

CHAPTER 2b

Bats

CHAPTER 2b:

Bats

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Appointment of Specialist

<i>Study:</i>	Chapter 2b: Bats. Strategic environmental assessment for the proposed Boegoebaai port, special economic zone (SEZ) and the Namakwa region. Work Package 2 – Namakwa region
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<i>Appointed by:</i>	Council for Scientific and Industrial Research (CSIR)

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- NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT 10 OF 2004; Especially sections 2, 56 & 97). The Act calls for the management and conservation of all biological diversity within South Africa. Bats constitute an important component of South African biodiversity and therefore all species receive attention, in addition to those listed as Threatened or Protected.

Applicable Guidelines

Guidelines dealing with biodiversity applies to bats and includes the following:

- THE SOUTH AFRICAN BEST PRACTICE GUIDELINES for pre-construction studies recommends sensitivity map buffer rules and mitigation by avoidance. MacEwan, K., Sowler, S., Aronson, J., and Lötter, C. 2020. *South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities* - ed 5. South African Bat Assessment Association.
- THE BAT MORTALITY THRESHOLD GUIDELINES impose sustainable bat mortality thresholds for operating wind farms, indicating when wind farms need to apply active mitigation measures. MacEwan, K., Aronson, J., Richardson, E., Taylor, P., Coverdale, B., Jacobs, D., Leeuwener, L., Marais, W., Richards, L. 2020. *South African Bat Fatality Threshold Guidelines* – ed 3. South African Bat Assessment Association.

Executive Summary

Animalia Consultants (Pty) Ltd ('Animalia') was appointed by the Council for Scientific and Industrial Research ('CSIR') to conduct a Bat Specialist Assessment for the Strategic Environmental Assessment (SEA) of the proposed Boegoebaai Port, Special Economic Zone (SEZ) that would support the green hydrogen economy and required renewable energy development in the Namakwaland region, South Africa. The development of green hydrogen and its derivatives (e.g., green ammonia, green methanol) aims to decarbonise the South African energy sector, create jobs and skills, and support a Just Energy Transition. This assessment focuses on the Richtersveld, Nama Khoi, Kamiesberg, and Khaï Ma Local Municipalities, covering approximately 5.8 million hectares, and highlights key bat-related sustainability considerations for the proposed regional renewable energy developments.

Site Sensitivity Analysis

The bat sensitivity assessment categorised areas based on their relative importance for roosting, foraging, and conservation value, providing a framework to guide development planning and risk avoidance (**Figure (i)**). Areas of **very high or high sensitivity** represent habitats with exceptional to strong roosting or foraging potential, high bat activity, or the presence of species of conservation concern. These areas pose significant risks to bat populations and are generally unsuitable for development. **Medium sensitivity** areas have moderate or uncertain bat activity and may host Near Threatened or Rare species. Development may be possible here but requires detailed, site-specific assessment and mitigation during the EIA phase. **Low sensitivity** areas offer limited roosting or foraging potential and low bat activity, making them comparatively more suitable for development, though local sensitivities must still be verified through further investigation.

Areas of Very High Sensitivity include open water sources, perennial rivers, wetlands, coastlines, protected areas, and bat roosts. These features are crucial for bat activity as they offer water, moisture, and abundant insect or fruit food sources, with roosts being particularly important due to the potential for large-scale impacts on bat populations. High Sensitivity zones are associated with limestone geology, which may contain undiscovered caves that serve as ideal roosting habitats. Medium Sensitivity areas include non-perennial watercourses, where seasonal moisture may attract insect prey, supporting bat foraging. Low Sensitivity applies to all remaining areas without these specific features. In addition to these categories, Roost Investigation Zones and Roost Caution Zones are identified around known bat roosts, with their size and importance determined by species, colony size, and roost type, highlighting areas that may be used extensively by bats and therefore require careful consideration.

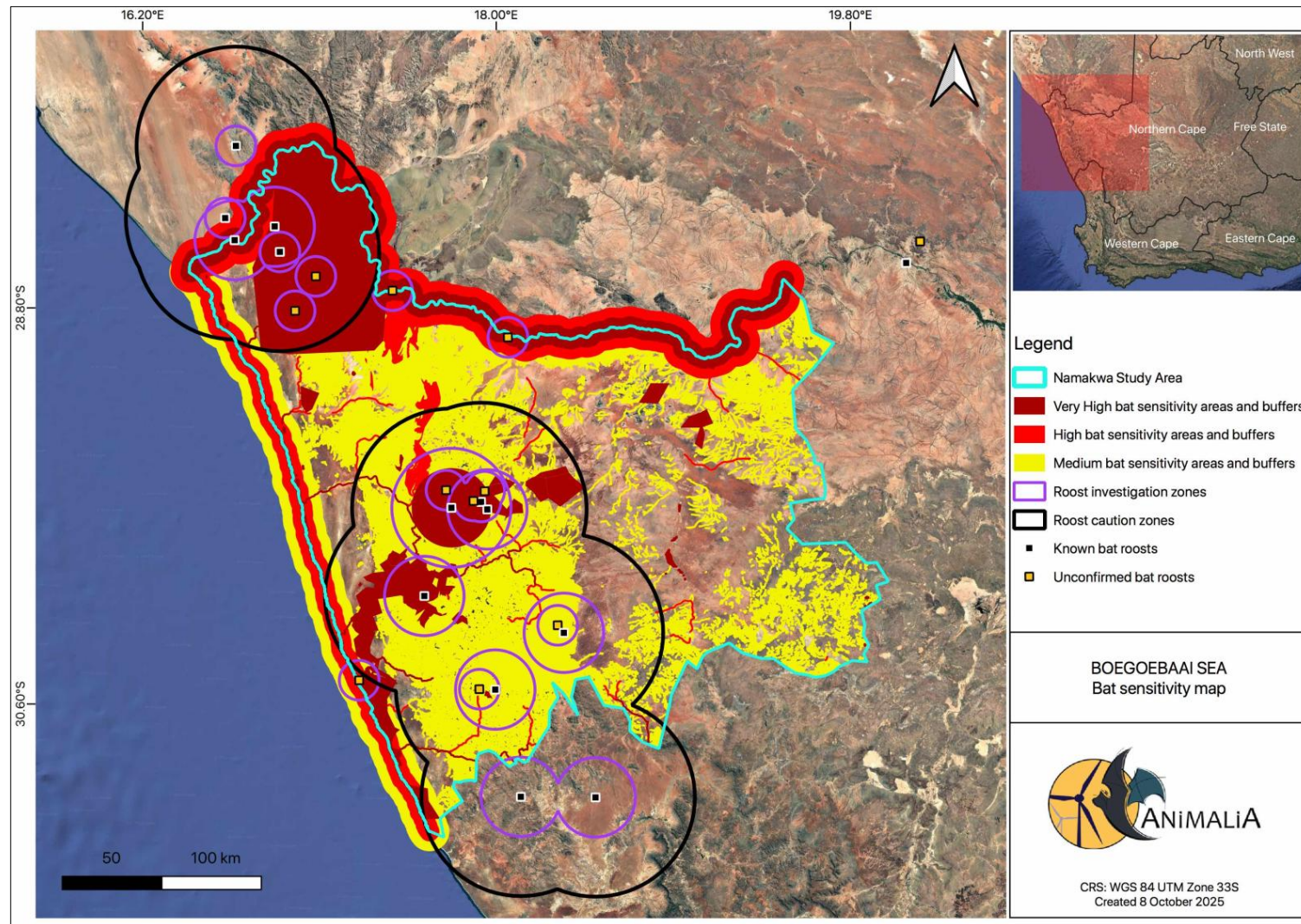


Figure (i). Bat sensitivity map of the Namakwa study region, showing Very High, High, Medium and Low sensitivity zones and their buffers. As well as Roost Investigation and Roost Caution zones

Impact Assessment

Three potential negative impacts on bats have been identified in relation to the proposed expansion of renewable energy infrastructure within the Namakwa Region, namely the **destruction or disturbance of bat roosts** during construction, the **loss and fragmentation of foraging habitat** during construction and operation, and **bat mortalities** due to direct blade impact or barotrauma during foraging and migration. Each identified impact has been assigned a consequence, likelihood, and overall risk rating for each development scenario (Sc0, Sc1, and Sc2). For each impact under all development scenarios, risk to bats increases with both project scale and habitat sensitivity. Very High and High sensitivity areas present the greatest risk, with impacts remaining High to Very High even after mitigation. Medium sensitivity areas show moderate risks that can be reduced through effective management, while Low sensitivity areas consistently represent minimal risk. While the level of risk varies between scenarios, all potential impacts show a reduction in risk when appropriate mitigation and management measures are implemented. The risks associated with each impact, across all scenarios and sensitivity tiers, both before and after mitigation, are summarized below:

Table (i). Risks to bats associated with each impact across all scenarios and sensitivity tiers, both before and after mitigation

Scenario	Sensitivity Tier	Impact	Risk Without Mitigation	Risk With Mitigation
S0: Baseline	Very High	Roost disturbance	Moderate	N/A
		Habitat loss	Moderate	N/A
		Bat mortalities	High	N/A
	High	Roost disturbance	Moderate	N/A
		Habitat loss	Moderate	N/A
		Bat mortalities	Moderate	N/A
	Medium	Roost disturbance	Low	N/A
		Habitat loss	Low	N/A
		Bat mortalities	Low	N/A
	Low	Roost disturbance	Very Low	N/A
		Habitat loss	Very Low	N/A
		Bat mortalities	Low	N/A
S1: Small GH2	Very High	Roost disturbance	High	High
		Habitat loss	High	High
		Bat mortalities	Very High	High
	High	Roost disturbance	High	Moderate
		Habitat loss	High	Moderate
		Bat mortalities	High	Moderate
	Medium	Roost disturbance	Moderate	Low
		Habitat loss	Moderate	Low
		Bat mortalities	Moderate	Low
	Low	Roost disturbance	Low	Very Low
		Habitat loss	Low	Very Low
		Bat mortalities	Moderate	Low

Scenario	Sensitivity Tier	Impact	Risk Without Mitigation	Risk With Mitigation
S2: Big GH2	Very High	Roost disturbance	Very High	Very High
		Habitat loss	Very High	Very High
		Bat mortalities	Very High	Very High
	High	Roost disturbance	High	High
		Habitat loss	High	High
		Bat mortalities	Very High	High
	Medium	Roost disturbance	High	Moderate
		Habitat loss	High	Moderate
		Bat mortalities	Moderate	Moderate
	Low	Roost disturbance	Low	Low
		Habitat loss	Low	Low
		Bat mortalities	Moderate	Low

Strategic Management Recommendations

To manage and mitigate the potential impacts of renewable energy and green hydrogen (GH₂) development, the following strategic actions are recommended:

National Policy:

- Operational bat mortality monitoring reports from wind energy facilities should be shared with DFFE and SABAAP to support ongoing development of effective mitigation measures.
- Conduct a national-scale SEA spatial risk analysis to identify areas unsuitable for GH₂, PV, or wind energy development, preventing proposals in Very High-risk areas.

Regional Planning:

- Avoid renewable energy or GH₂ development in areas of Very High bat sensitivity, using the sensitivity analysis and impact-risk assessment to guide proposals.
- Initiate research to map migratory routes of cave-dwelling bats within and near the Namakwa Region.

Future EIA Studies:

- Preconstruction bat studies for wind energy facilities should cover a minimum of 12 months, including at least 75% of the rainy season, to account for seasonal and climatic variability.
- Bat EIA studies should account for potential fruit bat activity, considering proximity to natural or agricultural food sources, and monitor non-echolocating species.
- Studies must consider the Near Threatened *Cistugo seabrae* (Angolan Hairy Bat), addressing knowledge gaps in its behaviour, habitat use, and turbine collision risk.
- It is critical for Roost Investigation zones around bat roosts to receive further field investigations during the EIA phase of a renewable energy project to verify species presence, colony size, and roost significance.

- If a proposed renewable energy project is located within a Roost Caution zone, the identified roost must be explicitly considered during the EIA process. The study design and data analysis should make appropriate provision for roost location, species, and potential impacts to determine if species present in the applicable roost may be impacted by the proposed project.

Enhancing Positive and Reducing Negative Impacts:

- Preserve non-transformed habitats to maintain the floral and faunal biodiversity that supports bat populations.
- Ensure that Very High sensitivity areas are avoided for any renewable energy or GH₂ development proposals, integrating regional-level risk assessments for planning and site selection.
- Initiate research programs and projects to contribute data and knowledge required for the long-term positive benefit of bat conservation in the Namakwa region.

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Abbreviations

Abbreviation	Explanation
ACR	African Chiroptera Report
CSIR	Council for Scientific and Industrial Research
DFFE	Department of Forestry, Fisheries and Environment
EIA	Environmental Impact Assessment
PLP	Polarized light pollution
PV	Photovoltaic
REDZ	Renewable Energy Development Zone
SABAA	South African Bat Assessment Association
SABAAP	South African Bat Assessment Association Panel
SEA	Strategic Environmental Assessment
SEZ	Special Economic Zone
WEF	Wind Energy Facility

1. INTRODUCTION

Animalia Consultants (Pty) Ltd (hereafter 'Animalia') has been appointed by Council for Scientific and Industrial Research (hereafter 'CSIR'), to undertake a Bat Specialist Assessment for the Strategic Environmental Assessment (SEA) of the Proposed Green Hydrogen economy and associated renewable energy (wind energy and solar voltaic) within the Namakwa Region, South Africa.

This report will highlight the key bat-related sustainability considerations associated with the development of a Northern Cape Green Hydrogen economy. The assessment will focus on parts of the Namakwa District, including the Richtersveld, Nama Khoi, Kamiesberg, and Khaî Ma Local Municipalities, collectively covering approximately 5.8 million hectares.

1.1 Terms of reference

The objectives and terms of reference for the strategic environmental assessment are the following from a bat impact perspective:

- Describe the existing baseline characteristics of the regional area, including existing impacts in the region;
- Classify spatial regions according to their sensitivity to bats, identifying which regions are more or less suitable for future development;
- Identify strategic-level constraints, opportunities, impacts, and strategic management actions to protect bats;
- Provide a bat sensitivity map indicating areas of avoidance and mitigation zones for the proposed region.
- Recommend mitigation measures to avoid and/or minimise impacts and/or optimise benefits associated with the expansive regional renewable energy (wind and solar PV) generation and transmission infrastructure; and
- Provide an integrated decision-making framework to guide project developers, practitioners, and policymakers to minimise the impacts on bats.

1.2 The bats of South Africa

Bats form part of the order Chiroptera and are the second largest group of mammals after rodents. They are the only mammals to have developed true powered flight and have undergone various skeletal changes to accommodate this. The forelimbs are elongated, whereas the hind limbs are compact and light, thereby reducing the total body weight. This unique wing profile allows for the manipulation of wing camber and shape, exploiting functions such as agility and manoeuvrability. This adaption surpasses the static design of bird wings in function and enables bats to utilise a wide variety of food sources, including, but not limited to, a large diversity of insects (Neuweiler 2000). Species-based facial features may differ considerably as a result of differing lifestyles, particularly in relation to various feeding and echolocation navigation strategies.

Most South African bats are insectivorous and can consume large quantities of insects each night (Taylor 2000; Tuttle & Hensley 2001). Some species also feed on amphibians, fruit, nectar and other invertebrates (Rautenbach 1982; Taylor 2000). Collectively, bats deliver critical ecosystem services, notably insect pest regulation, pollination and seed dispersal, that underpin ecosystem stability as well as agricultural productivity and human well-being (Tuneu-Corral *et al.* 2023). Fruit bat-mediated pollination is increasingly threatened by climate change (Ratto *et al.* 2018; Zamora-Gutierrez *et al.* 2021), while seed dispersal by fruit bats is important for forest regeneration and has substantial economic value (van Toor *et al.* 2019). Large, abundant populations of insectivorous and fruit bats are particularly important for

maintaining these services (Winfree *et al.* 2015), and migratory species can further suppress local insect pest outbreaks that resident predators cannot control (McCracken *et al.* 2012). Bats are, however, highly sensitive to human pressures — including habitat loss, pesticides, agricultural intensification, invasive predators (e.g. free-ranging cats), hunting, collisions with vehicles and wind turbines, and climate change (Frick *et al.* 2020).

Bats are regarded as keystone species within cave ecosystems (Tanalgo *et al.* 2022). Their presence supports a wide range of highly specialised and often endemic cave-dwelling organisms, many of which depend on bat guano as their primary nutrient source (Ferreira 2019; Furey and Racey 2016). Globally, it is estimated that at least half of all bat species make use of caves for roosting, either seasonally or throughout their life cycle (Furey and Racey 2016). As such, bats play a central role in maintaining the ecological functioning of cave systems and can serve as valuable ecological indicators and conservation surrogates, providing insight into ecosystem health and priorities for safeguarding (Ferreira 2019; Cunha *et al.* 2020).

Urban development and agricultural practices have contributed to the deterioration of bat populations on a global scale. Public participation and funding of bat conservation are often hindered by negative public perceptions and unawareness of the ecological importance of bats. Some species choose to roost in domestic residences, causing disturbance and thereby decreasing any esteem that bats may have established. Other species may occur in large communities in buildings, posing as a potential health hazard to residents in addition to their nuisance value. Unfortunately, the negative association with bats obscures their importance as an essential component of ecological systems and their value as natural pest control agents, which actually serves as an advantage to humans.

Many species of bats roost in large communities and congregate in small areas. Therefore, any major disturbances within and around the roosting areas may adversely impact individuals of different communities concurrently (Hester and Grenier 2005). Secondly, nativity rates of bats are much lower than those of most other small mammals. This is because, for the most part, only one or two pups are born per female per annum. Under natural circumstances, a population's numbers may accumulate over long periods of time. This is due to the longevity of up to 30 years (O'Shea *et al.* 2003) and the relatively low predation of bats when compared to other small mammals. However, bat populations are not able to adequately recover after mass mortalities and major roost disturbances.

1.3 Bats and wind turbines

Although most bats are highly capable of advanced navigation through the use of echolocation and excellent sight, they are still at risk of physical impact with the blades of wind turbines. The corpses of bats have been found in close proximity to wind turbines and, in a case-study conducted by Johnson *et al.* (2003), were found to be directly related to collisions. The incident of bat fatalities for migrating species has been found to be directly related to turbine height, increasing exponentially with altitude, as this disrupts the migratory flight paths (Howe *et al.* 2002, Barclay *et al.* 2007). Although the number of fatalities of migrating species increased with turbine height, this correlation was not found for increased rotor sweep (Howe *et al.* 2002, Barclay *et al.* 2007). In the USA it was hypothesized that migrating bats may navigate without the use of echolocation, rather using vision as their main sense for long distance orientation (Johnson *et al.* 2003, Barclay *et al.* 2007). Despite the high incidence of deaths caused by direct impact with the blades, most bat mortalities have been found to be caused by barotrauma (Baerwald *et al.* 2008). This is a condition where low air pressure found around the moving blades of wind turbines causes the lungs of a bat to collapse, resulting in fatal internal haemorrhaging (Kunz *et al.* 2007). Baerwald *et al.* (2008) found that 90% of bat fatalities around wind turbines involved internal haemorrhaging consistent with barotrauma.

Three factors need to be present for most South African bats to be prevalent in an area: availability of roosting space, food (insects/arthropods or fruit), and accessible open water sources. However, the dependency of a bat on each of these factors is subject to the species, its behaviour and ecology. Nevertheless, bat activity, abundance and diversity are likely to be higher in areas supporting all three above-mentioned factors. Although bats are predominately found roosting and foraging in areas near trees, rocky outcrops, human dwellings and water; in conditions where valleys are foggy, warmer air is drawn to hilltops through thermal inversion which may result in increased concentrations of insects and

consequently bats at hilltops, where wind turbines are often placed (Kunz *et al.* 2007). Some studies (Horn *et al.* 2008) suggest that bats may be attracted to the large turbine structure as roosting spaces or that swarms of insects may get trapped in low pressure air pockets around turbines, also encouraging the presence of bats. The presence of lights on wind turbines has also been identified as a possible cause for increased bat fatalities for non-cave roosting species. This is thought to be due to increased insect activity and subsequent increased foraging activity of bats (Johnson *et al.* 2003). Clearings around wind turbines, in previously forested areas, may also improve conditions for insects, thereby attracting bats to the area. The swishing sound of turbine blades has also been proposed as a possible source for disorientation in bats (Kunz *et al.* 2007). Electromagnetic fields generated by the turbine may additionally affect bats which are sensitive to magnetic fields (Kunz *et al.* 2007). It could also be hypothesized, from personal observations, that the echolocation capabilities of bats are designed to locate smaller insect prey or avoid stationary objects, and may not be primarily focused on the detection of unnatural objects moving sideways across the flight path.

A cautionary tale regarding the cumulative impacts that wind energy is able to exert on bat populations is provided through the case study of the hoary bat (*Lasiurus cinereus*). This bat is a common, migratory species across much of the Americas and is currently listed as Least Concern (Gonzalez *et al.* 2016). However, it is also the most frequently encountered victim of fatality around turbine stands in North America. Using population modelling, it has been calculated that hoary bats could decline by as much as 90% over the next 50 years, assuming static population growth rates, and allowing for the current expansion of the wind energy industry in the United States and Canada (Frick *et al.* 2017). There has been an urgent call to curb hoary bat deaths on account of wind farms before the risk of extinction escalates.

South African operational monitoring studies currently point to South African bats being just as vulnerable to mortality from turbines as international studies have previously indicated. The main species of concern are *Laephotis capensis* (Cape serotine bat), *Tadarida aegyptiaca* (Egyptian free-tailed bat) and *Miniopterus natalensis* (Natal long-fingered bat), in this region and in general. It is important from both a conservation and an ecological standpoint to maintain the abundance of even our common species, especially given the scale of wind energy prospecting occurring in South Africa at present.

Whatever the reason for bat fatalities in relation to wind turbines, it is clearly a significant ecological problem which requires attention. Most bat species only reproduce once per year, bearing one young per female, thus their numbers are slow to recover from mass mortalities. It is very difficult to assess the true number of bat deaths in relation to wind turbines, due to carcasses being removed from sites through predation, the rate of which differs from site to site as a result of habitat type, species of predator and their numbers (Howe *et al.* 2002, Johnson *et al.* 2003). Various mitigation measures are being researched and experimented with globally. The implementation of curtailment processes, where the turbine cut-in speed is raised to a higher wind speed, has been proven to be the most effective mitigation measure currently. This relies on the principle that the prey of bats will not be found in areas of strong winds and more energy is required for the bats to fly under these conditions. The impact on bats foraging in the area will be higher when uncurtailed turbine blades are left to turn slowly in low wind speeds; it is a misperception that faster turning blades present a higher mortality risk.

1.4 Bats and solar energy

Currently there is no evidence of photovoltaic (PV) facilities posing a direct threat of fatality impact on bats during operation. However, roosting and foraging habitats may be significantly impacted during the construction phase. This is primarily due the fact that PV facilities require large areas of land to be cleared, and in some cases, earthworks are required for levelling purposes. This can result in habitat that is suitable for micro roosts, such as rocky outcrops, clumps of trees and certain vegetation being destroyed, which can also be fatal to bats residing in such roosts. Natural vegetation can support higher insect food quantities and diversity than cleared land, therefore foraging habitat can also be displaced by PV facilities.

The presence of security lights on and around PV facilities can create significant light pollution that will impact bat feeding habits and species compositions negatively, by discouraging photophobic (light averse) species and encouraging species that readily forage around lights attracting insects.

Evidence exists of bats using polarised light at dusk to calibrate their internal magnetic compasses (Grief *et al.* 2014), and some PV solar panels are strong reflectors of horizontally polarised light (Polarised Light Pollution or PLP) which can possibly interfere with this method of navigation, additionally horizontal polarised light can mimic light reflected from water bodies (Szaz *et al.* 2016). Although, the degree of impact on bats needs to be determined for bats foraging near and around their roost, since the study referenced experimented on the homing capabilities of bats released away from their roost.

2. PROJECT DESCRIPTION

2.1 Renewable energy and transmission lines

Some power generation infrastructure (wind and solar PV) will be located in reasonably close proximity to the SEZ, however, due to the sensitivity of the local receiving environment and potential impacts of the coastal environment on the generation facility (e.g. corrosion), in most cases, power will be generated from dispersed renewable energy projects (each requiring their own EIA processes), in some cases, several hundred kilometers away. Electricity will then be delivered to the GH₂ production plant using a combination of new and existing transmission and distribution infrastructure (**Table 2-1**). In such cases the development and permitting of the generation components will be undertaken by 3rd parties, and the developer may not have control of the whole project. The project owner will purchase power from 3rd parties (or purchase the projects outright and own and operate them) and negotiate with the utility to wheel the power using the existing or new build grids. The project components are likely to be permitted separately, with the hydrogen developer permitting the electrolyser, ammonia plant, desalination plant and, in some cases, the export port facilities, and the generation (wind and solar PV) and transmission being permitted by several other 3rd party entities such as Independent Power Producers (IPPs) and Eskom.

Table 2-1: Brief description of the main renewable energy aspects.

Renewable energy	Aspect	Description
Wind	Turbines	Rotor with blades, nacelle, tower; sizes 4-8 MW, hub height 150-180 m, blade length ~100 m.
	Other	Foundations (~32 m ²), access roads, Battery Energy Storage System (BESS), on-site electrical system, substation, transmission lines, construction camp, operations & maintenance facilities, meteorological towers.
Solar	Solar panels	Monocrystalline/polycrystalline silicon cells; height ~6 m. Fixed or dual-axis tracking. Single or bifacial modules.
	Other	Inverters, mounting structures, BESS, foundations, access roads, electrical system, substations, transmission lines, electrical components, construction camp, operations & maintenance facilities.

2.2 The three GH₂ scenarios proposed

Two GH₂ development scenarios will be assessed, each compared to an existing dynamic baseline (**Figure 2-1**), where no GH₂ development occurs but other anthropogenic and climate changes continue, described as follows:

- **SCENARIO 0 – DYNAMIC BASELINE (2023 – 2050):** Boegoebaai Port and SEZ remains undeveloped. No GH₂ is produced in the Northern Cape. The region proceeds on current ecological, climatic (e.g.

desertification, storm surges) and developmental trends, including all other non-GH₂ activities (e.g. independent renewable energy development). The Springbok Renewable Energy Development Zone (REDZ) is located within the Namakwa study region (**Figure 2-2**). REDZs are areas designated by the government to fast-track renewable energy development. Consequently, renewable energy projects are likely to proceed within the Springbok REDZ even under Scenario 0 (Sc0).

- **SCENARIO 1 – “SMALL GH₂” (by 2030):** 5 GW electrolyser producing 0.5 mtpa GH₂ and derivatives supported by 10 GW of renewable energy (assume 60% solar / 40% wind)
- **SCENARIO 2 – “BIG GH₂” (by 2050):** Upscaled GH₂ development to a 40 GW electrolyser producing a total of 4 mtpa GH₂ and derivatives supported by 80 GW of renewable energy (assume 60% solar / 40% wind)

Each of the GH₂ development scenarios will be associated with different development footprints and scales of infrastructure (**Table 2-2**).

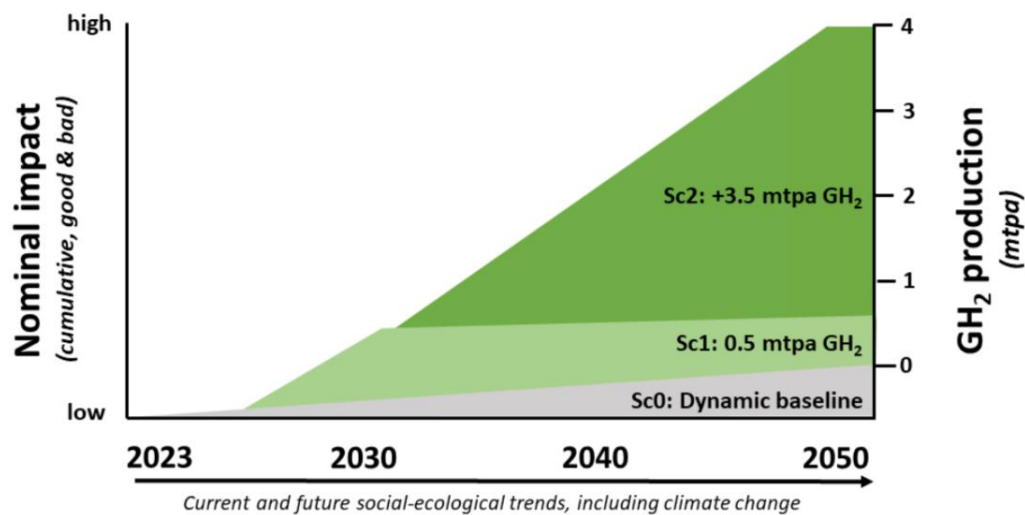


Figure 2-1: Indicative diagram of the scenarios approach for assessing cumulative impacts

Table 2-2: GH₂ development scenario quantifications (Sc1 and Sc2) for the regional assessment.

Aspect		Unit	Sc1: Small GH ₂	Sc2: Big GH ₂	Assumptions
SEZ	Electrolyser capacity	GW	5	40	Northern Cape Green Hydrogen Master Plan ambition
	Electrolyser footprint	ha	75	600	15 ha per 1 GW
	GH ₂ volume	mtpa	0,5	4,0	10 GW electrolyser = 1 mtpa GH ₂
	GH ₂ storage footprint	ha	250	2 000	10 ha per 20 000 tpa (500 ha for 1 mtpa)
	Ammonia volume	mtpa	2,8	22,7	1 mt H ₂ for 5,67 mt NH ₃ (1Mt of ammonia contains 176.5 kg (just 17.65%))
	Ammonia footprint	ha	57	454	1 ha per 50 000 tpa NH ₃ (e.g. Enertrag Hendrina) (20 ha for 1 mtpa)
	Ammonia storage footprint	ha	28	227	0,5 ha per 50 000 tpa NH ₃ (e.g. Enertrag Hendrina) (10 ha for 1 mtpa)
	Desalination output volume	ML/day	36	286	25 kg water per 1 kg GH ₂ (considering electrolysis and cooling). 1Mtpa GH ₂ output required 25 Mtpa (=25000 MLpa) water / 350 operational.
	Desalination footprint	ha	7	57	5 ML/day output needs 1 ha
	Desalination discharge	ML/day	48	387	Ratio of desalinated water to brine discharge water to be 42.5:57.5. (i.e 42.5% of intake sea water is converted to desalinated water and 57.5% is discharged as brine).
	Pipeline intake volume	ML/day	84	672	Output + discharge
REGION	RE capacity total	GW	10	80	1 Mt/yr of H ₂ needs 10 GW electrolyser, that is powered by 20 GW
	RE capacity - solar	GW	6	48	60 % solar : 40 % wind
	RE footprint - solar	ha	12 000	96 000	0,5MW/ha
	RE extent - solar		12 000	96 000	Footprint = extent
	RE facilities - solar	no of facilities	6	48	Clusters of 1 GW facilities
	RE capacity - wind	GW	4	32	60 % solar : 40 % wind
	RE footprint - wind	ha	4 000	32 000	1 MW/ha
	RE extent - wind	ha	40 000	320 000	0,1 MW/ha
	RE facilities - wind	no of facilities	3	21	Clusters of 1,5 GW facilities
	Road length	km	300	600	New roads and upgrades same distances / routes as pipelines
	Road footprint	ha	1 200	2 400	40 m (Rural class 2 road 40-70 m. TRH26 Road Classification and Access Management)
	Rail length	km	550	550	Boegoebaai – Kenhardt. New rail direction south-east to connect to the existing Saldanha-Sishen route.
	Rail footprint	ha	1 600	1 650	30 m for rail and service track
	Pipeline length	km	300	600	Sc1: NAM<BB>SB (300km); Sc2: BB>Prieska (300km)
	Pipeline footprint	ha	600	1 200	20 m servitude
	Powerline length	km	260	1 387	Assume grid strengthening / shared infrastructure 30 km TX associated with each RE cluster.
	Powerline footprint	ha	1 300	6 933	50 m servitude (TRH 27 South African Manual for Permitting Services in Road Reserves)
Main infrastructure components footprint		ha	21 082	142 240	

Units: GW = gigawatt; mtpa = million tonne per annum; ha = hectare; ML/day = million litres per day; km = kilometre

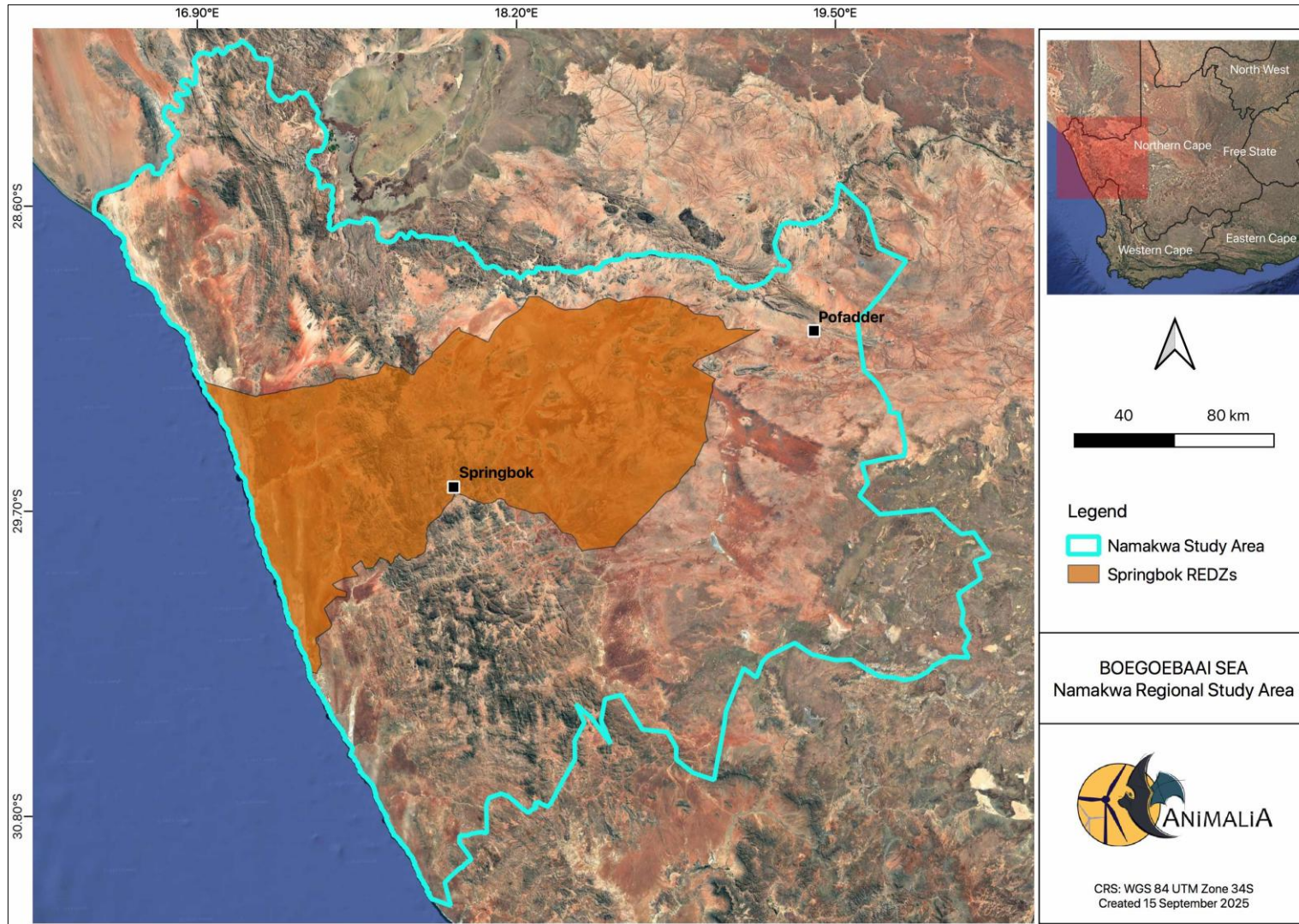


Figure 2-2: The proposed Namakwa region project study area

3. ASSESSMENT METHODOLOGY

3.1 Specialist credentials

Details of the Specialist, Declaration of Interest and Curriculum Vitae of the team are provided in **Appendix 1 – 3**.

3.2 Desktop assessment and sensitivity mapping

A comprehensive desktop assessment was undertaken to evaluate bat sensitivity within the study region. This process considered multiple environmental and ecological factors, including the distribution of ecoregions, known bat roost locations, land-cover types, irrigated agricultural areas, protected areas, urban development, and the occurrence of species of conservation importance. Additional layers such as coastlines, rivers, wetlands, dams, and regional geology were incorporated to generate a spatially explicit bat sensitivity map.

The sensitivity mapping process involved assessing habitat features and landscape characteristics likely to support bat roosting, foraging, and movement. Key considerations included the presence of man-made structures, surface rock formations (potential roosting habitat), topography (which can influence surface rock occurrence), landcover and vegetation types (roosting and foraging habitat), climate (affecting insect abundance and fruit availability), and surface water resources (providing drinking water and attracting insects). These factors were evaluated through a review of geographic and ecological literature as well as analysis of satellite imagery.

3.3 Assumptions and limitations

As with any environmental study, there are certain assumptions and limitations that exist around the current knowledge we possess regarding bats and their behaviour, movements and distribution. Some important points are discussed briefly below:

- This assessment provides a strategic, high-level desktop evaluation to support the SEA. The protocols developed and recommendations provided may require targeted field verification in specific areas.
- Distribution maps of South African bat species still require further refinement, therefore, the list of bat species presented for this region should be regarded as indicative rather than exhaustive. Where a species is known to occur near the region, its presence has been assumed for this assessment.
- The migratory paths of South African bats are largely unknown, thus limiting the ability to determine if renewable energy development in this region will have a large-scale effect on migratory species.
- Available bat roost data is limited to records voluntarily contributed by bat specialists and information published in the literature. In some cases, the coordinates provided in published sources are dated and may no longer reflect current conditions.
- There is a lack of region-specific research on the impacts of solar PV developments on bats in South Africa, limiting the ability to make fully evidence-based predictions.
- The sensitivity map is based partially on satellite imagery and information from several databases. However, given the large extent of the region, there is always the possibility that what has been mapped may differ slightly to what is on the ground.

4. BASELINE DESCRIPTION OF THE RECEIVING ENVIRONMENT

The following chapter presents the baseline description of the receiving environment within the Namakwa study region, reflecting current conditions in the absence of renewable energy facilities associated with this project (Scenario 0).

4.1 Biomes, ecoregions and land use

South Africa is characterized by a rich diversity of ecological regions, which can be described at different scales using biomes and ecoregions. Biomes are broad ecological units defined by general climate, vegetation types, and associated fauna, with South Africa comprising nine major biomes, including Fynbos, Grassland, and Savanna. Ecoregions, such as those defined by Dinerstein *et al.* (2017), are finer-scale areas within or across biomes that share distinctive ecological characteristics, including specific species composition, vegetation structure, and ecological processes. While biomes provide a general overview of ecological patterns, ecoregions offer more spatially explicit information useful for conservation planning and environmental assessments.

The study region contains five of South Africa's nine biomes, predominantly Nama Karoo and Succulent Karoo, as well as Desert, and scattered extents of the Fynbos and Azonal biomes. In 2014, Seamark conducted a study whereby estimates of species richness were calculated based on the assemblages of bats within each biome (Figure 4-1). Bat species richness varies markedly across South African biomes (Seamark 2014). The Azonal biome supports the highest diversity within this region, with 45 species recorded, representing 73% of the country's total bat fauna. In contrast, the desert biome hosts the lowest diversity, with only five species (8% of the national total). Intermediate levels of diversity are found in other biomes: 17 species (27%) in Fynbos, 12 species (19%) in Nama-Karoo, and 13 species (21%) in the Succulent Karoo. This gradient reflects differences in habitat complexity, resource availability, and ecological conditions across the biomes.

Ecoregions often share the majority of their species and ecological processes, experience similar environmental conditions, and interact in ways that are essential for their long-term persistence. Consequently, conservation strategies are most effective when designed at the ecoregional scale (Anderson 2003; Ricketts and Imhoff 2003). The study region encompasses four ecoregions: the Namaqualand-Richtersveld Steppe, Gariep Karoo, Succulent Karoo and Xeric Shrublands, and Renosterveld Shrubland (Figure 4-2).

4.1.1 Namaqualand-Richtersveld Steppe

The Namaqualand-Richtersveld Steppe extends along the western coast of Namibia into South Africa, encompassing fog-affected coastal plains and the adjacent escarpment. The region is underlain by ancient granites and gneisses of the Namaqualand Metamorphic Province, with rugged mountains, rocky outcrops, and gently undulating plains creating a highly heterogeneous landscape. Rainfall is mostly in winter, ranging from 20 mm in the arid northwest to over 400 mm in the escarpment, supplemented by fog and dew. The flora is dominated by succulents, geophytes, and dwarf shrubs, with extremely high levels of plant endemism. Much of the ecoregion remains natural or semi-natural, though overgrazing, agriculture, and mining have caused localized habitat degradation.

4.1.2 Gariep Karoo

The Gariep Karoo ecoregion is an extensive, arid landscape of low, succulent dwarf shrubs and tall stem succulents, interspersed with perennial grasses and riparian thickets along the Orange River. Vast areas in this ecoregion within the study area are comprised of arid, flat, barren areas. However, in the north and north-west of the study area the terrain is rugged, with mountains creating local variations in rainfall and temperature, and the geology is dominated by arid-adapted soils overlying sedimentary and metamorphic rocks. Vegetation structure is highly heterogeneous, with shrubs, grasses, and isolated trees providing shelter and foraging sites for wildlife. Heavy grazing, invasive plants, and mining have altered plant composition in parts of the ecoregion, but remaining natural and semi-natural areas continue to support diverse ecological processes.

4.1.3 Succulent Karoo and Xeric Shrublands

The Succulent Karoo ecoregion is an arid, semi-desert landscape with reliable winter and spring rainfall (150–300 mm) and extreme summer temperatures often exceeding 40°C. Vegetation is dominated by highly diverse dwarf succulents and geophytes, with poor tree richness. Trees derived from distant savannas can be found in close proximity to perennial river corridors. The region's soils and topography support these specialized plants, resulting in high levels of endemism, particularly in centers such as the Van Rhynsdorp and Little Karoo. Despite overgrazing and agricultural pressures in some areas, much of the ecoregion remains intact, providing structurally complex habitats.

4.1.4 Renosterveld Shrubland

The Renosterveld Shrubland, part of the Cape Floristic Region, is a species-rich, Mediterranean-climate ecoregion in southwestern South Africa, with annual rainfall of 250–650 mm and mild summer temperatures rarely exceeding 30°C. Vegetation is dominated by low shrubs, especially ericoids such as renosterbos (*Elytropappus rhinocerotis*), with a rich ground layer of grasses and geophytes, including many highly endemic species. Soils are fertile, fine-textured, and derived from shale and sandstone, which historically supported dense vegetation but have been heavily transformed by agriculture in lowland areas.

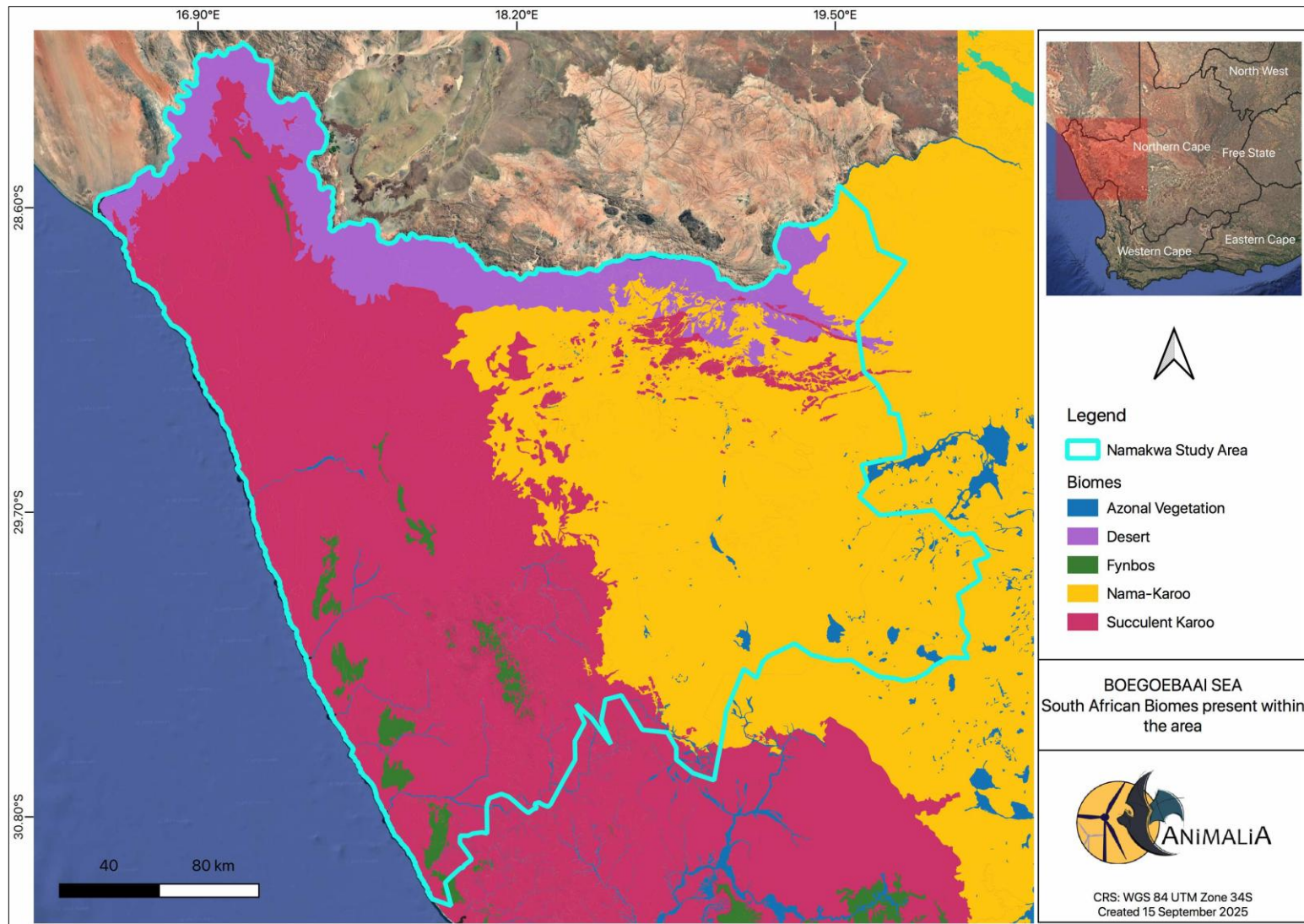


Figure 4-1: Biomes on and surrounding the proposed study area (Mucina and Rutherford 2018).

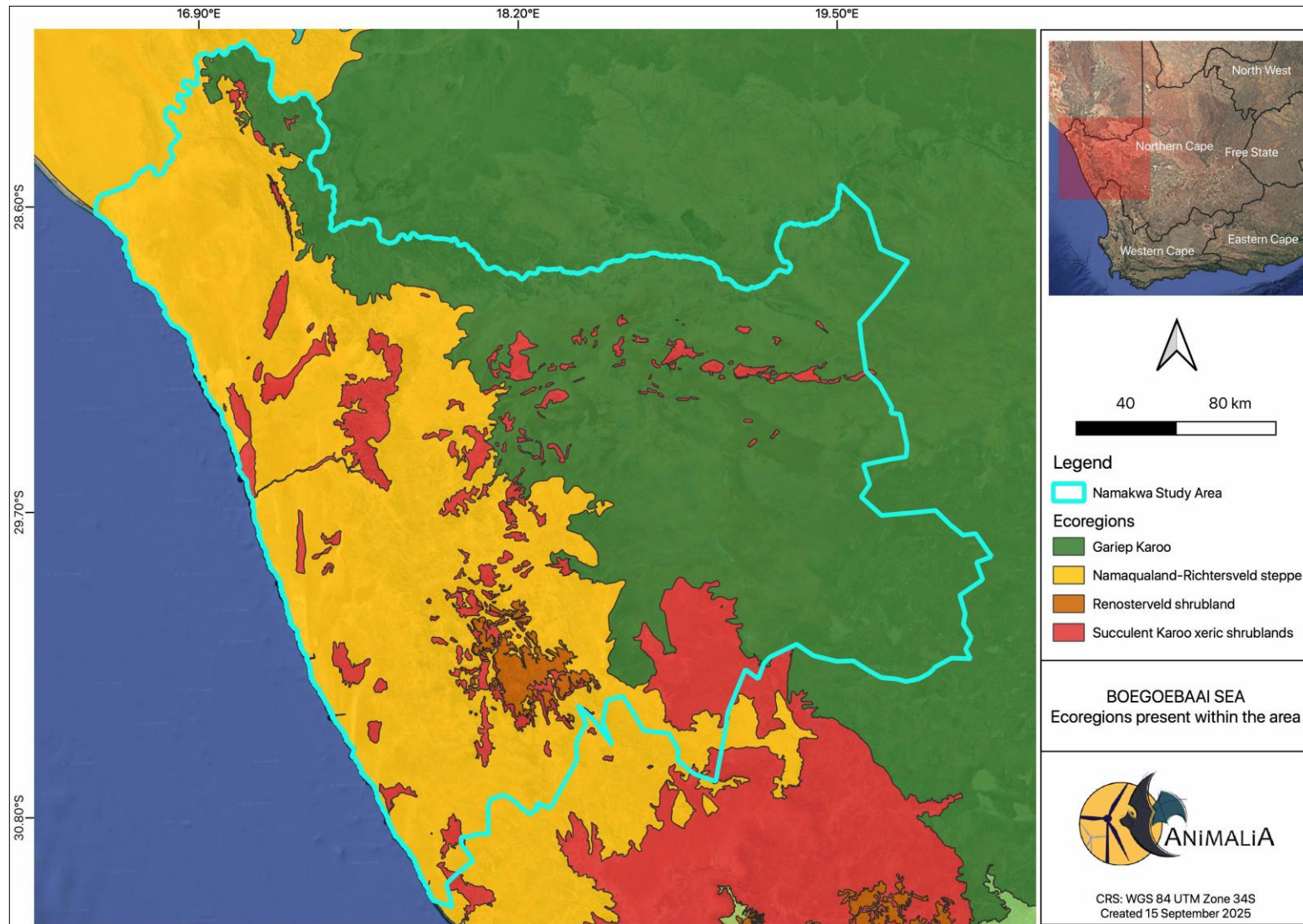


Figure 4-2: Ecoregions on and surrounding the proposed study area (Dinerstein *et al.* 2017).

Table 4-1: Potential of the ecoregions to serve as suitable roosting and foraging spaces for bats, specifically to the terrain and habitat in the study region.

Vegetation Unit	Foraging Potential	Comments	Roosting Potential	Comments
Namaqualand-Richtersveld Steppe	Medium - High (spaces between hills and koppies, built up areas and waterbodies) Low - Medium (other areas)	The hills and koppies can offer shelter from wind for bats and insect prey. Often farmsteads and buildings have water available, and insects are attracted to such areas because of domestic activities.	Medium - High (rocky areas, limestone geology, mining areas and built-up areas) Low - Medium (other areas)	Roosting space is available in the form rocky outcrops and crevices, mines, fissures in rocks and hollows. Man-made structures in built up areas such as houses and buildings can offer an abundance of roosting habitat for certain species in the area.
Gariiep Karoo	Medium (grassland areas, around waterbodies and buildings) Low (other areas)	Grassland habitats are associated with a wide insect diversity and can offer an abundance of insect prey. Foraging potential is higher in areas with water as insect diversity is generally higher in these areas. Often farmsteads and buildings have water available, and insects are attracted to such areas because of domestic activities.	High (Buildings) Low (other areas)	Man-made structures in built up areas such as houses and buildings can offer an abundance of roosting habitat for certain species in the area.
Succulent Karoo and Xeric Shrublands	Medium - High (spaces between hills and koppies, built up areas and waterbodies) Medium (other areas)	The hills and koppies can offer shelter from wind for bats and insect prey. Often farmsteads and buildings have water available, and insects are attracted to such areas because of domestic activities.	Medium - High (rocky areas and built-up areas) Low - Medium (other areas)	Roosting space is available in the form rocky outcrops and crevices as well as mines. Man-made structures in built up areas such as houses and buildings can offer an abundance of roosting habitat for certain species in the area.
Renosterveld Shrubland	Medium - High (spaces between hills and koppies) Medium (other areas)	The hills and koppies can offer shelter from wind for bats and insect prey. Often farmsteads and buildings have water available, and insects are attracted to such areas because of domestic activities.	Medium - High (rocky areas and built-up areas) Medium (other areas)	Roosting space is available in the form rocky outcrops and crevices. Man-made structures in built up areas such as houses and buildings can offer an abundance of roosting habitat for certain species in the area.

4.2 Land-use

The National Landcover Dataset provides a country-wide classification of land cover types for South Africa, categorised into nine classes: forest, shrubland, grassland, waterbodies, wetlands, barren land, cultivated land, built-up areas, and mines & quarries. Within the study area, shrubland dominates, interspersed with extensive areas of barren land. Mines and quarries are primarily located along the western edge of the study region, while grasslands are concentrated in the north-east and forested areas in the south-west (**Figure 4-3**). Small pockets of cultivated land occur in the south-west, and major waterbodies are largely restricted to the south-east of the study area.

The distribution of landcover types within the study area has direct implications for bat habitat and foraging opportunities. Shrubland and forested areas provide potential roosting and foraging habitats, while grasslands offer foraging grounds for open-air and clutter-edge foraging species. Barren land and mined areas are generally of low habitat value but may contain caves or crevices that serve as roost sites. Waterbodies, wetlands, and cultivated areas may act as important foraging sites due to higher insect availability. Bats in farmlands play a vital role as natural predators of crop pests (Taylor *et al.* 2011; Noer *et al.* 2012). More recently, they have also been shown to prey on commensal livestock insects (insects that live around livestock) and parasitic livestock insects (insects that feed on livestock; Downs and Sanderson 2010; Ancillotto *et al.* 2017). Livestock-dominated areas can support bat populations by maintaining semi-open habitats preferred by certain species (Duvergé and Jones 2003; López-González *et al.* 2015), increasing the availability of prey such as dung-associated insects (Duvergé and Jones 2003), and providing artificial water sources for drinking (Korine *et al.* 2015; Russo *et al.* 2016). The spatial arrangement and extent of these landcover types should therefore be considered when assessing potential impacts of renewable energy developments on bat populations.

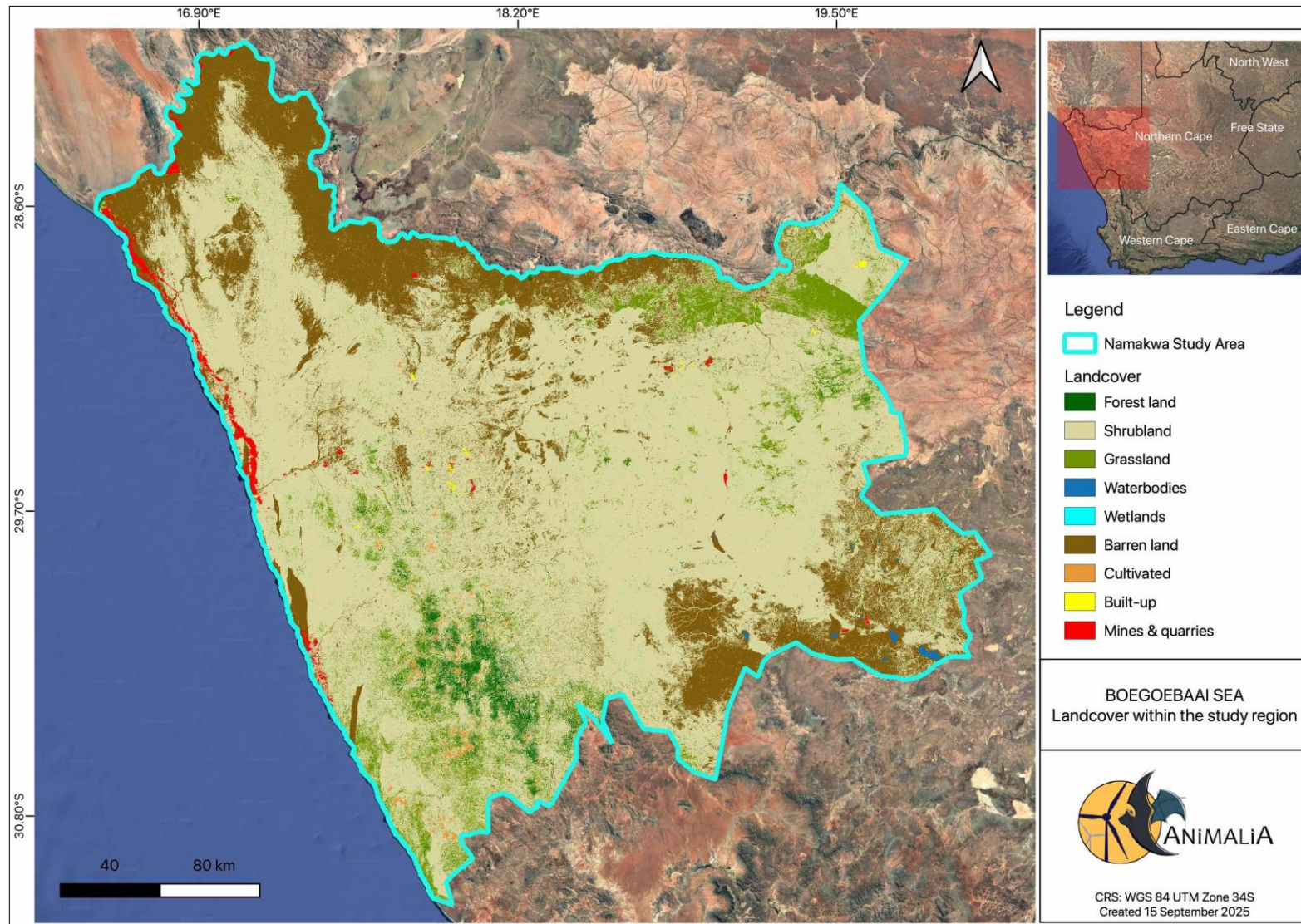


Figure 4-3: Land cover across the Namakwa study region.

4.3 Conserved and protected areas, known sensitivities and cave/roosts within the regional project area

The study region contains 19 protected areas but no formally conserved areas (SAPAD and SACAD, DFFE 2025 Q1; **Figure 4-4**). Richtersveld National Park, also designated as a Heritage Site, has two known roosts. Goegap Nature Reserve supports two known roosts and records of four bat species, while Namaqua National Park contains a single roost. Beyond these examples, most bat records and roosts fall outside protected areas, indicating that these protected sites are generally not major hotspots for bat activity or roosting. However, the presence of intact natural vegetation within protected areas may enhance bat diversity and activity levels.

The Strategic Environmental Assessment (SEA; Department of Environment Forestry and Fisheries 2019) assigns a minimum buffer of 500 m to all known bat roosts for wind and solar PV energy. Maximum buffers vary depending on the size of roost and the type of bats. Maximum buffers are assigned in accordance with the buffers designated in the South African Best Practice Guidelines for Pre-construction Monitoring of Bats at Wind Energy Facilities (MacEwan *et al.* 2020). Therefore, any possible cave/roost locations may be assigned a No-Go buffer for renewable energy of up to 20 km if they are found to be supporting large enough bat colonies.

To manage potential impacts of proposed renewable energy developments on bats, three types of zones have been applied around known and potential roosts: No-Go (Very High sensitivity) zones, Roost Investigation zones, and Caution zones. These buffers are based on colony size and foraging guild, as summarised in **Table 4-2**.

No-Go (Very High sensitivity) zones: Turbines cannot be sited within these distances of roosts. For roosts with more than 2,000 individuals, No-Go zones are 20 km. For roosts with fewer than 2,000 individuals, and for roosts of unknown size, a standard precautionary distance of 500 m is applied or buffer distances described in **Table 4-2** are adhered to.

Roost Investigation zones: Within these zones, it is critical to conduct further field investigations during the EIA phase of a renewable energy project to verify species presence, colony size, and roost significance.

Caution zones: During the EIA process, any identified roosts must be explicitly considered. The study design and data analysis should make appropriate provision for roost location, species, and potential impacts to determine if species present in the applicable roost may be impacted by the proposed project.

These buffers and investigation zones provide a precautionary approach to minimise potential impacts on bats while ensuring that proposed renewable energy developments are informed by accurate field data.

Table 4-2: Bat roost buffer distances and investigation zones by colony size and foraging guild.

Colony size	Foraging guild	No-Go (Very High sensitivity) zone	Roost investigation zone	Caution Zone
> 2000 individuals	Open-air	20 km	30 km	50 km
	Clutter-edge	20 km	30 km	50 km
	Clutter	20 km	30 km	50 km

	Unknown	20 km	30 km	50 km
500 - 1999 individuals	Open-air	10 km	20 km	50 km
	Clutter-edge	10 km	20 km	50 km
	Clutter	2.5 km	10 km	50 km
	Unknown	2.5 km	20 km	50 km
< 500 individuals	Open-air	500 m	5 km	10km
	Clutter-edge	500 m	5 km	10km
	Clutter	500 m	1 km	N/A
	Unknown	500 m	5 km	10km
Unknown	Open-air	500 m	20 km	50 km
	Clutter-edge	500 m	20 km	50 km
	Clutter	500 m	10 km	50 km
	Unknown	500 m	20 km	50 km

Known bat roosts in the study area were assessed. A larger radius of 50 km was considered in this study to account for migration paths from roosts to foraging areas. Thirteen known bat roosts have been identified, based on collected specimens and observations (Bats KZN and SABAA databases; ACR 2020, **Figure 4-5** and

Table 4-3).

Within the study region, areas of limestone geology are present (**Figure 4-5**). These formations are highly susceptible to the development of extensive cave systems. As caves provide ideal roosting habitat for bats, it is possible that undiscovered roosts may occur within these areas.

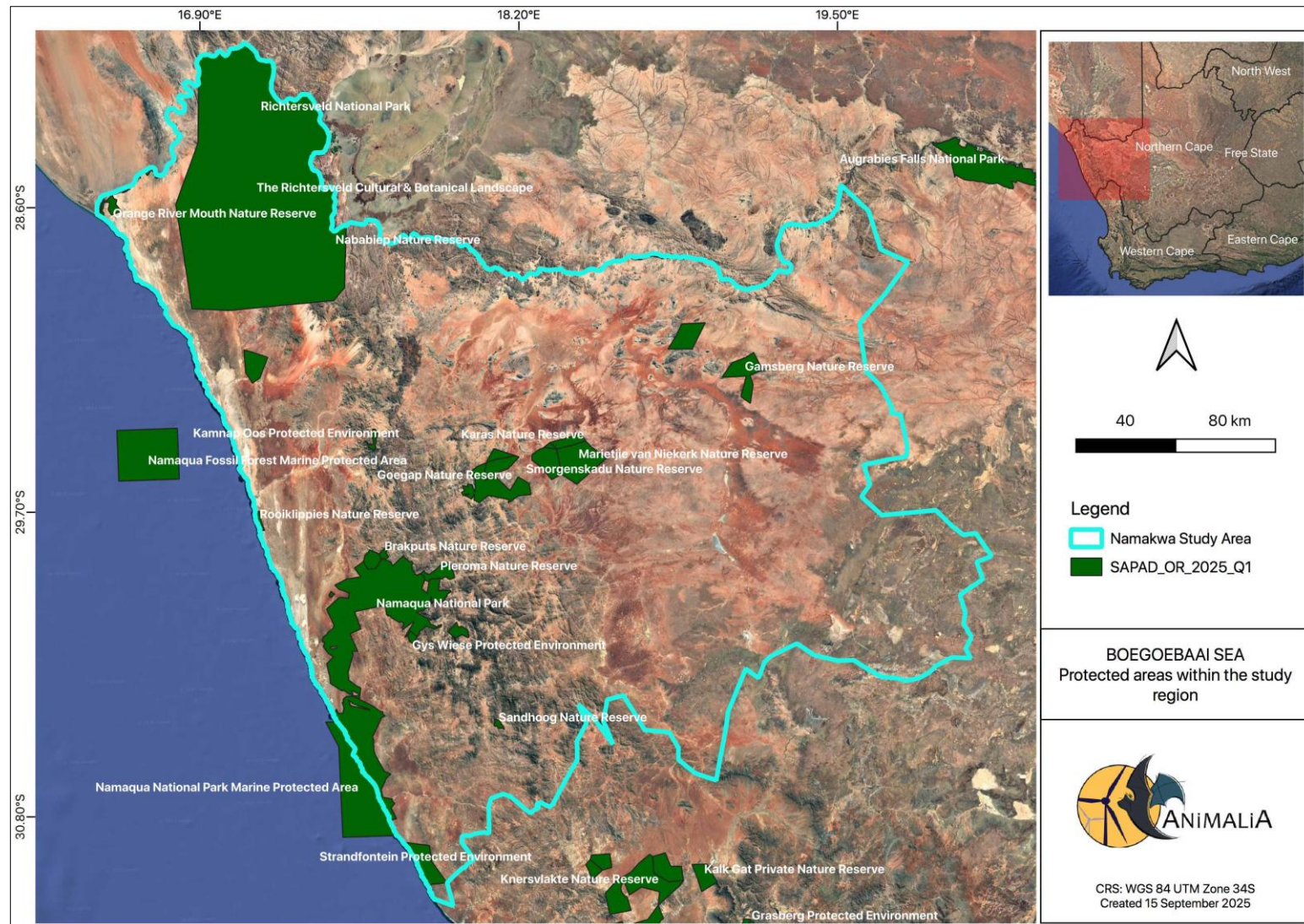


Figure 4-4: Protected areas within the Namakwa study region (DFFE, Q1 2025).

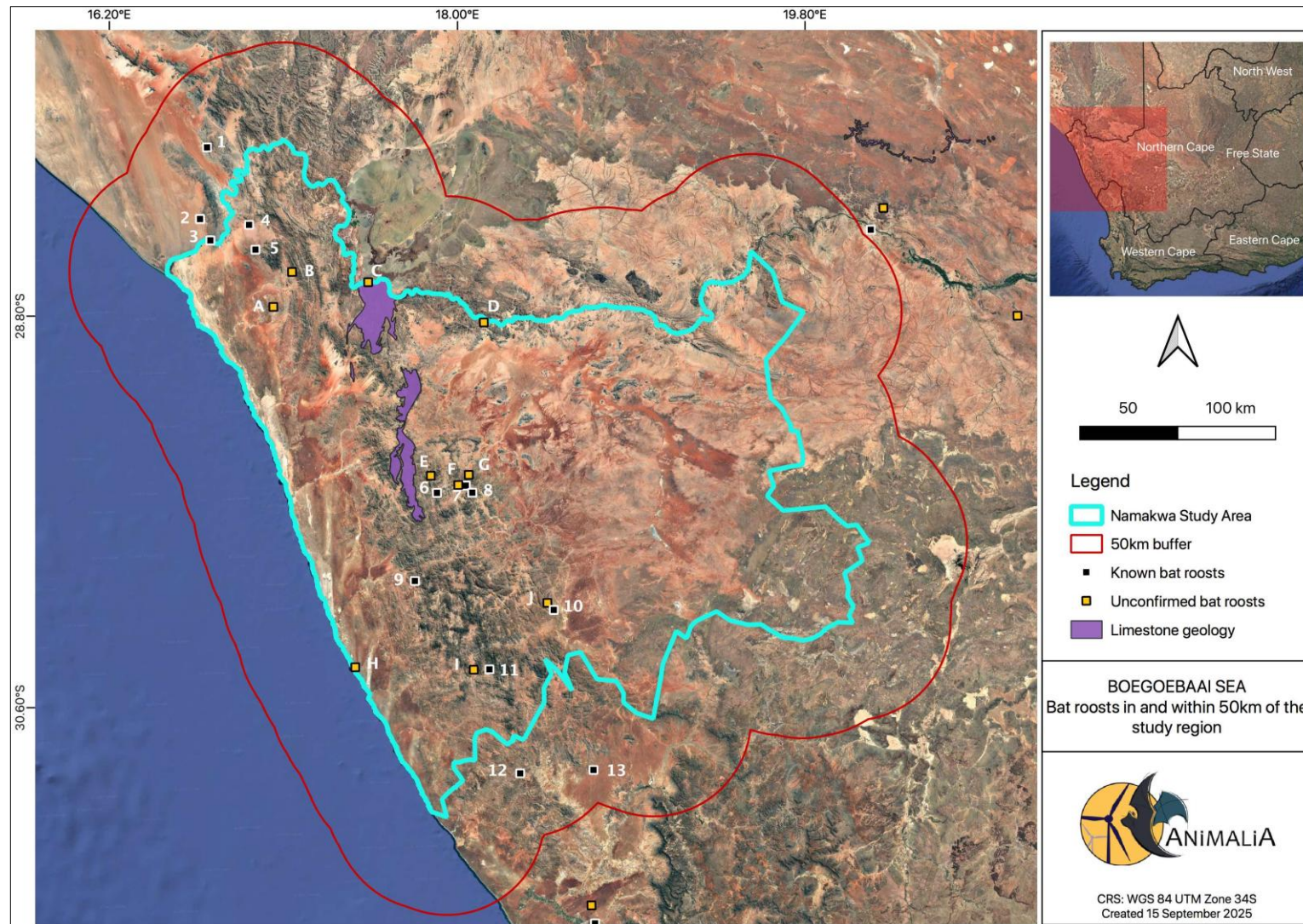


Figure 4-5: Bat roosts and areas of limestone in the study region and within 50 km of the proposed study region (Bats KZN and SABAA).

Table 4-3: Bat roosts in and within a 50km of the proposed Namakwa study region.

Map ID	Roost Name	Additional information	No-Go (Very High sensitivity), Roost Investigation zones, Caution zones
1	Brandkaros	<i>Hipposideros caffer</i> and <i>Nycteris thebaica</i> ; colony size unknown	500 m No-Go zone 10 km roost investigation zone 50 km caution zone
2	Wondergat	<i>Nycteris thebaica</i> and <i>Rhinolophus capensis</i> ; colony size unknown	500 m No-Go zone 10 km roost investigation zone 50 km caution zone
3	Brandkaros II	None	500 m No-Go zone 20 km roost investigation zone 50 km caution zone
4	Wondergat Cave	Large size roost (500-1999), species unknown	2.5km No-Go zone 20 km roost investigation zone 50 km caution zone
5	Doringpoort river	<i>Nycteris thebaica</i> ; colony size unknown	500 m No-Go zone 10 km roost investigation zone 50 km caution zone
6	Welbedacht Mine	<i>Nycteris thebaica</i> , <i>Miniopterus natalensis</i> ; > 2000 individuals	20 km No-Go zone 30 km roost investigation zone 50 km caution zone
7	Hester	<i>Nycteris thebaica</i> ; colony size unknown	500 m No-Go zone 10 km roost investigation zone 50 km caution zone
8	Goegab	<i>Miniopterus natalensis</i> , <i>Tadarida aegyptiaca</i> ; colony size unknown	500 m No-Go zone 20 km roost investigation zone 50 km caution zone
9	Aronegas	None	500 m No-Go zone 20 km roost investigation zone 50 km caution zone
10	Orrelgat	None	500 m No-Go zone 20 km roost investigation zone 50 km caution zone
11	Roodebergskloof	None	500 m No-Go zone 20 km roost investigation zone 50 km caution zone
12	Kersbos	None	500 m No-Go zone 20 km roost investigation zone 50 km caution zone
13	Steenkampskraal Mine	<i>Miniopterus natalensis</i> , <i>Rhinolophus capensis</i> and <i>Rhinolophus clivosus</i> ; colony size unknown	500 m No-Go zone 20 km roost investigation zone 50 km caution zone
A	Unconfirmed bat roost a	None	500 m No-Go zone 10 km roost investigation zone
B	Unconfirmed bat roost b	None	500 m No-Go zone 10 km roost investigation zone
C	Unconfirmed bat roost c	None	500 m No-Go zone 10 km roost investigation zone
D	Unconfirmed bat roost d	None	500 m No-Go zone 10 km roost investigation zone

Map ID	Roost Name	Additional information	No-Go (Very High sensitivity), Roost Investigation zones, Caution zones
E	Unconfirmed bat roost e	None	500 m No-Go zone 10 km roost investigation zone
F	Unconfirmed bat roost f	None	500 m No-Go zone 10 km roost investigation zone
G	Unconfirmed bat roost g	None	500 m No-Go zone 10 km roost investigation zone
H	Unconfirmed bat roost h	None	500 m No-Go zone 10 km roost investigation zone
I	Unconfirmed bat roost i	None	500 m No-Go zone 10 km roost investigation zone
J	Unconfirmed bat roost j	None	500 m No-Go zone 10 km roost investigation zone

4.4 Currently confirmed, previously recorded as well as literature-based species probability of occurrence

“Occurrence in area” was determined based on species distribution information (Table 4-4). Species records from the ACR database (2020) were also consulted to confirm species presence within a 100 km radius of the site, providing further context for regional occurrence and likelihood of encounter. In addition, the presence of suitable roosting and foraging habitats was assessed relative to known habitat preferences described in the literature.

The column of “Likelihood of risk of fatality” describes the likelihood of risk of fatality from direct collision or barotrauma with wind turbine blades for each bat species. The risk was assigned by MacEwan *et al.* (2020) based on species distributions, altitudes at which they fly and distances they traverse; and assumes a 100% probability of occurrence.

4.5 Description of trends influencing the baseline receiving environment up to 2050 (Scenario 0 - Boegoebaai Port and SEZ remains undeveloped)

Availability of artificial bat roosting spaces may increase substantially:

Natural bat roosting spaces in the forms of crevices, hollows and caves are limited in the region, the increase of man-made structures and buildings will create artificial roosting space for several bat species. Even though the district’s population is expected to decline by 11% by 2050, with Kamiesberg facing a 42% decrease, the Richtersveld and Karoo Hoogland may see moderate population growth (CSIR, 2023) and new mining developments, particularly in Aggeneys and the Namakwa Special Economic Zone (SEZ) will result in an increase of artificial bat roosting space.

Availability of natural bat foraging habitat may decrease moderately:

Desertification, overgrazing and resulting wind erosion can result in natural bat foraging habitat to be declining. Projected changes in temperature, rainfall levels and patterns could shift vegetation and corresponding animal distributions. These factors can decrease insect activity and alter natural habitats, therefore decreasing the availability of natural bat foraging habitat.

Light pollution will increase substantially:

An increase in man-made structures will result in an increase of light pollution. Certain bat species can benefit from this since the lights attract insects and these species forage readily around lights. But photophobic bat species will be deterred by lighting, therefore altering the species composition of a population in an area.

Agricultural practices (croplands) may increase moderately:

Croplands can provide artificial foraging habitat for bats due to irrigation and sometimes increased insect activity, although insect diversity is lower in croplands. Since agriculture in the Namakwa District is shifting toward high-value crops such as table grapes and dates along the Orange River (CSIR, 2023), this may be a localised driver of change.

Agricultural practices (livestock) may decrease moderately, or remain unchanged as a netto effect of several factors:

Livestock farming attracts bats, since animal dung and activity attracts concentrations of insect prey. Water scarcity, harsh conditions and overgrazing may cause a decrease of livestock farming in the area. However, the increasing renewable energy industry in the region will provide more financial stability to farmers, allowing more sustained farming practices.

Agricultural pest control (chemical) may decrease substantially:

The drive to organic farming, increased revenue from pesticide restricted exports and global awareness will lower the use of chemical pesticides in the region. Pesticides are harmful to bats due to bioaccumulation of toxins from insect prey, which can be transferred to pups during suckling.

Renewable wind energy development will increase substantially:

Wind energy is expected to increase significantly in the region. This can have negative effects on bat populations if managed incorrectly. Ongoing research, mitigations and mortality prevention strategies are critical.

Accessible surface water may decrease substantially:

Bats need to drink from water sources with available open surface water. Climate change projections for the Namakwa District indicate drier, hotter conditions, heightening water demand. This trend is expected to significantly increase pressure on water resources, with rising temperatures and reduced rainfall exacerbating water scarcity (Bourne et al., 2015). And groundwater recharge is expected to decrease over most parts of the district (CSIR, 2023). Therefore, available open water sources are expected to decline.

Protected areas may increase moderately:

Protected areas preserve natural bat foraging habitat, insect prey diversity and therefore also diversity of bats in the region. The distinctive biodiversity of the Succulent Karoo biome has gained global attention, prompting substantial investments from the government, non-governmental organisations, and the private sector to expand conservation areas across the biome (Hoffman et al. 2015).

Table 4-4: Table of species that have been previously recorded within the study region and within 100 km of the study region. Roosting or foraging behaviour is also briefly described (Monadjem *et al.* 2020).

Species name Common name	Occurrence in region	Conservation status (Red List Regional Listing 2016)*	Possible roosting habitat on or near the region	Possible foraging habitat utilised on or near the region	Likelihood of risk of fatality (MacEwan <i>et al.</i> 2020; Animalia evaluation)
<i>Tadarida aegyptiaca</i> Egyptian free-tailed bat	Occurrence record in the region	LC	Roosts in rock crevices, hollows in trees, and behind the bark of dead trees. The species has also taken to roosting in roofs of buildings.	It forages over a wide range of habitats; its preferences of foraging habitat seem independent of vegetation. It seems to forage in all types of natural and urbanised habitats.	High
<i>Sauromys petrophilus</i> Robert's flat-headed bat	Occurrence record in the region	LC	Crevice dwelling species, roosting in rock crevices, as well as other crevices in buildings.	Open-air forager, capable of flying in high, open areas.	High
<i>Eidolon helvum</i> African straw-coloured fruit bat	Occurrence record in the region	LC	Little known about active roosts in South Africa, in other areas this species roosts in trees.	Feeds on fruit and flowers, will forage up to 60km from their roosts	High
<i>Miniopterus natalensis</i> Natal long-fingered bat	Occurrence record in the region	LC	Cave and hollow dependent. Caves/mines present in the larger area. Will also roost in small groups or individually in culverts and other hollows.	Clutter-edge forager. May forage in more open terrain during suitable weather.	Medium-High
<i>Myotis tricolor</i> Temminck's Myotis	Occurrence record within 100km of the region	LC	Usually roosts gregariously in caves. Caves/mines present in the larger area. Sometimes culverts or other hollows.	Clutter-edge forager. May forage in more open terrain during suitable weather.	Medium-High
<i>Pipistrellus reupPELLII</i> Rüppell's Pipstrelle	Occurrence record within 100km of the region	LC	Presumed to roost under rocks and in buildings.	Clutter-edge forager, often hunts over water.	Medium-High
<i>Laephotis capensis</i> Cape serotine	Occurrence record in the region	LC	Roosts in the roofs of houses and buildings, and also under the bark of trees.	It appears to tolerate a wide range of environmental conditions from arid semi-desert areas to montane grasslands, forests, and savannahs. But is predominantly a medium height clutter edge forager.	Medium
<i>Eptesicus hottentotus</i> Long-tailed serotine	Occurrence record in the region	LC	It is a crevice dweller roosting in rock crevices, as well as other crevices in buildings. Exposed rocky cliffs.	It generally seems to prefer foraging on the clutter edge of vegetation, such as the vegetated drainage areas and also over open water sources such as farm dams.	Medium

Species name Common name	Occurrence in region	Conservation status (Red List Regional Listing 2016)*	Possible roosting habitat on or near the region	Possible foraging habitat utilised on or near the region	Likelihood of risk of fatality (MacEwan et al. 2020; Animalia evaluation)
<i>Nycteris thebaica</i> Egyptian slit-faced bat	Occurrence record in the region	LC	Roosts in aardvark burrows, culverts under roads, the trunks of dead trees and rocky hollows.	Tends to avoid open grasslands. May occur in the thickets that may be found in the vegetated drainage areas.	Low
<i>Rhinolophus clivosus</i> Geoffroy's horseshoe bat	Occurrence record in the region	LC	Roosts in caves and mine adits. Caves/mines present in the larger area. May utilise man-made hollows, aardvark burrows or hollows formed by rocky boulder koppies.	Associated with a variety of densely vegetated habitats including the limited thickets that may be found in the vegetated drainage areas.	Low
<i>Rhinolophus capensis</i> Cape Horseshoe Bat	Occurrence record in the region	LC	Roosts in caves, dark lofts and disused mines, avoids houses.	Clutter forager – forage in the canopy of trees and in orchards close to water.	Low
<i>Rhinolophus damarensis</i> Damara Horseshoe Bat	Occurrence record in the region	LC	Roosts in natural caves and mines.	Clutter forager – vegetation important for foraging.	Low
<i>Cistugo seabrae</i> Angolan Hairy Bat	Occurrence record in the region	NT	Very little is known about the roosting behaviour of this species. Suspected to roost in buildings.	Clutter-edge forager, observed circling low around trees and bushes to hunt.	Low
<i>Cistugo lesueuri</i> Lesueur's Hair Bat	Occurrence record within 100km of the region	LC	Roosts in rock crevices usually near water.	Clutter-edge forager – vegetation important for foraging.	Low

5. SENSITIVITY ANALYSIS

The bat sensitivity assessment classified areas according to their relative importance for roosting, foraging, and conservation value. This classification provides a framework for identifying locations where development may present higher risks to bat populations.

Areas of **Very High sensitivity** are characterised by exceptional roosting or foraging potential, very high levels of bat activity, and/or the possible presence of species of conservation concern (e.g., Vulnerable, Endangered, or Data Deficient). From a bat conservation perspective, such areas are generally unsuitable for development of GH₂ and associated renewable energy because of the significant risks they pose to bat populations.

High sensitivity areas include habitats with strong roosting or foraging potential and consistently high levels of bat activity. These areas are likely to present considerable risks to bats, and renewable energy development within them is generally discouraged.

Medium sensitivity areas are associated with moderate roosting or foraging potential, moderate or uncertain levels of bat activity, and/or the potential presence of Near Threatened or Rare species. While development may be possible, site-specific assessments during the EIA phase of a renewable energy facility remain essential to confirm impacts and identify robust mitigation measures.

Low sensitivity areas are characterised by limited roosting or foraging opportunities, low bat activity, and the absence of conservation-important species. These areas are considered more compatible with renewable energy development, though sensitivity mapping will still be refined at the EIA stage to confirm site-level risks.

Roost Investigation zones: Within these zones, it is critical to conduct further field investigations during the EIA phase of a renewable energy project to verify species presence, colony size, and roost significance.

Roost Caution zones: During the EIA process, any identified roosts must be explicitly considered. The study design and data analysis should make appropriate provision to determine if species present in the applicable roost may be impacted by the proposed project.

Figure 5-1 depicts the sensitive areas of the region, based on features identified to be important (**Table 5-1**) for foraging and roosting of bat species that most commonly occur in the region. **Table 5-2** describes the implications of the sensitivity and risk criteria for GH₂ and associated renewable energy developments. More specific information relating to feature buffers is provided in **Table 5-3**.

Table 5-1: Description of parameters used in the construction of the sensitivity map

Sensitivity	Sensitivity Feature	Motivation
Very High Sensitivity and buffers	Open water sources and other perennial watercourses (Order 2, 3, 4 and 7 in catchment area)	Available water and moisture will attract insect food. Fruit bats are also more likely to utilise riparian vegetation for roosting and even foraging if fruit is available seasonally.
	Wetlands	Available water and moisture will attract insect food.
	Coastline	Available moisture and tidal pools will attract insect food.
	Protected areas within the Namakwa region	Floral and faunal biodiversity may be higher in protected areas resulting in a higher abundance of natural food sources for different species of bats found in the Namakwa Region.
	Bat roosts	Areas where bats congregate are particularly important since many individual bats may be impacted simultaneously.
High Sensitivity and buffers	Limestone geology	These formations are highly susceptible to the development of extensive cave systems. As caves provide ideal roosting habitat for bats, it is possible that undiscovered roosts may occur within these areas.
Medium Sensitivity and buffers	Non-perennial watercourses (Order 1 in catchment area)	Seasonally available moisture may attract insect food
Low Sensitivity	The remainder of the study region not delineated by buffers	
Roost Investigation zone	Bat roost buffer	A zone that may be utilised extensively by bats around a bat roost. The size of this zone is based on the colony size, type of roost and/or species occupying the roost.
Roost Caution zone	Bat roost buffer	A zone that may be utilised by bats around a bat roost. The size of this zone is based on the colony size, type of roost and/or species occupying the roost.

Table 5-2: The significance of sensitivity map (risk) categories for GH₂ and associated renewable energy developments

Sensitivity areas	Significance for GH ₂ and associated renewable energy developments
Very High Sensitivity and buffers	These areas are 'no-go' zones and GH ₂ with associated renewable energy developments may not be proposed in these areas and their buffers.
High Sensitivity and buffers	The risks assessed in Section 6 for each identified impact must be considered for this sensitivity tier in relation to the identified Consequence description for each development scenario.
Medium Sensitivity and buffers	The risks assessed in Section 6 for each identified impact must be considered for this sensitivity tier in relation to the identified Consequence description for each development scenario.
Low Sensitivity	The risks assessed in Section 6 for each identified impact must be considered for this sensitivity tier in relation to the identified Consequence description for each development scenario.
Roost Investigation zones	Within these zones, it is critical to conduct further field investigations during the EIA phase of a renewable energy project to verify species presence, colony size, and roost significance.
Roost Caution zones	During the EIA process, any identified roosts must be explicitly considered. The study design and data analysis should make appropriate provision for roost location, species, and potential impacts to determine if species present in the applicable roost may be impacted by the proposed project.

Table 5-3: Specific buffer details of features highlighted in the sensitivity map.

Sensitivity Category	Feature	Buffer Distance
Very High Sensitivity	Protected areas	None
	Wetlands	500m
	NFEPA River orders 2, 3 and 4	500m
	NFEPA River order 7	5km
	Coastline	1km
	Bat roosts (as per Table 4-2)	500m, 2.5km and 20km
High Sensitivity	Limestone	None
	Coastline	5km
	NFEPA River order 2	500m
	NFEPA River order 7	10km
Medium Sensitivity	Coastline	10km
	Non-perennial watercourses	500m
Roost Investigation zones	Bat roosts	10km, 20km and 30km
Roost Caution zones	Bat roosts	50km

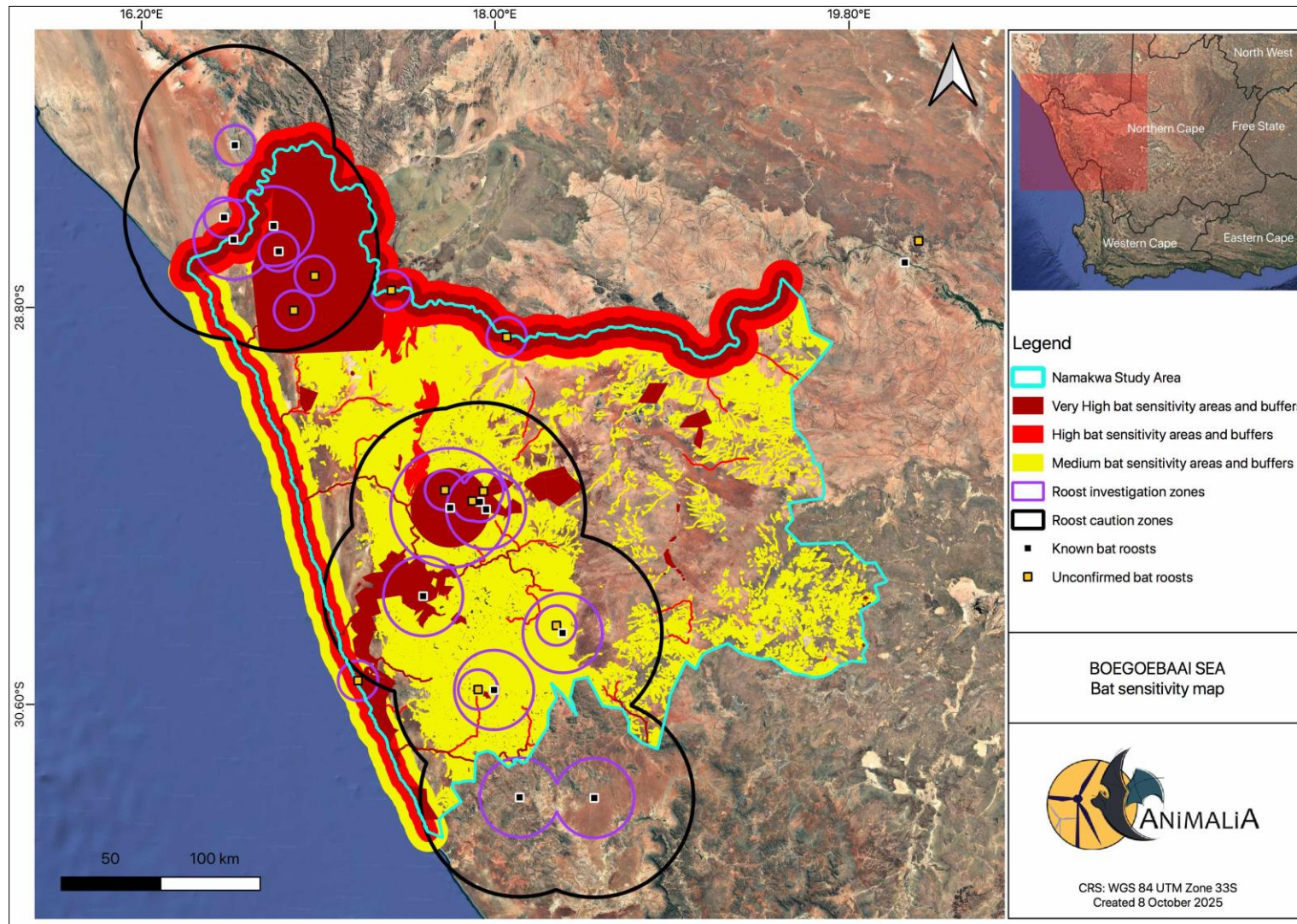


Figure 5-1: Bat sensitivity map of the Namakwa study region, showing Very High, High, Medium and Low sensitivity zones and their buffers. As well as Roost Investigation and Roost Caution zones.

6. RISK ASSESSMENT

6.1 General approach

This chapter undertakes a systematic risk assessment of the impacts to bats relating to the different scenarios for GH₂ development. Risks are assessed by evaluating the probability of events occurring in relation to the severity of their potential positive or negative consequences (i.e., likelihood × consequence; **Figure 6-1**).

To ensure a transparent and systematic approach, consequence ratings have been defined in this chapter for each of the three identified bat impacts, as presented in

Table 6-1. The corresponding risk and opportunity categories (Very Low to Very High) are described in CSIR (2024).

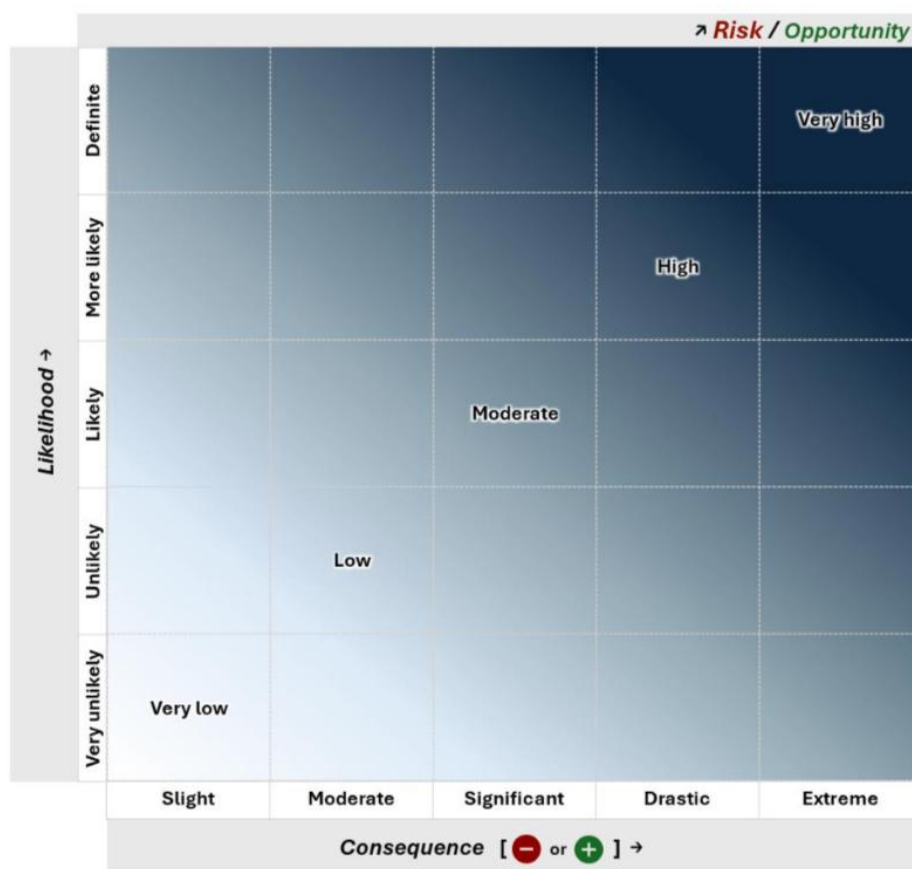


Figure 6-1: Schematic illustrating the qualitative assessment of Risk and Opportunity, derived by multiplying the likelihood of an impact (positive or negative) by the severity of its consequences for a specific theme.

Table 6-1: Description of negative consequences as defined for bats based on expert judgement. Consequence categories as per CSIR (2024) requirements

Negative consequence	Impact		
	Destruction / disturbance of bat roosts	Bat foraging habitat loss	Bat mortalities
Slight	Slight disturbance of bat roosts in habitat with very low density of micro roosts. Rehabilitation and mitigation not required.	Low density of foraging habitat loss, pertaining to widespread bat foraging habitat. Rehabilitation of foraging habitat not required.	Rare mortality events with barely perceivable bat population or ecological consequences. Required human intervention not anticipated.
Moderate	Disturbance of bat roosts in habitat with a low density of micro roosts, and very rare occurrences of macro roosts disturbance. Rehabilitation is achievable and mitigation is practical.	Moderate density areas of foraging habitat loss, pertaining to widespread bat foraging habitat. Rehabilitation of foraging habitat not required in most cases.	Moderate bat mortalities, but within sustainable levels. Human intervention may possibly be required from time to time.
Significant	Disturbance or destruction of roosts in habitat with a medium density of micro roosts, or significant disturbance of a macro roost. Rehabilitation of roosts possible, mitigation required.	High density areas of foraging habitat loss, pertaining to important bat foraging habitat. Will require rehabilitation of foraging habitat.	Significant bat mortalities which will require mitigations and human intervention on a reactive basis to keep mortalities at sustainable levels.
Drastic	Complete destruction of roosts in habitat supporting a medium density of micro roosts, or severe disturbance of a macro roost. Resulting in displacement or mortalities of bats utilising the roost. Rehabilitation of roosts not possible, mitigation costly.	Higher density areas of foraging habitat loss, pertaining to critical habitat supporting a high diversity of bats. May cause long term species-specific displacement for decades, or lower local bat population numbers significantly. Will require costly and long-term rehabilitation of foraging habitat.	Unacceptably high bat mortalities requiring proactive and active, costly human intervention over decades to prevent unsustainable mortalities, consequent bat population collapse, and severe epigeal (above ground) or hypogean (subterranean) ecosystem disruptions. Even after human intervention mortalities may still remain unacceptably high.
Extreme	Complete destruction of bat roosts in areas with a high density of micro roosts, or destruction of a macro roost. Resulting in displacement or mortalities of bats utilising the roosts. Rehabilitation of roosts not possible, mitigation not effective.	Large continuous areas of foraging habitat loss that may be permanent or lasting for decades, pertaining to critical habitat supporting a high diversity of bat species and/or habitat critical for specific species. Resulting in complete species-specific displacement of bats and localised consequent negative ecological effects. Rehabilitation of foraging habitat may be unsuccessful.	Unsustainable mortalities leading to bat population collapse, and consequent severe disruption of epigeal (above ground) ecosystems, and collapse of subterranean/hypogean (cave) ecosystems. Human intervention may not be successful. Commonly occurring species with a Least Concern conservation status may become locally extinct or threatened.

The risks of potential impacts for each development scenario are discussed below.

6.2 Disturbance and/or destruction of bat roosts during construction

6.2.1 Impact description

Probable roosting spaces within the region are most likely associated with man-made structures such as houses and farm buildings along with natural features including fissures in rocks, and less prevalent hollows in trees or loose bark. The construction of GH₂, solar PV facilities, wind energy facilities (WEFs), and associated infrastructure (e.g., turbines, panels, roads, substations, power lines, offices, and maintenance buildings) may result in the disturbance or permanent loss of these roosting habitats. The severity of impacts depends on the type and sensitivity of the roost or roosting habitat and its proximity to development activities.

6.2.2 Mitigation measures

No proposals for renewable energy or GH₂ developments should be allowed within the Very High sensitivity areas indicated in the sensitivity analysis map in this report, and the risk assessment for each impact and sensitivity tier should be considered on a regional management level when GH₂ and renewable energy facilities are proposed. Additionally, adhering to site-specific bat specialist sensitivity maps created during EIA studies will also assist in mitigating this risk. If undiscovered bat roosts are encountered during the construction phase of renewable energy facilities, the respective Environmental Compliance Officer (ECO) must be notified immediately and a bat specialist consulted to advise the appropriate action.

6.2.3 Impact assessment

aTable 6-2 highlights the formal ratings of the above impact, considering their relevance across areas of varying bat sensitivity (Very High to low as mapped in **Figure 5-1**), for the Baseline Scenario (Sc0) and the two development scenarios (Sc1 and Sc2). Impact ratings are assessed independently for scenarios with and without the implementation of the recommended mitigation and management measures described above.

aTable 6-2: Assessment of potential impacts associated with the destruction or disturbance of bat roosts

Negative Impact	Scenario	Spatial receiving environment (sensitivity tier)	Without mitigation			With mitigation		
			Consequence (-)	Likelihood	Risk	Consequence (-)	Likelihood	Risk
Destruction/disturbance of bat roosts	S0: Baseline	Very High	Significant	Likely	MODERATE	N/A	N/A	N/A
	S1: Small GH ₂		Drastic	Definite	HIGH	Drastic	More Likely	HIGH
	S2: Big GH ₂		Extreme	Definite	VERY HIGH	Extreme	Definite	VERY HIGH
	S0: Baseline	High	Significant	Likely	MODERATE	N/A	N/A	N/A
	S1: Small GH ₂		Drastic	More Likely	HIGH	Drastic	Likely	MODERATE
	S2: Big GH ₂		Drastic	Definite	HIGH	Drastic	More Likely	HIGH
	S0: Baseline	Medium	Moderate	Unlikely	LOW	N/A	N/A	N/A
	S1: Small GH ₂		Significant	Likely	MODERATE	Significant	Unlikely	LOW
	S2: Big GH ₂		Drastic	More Likely	HIGH	Drastic	Likely	MODERATE
	S0: Baseline	Low	Slight	Very Likely	VERY LOW	N/A	N/A	N/A
	S1: Small GH ₂		Moderate	Unlikely	LOW	Slight	Very Likely	VERY LOW
	S2: Big GH ₂		Moderate	Likely	LOW	Moderate	Unlikely	LOW

6.3 Displacement due to foraging habitat loss and fragmentation due to solar PV panel or wind turbine construction and operation

6.3.1 *Impact description*

Construction activities will result in both permanent and temporary loss of foraging habitat. Permanent loss will occur through the clearing of vegetation for GH₂ and associated renewable energy infrastructure, while temporary loss may arise from storage areas and the movement of heavy vehicles during construction. In addition, construction-related disturbances such as elevated levels of light and noise may lead to the temporary or permanent displacement of more sensitive bat species.

6.3.2 *Mitigation measures*

No proposals for renewable energy or GH₂ developments should be allowed within the Very High sensitivity areas indicated in the sensitivity analysis map in this report, and the risk assessment for each impact and sensitivity tier should be considered on a regional management level when GH₂ and renewable energy facilities are proposed. Additionally, adhering to site-specific bat specialist sensitivity maps created during EIA studies will also assist in mitigating this risk. Construction activities should be confined to designated areas for the storage of materials, equipment, and vehicles, and all vehicle movements should be restricted to established access routes. Any areas disturbed during construction should be rehabilitated following completion, using appropriate ecological restoration techniques.

6.3.3 *Impact assessment*

Table 6-3 highlights the formal ratings of the above impact, considering their relevance across areas of varying bat sensitivity (Very High to low as mapped in **Figure 5-1**), for the Baseline Scenario (Sc0) and the two development scenarios (Sc1 and Sc2). Impact ratings are assessed independently for scenarios with and without the implementation of the recommended mitigation and management measures described above.

Table 6-3: Assessment of potential impacts associated with the loss and fragmentation of bat foraging habitat

Negative Impact	Scenario	Spatial receiving environment (sensitivity tier)	Without mitigation			With mitigation		
			Consequence (-)	Likelihood	Risk	Consequence (-)	Likelihood	Risk
Bat foraging habitat loss	S0: Baseline	Very High	Significant	Likely	MODERATE	N/A	N/A	N/A
	S1: Small GH ₂		Drastic	Definite	HIGH	Drastic	More Likely	HIGH
	S2: Big GH ₂		Extreme	Definite	VERY HIGH	Extreme	Definite	VERY HIGH
	S0: Baseline	High	Significant	Likely	MODERATE	N/A	N/A	N/A
	S1: Small GH ₂		Drastic	More Likely	HIGH	Drastic	Likely	MODERATE
	S2: Big GH ₂		Drastic	Definite	HIGH	Drastic	More Likely	HIGH
	S0: Baseline	Medium	Moderate	Unlikely	LOW	N/A	N/A	N/A
	S1: Small GH ₂		Significant	Likely	MODERATE	Significant	Unlikely	LOW
	S2: Big GH ₂		Drastic	More Likely	HIGH	Drastic	Likely	MODERATE
	S0: Baseline	Low	Slight	Very Likely	VERY LOW	N/A	N/A	N/A
	S1: Small GH ₂		Moderate	Unlikely	LOW	Slight	Very Likely	VERY LOW
	S2: Big GH ₂		Moderate	Likely	LOW	Moderate	Unlikely	LOW

6.4 Bat fatalities due to collision or barotrauma caused by wind turbines during foraging and migration

6.4.1 Impact description

Collisions with turbine blades and barotrauma pose a significant risk to resident bat populations, with potential impacts persisting over the operational lifetime of the facility. Effective management and mitigation of this risk are therefore essential. During operational periods, artificial lighting can attract insects and, consequently, foraging bats, increasing the likelihood of turbine-related mortality where lights are positioned near turbines. Similarly, the creation of artificial water bodies, such as stormwater retention areas, may draw bats into proximity with turbines, further elevating collision risk. Renewable energy and GH₂ infrastructure may also inadvertently provide artificial roosting opportunities; where these occur near turbines, the potential for bat mortality is significantly increased.

Fruit bats may occur in the region near rivers, some natural food sources and agricultural activities (e.g. date farms), and may commute large distances seasonally following available fruit and other natural food sources such as nectar. Fruit bats are not detected during acoustic based bat EIA studies since they don't echolocate. This increases their risk of collision if wind farm design does not accommodate these commuting routes.

The bat species *Cistugo seabrae* (Angolan Hairy Bat) are occurring in the Namakwa Region with a Near Threatened conservation status, with less than 1000 individuals estimated. They are believed to have a low risk of impact by wind energy facilities, but are significantly understudied in behaviour, habitat preferences and risk to turbine collision.

Cave-dwelling bats provide a critical ecological function by supplying energy to cave ecosystems through their guano, which forms the basis of food webs in the absence of sunlight. Mortality of bats during migration between caves—whether due to collisions with turbine blades or barotrauma—can disrupt this energy input, potentially leading to the collapse of one or more cave ecosystems. These ecosystems are often isolated and contain unique, specialized biota, making them particularly vulnerable to the loss of bats. In the study region, migratory routes are currently unknown, and it is unclear whether such movements occur, increasing the uncertainty and potential risk of significant ecological impacts from turbine-related bat fatalities.

6.4.2 Mitigation measures

The mitigation potential for this risk is high and involves various aspects.

Placement: No proposals for wind energy facility developments should be allowed within the Very High sensitivity areas indicated in the sensitivity analysis map in this report, and the risk assessment for each impact and sensitivity tier should be considered on a regional management level when wind energy facilities are proposed. Additionally, adhering to the site-specific bat sensitivity maps created during EIA studies will contribute to mitigating this risk.

Wind energy facility design:

Avoid creation of artificial foraging habitat: Lighting across all renewable energy infrastructure, including turbine bases, operations and maintenance buildings, and ancillary facilities, should be minimised while maintaining safety and security requirements. Aviation lighting must comply with applicable regulations. Exterior lighting should, where possible, be fitted with low-sensitivity motion sensors to switch off automatically when areas are unoccupied, preventing the formation of regular insect congregations. Where motion sensors are not feasible, lights should use wavelengths that attract fewer insects, typically “warm white,” yellow, or amber, with a colour temperature below 4000 K. Floodlights should be hooded to limit illumination to only the areas required. Stormwater management plans should avoid creating artificial water bodies, ponds, or wetlands within turbine zones (defined as the turbine blade length plus relevant sensitivity buffers), as these could increase insect activity and, consequently, bat foraging activity near turbines.

Avoidance of artificial roosting habitat:

Buildings: All new buildings on site should be designed and constructed to prevent the formation of potential bat roosts. Roofs and wall junctions must be thoroughly sealed. Corrugated iron roofing, if used, must be sealed with a durable, flexible sealant (cement should be avoided due to potential loosening in wind). Thatched roofs should be avoided entirely. Bargeboards or sideboards mounted against walls should be avoided where possible; if unavoidable, these must also be sealed with a flexible sealant.

Culverts: New culverts should be designed to avoid creating ceiling hollows or voids that could serve as bat roosts. If any such voids are unavoidable, they must be filled flush with the culvert ceiling.

Inspection and eviction: During operational monitoring and mortality audits, all infrastructure should be inspected by a qualified bat specialist for the presence of artificial roosts. Any identified roosts should be safely evicted by a bat specialist during the appropriate season, ensuring that dependent pups are not present to prevent mortality.

Operational management: To reduce bat fatalities during operation, turbines may need to be curtailed or other mitigation (deterrents or shut down on demand) applied during periods of high bat activity identified in EIA studies, as recommended by the bat specialist that conducted the bat EIA assessment.

Operational monitoring: Continuous monitoring of bat fatalities should be conducted for the operational lifetime of facilities. Data collected should inform adaptive management measures, including additional curtailment or mitigation strategies where necessary, to ensure bat populations are protected. Operational bat mortality data or reports should be submitted to DFFE and SABAAP.

6.4.3 Impact assessment

Table 6-4 highlights the formal ratings of the above impact, considering their relevance across areas of varying bat sensitivity (Very High to Low as mapped in **Figure 5-1**), for the Baseline Scenario (Sc0) and the two development scenarios (Sc1 and Sc2). Impact ratings are assessed independently for scenarios with and without the implementation of the recommended mitigation and management measures described above.

Table 6-4: Assessment of potential impacts associated with bat mortalities due to collision or barotrauma when foraging and/or migrating

Negative Impact	Scenario	Spatial receiving environment (sensitivity tier)	Without mitigation			With mitigation		
			Consequence (-)	Likelihood	Risk	Consequence (-)	Likelihood	Risk
Bat mortalities	S0: Baseline	Very High	Drastic	More Likely	HIGH	N/A	N/A	N/A
	S1: Small GH ₂		Extreme	Definite	VERY HIGH	Extreme	More Likely	HIGH
	S2: Big GH ₂		Extreme	Definite	VERY HIGH	Extreme	Definite	VERY HIGH
	S0: Baseline	High	Significant	More Likely	MODERATE	N/A	N/A	N/A
	S1: Small GH ₂		Drastic	More Likely	HIGH	Drastic	Likely	MODERATE
	S2: Big GH ₂		Extreme	Definite	VERY HIGH	Extreme	More Likely	HIGH
	S0: Baseline	Medium	Moderate	Likely	LOW	N/A	N/A	N/A
	S1: Small GH ₂		Significant	More Likely	MODERATE	Moderate	Likely	LOW
	S2: Big GH ₂		Drastic	Likely	MODERATE	Significant	Likely	MODERATE
	S0: Baseline	Low	Moderate	Likely	LOW	N/A	N/A	N/A
	S1: Small GH ₂		Significant	Likely	MODERATE	Significant	Unlikely	LOW
	S2: Big GH ₂		Significant	More Likely	MODERATE	Significant	Unlikely	LOW

7. RECOMMENDED STRATEGIC MANAGEMENT ACTIONS

The following strategic management actions are recommended to develop and progress knowledge required to more effectively manage the impacts of renewable energy and GH₂ development over the long term in the Namakwa Region. Additionally, a strong focus is placed on avoiding Very High risk areas at the proposal stage (pre-EIA) of such developments.

7.1 Recommendations to inform national policy

- 1) Bat mortality monitoring reports from operational wind energy facilities must be shared with both DFFE and designated individuals at SABAAP. This will enable the continuous development of more efficient mitigation measures and recommendations during wind energy facility planning phases.
- 2) An updated national scale SEA spatial risk analysis must be conducted to identify areas where GH₂, PV and/or wind energy facilities may not be proposed for development. To prevent EIA studies and applications from being initiated in Very High risk areas.

7.2 Recommendations to inform regional planning

- 1) No proposals for renewable energy or GH₂ developments may be allowed within the Very High sensitivity areas indicated in the sensitivity analysis map in this report (**Figure 5-1**), and the risk assessment for each impact and sensitivity tier should be considered on a regional management level when GH₂ and renewable energy facilities are proposed.
- 2) A research program should be initiated with appropriately skilled specialists/academic researchers to establish the migratory routes of cave dwelling bat species inhabiting caves/mines within or near the Namakwa Region.

7.3 Recommendations for future EIA studies

- 1) Bat preconstruction EIA studies for wind energy facilities must be a minimum of 12 months (as per details stipulated in the current Best Practice Guidelines, MacEwan *et al.*, 2020), but ensuring that at least 75% of the rainy season must be covered with acoustic bat activity data collection. This is due to the high seasonality and drastic climatic fluctuations experienced in arid to semi-arid environments. The rainy season may in some cases last less than a month, therefore the bat EIA study design must identify this predicted period beforehand and make provision to ensure bat activity monitoring during this period.
- 2) Potential fruit bat activity must be considered during the bat EIA study design, noting the proximity and occurrence of agricultural activities (e.g. date farms) and/or natural sources of food (e.g. nectar from succulents) in relation to the proposed wind energy facility. The bat EIA study methodology must make provision for establishing the presence/absence and/or monitoring of non-echolocating fruit bats.
- 3) The bat species *Cistugo seabrae* (Angolan Hairy Bat) are occurring in the Namakwa Region with a Near Threatened conservation status, with less than 1000 individuals estimated. They are believed to have a low risk of impact by wind energy facilities, but are significantly understudied in behaviour, habitat preferences and risk to turbine collision. Bat preconstruction EIA study methodology must make provision for the consideration of occurrences and possible impacts on the Near Threatened bat species *Cistugo seabrae* (Angolan Hairy Bat) found in and around the Namakwa Region.
- 4) It is critical for Roost Investigation zones around bat roosts to receive further field investigations during the EIA phase of a renewable energy project to verify species presence, colony size, and roost significance.

- 5) If a proposed renewable energy project is located within a Roost Caution zone, the identified roost must be explicitly considered during the EIA process. The study design and data analysis should make appropriate provision for roost location, species, and potential impacts to determine if species present in the applicable roost may be impacted by the proposed project.

7.4 Recommendations to enhance positive impacts and reduce negative impacts

- 1) No proposals for renewable energy or GH₂ developments may be allowed within the Very High sensitivity areas indicated in the sensitivity analysis map in this report (**Figure 5-1**), and the risk assessment for each impact and sensitivity tier should be considered on a regional management level when GH₂ and renewable energy facilities are proposed.
- 2) Preservation of floral and faunal biodiversity in non-transformed habitats is crucial to preserving the biodiversity of the natural food sources of different species of bats found in the Namakwa Region.
- 3) Initiate research programs and projects to contribute data and knowledge required for the long-term positive benefit of bat conservation in the Namakwa region.

8. REFERENCES

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https://egis.environment.gov.za/gis_data_downloads

APPENDIX 1: SPECIALIST INFORMATION

Specialist Company Name:	Animalia Consultants (Pty) Ltd			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	4	Percentage Procurement recognition	100%
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APPENDIX 2: DECLARATION BY THE SPECIALIST

I, _____Werner Marais_____, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing
 - any decision to be taken with respect to the application by the competent authority; and
 - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.



Signature of the Specialist

Animalia Consultants (Pty) Ltd

Name of Company

08 October 2025

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