *et al*. 2000; Akasaka *et al*. 2009; Hagen and Sabo 2012; Sirami *et al*. 2013); ii) the minimum 200 m buffer recommendation in the best practice guidelines by MacEwan *et al.* (2020a) for known and potential bat important features; and iii) the recorded high activity of bats at monitoring stations VK5 and VK6 and the anticipated high activity of bats at the dam and along the river between these two locations.

Medium–High Bat Sensitive Areas include:

- Patches of indigenous and exotic woody vegetation, based on the known importance of trees for clutter and clutter-edge foraging, tree-roosting, and fruit-eating bat species. Dense stands of woody vegetation were assigned a 200 m buffer, based on the minimum 200 m buffer recommendation in the best practice guidelines by MacEwan *et al*. (2020a) for known and potential bat important features.

Medium Bat Sensitive Areas include:

- The locations of two bat monitoring stations (VK5 and VK6) and a 2.5 km buffer around each of these, where possible cave roosts are suspected based on the high levels of activity of certain cavity- and crevice-roosting bat species that were recorded at these two stations.

Remaining areas have **Low** sensitivity.

In addition to the identified local sensitivities, according to the spatial data and other information sources that were consulted by IWS, seven protected areas are situated within only 10 km of the proposed Verkykerskop WEF Cluster site (**Figure 3**). Of these, the nearest include: the Upper Wilge National Protected Environment, which comprises a collection of land parcels located near the southern tip and up to 30 km south-west of the site; the Ncandu Private Forest and Grassland Reserve ca. 1.6 km to the east; Ncandu Nature Reserve ca. 5 km north-east; Normandien Protected Environment located ca. 4 km and up to 20 km to the south-east; Ora Nature Reserve ca. 5 km to the south-east; Kiepersol Protected Environment ca. 9 km to the north-east; and uMsonti Private Nature Reserve ca. 6 km to the east. Many other formal and informal protected and conservation areas occur within a 50 km radius of the Cluster site (**Figure 3**).

Bats which should be conserved within these protected areas could potentially be impacted in various ways by the proposed Verkykerskop WEF Cluster and, therefore, a 0-2.5 km High and 2.5-5 km Medium sensitivity buffer has been assigned around each of the seven closest protected areas (Figure 4) based on the minimum buffer recommendations in the MacEwan *et al.* (2020a) guidelines of, respectively, 2.5 km for a large roost of Least Concern bats and/or Low fatality risk bats and/or a medium roost for a Species of Conservation Concern (SCC) with a Medium, Medium-High or High turbine fatality risk, and 5 km for a large roost of a SCC with a Low fatality risk.

The sensitivity mapping should be interpreted as follows:

- **High** Bat Sensitive Areas are No-Go areas for turbines and other non-linear infrastructure *viz.* substations, buildings, construction camps, laydown areas, and possible quarries (to avoid disturbing key bat roosting, foraging, and/or commuting habitat, and to avoid high bat fatalities in these areas where high bat activity is anticipated).
- **Medium-High** Bat Sensitive Areas represent No-Go areas for turbine towers but which may be encroached by turbine blades and other infrastructure (to prevent turbines from spinning directly over cliff faces and/or woody vegetation where bats may roost and/or where high bat activity is anticipated).
- **Medium** Bat Sensitive Areas will require bat fatality mitigation (as prescribed in the IWS Bat Monitoring and Impact Assessment Report for each WEF).
- In remaining **Low** Bat Sensitive Areas, impacts such as light pollution, should be minimized.

Detailed bat impact mitigation recommendations will be provided in the Bat Monitoring and Impact Assessment Report for each WEF, and will depend, inter alia, on the pre-construction monitoring results, the layout and infrastructure details of each proposed WEF, and the latest relevant scientific research and best practice requirements.

Table 2 Sensitivity and buffering of local bat important features, and nearby protected areas

LANDSCAPE FEATURES			BUFFER	
Type	**Name**	**Sensitivity**	**Sensitivity**	**Size**
Building	Confirmed roost	HIGH	HIGH	500 m
Building	Potential roost	HIGH	HIGH	200 m
Natural Waterbodies	River with large dam	HIGH	HIGH	500 m
Natural Waterbodies	Streams and smaller drainage lines	HIGH	HIGH	200 m
Natural Waterbodies	Wetlands (mostly with open water)	HIGH	HIGH	200 m
Artificial Waterbodies	Dams	HIGH	HIGH	200 m
Rocky Terrain	Cliff faces, overhangs, cavities, crevices, etc.	HIGH	HIGH on *downslope* only	200 m
Wooded Areas	Tree clumps	MEDIUM–HIGH	MEDIUM–HIGH	200 m
Bat Stations	VK5 and VK6	N.a.	MEDIUM	2.5 km
NEARBY PROTECTED AREAS			**BUFFER**	
Type	**Name**	**Sensitivity**	**Sensitivity**	**Size**
Protected Environment	Upper Wilge Protected Environment	HIGH	HIGH	2.5 km
			MEDIUM	2.5-5 km
Forest Nature Reserve	Ncandu Private Forest and Grassland Reserve	HIGH	HIGH	2.5 km
			MEDIUM	2.5-5 km
Nature Reserve	Ncandu Nature Reserve	HIGH	HIGH	2.5 km
			MEDIUM	2.5-5 km
Nature Reserve	uMsonti Private Nature Reserve	HIGH	HIGH	2.5 km
			MEDIUM	2.5-5 km
Protected Environment	Kiepersol Protected Environment	HIGH	HIGH	2.5 km
			MEDIUM	2.5-5 km
Nature Reserve	Ora Nature Reserve	HIGH	HIGH	2.5 km
			MEDIUM	2.5-5 km
Protected Environment	Normandien Protected Environment	HIGH	HIGH	2.5 km
			MEDIUM	2.5-5 km

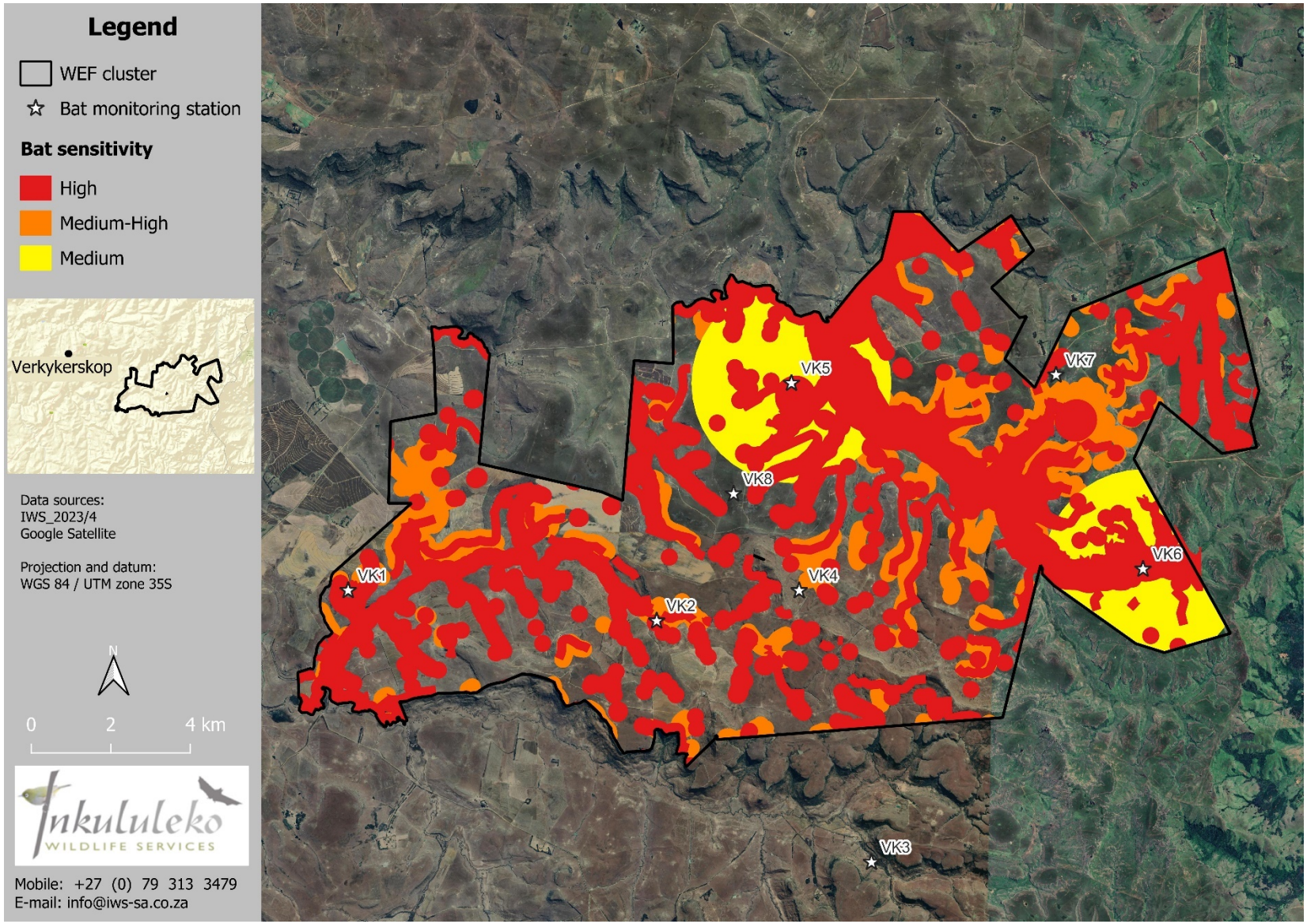

Figure 2 **Bat sensitivity map for the proposed Verkykerskop wind energy facility cluster site – EXCLUDING the buffers around nearby protected areas**

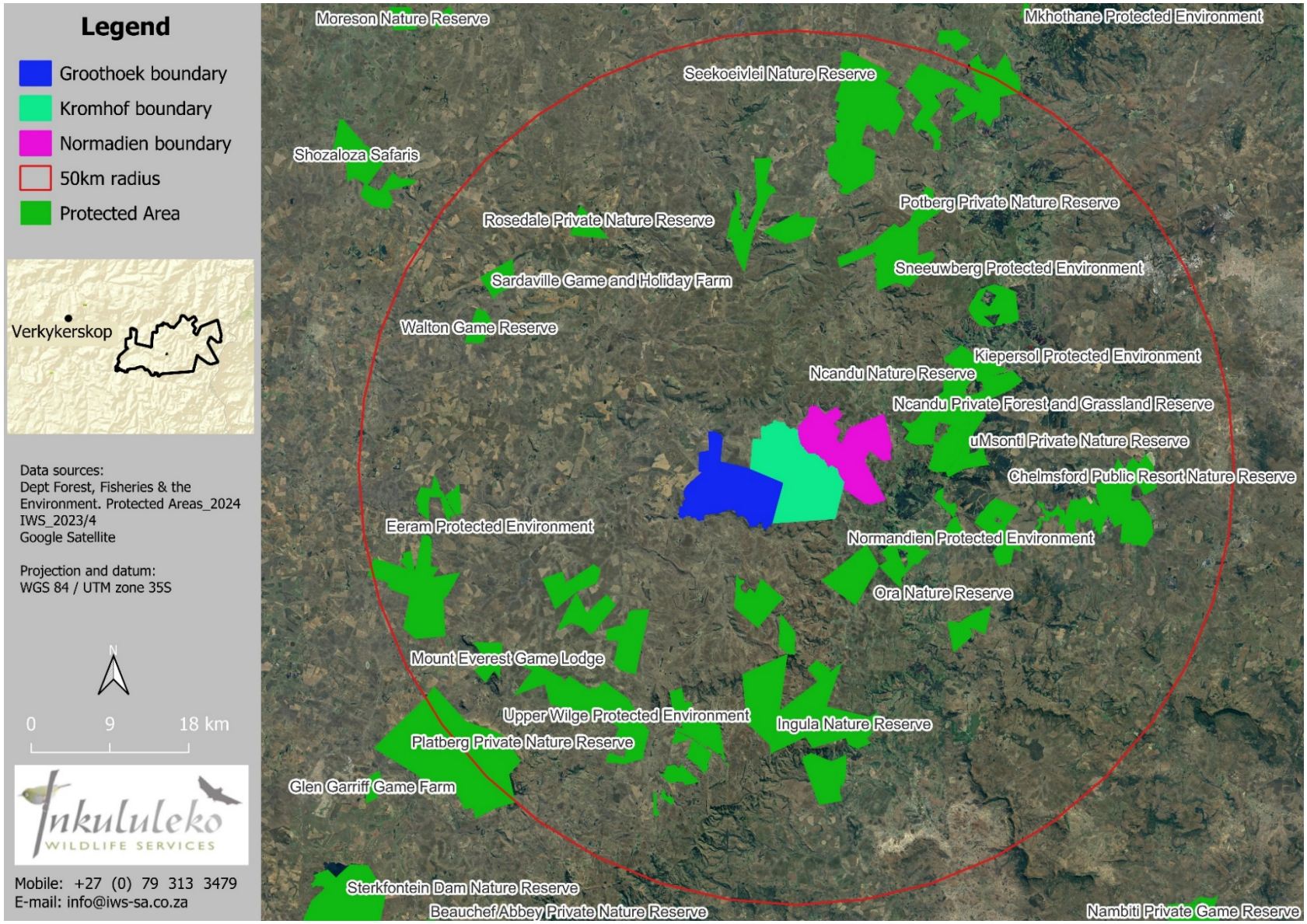

Figure 3 **Protected areas situated within 50 km (red outline) of the proposed Verkykerskop wind energy facility cluster site**

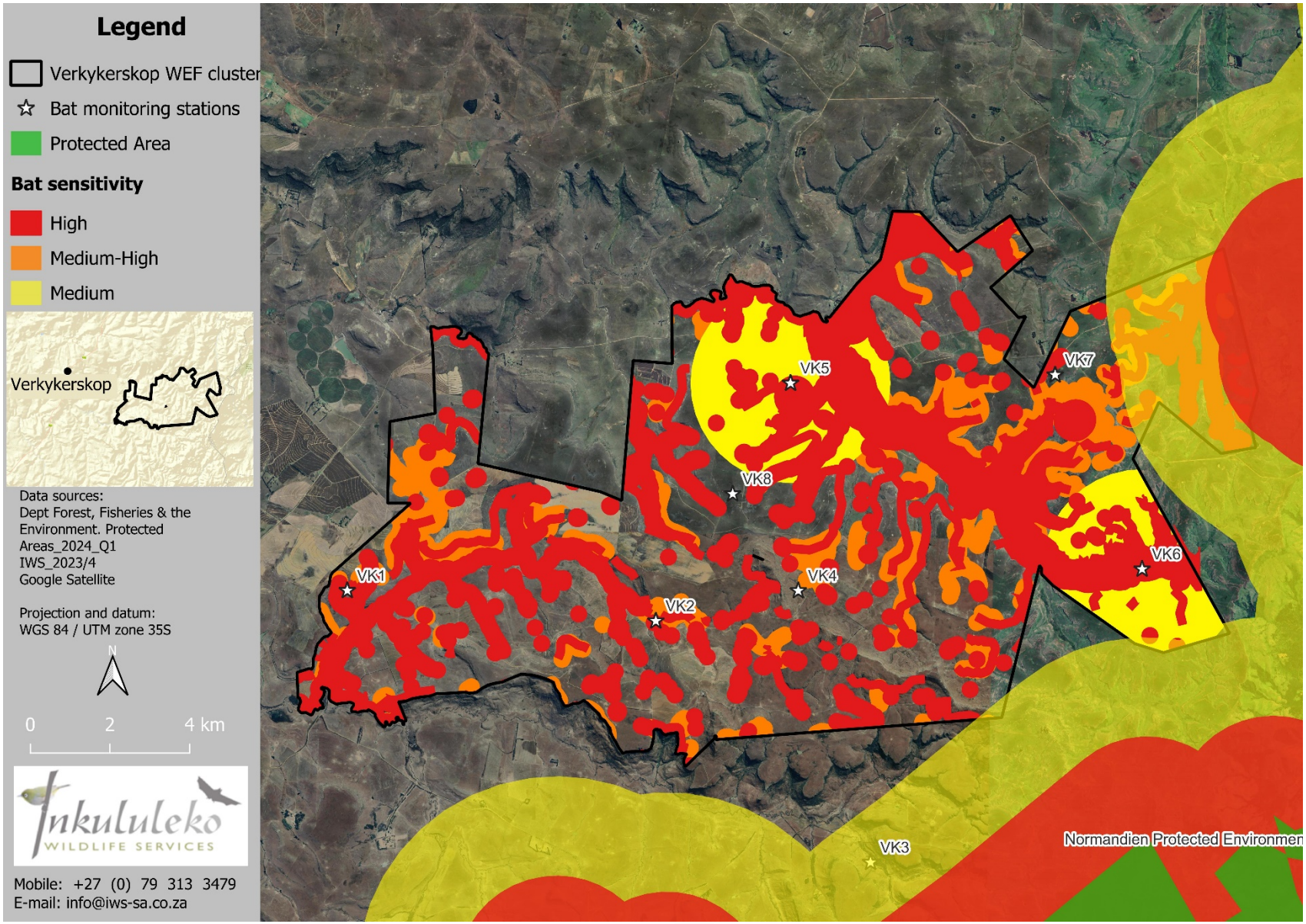

Figure 4 **Buffers around nearby protected areas, in relation to the proposed Verkykerskop wind energy facility cluster site**

6.3 Potential impacts

6.3.1 Roost disturbance or destruction

During construction of the proposed WEF Cluster, bat roosts (roosting bats and/or roost sites) in buildings, rocky places, and/or woody vegetation, could be disturbed or destroyed (e.g., from vegetation clearing, excavation works, blasting, and noise) if overlooked and/or not adequately avoided. To reduce (mainly the probability of) this impact, all High sensitive areas (especially rocky areas, buildings, and dense woody vegetation) should be avoided.

6.3.2 Destruction, degradation, and fragmentation of and displacement from foraging habitat

Construction of the WEF Cluster will cause widespread destruction, degradation, and fragmentation of natural terrestrial habitat, which is used by bats for foraging. Without careful planning, there could (during construction) also be destruction or disturbance of hydrological features, which provide bats with drinking water, and concentrated insect prey, and/or which may represent important beacons or pathways for bat navigation and commuting (Serra-Cobo *et al*. 2000; Salata 2012; Sirami *et al.* 2013). Furthermore, during operation, certain bats (including those from nearby protected areas) may be displaced from foraging habitat if they avoid turbines and possibly other WEF infrastructure. To reduce (the severity and extent of) this impact, all High sensitive areas should be avoided, and all Medium-High sensitive areas should be avoided where possible. Ideally, infrastructure should be constructed in already-transformed areas such as fallow, and old fields, and eroded and other barren areas. The extent (total area) of all new roads should be minimized, the total number of turbines should be minimized, light pollution should be minimized, and disturbed natural areas should be rehabilitated post-construction.

6.3.3 Bat fatalities from collision and barotrauma, and population declines

During operation of the WEF Cluster there will be unavoidable fatality of bats (including those from nearby protected areas) from their collision with and possible barotrauma from turbines. Migratory species (such as the Natal and Lesser long-fingered bats and Temminck's Myotis) may be particularly at risk if the WEF Cluster intercepts a migration route of one or more of these species (Pretorius *et al.* 2020). To mitigate this impact pre-construction, all High sensitive areas should be avoided, all Medium-High sensitive areas should be avoided where possible, and Mulilo should plan to: i) minimize the turbine Area of Influence i.e. the minimum convex polygon for all turbines comprising each WEF; ii) minimize the total rotor swept area; and iii) maximize the lowest reach of the turbine blades. To mitigate this impact during operation, bat fatality mitigation measures will be prescribed in the IWS Bat Monitoring and Impact Assessment Report for each WEF, and proper bat fatality monitoring and adaptive management of bat fatalities must be performed.

6.4.4 Decline or loss of bat ecosystem services

If bat populations in the study region start declining because of roost disturbance, loss of and/or displacement from foraging habitat, and/or high bat fatalities, the ecosystem services that the bats provide (including in nearby protected areas) will be impacted. Local bat eco-services possibly include population control of maize and livestock pests and numerous other insect species that interact with other biodiversity. The plant pollination, seed dispersal, and habitat regeneration services provided by fruit bats could be impacted if the WEF Cluster causes fatalities of fruit bats – which might not reside but could possibly commute through the area. Mitigation of this potential impact will depend on effective mitigation of the afore-mentioned impacts.

6.4 Cumulative impacts

Of additional concern is the potential cumulative impact on bats from increasing anthropogenic activities in the region including commercial crop cultivation (involving e.g., pesticide spraying), burning, urban settlement (involving e.g., persecution of bats in roofs and light pollution), and energy development. According to the Department of Forestry, Fisheries, and the Environment's Renewable Energy EIA Applications Database (https://egis.environment.gov.za/data_egis - consulted in September 2024) there is within 50 km of the proposed Verkykerskop WEF cluster site at least one proposed WEF, *viz*. the Newcastle Wind Power 2 project ca. 32 km north-east (**Figure 5**). A proposed biofuel plant near Newcastle has apparently been refused. Within 100 km of the proposed Verkykerskop WEF cluster site there are at least two approved solar photo-voltaic projects (near Ladysmith and Majuba) and at least one proposed WEF, *viz.* the Waaihoek WEF ca. 77 km east-north-east, near Utrecht. Additional wind farms may be planned in the region, which are not shown. **Of chief concern is that, without considerable mitigation (primarily, pre-construction avoidance of High sensitive areas, and secondarily, operational management of bat fatalities below the cluster's WEF fatality threshold), the proposed Verkykerskop project could have a significant adverse impact on certain bat populations that are meant to be conserved by the various protected areas in the surrounding region (Figure 3).**

7. Conclusion

For the proposed Verkykerskop WEF Cluster, based on this Bat Scoping Assessment IWS advises the following:

- **Ensure that the layout of each proposed WEF will avoid all High sensitive areas, and Medium-High sensitive areas where possible.**
- **Plan to construct infrastructure in already-transformed areas such as extraction pits and quarries, cultivated, fallow, and old fields, and eroded and barren areas.**
- Plan to minimize the turbine Area of Influence i.e., the minimum convex polygon for all turbines comprising each WEF.
- **Plan to minimize the total number of turbines**, and the total rotor swept area of each WEF.
- **Plan to maximize the lowest reach of the turbine blades.**
- Minimize the extent (total area) of the proposed road network for all WEFs. Plan to use and upgrade existing roads and tracks so far as possible.
- Plan to minimize artificial lighting on site.
- Plan to effectively rehabilitate all disturbed areas.
- **Carefully consider the full findings and recommendations in the Bat Monitoring and Impact Assessment for each WEF, which will be submitted in due course.**

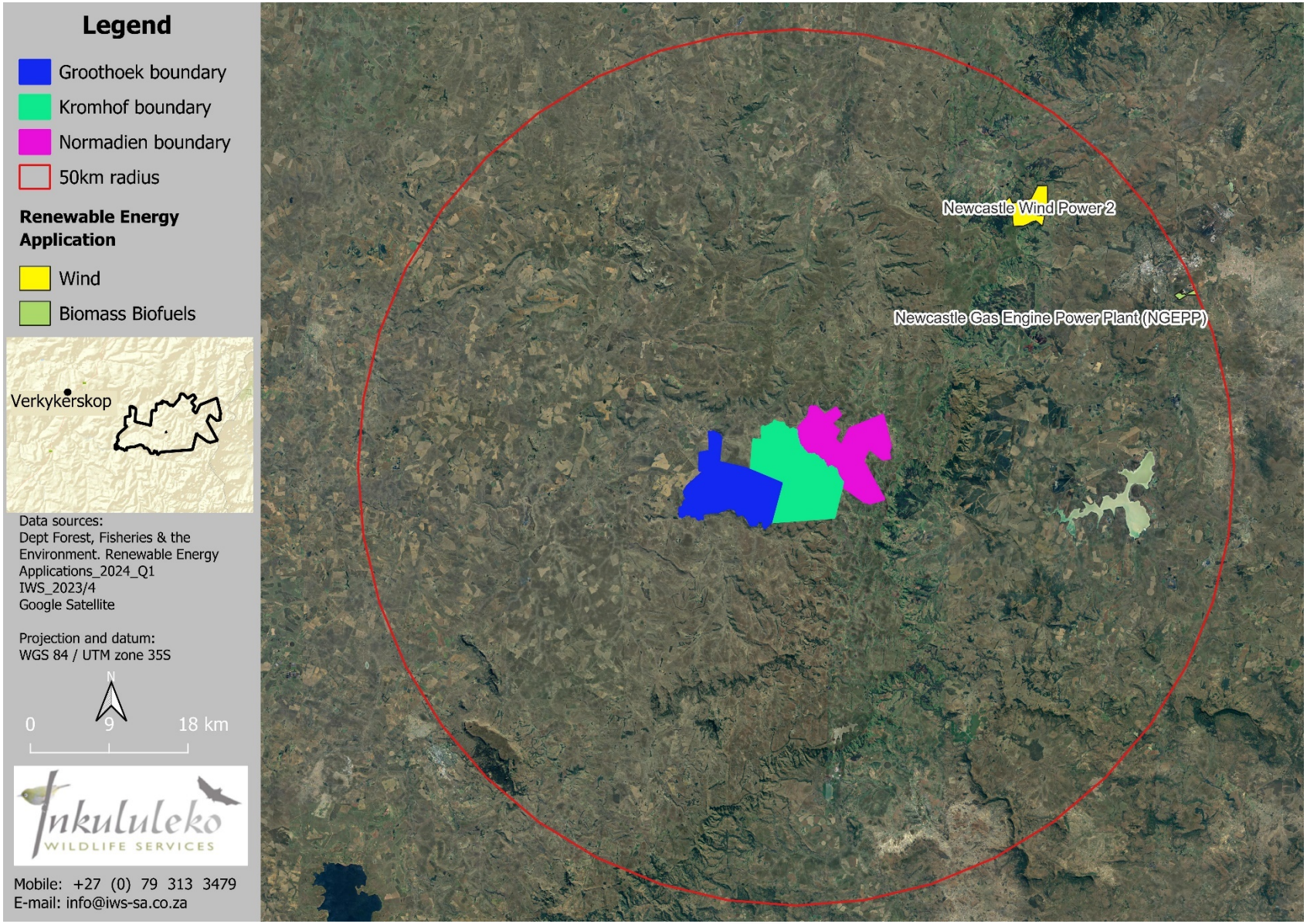

Figure 5 **Energy developments within a roughly 50 km radius (red) around the proposed Verkykerskop wind energy facility cluster site**

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9. Appendix: CV of Dr Caroline Lötter

Name: **DR CAROLINE ANGELA LöTTER (NEÉ YETMAN)**

Name of Firm:	Inkululeko Wildlife Services (Pty) Ltd
Position:	Managing Director
Date of Birth:	6 November 1979
Nationality:	South African
Languages:	English, Afrikaans

QUALIFICATIONS and PROFESSIONAL REGISTRATION

- PhD – Zoology (University of Pretoria: 2003-2011)
- MSc – African Mammalogy (University of Pretoria: 2002)
- BSc Hons – Zoology (University of Pretoria: 2001)
- BSc – Ecology (University of Pretoria: 1998-2000)
- Registered with SACNASP (no. 400182/09) as a Professional Natural Scientist in the field of Zoology

KEY EXPERIENCE

- **Specialist Assessments:**
  - Long-term bat monitoring at more than 70 wind farm sites in southern Africa, including field work, desktop research, report writing, and project management.
  - Surveys and impact assessments for the Square Kilometre Array project and several bat caves.
  - Baseline and impact assessments for fauna in general at over 100 sites in South Africa.
  - Biodiversity Management Plans for large South African mining complexes.
  - Specialist Giant Bullfrog assessments for more than 50 proposed development sites.

EMPLOYMENT EXPERIENCE

- **Inkululeko Wildlife Services, Johannesburg (June 2019 – present)**
  Position Title: Managing Director and Senior Zoologist
  - Bat project management
  - Proposals
  - Desktop research
  - Field work
  - Reporting and report reviews
  - Analysis and reporting of data for peer-review publication
  - Co-author of South African pre-construction bat monitoring guidelines (MacEwan *et al*. 2020a)
  - Co-author of article on bat activity in South Africa and its implications for wind farm development (MacEwan *et al.* 2020b)

- **Natural Scientific Services, Johannesburg (November 2011 – April 2019)**
  Position Title: Senior Zoologist
  - Bat, faunal, and general biodiversity (i.e., faunal, flora, wetland, and aquatic) project management
  - Proposals
  - Desktop research
  - Field work
  - Reporting and report reviews
  - Analysis and reporting of data for peer-review publication

BATS (WIND) SITE SENSITIVITY VERIFICATION REPORT

Inkululeko Wildlife Services (IWS) was appointed to conduct a Bat Scoping Assessment and a Bat Monitoring and Impact Assessment as part of the Scoping and Environmental Impact Assessment (EIA) (S&EIA) process for the proposed Verkykerskop Wind Energy Facility (WEF) Cluster in the Free State Province. The Verkykerskop WEF Cluster comprises the Groothoek, Kromhof, and Normandien WEFs, each up to 300 MW. Each of the three WEFs will have its own 132 kV grid connection.

This report serves as the Bats (Wind) Site Sensitivity Verification Report for all three WEF's comprising the Cluster.

The IWS Bat Scoping Report was completed for the Cluster site in June 2023 after two brief site visits, and was revised in September 2024 following a change in the proposed infrastructure layout. The Bat Monitoring and Impact Assessment Report for each proposed WEF was based on the findings of monitoring conducted by IWS between June 2023 and July 2024 which involved, inter alia, a total of seven site visits.

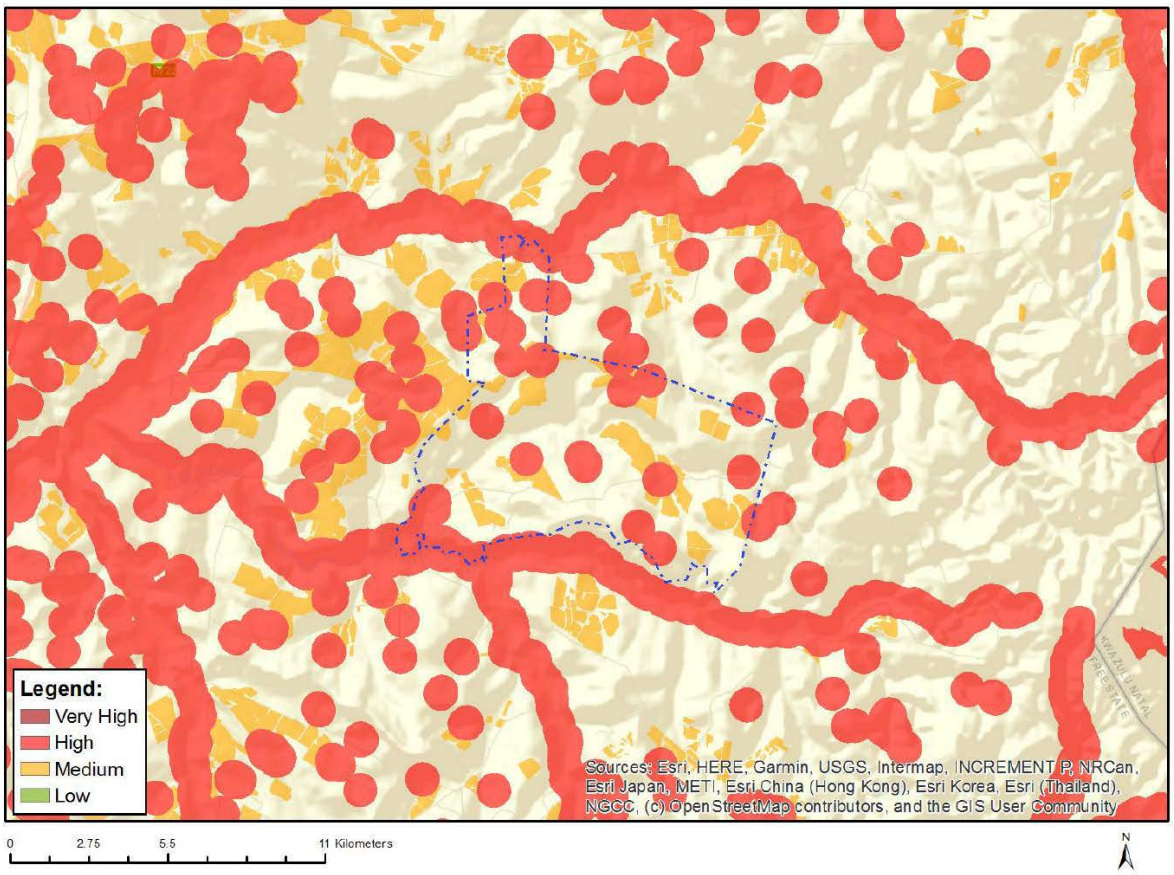
The table below provides information regarding the outcome of the Screening Tool in terms of the bat theme sensitivities associated with the proposed Cluster project and the specialist sensitivity verification.

Table 1: Bats (wind) theme sensitivity for the Verkykerskop WEF Cluster

ENVIRONMENTAL THEME	DFFE SCREENING TOOL SENSITIVITY	APPLICABLE PROTOCOL	SPECIALIST SENSITIVITY VERIFICATION
Bats (Wind)	Groothoek WEF: High	South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities (MacEwan *et al*. 2020)	Groothoek WEF: High
Bats (Wind)	Kromhof WEF: High	South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities (MacEwan *et al*. 2020)	Kromhof WEF: High
Bats (Wind)	Normandien WEF: High	South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities (MacEwan *et al*. 2020)	Normandien WEF: High

Groothoek WEF:

MAP OF RELATIVE BATS (WIND) THEME SENSITIVITY



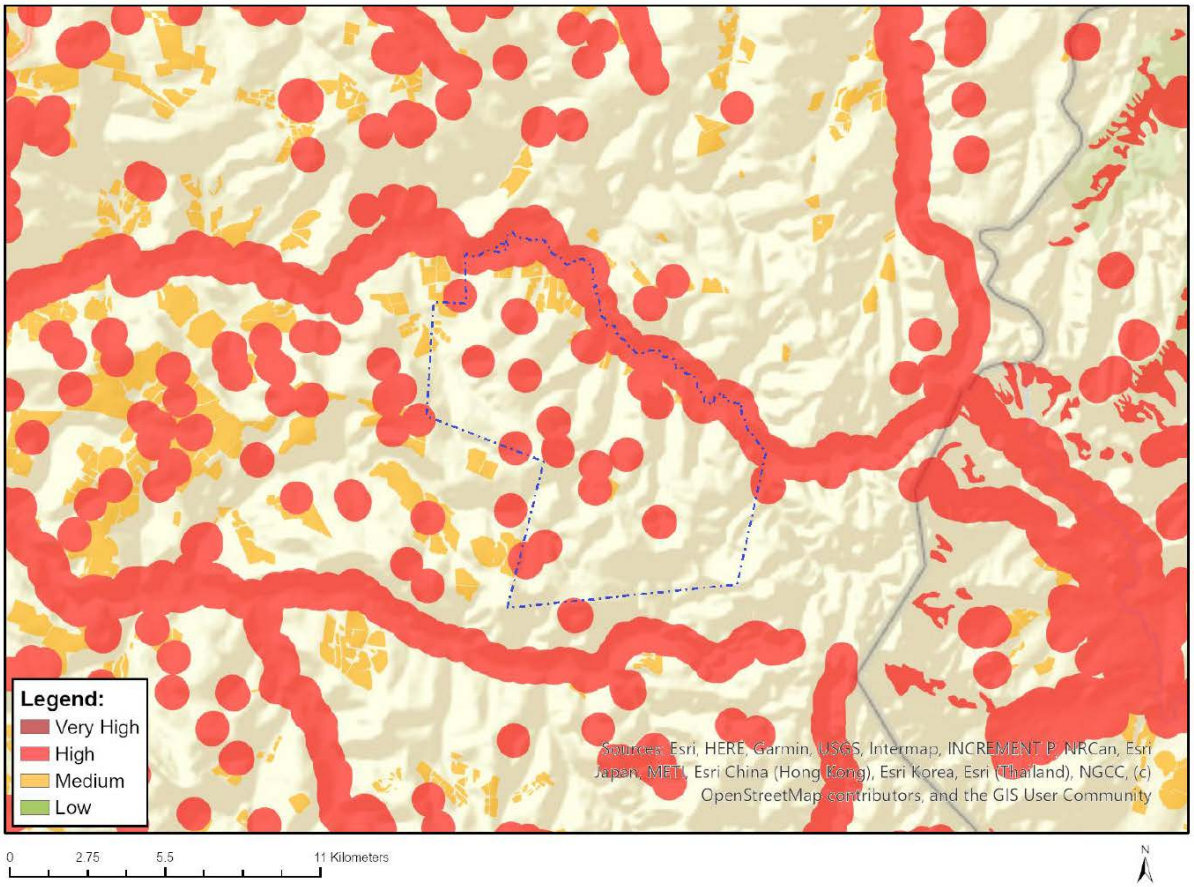
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Within 500 m of a river
High	Wetland
High	Within 500 m of a wetland
Medium	Croplands

Kromhof WEF:

MAP OF RELATIVE BATS (WIND) THEME SENSITIVITY



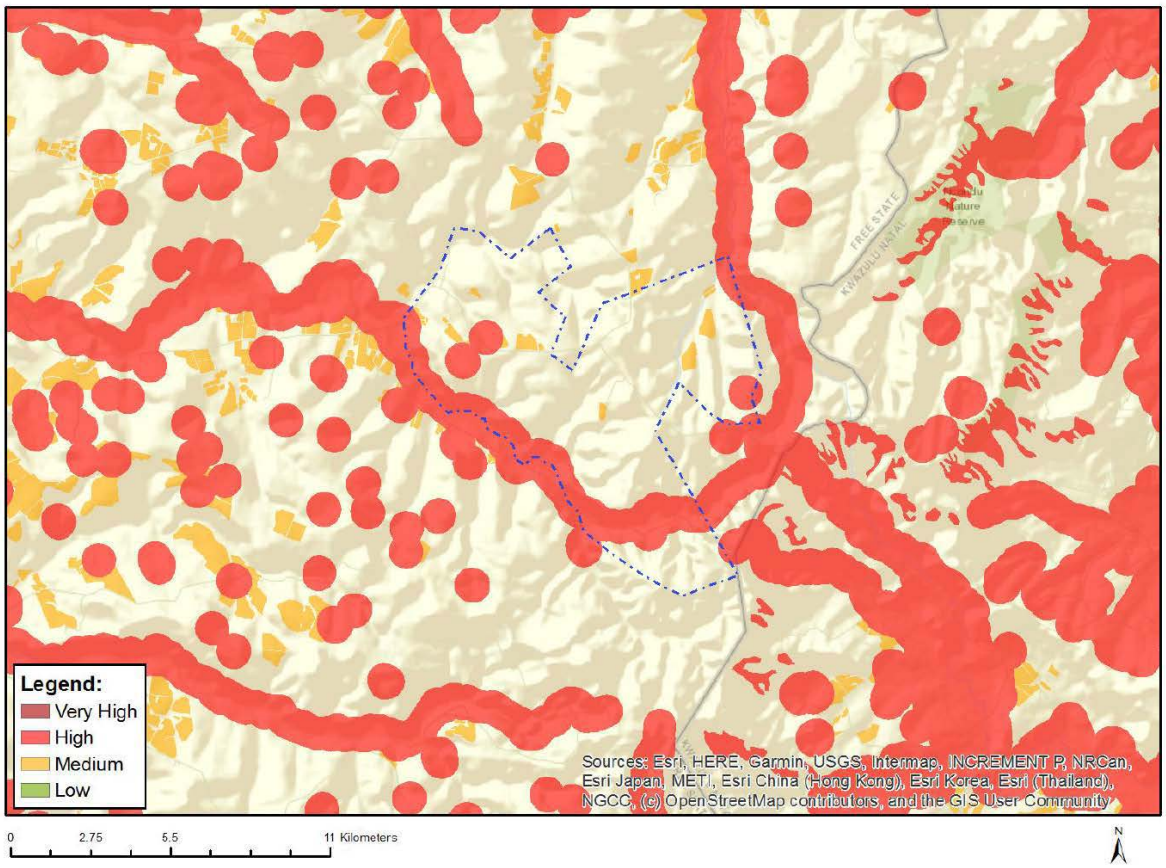
Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Within 500 m of a river
High	Wetland
High	Within 500 m of a wetland
Medium	Croplands

Normandien WEF:

MAP OF RELATIVE BATS (WIND) THEME SENSITIVITY



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
	X		

Sensitivity Features:

Sensitivity	Feature(s)
High	Within 500 m of a river
High	Wetland
High	Within 500 m of a wetland
Medium	Croplands

Bat sensitivity mapping conducted by IWS for the Cluster site was based on desktop and infield findings from the pre-construction bat monitoring study, and specifically took into consideration, within the study area (where present):

- Known significant bat roosts in the region.
- Local buildings with confirmed or potential bat roosts.
- South African National Land-cover data.
- Rocky terrain.
- Hydrological features.

Buffering of identified bat important features was based on recommendations in the South African guidelines on bat monitoring for proposed wind farms (MacEwan *et al*. 2020), and IWS' professional judgement.

A bat sensitivity map for the Cluster site was compiled (**see last page**), where:

High Bat Sensitive Areas include:

- Confirmed roosts with a 500 m buffer around these, based on evidence of bat roosting activity and suitable roosting habitat for certain cavity/roof-roosting bat species in identified buildings onsite, and the minimum 500 m buffer recommendation in the MacEwan *et al*. (2020) guidelines for a small roost of Least Concern bats and/or Low fatality risk bats.
- Potential roosts with a 200 m buffer around these, based on the strong possibility that occupied and abandoned dwellings may provide suitable roosting habitat for certain cavity/roof-roosting bat species, and the minimum 200 m buffer recommendation in the MacEwan *et al*. (2020) guidelines for any potentially important bat features.
- Significant natural rocky terrain including cliff faces, overhangs, cavities, crevices, and/or exfoliating rock, and a 200 m buffer extending *downslope* from these, based on: i) the possibility that these may provide roosting habitat for the cave-, cavity-, and crevice-roosting bat species that have been listed for the study area; ii) the minimum 200 m buffer recommendation in the MacEwan *et al.* (2020) guidelines for any potentially important bat features; and iii) the generally higher levels of bat activity recorded by IWS at monitoring stations at lower elevations, compared to those at higher elevations.
- Natural and artificial hydrological features including rivers, dams, pans, and certain herbaceous wetlands, and a 500 m buffer around the large dam and river onsite, and 200 m buffer around all other hydrological features, based on: i) the known importance of surface water resources for bats (Serra-Cobo *et al*. 2000; Akasaka *et al*. 2009; Hagen and Sabo 2012; Sirami *et al*. 2013); ii) the minimum 200 m buffer recommendation in the best practice guidelines by MacEwan *et al*. (2020) for known and potential bat important features; and iii) the recorded high activity of bats at monitoring stations VK5 and VK6 and the anticipated high activity of bats at the dam and along the river between these two locations.

Medium–**High** Bat Sensitive Areas include:

- Patches of indigenous and exotic woody vegetation, based on the known importance of trees for clutter and clutter-edge foraging, tree-roosting, and fruit-eating bat species. Dense stands of woody vegetation were assigned a 200 m buffer, based on the minimum 200 m buffer recommendation in the best practice guidelines by MacEwan *et al*. (2020) for known and potential bat important features.

Medium Bat Sensitive Areas include:

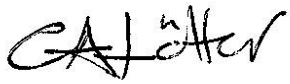
- The locations of two bat monitoring stations (VK5 and VK6) and a 2.5 km buffer around each of these, where possible cave roosts are suspected based on the high levels of activity of certain cavity- and crevice-roosting bat species that were recorded at these two stations.

In addition to the identified local sensitivities, according to the spatial data and other information sources that were consulted by IWS, seven protected areas are situated within only 10 km of the proposed Verkykerskop WEF Cluster site. Of these, the nearest include: the Upper Wilge National Protected Environment, which comprises a collection of land parcels located near the southern tip and up to 30 km south-west of the site; the Ncandu Private Forest and Grassland Reserve ca. 1.6 km to the east; Ncandu Nature Reserve ca. 5 km north-east; Normandien Protected Environment located ca. 4 km and up to 20 km to the south-east; Ora Nature Reserve ca. 5 km to the south-east; Kiepersol Protected Environment ca. 9 km to the north-east; and uMsonti Private Nature Reserve ca. 6 km to the east. Many other formal and informal protected and conservation areas occur within a 50 km radius of the Cluster site.

Bats which should be conserved within these protected areas could potentially be impacted in various ways by the proposed Verkykerskop WEF Cluster and, therefore, a 0-2.5 km High and 2.5-5 km Medium sensitivity buffer was assigned around each of the seven closest protected areas based on the minimum buffer recommendations in the MacEwan *et al.* (2020) guidelines of, respectively, 2.5 km for a large roost of Least Concern bats and/or Low fatality risk bats and/or a medium roost for a Species of Conservation Concern (SCC) with a Medium, Medium-High or High turbine fatality risk, and 5 km for a large roost of a SCC with a Low fatality risk.

High Bat Sensitive Areas are No-Go areas for turbines and other non-linear WEF infrastructure. Medium-High Sensitive Areas represent No-Go areas for turbine towers but which may be encroached by turbine blades and other infrastructure. In Medium Sensitive Areas, bat fatality mitigation is required (as prescribed in the IWS Bat Monitoring and Impact Assessment Report for each WEF).

Based on the identified bat sensitivities, IWS agrees with the “High” overall sensitivity rating of the three WEF sites comprising the Verkykerskop Cluster as per the national Screening Tool. However, this is not only due to the presence of various hydrological features and croplands onsite, but due to the collective presence of local rocky terrain, hydrological features, woody vegetation, confirmed and potential bat roosts in buildings and other locations, and nearby protected areas.



Dr Caroline Lötter, Pr. Nat. Sci.

Managing Director

Inkululeko Wildlife Services

WEF cluster sensitivity: