DES
DONATO
ENVIRONMENTAL SERVICES

Wind turbine electricity generators: Avian and microbat risk assessment

Report to:
Northern Star Resources Ltd
September 2025

ABN: 54 652 406 856 | Email: david@desenvironment.com.au | WhatsApp: +61 417 819 196

Disclaimer

Citation

Donato, D. B., 2025. Wind turbine electricity generators: Avian and microbat risk assessment: Report to Northern Star Resources v2. Donato Environmental Services Pty Ltd, Darwin.

Distribution

Receivers	Copies	Date issued	Contact name
Northern Star Resources Ltd	Electronic	4 July 2025	Yvonne Hynes, Brendon McGillivray
DES Pty Ltd	Electronic	1 August 2025	David Donato
Northern Star Resources Ltd	Electronic	22 August 2025	Yvonne Hynes, Brendon McGillivray, Cliff Bennison
DES Pty Ltd	Electronic	7 September 2025	David Donato
Northern Star Resources Ltd	Electronic	8 September 2025	Yvonne Hynes, Brendon McGillivray, Cliff Bennison, Dylan Martini

Executive Summary

Donato Environmental Services Pty Ltd (DES) has been engaged to undertake an avian and microbat fauna risk assessment regarding the proposed wind turbine electricity generators associated with Northern Star Resources Ltd (NSR), immediately north of the Kalgoorlie Consolidated Gold Mine (KCGM).

Baseline information on the NSR fauna inventory was obtained through specific baseline surveys and desktop surveys, including database searches, literature reviews, previously reported field surveys, and associated reports. From the baseline taxa collation, all avian and microbat species specific to the Kalgoorlie region (within 50 km of Kalgoorlie township) were compiled. The entire species list was risk assessed, and a closer examination was conducted on those species that could or do fly above the vegetation canopy; hence, a risk exists of a collision with the proposed wind turbines. All taxa were examined for legislative conservation status with Western Australian legislation (Biodiversity Conservation Act 2016), federal legislation (Environment Protection and Biodiversity Conservation Act 1999), Birdlife Australia Action Plan for Australian Birds 2020 and the International Union for Conservation of Nature (IUCN) Red List. The baseline survey commenced in October 2024 and is ongoing until October 2026, and specific data analysis of the baseline survey will be provided in the subsequent baseline report. Prima facie data analysis is input into the risk assessment and is reflected in the risk assessment tables. Specific data analysis is demonstrated in this report where it's deemed pertinent.

Consideration of boom-and-bust seasons (associated with exceptional rainfall and longer periods of dry conditions) of the arid and semi-arid zones is unique to the assessment of wind turbine risks to birds and bats, and consequently, is not reported in the literature. This stochastic seasonality is introduced in this report and incorporated into the likelihood probability associated with risks to species that live on these seasonal life cycles. Essentially, the likelihood of impact for some species increases significantly during boom conditions and is negligible at other times. The frequency of such boom conditions is assumed to occur once every ten years, with a wind turbine life of 20 years.

The combined literature, desktop surveys and field surveys have identified 192 avian taxa from 56 families (Appendix A) as occurring, likely to occur, or may occur regionally within 50 km of Kalgoorlie township.

The combined literature, desktop surveys and field surveys have identified 12 bat taxa from 3 families (Appendix A) as occurring, likely to occur, or may occur regionally within 50 km of the Kalgoorlie township.

The critical parameters of the wind turbines are a 182 m rotor diameter, a rotor coverage area of 26 016 m^2, three rotor blades per turbine, and a hub (nacelle) height of 150 m. This equates to a rotor swept path of 59 m above the ground level. With a diameter of 182 m, a maximum of 9.3 rpm (typical for wind turbines) equates to a wind tip speed of 89 m/s.

Avian and bat flight height is a critical parameter in the context of wildlife's potential collision risks with wind turbine blades. A species' ecology and whether it flies above the vegetation canopy are used as determining factors because it is generally known for each species. The vegetation canopy height is between one and five metres, yet the rotor blade swept path is 59 metres above ground level. A precautionary principle is inherent in this risk assessment, which uses the definition of flying above the vegetation canopy as a risk factor (and not whether a species flies at the height of the turbine swept path).

From all avian taxa determined to occur, 120 were determined, at least at times, to fly above the vegetation canopy (Appendix A). Of the 12 bat taxa, ten were determined, at least at times, to fly above the vegetation canopy (Appendix A). On a prima facie, these species have a plausible risk of collision with the wind turbines. All avian and bat species are further examined, their relevant ecologies described, and a risk matrix determination is then given.

A total of 32 avian and one bat taxa are listed under the EPBC and BC Acts. Only the taxonomic status of Western Australian subspecies was considered where relevant or recognised taxonomically.

The threatened or conservation status of species was considered in the consequence of the risk matrix.

A qualitative risk assessment procedure was applied in accordance with Standards Australia/Standards New Zealand *Environmental risk management – principles and process HB 203:2006* (the risk assessment guide) [1], and contextualised for wildlife impact from wind turbines. Assuming a wind turbine operational life of

20 years, a qualitative analysis (Table 5 and Table 6) has been used to assess the impacts (Table 8) on avian and microbat fauna.

The analysis derives a measure of inherent risk (Low, Moderate, High or Extreme) for each impact. It is considered that a Low risk requires no actions, and that procedure is followed. Moderate risks equate to an impact on individuals of that species, not a detectable impact on the population. High risks equate to an impact on the regional population.

High or moderate risks would require implementation of risk mitigation measures and considered monitoring regimes to detect and measure changes in the impact, if any, on at least these species. Mitigation measures may need to be amended according to monitoring data and metadata interpretations.

Wildlife deaths are almost certain to occur at all commercial wind turbine electricity generators, and the proposed development described in this report would not be any different. This report has found, in simplistic terms, that most of the impact on wildlife will comprise migratory species, birds of prey and bats. This is no different to other wind turbine operations globally [2-28].

This report has determined that inherent medium-risk levels exist for a number of bird and one bat species. This report has determined that inherently high-risk levels exist, if no remedial actions are implemented, for the following species (taxa):

- White-striped Free-tailed Bat (*Austronomus australis*) (H)
- Inland Free-tailed Bat (*Ozimops petersi)* (H)
- Southern Free-tailed Bat (*Ozimops kitcheneri*) (H)

The literature review has identified mitigations that may be applicable to this proposed development, that of:

- curtailment (stopping rotation of turbines) during high migration or activity seasons has been effective for birds and bats;
- curtailment during low wind speeds (<5 m/s) reduces the impact on bats;
- installing ultrasonic deterrents; and
- curtailment of specific turbines contributing a disproportionately high number of bird and bat carcasses.

Although a success mitigation measure for birds, painting one turbine blade black amongst white turbine blades is not considered practical for bat species and is not considered further.

The moderate risk to avian species remains unchanged as no proactive mitigation measures are deemed practical.

Turbine curtailment mitigation measures are specified in this report for those bat species with an inherent High (H) risk level. With the successful implementation of turbine curtailment, through an articulated adaptive mitigation plan, the residual risk to White-striped Free-tailed Bat, Inland Free-tailed Bat and Southern Free-tailed Bat are reduced to Moderate (M) residual risk.

This qualitative risk assessment has not identified risks to any species populations that meet the criteria for referral under the BC Act or EPBC Act.

It is recommended that the operation develop, articulate and implement a wind turbine wildlife impact monitoring and mitigation plan that:

- detects and quantifies any impact;
- is amended to address the unacceptable impacts;
- is amended to address the perceived increase in risk during favourable environmental conditions;
- records and retains data in a manageable format;
- directs implementation of mitigation measures; and
- is reviewed and amended accordingly.

Table of Contents

List of Figures

List of Tables

Introduction

Background

Donato Environmental Services Pty Ltd (DES) was engaged to undertake an avian and microbat fauna risk assessment regarding the proposed wind turbine electricity generators associated with Northern Star Resources Ltd (NSR). As part of the risk assessment, DES was engaged in conducting two years of site- and wind turbine-relevant ecological surveys. These surveys commenced in October 2024 and are ongoing.

Additionally, considerable historical baseline ecological work has been conducted in the vicinity of the Kalgoorlie township, along with contemporary baseline (ground clearance) work specific to this wind turbine and photovoltaic proposal.

Specific to this NSR proposal, DES has conducted baseline surveys and risk assessments and monitored wildlife impacts at several wind turbine proposals in semi-arid and arid Western Australia. The avian and bat species inventory and flight characteristics of arid Australia are significantly transferable to the NSR location.

Energy supply

As part of Northern Star's global target to achieve net-zero emissions at its operations by 2050, it is currently undertaking a study to develop and operate a renewable energy power generation facility. It is envisaged that this will be a combination of wind turbine generators and solar photovoltaic (PV) generation with a battery energy storage system. As such, Northern Star Resources Limited requires the execution of relevant technical studies in support of environmental risk assessments as part of the environmental approvals process.

Proposed wind turbine specifications

The development will include 32 x, 8.0 MW Goldwind GWH182-6.2/7.2 V12R04C100 wind turbines [29].

Considering fauna collision risks, the critical parameters, as provided to DES (email dated 17 June 2025) are a 182 m rotor diameter, a rotor coverage area of 26 016 m^2, three rotor blades per turbine, and a hub (nacelle) height of 150 m, equating to a rotor swept path of 59 m above the ground level. With a diameter of 182 m, a maximum of 9.3 rpm (typical for wind turbines) equates to a wind tip speed of 89 m/s.

Critically, the proposed wind turbine development includes permanent and temporary native vegetation clearance. The native vegetation will be replaced with either bare ground (maintained as bare ground for operational purposes) or short seasonal grasses or grasslands. This risk assessment considers the influences of vegetation clearance on bird and bat inventory and behaviour.

Table 1. Proposed permanent and temporary vegetation clearance

	Vegetation clearance (ha)
Proposed Development Envelope	2313
Total Footprint	652
Permanent Footprint	423
Temporary Footprint	229

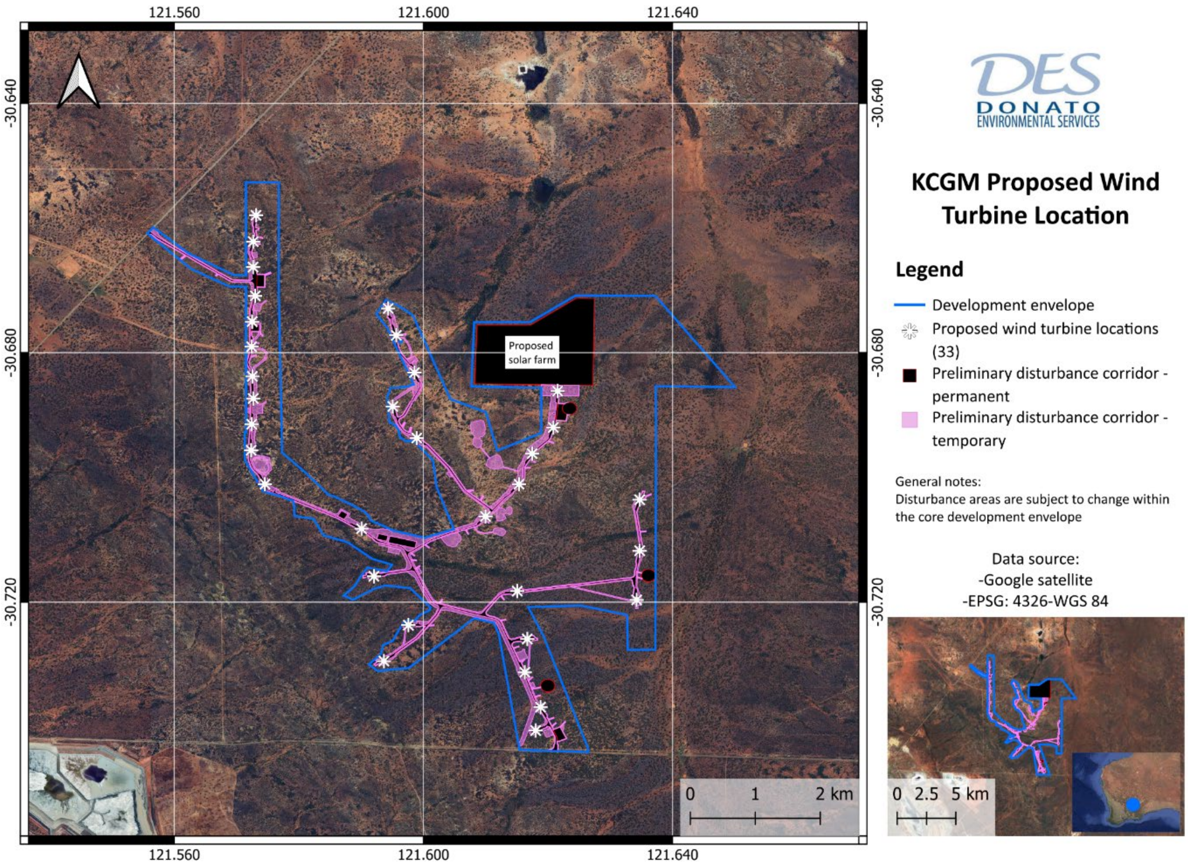

Figure 1. Proposed wind turbine location (proposed), and location and extent of vegetation clearance

Natural environment

Biogeographic Region

The study area is situated near the northern boundary of the Coolgardie IBRA biogeographic region, and more specifically the COO3 Eastern Goldfields subregion [30]. The Coolgardie bioregion is described as being a:

"Granite strata of Yilgarn Craton with Archaean Greenstone intrusions in parallel belts. Drainage is occluded. Mallees and scrubs on sandplains associated with lateritised uplands, playas and granite outcrops. Diverse woodlands rich in endemic eucalypts, on low greenstone hills, valley alluvials and broad plains of calcareous earths. In the west, the scrubs are rich in endemic Proteaceae; in the east, they are rich in endemic acacias. Arid to Semi-arid Warm Mediterranean" [31]. The underlying geology is of gneisses and granites eroded into a flat plane covered with tertiary soils and with scattered exposures of bedrock. Calcareous earths are the dominant soil group and cover much of the plains and greenstone areas. A series of large playa lakes in the western half is the remnant of an ancient major drainage line [30].

Climate

The climate of the Eastern Goldfields subregion is described as arid to semi-arid, and the climate of the Eastern Murchison subregion is defined as arid. Both subregions receive 200-300 mm of annual rainfall, the majority occurring during winter months. The nearest Bureau of Meteorology (BoM) weather station with comprehensive data collection and recent historic climate data is Kalgoorlie-Boulder Airport (no. 012038, Latitude: 30.78°S, Longitude 121.45°E), located 8 km west of the study area [30].

Kalgoorlie-Boulder Airport records the highest mean maximum monthly temperature (33.7°C) in January (lowest in July, 16.8°C) and the lowest minimum mean monthly temperature (5.1°C) in July (highest in January, 16.9°C) [32]. Average annual rainfall is 265 mm, with February, January and June recording the highest monthly averages (31.8, 26.2 and 27.7 mm, respectively). Tropical rain-bearing depressions moving southwards from northern Australian waters can cause heavy rainfall events in summer.

Daily average temperatures at Kalgoorlie-Boulder Airport in the months preceding the surveys were mostly close to historical averages, with only the average maximum temperature of October, February and June deviating more than 3°C (above). Minimum temperatures were, on average, 1.65°C warmer than the lowest minimum monthly temperatures.

Records from Kalgoorlie-Boulder Airport show that the annual rainfall of 293.2 mm in the 12 months preceding the survey exceeded the historical average of 265 mm. The climatic data could be loosely described as an average year.

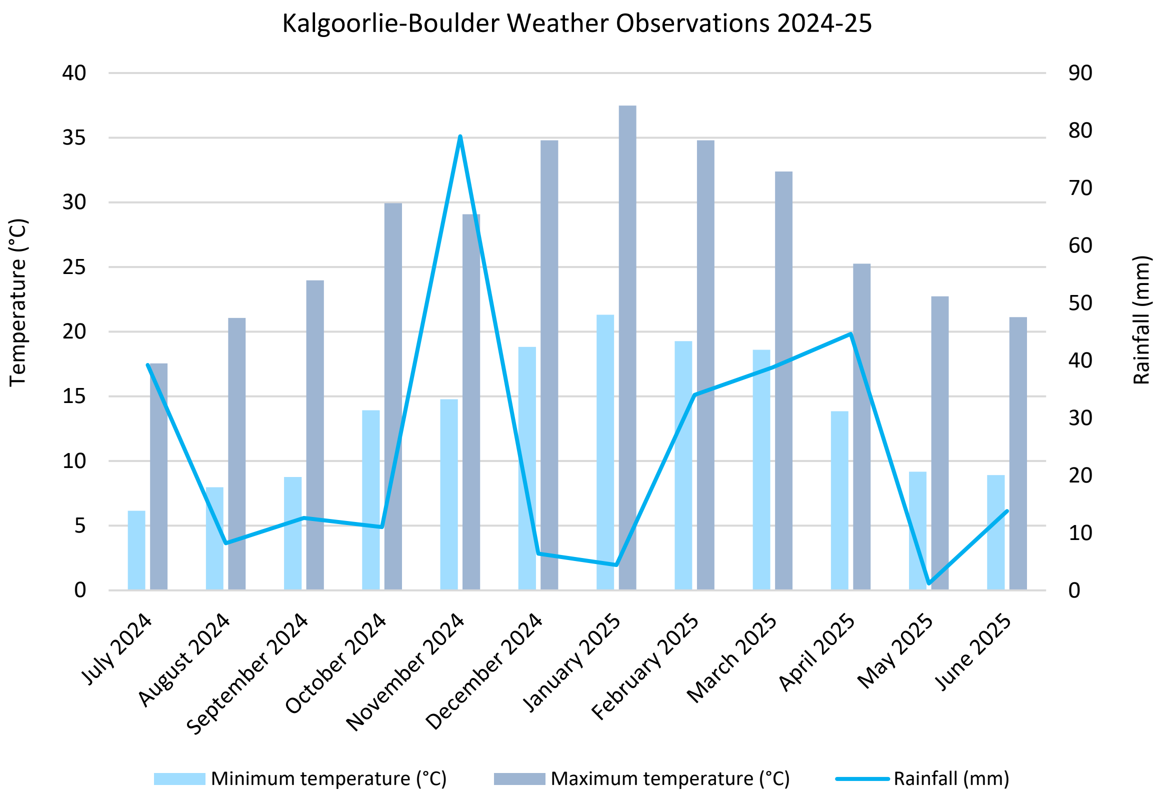

Figure 2. Twelve months of climatic data (maximum, minimum temperature and rainfall data) [32]

Vegetation

A total of 13 vegetation types were defined for the study area, which comprised Eucalyptus and Casuarina woodlands, Eucalyptus mallee woodlands, a tall Acacia shrubland and two chenopod shrublands. A small proportion (2.9%) of the study area was disturbed and mostly devoid of native vegetation, including infrastructure such as roads and an industrial estate. The Acacia shrubland was the most restricted vegetation type, comprising just 0.5% of the study area. The Eucalyptus woodlands were the most extensive, accounting for 62.4% of the study area, followed by the Casuarina woodlands (27.5%), the chenopod shrublands (4%) and the Eucalyptus mallee woodlands (2.7%) [33].

Fauna

Several fauna surveys have been conducted within the vicinity of the proposed wind turbine development footprint (see Methodology). They include:

Most fauna surveys provide fauna inventory specific to the area, but do not provide information such as measures of abundance, seasonality, and behavioural information that could inform us of risks associated with wind turbines. Studies at the NSR cyanide-bearing tailings facilities provide insight into bird and bat behaviour, diurnal and nocturnal movements, flight patterns, seasonality and relative abundance, which is used here as part of any wind turbine risk assessment.

Although the typical fauna surveys provide fauna inventory, caution is required, as these surveys were of relatedly intact vegetation and habitats. The proposed wind turbine development includes substantial vegetation clearance which changes the existing habitat, bat and bird species abundance and behaviour.

Significant landscape features

Kalgoorlie Consolidated Gold Mines operates the Fimiston Process plant and manages the associated waste rock dumps and tailings facilities. Waste rock is managed using a series of surface water rock dumps (WRDs) located south, east and north of the pit. Subsequently, the WRDs have undergone various modifications. Specific design parameters vary between WRDs, which are in various stages of construction and rehabilitation. These waste rock features provide updrafts and perching opportunities for raptor and corvid species.

Tailings facilities attract and provide habitat to waterbirds, swallows and martins, which are in turn are predated by raptors.

Waste rock dumps and tailings facilities attract and provide habitat to these guilds of bird species, which are known to be at risk from collision with wind turbines [4, 6, 27, 34-60].

From opportunistic observations, the vegetative life form is substantially comprised of regrowth woodland. This is determined by the lack of emergent trees above the surrounding canopy, lack of hollows within the eucalypts and a substantial and diverse understorey. The lack of emergent trees reduces breeding and nesting opportunities for raptors. The lack of hollows (and other microhabitats) simplifies the avian species composition and reduces roosting opportunities for bats.

Windfarms and wildlife: A review

Wind turbines involve collision risks to wildlife and have two essential structures: a tower and associated rotor blades. Wind turbines are usually arrayed in the landscape with some change to pre-existing land use. Thus, local populations of fauna are generally not expected to alter from the levels at which they existed prior to the construction of a wind farm [3, 8, 61].

Avian collisions with wind turbines have been well documented at various sites in North America and Europe [6, 7, 26, 27, 61-63] and less so in Australia [3, 64]. Tree roosting or migratory bats have been found to be more prone to mortalities at wind farms overseas than other groups [65]. However, it is unknown if the same patterns occur in the Australasian region [3, 56]. In addition to the risks of colliding with the turbines, wind farms and the construction of these also have the potential to create barrier effects, noise pollution and habitat disturbances, all of which can impact wildlife, including birds and bats.

The principal risk to birds and bats believed to be posed by wind turbines is the potential for wildlife to be killed due to collision with moving rotor blades [3, 8, 61]. In Australia, most commercial wind farms use wind turbines with rotor blade diameters in the range of 60 to 90 m, with a swept path approaching 35 to 50 m above ground level. At such dimensions, rotational speeds are generally 14 to 18 rpm [8]. Thus, the tips of wind turbine rotor blades usually travel between 55 and 90 m/s [8].

The dimensions of the wind turbine components affect the risk of birds and bats colliding with the turbine; however, the effects vary greatly between birds and bats and even between individual bird species. For bats, higher turbines generally mean higher mortality rates [5, 66]. This is believed to be because migrating bats fly at an altitude where older and smaller wind turbines do not reach them. Whereas newer, larger turbines may [5].

Studies completed on the relation between turbine height and the effects on birds are, however, much more complex. One study found that the height of the turbine did not affect bird fatalities [5], while others have found either positive [17, 26] or negative [67] correlations between the turbine height and bird fatalities. There are other technical specifications of wind turbines, such as rotor speed [26, 68], and rotor diameter, adding complex effects on bird mortality [28]. Studies of bats are less conflicting, rotor diameter [5] and red flashing aviation light [69] have been found to have no impact on bat fatalities. The difference in birds and bats and their relationship to wind turbine design is likely to be partly caused by significantly fewer studies being conducted on bats and the greater difference in the size and ecology of birds.

The abundance of birds often drops during the construction of wind farms, however, some species appear to come back once the wind farm becomes operational [24]. Wind farms have often caused permanent changes to the bird community structure, as some species disappear or become less abundant, most likely because of habitat changes [12, 49, 70, 71]. These species are geese and large waders, who seem particularly nervous around wind farms and often keep several hundred metres from them [70, 71]. There is no indication that birds become habituated to wind farms [17, 70], so bird species easily disturbed by wind farms rarely collide with the turbines [70].

Wind turbines are positioned to maximise wind exposure and minimise turbulence from topographic features and other wind turbines [72]. This results in irregular positioning of wind turbines and large and variable spaces between them [72]. Smallwood [26] found that wind turbines installed in a wind wall configuration consisting of parallel rows closely aligned to each other but with alternating tower heights, and wind turbines in dense clusters were safer for birds [22]. The wind turbines with the highest fatality rates were isolated turbines and turbines at the edges of clusters or at the end of rows [26]. Piles of rocks left over from the construction of the wind turbines were also problematic, as they attracted small mammals, which attracted raptors to the areas close to the turbines [26]. Wind farms arranged perpendicular to flight paths may be responsible for higher bird fatalities than wind farms where the turbines are arranged in rows parallel to the flight path [68]. Similar information relating to bats and wind farm planning is not available; however, some studies show that wind farms close to forests have increased bat fatalities [70].

The nacelle (hub) swivels in the horizontal plane around the tower to face the wind. The tower is stationary, which has minimal collision risk to birds and bats. A risk exists for collision with moving rotor blades only when a bird or bat is in flight within the rotor-swept area or a zone which may be affected by turbulence caused by rotors [8, 73].

Flight behaviours, including the heights at which birds and bats fly, vary considerably between species and are the prime consideration in this risk characterisation report in determining the likelihood of a collision.

Other considerations are also believed to contribute to the risk to wildlife from wind turbines: proximity to wetlands (saline, ephemeral and tailings systems), location within migratory corridors or staging grounds, sites strongly favoured for soaring birds and protected areas that are significant for bird and bat conservation [9, 72]. Wind turbine design also influences risk to wildlife, with relative positioning of wind turbines, the height above the landscape at which the turbine blade passes, with a lower height contributing to more wildlife deaths and turbines with three or four blades contributing to more wildlife deaths than two-bladed turbines [3, 6, 74].

A literature review has shown that methods and monitoring of wildlife deaths in Australia, and less so globally, lack quality control and quality assurance, and reporting of wildlife deaths is not publicly available. Reporting of wildlife deaths is usually associated with a one-off or opportunistic analysis of some collected data [3, 75, 76].

Ground-based acoustic monitoring is often used to conduct bat surveys. Still, studies have shown that while acoustic monitoring is useful for studying near-ground bat activity, it is a poor predictor of fatality levels [66]. Another possible cause for the lack of correlation between EIA predictions and actual observed mortality is the modelling used to make the EIA predictions. The main limitation of a model is the data used in the model. For many rare or endangered species, information about flight patterns, population size etcetera is not available, and as such, the models are based on assumptions which may be incorrect [8].

Measuring impacts on wildlife

Predicting impact

A range of species-specific factors also affect mortality and contribute to their vulnerability to turbine collision. Migratory status, dispersal distance and habitat, [77] as well as size, wing loading [6, 18] and flight behaviour [78] have all been shown to contribute [79]. Of species present in Australia, birds of prey, storks, herons and some shorebirds could be highly vulnerable [77], although small passerines account for most mortality records, potentially due to greater abundance [34].

Flight behaviour is one of the prime considerations in determining the likelihood of a collision. This includes the heights at which birds and bats fly, which vary considerably between species. For example, one American study found that despite their higher relative abundance, Barn Swallows had the lowest per-turbine fatalities compared to other higher-flying swallow species. Additionally, fatalities of Purple Martins, the least abundant but highest-flying species in Ontario, were greater at taller turbines than at shorter turbines. This could suggest that differences in fatalities of avian aerial insectivores at turbines are due to differences in flight altitude [35].

For bat species, open-air foraging, migratory species and tree-roosting species appear to be most vulnerable [79]. There is also evidence that some species of bats are attracted to wind turbines but the reasons for this are still uncertain and seem species-specific. Potential reasons include turbine noise, insect concentrations around turbines, or bat mating behaviour [80] in [79]. Attraction to wind turbines based on lighting and noise appears unlikely given the available data [81]. Despite the small body of research in Australia, one study has shown that White-striped Free-tailed (WSFT) bats were the most impacted species, possibly due to their need to forage in cleared areas and as such, this could increase their susceptibility to turbine collision. They have also been recently reported as the most frequent species impacted at wind farms in south-east Australia and Victoria [50] in [82]. In addition, the critically endangered Southern Bent-wing bats are also aerial hunters well-adapted to high-speed open-area foraging, which may mean they are also susceptible to collisions at wind farms in open agricultural land [82].

Methodologies that allow for species identification and species-specific effects related to differences in foraging, flight, and social behaviours that exist among species are important to understanding the true impact [81].

Measuring impact

The population-level consequences for bird and bat species and wind turbine-related deaths remain understudied but are an evolving field of study. While currently available data on wind turbine collisions and affected species shows only a negligible impact [77]. This is probably because there isn't enough data, and it is not accurate enough.

Although estimates of total bird mortality from wind turbine collisions are much lower than from collisions with buildings and windows [79], mortality could have cumulative, population-level effects for certain sensitive species. The Golden Eagle (*Aquila chrysaetos*) population in the Altamont Pass in California, USA, is being affected to such a degree that it has become a sink population, dependent on migrating birds from the surrounding areas to maintain the population [21]. On a larger scale, a model made to calculate the effect of wind farms on the Red Kite (*Milvus milvus*) population in the German state of Brandenburg indicated that fatalities caused by wind farms were close to the population's mortality threshold [83]. Large eagles are one of the most vulnerable birds to collide with wind turbines (e.g. [77]. The Tasmanian subspecies of Wedge-tailed Eagle in Australia is an ongoing concern due to its small population size, susceptibility to collision, and the number of recorded deaths despite the lack of easily accessible public data. A recent study from the Netherlands found that a small increase in mortality of 1% of 'post-fledging cohorts' in slow-breeding, long-lived birds such as eagles can see a 2-24% decrease in the population over a decade ([84] p. 1).

Population-level data for bats is also lacking; the high level of estimated fatalities and current data is considered unsustainable due to the slow life history of bats. Bats are long-lived, and many species have relatively low reproductive rates, making populations susceptible to localised extinction [82]. Unlike for birds, wind turbine collision is the primary source of collision mortality in bats, and the bat mortality rate from collision is higher than for birds [85]. Internationally, increasing evidence suggests that without intervention, wind farm collisions could bring even common bat species to extinction [82]. There is a lack of knowledge on the populations and demographics of many of Australia's bat species; as such, the consequences of any turbine collision-driven population impacts are unknown, challenging evidence-based conservation [86]. In Europe, avoidance of bat mortality, or at least reduction to a minimum, is a priority for their conservation, as well as a legal obligation [87] in [82].

Monitoring protocols of wind turbines

Moloney et al. [50] collected data from 15 Victorian wind farms, of which only two had data that was sufficient for a rigorous analysis of mortality rates. Survey methods varied markedly in all the wind farms. Surface efficiency trials were typically not undertaken as valid blind trials, even though this was specified in the Bat and Avifauna Management Plans [50]. When it comes to estimations of mortality rates, scavenging is an important factor; Molony et al. [50] showed that bird carcasses remained for much longer than bat carcasses (estimated 33 vs. 8 days) and that medium and large bird carcasses were more likely to be found than bat carcasses. When comparing search efficiency, it has been found that dogs are more efficient at finding bat carcasses [50]. The scavenger and detection rates depend on region, methodology, and vegetation [67].

Elsewhere, comparisons of impact assessments and mortality counts from wind farms do, however, show that the mortality estimates predicted by the assessments do not correlate with the actual recorded mortality [17, 18, 88]. This can have many causes, but one possible cause is the way monitoring is conducted. Many environmental impact assessments (EIAs) are based on abundance surveys, but abundance is a poor predictor of which birds are at risk [2].

Mitigation

Since the factors affecting bird and bat collisions with wind turbines are still relatively unclear, mitigation can be difficult; nevertheless, several attempts have been made with varying success.

Wind turbine curtailment and shut-down on demand

One mitigation strategy is turbine curtailment. Turbine curtailment can take two forms: inhibiting turbine rotation during high bat activity and/or restricting turbines at low wind speeds (bats forage and are more active during low wind speeds).

Curtailment (restricting blade rotation at low wind speeds, for example, <7 m/s, when bats are active; [38, 89] [90] is the most successful method of reducing collisions globally, with typical fatality reductions ranging from 44% to 93% [37, 82, 85, 91, 92].

Investigations into the contributing factors of bat fatalities at wind farms are more researched in the Northern Hemisphere [37, 38, 44, 86, 90, 93] than Australia. From this work, it is widely agreed that curtailment is the most successful method of reducing turbine-associated fatalities. Curtailment involves the operational restriction of turbines at low wind speeds (often lower than 6 m/s) between dusk and dawn during periods of high bat activity, generally from summer to autumn [6, 17, 18, 37, 38, 42, 82, 83, 85, 90-92]. These results suggest that applying curtailment significantly drops bat mortality by 54% [82].

A 2021 quantitative meta-analysis to evaluate operational minimisation across 19 North American treatments at eight wind energy facilities indicates that operational minimisation is an effective strategy for reducing bat mortality at wind turbines and that the efficacy is measurable. Researchers estimate that total bat fatalities are reduced by 33% with every 1.0 m/s cut-in speed. Extrapolating this data across multiple facilities and years, a 5.0 m/s cut-in speed is estimated to reduce total bat fatalities by an average of 62%. They estimate total bat fatality reductions at individual facilities in any given year to fall between 33%-79%. In addition, the meta-regression analysis demonstrates that the efficacy of operational minimisation to reduce bat fatalities was not highly variable among facilities nor among turbine types (i.e., rotor swept areas or hub height), suggesting that operational minimisation can be expected to be effective at reducing bat fatalities across facilities and turbine types [92].

Despite increasing studies in the Northern Hemisphere demonstrating curtailment effectiveness, only one study has investigated curtailment in Australia (turbine cut-in speed 4.5 m/s-1; [82]. The curtailment study was implemented at the Cape Nelson North wind farm in southwest Victoria, Australia. Increasing turbine cut-in speed from 3.0 to 4.5 m/s-1 from dawn to dusk significantly reduced bat fatality by 54%. Curtailment was the principal explanatory variable for reduced mortality, as bat call activity did not differ significantly between study years. These findings are consistent with a growing body of global evidence demonstrating curtailment as an effective method for reducing turbine-associated bat fatalities. White-striped Free-tailed (WSFT) bats were the most impacted species in this study, with curtailment reducing their mortality by two-thirds [94].

Shut-down on Demand

Curtailment may not be an effective mitigation technique to reduce bird fatality [27, 37, 38, 58]. However, Shutdown on Demand (SDOD) may be based on real-time observations of species activity. A radar assisted SDOD system operated by observers has successfully eliminated fatalities for soaring birds over a five-year period, with the wind turbines only being shut down 0.2-1.2% of the time. SDOD data from 20 wind farms in

Cadiz, Spain, reduced the mortality of soaring birds by 62% and Griffon Vultures by 93%. As machine learning and Artificial Intelligence continue to increase, so may the accuracy and cost-effectiveness of this system [79].

Placement and layout of wind farms

Regarding avian fatalities, the placement and layout of the wind farms seem to be the most important mitigation measure. Relatively high mortality rates have been recorded at several large wind farms in poorly chosen locations with large concentrations of birds [95]. Clustering turbines together, providing corridors between the clusters and keeping turbines back from cliff edges to avoid soaring birds are all measures that have been proven to reduce bird fatality [21]. Size context is important, with literature derived from commercial wind farms that typically number between tens and thousands of wind turbines across a landscape. This suggests that wildlife mortality and improving management can only be loosely implied from the literature for smaller wind farm operations.

The use of ultrasonic transmitters to deter bats from rotor-swept areas and reduce bat fatalities

Experimental trials show evidence that ultrasonic devices can reduce bat activity, and evaluation of such devices installed on wind turbines has shown that they do reduce bat fatalities [96-98]. However, the effect seems to vary between species [97].

Insectivorous bat species emit ultrasonic (>20 kHz), (12-18 kHz for White-striped Free-tailed Bat) vocalisations to echolocate. Returning echoes of these vocalisations reflected from nearby objects are used for sensory perception [99]. Some insect prey have coevolved mechanisms to deter bat predation by emitting their ultrasound; effectively 'jamming' or masking an approaching bat's ability to receive and/or decipher its' own echolocation, thereby reducing capture success [100, 101].

Bat deterrents are based on aerodynamic whistles wherein flow-acoustic resonance is used to produce high-amplitude tonal sound at desired ultrasonic frequencies, which disturbs bats and interferes with and 'jams' bat navigation [102]. Ultrasonic disturbance has been considered a possible measure to deter bats from wind turbines. Trials conducted in a flight cage measuring approximately 60 m × 10 m × 4.4 m showed that ultrasonic emissions shifted the flight patterns of bats, although uniquely for different bat species [103].

Numerous studies have stated a reduction in bat fatalities from using amplified ultrasonic frequency emission [98, 104-108].

One potentially commercial example is the Bat Deterrent System (BDS) developed by NRG Systems https://www.nrgsystems.com. Each system unit consists of six sub-arrays, each generating tonal sound at a predetermined frequency using multiple transducers, e.g., a system could target 20, 26, 32, 38, 44 and 50 kHz frequencies. The six-tone BDS is effective in mitigating bat fatality. However, such electromechanical devices suffer from the following: (a) they require an external power supply, which limits the possible mounting positions of the devices to the nacelle and the tower, and (b) maintenance issues due to rain/water damage.

An Australian company, Bird Gard Australia, have ultrasonic bat deterrent devices (www.birdgard.com.au) that claim to be successful, although no commercial application can be found in the literature.

Modification of wind turbine design

Studies have also shown that bats will repeatedly try to drink from smooth surfaces and that detection of prey can be facilitated by a smooth background. For this reason, Bennett experimented [69] with textured surfaces on wind turbines. The results in the laboratory showed a 40% reduction of bat activity within 1 m of the textured surface, but unfortunately, field trials failed due to installation problems [69].

Another minimisation method that may reduce collision risk involves making wind turbines more visible to birds. Ultraviolet (UV) paint was thought to be more visible to birds but did not reduce collisions in one study [109] and controlled trials have indicated that some raptor species show little response to UV light (cited in American Wind Wildlife Institute [34]). However, painting one of the rotor blades black may be a more effective mitigation measure. One field study in the Smøla wind farm in Norway found that painting a single blade of each wind turbine black reduced annual bird fatality rates by over 70% and, interestingly, an even higher mortality reduction for raptors. A follow-up study due to be completed this year aims to "assess the impact on local birds, landscape aesthetics and aviation safety of painting blades black." [79].

Boom-and-bust ecology

Boom-and-bust seasons in the arid and semi-arid zones are novel considerations to wind turbine risks to birds and bats and, consequently, are not reported in the literature.

Although the Bureau of Meteorology records average annual rainfall, averages can be an inadequate indicator of what occurs in arid and semi-arid environments [25]. Typically, there are extended periods of drought episodically interrupted by extreme rainfall events, resulting in a boom-bust pattern of avian [25] and bat abundance [110]. The arid Australian environment fluctuates between spectacular boom periods when productivity and diversity are high, and drought when biotic resources are depleted [13, 111, 112]. Understanding and applying the boom-bust cycle critically influences the abundance of a species and the likelihood of collision or near collision with rotating turbines. Further, during boom seasons, the ecology of species does change; for example, some species, such as the male Pied Honeyeater (*Certhionyx variegatus*), conduct territorial and breeding display flights at a considerable height above the surrounding vegetation canopy. It is assumed that two boom seasons will occur within the 20-year life of the turbines.

In response to an episodic rainfall event, desert landscapes can change from zero permanent water bodies to an extensive network of resource-rich yet short-term wetland habitats [112]. How waterbirds can detect far-off floodwaters is still unknown, but their ability to do so is beyond doubt [25].

Birds in an arid and seasonal ecosystem have shown a marked increase in the amount of nocturnal flight, the total distance flown daily, and the number of sites visited at night following major rainfall events [112]. Recent research has shown that ducks almost exclusively flew long-distance flights following rainfall events at night, and the cumulative distance travelled at night was higher than during the day. They also visited more locations at night: different locations and ones that were more dispersed than those visited during the day when they remained relatively sedentary in an arid seasonal ecosystem [112]. Boom conditions increase the connectivity between waterbodies, night-time flying of waterbirds and the abundance and diversity of waterbirds. During these boom conditions, the significance of night-time flying is considered.

Nomadic waterbirds fly vast distances to take advantage of food resources by locating temporary water in arid biomes where rainfall is highly unpredictable in space and time [113]. Their nomadic temperament is often depicted as 'erratic' or 'unpredictable' and is regularly classified separately from seasonal migration [114]. Their capacity to respond to changing wetland distribution at broad scales [114] and their ability to fly vast distances in response to unpredictable climatic events may increase their vulnerability to anthropogenic threats [113].

Salt lakes are an additional fauna habitat that is predominantly dry. They are a temporary water and food source after flooding and intermittently provide habitat for several migratory taxa listed under the EPBC Act.

Many other much larger lakes can provide linkage and habitat, meaning that water birds will travel between temporary and semi-permanent water bodies. The presence of migratory waterbirds is likely to be associated with artificial habitats providing a water source during dry seasons. Still, they will occupy natural temporary water sources during wet seasons.

Satellite-tagged Banded Stilts (*Cladorhynchus leucocephalus*) have been recorded flying 1 000 to 2 000 km over several days or weeks through inland Australia to reach flooded salt lakes [113, 114]

The boom-bust cycle extends beyond waterbirds and occurs amongst seed eaters such as Zebra Finch, Budgerigar, Diamond Dove and Cockatiels, nectar and insectivores [25] and probably bats [110, 115].

Legislation and Industry Guidelines

Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act), Commonwealth of Australia

The EPBC Act [116] provides a legal framework to protect and manage nationally and internationally important flora, fauna, ecological communities and heritage places, defined as matters of national environmental significance.

The EPBC Act, under Subdivision C, Section 18, refers to "*actions with significant impact on listed threatened species or endangered community prohibited without approval*" [116]. Section 20 refers to the requirement for approval of activities with a significant impact on a listed or migratory species. The Act also provides legislative protection to migratory species under the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention*)*, Republic of Korea-Australia Migratory Bird Agreement (ROKAMBA) Japan and Australia Migratory Bird Agreement (JAMBA) and the China and Australia Migratory Bird Agreement (CAMBA) international treaties.

The relevant objectives of the EPBC Act are to:

- provide for the protection of the environment, especially matters of national environmental significance;
- conserve Australian biodiversity;
- provide a streamlined national environmental assessment and approvals process;
- enhance the protection and management of important natural and cultural places; and
- promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources [117].

Pertinent to the NSR proposed wind turbine development is any potential significant impact of the proposed wind turbines on nationally threatened species and migratory species.

If a proposal has the potential to significantly impact a species or a matter of national environmental significance and/or the environment, it must be referred for formal assessment under the EPBC Act.

Significant Impact Criteria (EPBC Act)

Significant impact guidelines 1.1, EPBC Act 1999, provide overarching guidance on determining whether an action is likely to have a significant impact on a matter protected under national environment law [118]. They assist any person who proposes to take action in deciding whether or not to submit a referral to the Australian Government Department of the Environment and Energy for a decision by the Australian Government Environment Minister.

Defined terms under the EPBC Act for critically endangered, endangered or vulnerable species

Population

A 'population of a species' is defined under the EPBC Act [118, 119] as an occurrence of the species in a particular area. In relation to critically endangered, endangered or vulnerable threatened species, occurrences include and are not limited to:

- a geographically distinct regional population, or collection of local populations; or
- a population, or collection of local populations that occurs within a particular bioregion.

Important population

An important population, as stated in the Significant Impact Guidelines 1.1 document [118], is a population that is necessary for a species' long-term survival and recovery. This may include populations identified as such in recovery plans and/or are:

- key source populations either for breeding or dispersal;
- populations that are necessary for maintaining genetic diversity; and/or
- populations that are near the limit of the species' range.

Population (migratory species)

Population, in relation to migratory species, as defined by the Bonn Convention [120] and adopted by the EPBC Act [19] means the entire population or any geographically separate part of the population of any species or lower taxon of wild animals, a significant proportion of whose members cyclically and predictably cross one or more national jurisdictional boundaries, including Australia.

An ecologically significant proportion of the population

Listed migratory species cover a broad range of species with different life cycles and population sizes. Therefore, what is an 'ecologically significant proportion' of the population varies with the species (each circumstance will need to be evaluated). Some factors that should be considered include the species' population status, genetic distinctiveness and species-specific behavioural patterns (for example, site fidelity and dispersal rates) [118].

Referral criteria

Critically endangered, endangered and vulnerable species

An action is likely to have a significant impact on a critically endangered or endangered species if there is a real chance or possibility that it will:

- lead to a long-term decrease in the size of a population;
- reduce the area of occupancy of the species;
- fragment an existing population into two or more populations;
- adversely affect habitat critical to the survival of a species;
- disrupt the breeding cycle of a population;
- modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline;
- result in invasive species that are harmful to a critically endangered or endangered species becoming established in the endangered or critically endangered species' habitat;
- introduce disease that may cause the species to decline; or
- interfere with the recovery of the species [118].

Migratory species

An action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;
- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or
- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species [118].

Biodiversity Conservation Act 2016, Western Australia

The *Biodiversity Conservation* Act 2016 (BC Act) [121] of Western Australia repeals the *Wildlife Conservation* Act 1950 and the *Sandalwood* Act 1929, both of Western Australia. The BC Act of Western Australia and

Biodiversity Conservation Regulations 2018 (the Regulations) [122] (commencement 1 January 2019) provide the legal framework for:

- the conservation and protection of biodiversity and biodiversity components in Western Australia; and
- the ecologically sustainable use of biodiversity components in Western Australia.

Possible threatened fauna or data deficient are listed as priority species and are ranked from one (the highest priority) to three as poorly-known species [123]. Species that are rare, near threatened, and other species in need of monitoring are ranked as priority 4 [123].

Environmental consideration guidelines for wind farms

This report follows and considers the guidelines provided herein. BirdLife Australia has developed a wind farm policy [9] which states whether the construction and operation of a wind farm poses a significant risk to important bird populations, particularly for species of conservation concern. BirdLife Australia advocates that consideration be given to protected areas network, Ramsar Wetlands, migratory corridors and sites strongly favoured by soaring birds. Furthermore, BirdLife Australia states that assessment and approval processes demonstrate sound scientific and risk assessment approaches and make the results publicly available.

The Australian Government, Department of Environment, Water, Heritage and the Arts (now DCCEEW) produced an EPBC Act, Policy Statement 2.3, Wind farm industry (2009) [124], and the draft (2024) Onshore Wind Farm Guidance under Australia's national environment law.

The Clean Energy Council Best Practice Guidelines provide guidelines for environmental technical aspects concerning the assessment of any bird and bat impacts [14] so that rigorous, scientifically-based approaches are used in assessing and monitoring ecological issues at Australian wind farms.

The Western Australian Department of Planning, Lands and Heritage, Position Statement: Renewable energy facilities [125] provide minimal guidance on the matter of bird and bat conservation. This Position Statement supersedes the Western Australian Planning Commission, Planning Bulletin No. 67 [126].

Methodology

Literature and data review

The information for this assessment was through reviewing the reports provided to DES, which included desktop surveys, database surveys, literature reviews, and specific surveys.

NSR provided DES with the relevant site-specific reports as listed:

- Phoenix Environmental Sciences Terrestrial fauna assessment Fimiston Gold Mine Operations (Revised) [127]; Phoenix Environmental Sciences Basic and Targeted Terrestrial Fauna Survey for the Kalgoorlie Operations Project [128]; Phoenix Environmental Sciences Basic and Targeted Terrestrial Fauna Survey for the Kalgoorlie Operations Project (Final) [129]; Phoenix Environmental Sciences Avian memo [130]; Phoenix Environmental Sciences Targeted Malleefowl survey for the Kalgoorlie Renewable Energy Project [131]; Phoenix Environmental Sciences Basic and terrestrial fauna survey for the Black Flag Pastoral Lease [132];
- Tailings Storage Facility Expansion Desktop Fauna Assessment [133];
- Proposed Tailings Storage Facility Expansion NSR Pty Ltd Kalgoorlie, Botanica Consulting [134];
- The Malleefowl species-specific surveys provided insight into fauna abundance and peri-urban influences on fauna abundances [135].

DES accessed the Birdlife Australia Database (accessed 21 April 2024) and the region's eBird Bird Records (accessed 21 May 2025).

DES reviewed additional wind turbine and wildlife impact literature through the Web of Science database of bibliography citations.

DES has conducted monthly avian and bat surveys at NSR since 2016 in accordance with the site's Hypersaline Cyanide Code Management Plan [136]. Initially, this work was to determine the fauna to be at risk with the proposed presence of a cyanide-bearing tailings system and the protective mechanism afforded by hypersaline [137]. DES conducted quarterly (seasonally) bat and avian wildlife monitoring of six to eight days duration. This work is ongoing. Since February 2016, 180 field TSF observation days (n=1014, 20-minute discreet observations) documenting avian use of NSR TSFs. Between September 2016 and March 2025, 819 bat survey nights have been conducted at the TSF and at other comparative water bodies. This data is considered in this risk assessment. DES has published wildlife risks from cyanide-bearing tailings [115, 137-140] which is used here for species inventory and behaviour.

Nomenclature and Taxonomy

Scientific and English common name nomenclature follow:

- Birds: BirdLife Australia (2022) Avian Taxonomic Working List; and
- Western Australian Museum's Checklist of the Vertebrates of Western Australia (Western Australian Museum, 2018; updated September 2018).

Baseline Ecological Surveys

A number of field baseline studies were implemented to characterise wind turbine collision risks to birds and bats. Five electronic survey stations were established within the vicinity of the proposed wind turbine locations, where Anabat™ Ranger (bat detectors) and Wildlife Acoustic Song Meter™ (bird call recorders) were established.

20-minute field bird surveys were also conducted within and near the proposed development footprint and at the Kalgoorlie Wastewater Treatment Plant (KWTP).

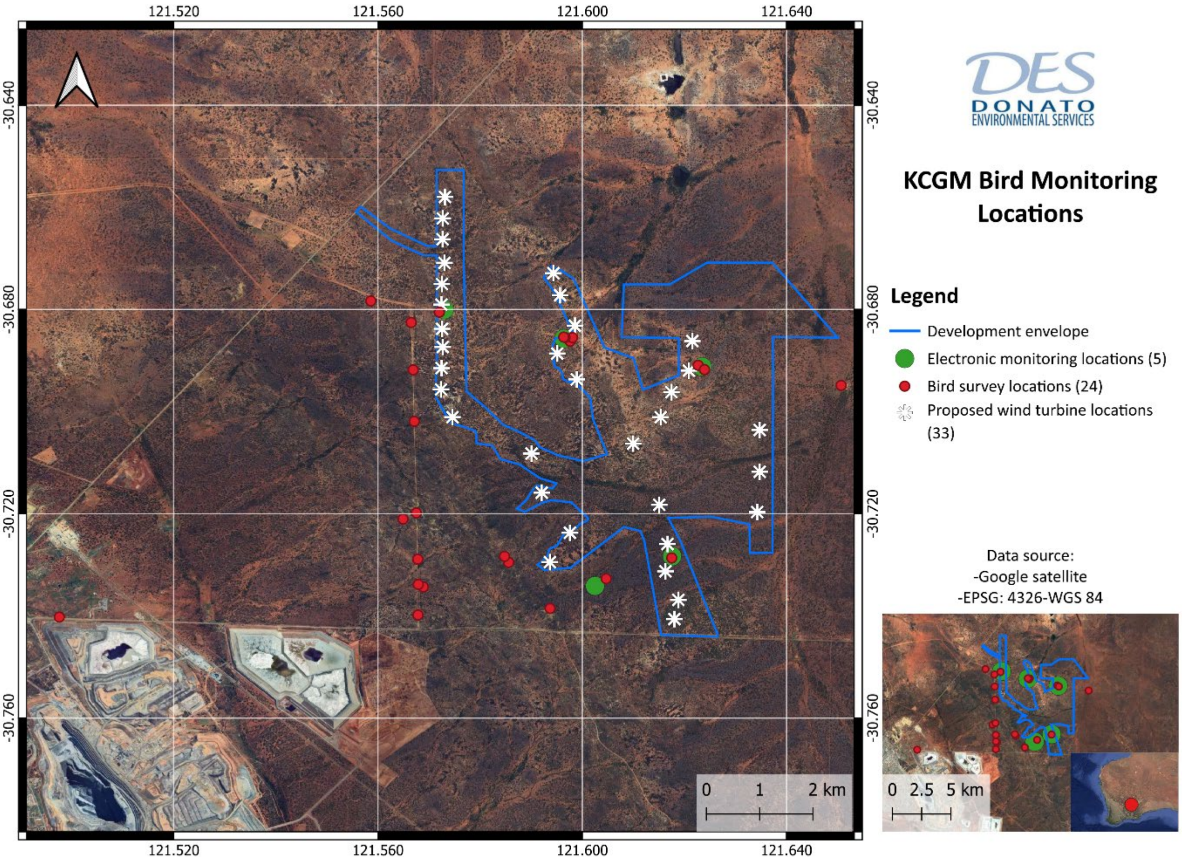

Figure 3. Bird and electronic survey locations

Bird Surveys

Bird surveys were conducted within the development footprint, in adjacent surrounding habitats, and at the KWTP. The purpose of these searches and subsequent analyses was to gain an insight into species' presence, seasonality, relative abundance, and distribution specific to the development footprint.

20-minute 2 Ha bird surveys (development footprint and KWTP)

Thirty 20-minute 2 Ha bird surveys (at 24 locations) were conducted within the development footprint by DES ecologists. Within the 2 Ha survey area, all bird species were identified (presence) typically by bird call, and collated on the eBird App. The surveys have thus far been conducted between October 2024 and July 2025.

20-minute 2 Ha bird surveys were conducted within the KWTP. Within the 2 Ha survey area, all bird species were identified (presence) typically by sight, and collated on the eBird App. Three surveys of the KWTP were conducted between October 2024 and July 2025.

5-min audio bird recordings (Kaleidoscope analysis)

To characterise the avian fauna within the development footprint, five Wildlife Acoustics Song Meter™ (SM4) were established within the development footprint (see Figure 3). They record audio for five minutes on the hour every hour (see Table 3). Each of the five SM4s recorded 422 hours of audio, equating to 2 110 recording hours between October 2024 and July 2025 and is ongoing.

Song Meter™ were set with the following parameters: Sample rate 16 000 Hz (mono), only left microphone on, compression off, 26 dB of preamplifier gain for the internal microphones for the SM4s, low filter off, high filter off, trigger level off and trigger window off.

Calls were initially identified by manually listening to and viewing through Wildlife Acoustics Kaleidoscope [141] sonograms, through random selection of 11 5-minute output song acoustic files from site 1. Calls (n=67) were aurally identified and collated to species taxa level by DES ecologists.

The 88 bush bird species calls likely to be and have been recorded in the region were extracted from the Bird Observers Club of Australia (BOCA) Birds Calls of Australia collection. These calls were duplicated and placed within the bird call dataset (as bait) recorded within the development footprint using the SM4s. Kaleidoscope™ Pro v5.1.8 (Kaleidoscope) software [141] was then used to cluster similar calls like-for-like and against the selected bird species recording within the BOCA (Birds Calls of Australia). The following Kaleidoscope parameters:

- Signal detection 250 to 20 000 (Hz);
- 0.1 to 7.5 seconds for minimum and maximum length of detection;
- 1 second maximum inter-syllable gap; and
- DC offset not removed (average value of the time domain waveform).

The clustering parameters were as follows:

- 2 for maximum distance from cluster centre;
- 5.33 ms for Fast Fourier Transformation (FFT);
- 12 for Algorithm states;
- 0.5 for maximum distance for building clusters;
- 500 for max clusters collation; and
- No noise filters were applied.

A collation of species and their relative abundance was then tabulated through Kaleidoscope csv outputs.

Specific call analysis was performed on the following species, because of their flying habits, extent of vocalisation, legislative status, and to determine night flying habits of waterbirds:

- Regent Parrot;
- Western Rosella;
- Mulga Parrot;
- Scarlet-chested Parrot;
- Purple-crowned Lorikeet;
- Night Parrot (see Appendix B);
- Grey Teal, (nocturnal high-pitched call);
- Spotted Nightjar;

- Pallid Cuckoo;
- Rainbow Bee-eater; and
- Dusky Woodswallow.

Energy searches were conducted on the nocturnal calls in an attempt to detect the wing noise of flying waterbirds and migratory waders.

All species were collated and tabulated, and information was input into the risk assessment Table 13.

5-min audio bird recordings (Wilder Sensoring analysis)

Data from KWT01 (site 1) was input into Wilder Sensing Software (WSS) to detect bird species using the BirdNet bird call dataset. Analysis of bird calls have not been undertaken until the baseline surveys have been completed. WSS detected 44 species, which were then tabulated into the site species list. WSS was also used to determine the seasonality of selective species and of bird species collectively. Although WSS is capable of providing landscape distributional data of bird species across the landscape, this will be undertaken when the baseline surveys have been completed.

All species were collated and tabulated, and information was input into the risk assessment Table 13.

Raptor drive searches

Raptors are generally silent for most of the time, and aural searches using SM4 recording equipment for this taxa are not effective.

Opportunistic driving searches have been conducted along Bulong Road, a 12 km distance between Kalgoorlie township and the junction of Bulong and Curtin Road. Searches were also conducted on roads skirting the Kalgoorlie township and around the KWTP. Further searches were conducted along Yarri Road between the Kalgoorlie township and the Kanowna Cemetery.

A total of 16 searches were conducted opportunistically, occurring each month between October 2024 and July 2025 (except April 2025). Ten specific locations were identified with raptors present.

When raptors were observed, the location was GPS marked, species identified, number counted and behaviour recorded.

All species were collated and tabulated, and information was input into the risk assessment Table 13.

Electronic Bat Monitoring

Bat surveys consisted of electronically recording bat calls (echolocation recorders) to measure bat activity within the proposed swept path of wind turbine blades. To determine bat activity in the airspace from ground level, up to 150 m above the surrounding terrain, DES used Anabat™ Ranger with specific directional microphones. The Ranger bat detectors' microphones were funnelled upwards to detect only calls about the detector. This enabled the detectors to be used in all weather conditions. The Ranger bat detectors survey effort is provided in Table 4 below.

Bat presence and relative activity were documented from 22 October 2024 to 12 May 2025 using five pre-programmed Anabat™ Ranger detectors equipped with directional microphones to record bat echolocation calls. The devices were located at five locations (KWT01-KWT05) within the proposed wind turbine area, Each detector was mounted on a star picket (Figure 4), and their location was GPS mapped.

The Anabat™ device settings were as follows:

- Fitted with directional ultrasonic microphones US-D (preroll-off frequency range 10-250 kHz);
- GPS-located for geometric sunset and sunrise times;
- Operating schedules set at 30 minutes before geometric sunset to 30 minutes after geometric sunrise;
- No filters were activated;
- Files were recorded as zero-cross (zc) for analysis; and
- The division ratio was set to 16.

The data were recorded onto compact flashcards with Anabat™ software (Corban 2000) used for reviewing echolocation calls. Kaleidoscope Pro (version 5.6.8) was used for pre-processing, during which noise files were removed, and for performing cluster analysis of bat echolocation calls. Signal parameters for cluster analysis were set as follows:

- A frequency range of 8-80 kHz was applied;
- A pulse duration of 2-500 ms (default) was used;
- A maximum inter-syllable gap of 5000 ms was applied;
- A minimum number of two pulses (default) was required; and
- The zero-CF Noise Filter (default settings) was applied.

Cluster analysis settings were left at default, allowing recordings to be scanned and grouped automatically. As a result, *cluster.kcs* and *cluster.csv* files were generated for further manual review.

Manual review of bat echolocation calls was conducted within Kaleidoscope Pro (version 5.6.8). Only search-phase bat calls (also referred to as cruising calls, which have relatively regular pulse shapes that differ between species) were used for species identification [142, 143]. Clustered calls were visually inspected, and characteristics such as call shape and characteristic frequency were examined to assist in identifying species presence. A minimum of three consecutive search-phase pulses was typically required for call identification. However, longer call sequences were preferable [143]. Therefore, calls with fewer than three pulses were usually classified as unidentified.

Some difficulty was encountered when distinguishing between the calls of Gould's Wattled Bat (*Chalinolobus gouldii*) and the Inland Broad-nosed Bat (Scotorepens spp.*),* between *C. gouldii* and Ozimops spp., and between Vespadelus spp. and Chocolate Wattled Bat (*Chalinolobus morio*) due to overlapping frequencies and similarities in call shape. Where a positive identification to species level could not be confidently made, the call was recorded as unidentified. *The Bat Calls of New South Wales* [142] and *Key to the Bat Calls of the Top End of the Northern Territory* [143] were used as references to assist in the identification of cruising calls.

After all calls had been identified, bat composition and activity were measured on a per-night or per-hour basis. Species and hourly cohorts collated the data, and results were tabulated as calls/hour or calls/night. A total of 8 203 hours of bat search-phase calls were recorded over 683 nights between 22 October 2024 and 12 May 2025, as considered in this report (Table 4).

Table 2. Location, serial number and naming of electronic monitoring sites

Song Meter™ Serial No	Site	Latitude	Longitude
6606	KWT01	-30.6800	121.5730
8737	KWT02	-30.6857	121.5964
8712	KWT03	-30.6912	121.6235
8714	KWT04	-30.7341	121.6025
6597	KWT05	-30.7283	121.6176

Table 3. Songmeter (SM4) survey efforts, KWT01, KWT02, KWT03, KWT04, and KWT05 refer to the turbine number

Site	Start Date	End Date	Recording Hours
KWT01	28-Oct-24	22-Jul-25	4 709
KWT02	1-Dec-24	22-Jul-25	4 484
KWT03	15-Nov-24	22-Jul-25	5 417
KWT04	29-Oct-24	22-Jul-25	5 727
KWT05	29-Oct-24	22-Apr-25	5 474
Total			25 811

Table 4. AnabatTM Ranger survey efforts, KWT01, KWT02, KWT03, KWT04, and KWT05 refer to the turbine number

Site	Start Date	End Date	Total Nights	Recording Hours
KWT01	28-Oct-24	12-May-25	152	1 854
KWT02	22-Oct-24	26-Apr-25	141	1 685
KWT03	22-Oct-24	16-Apr-25	113	1 358
KWT04	29-Oct-24	24-Apr-25	147	1 749
KWT05	29-Oct-24	22-Apr-25	130	1 557
Total			683	8 203

Figure 4. Ranger bat detector with directional microphone funnelling upwards

Risk Assessment

Predicting wildlife deaths associated with a collision by wind turbine blades is not a precise science. Quantitative models have been developed [8, 144] to estimate wildlife deaths and the probabilities of likelihood. They involve numerical assumptions on bird populations, bird tendency to fly at particular heights, birds' avoidance frequency, and environmental conditions such as fog, rain and blade speed and number [144]. Most of these parameters have to be subjectively applied, as for Australian bird species, these parameters have to be simply assumed; even less is known about Australian bat species. This, coupled with applying such models to inland semi-arid Australian environments, equates to quantitative models simply not being applicable in risk determination.

To assess risks in complex situations, with unknown variables and scenarios, subjective determinations through formalised risk assessment frameworks are best at achieving meaningful outcomes for decision makers [9, 14, 20, 56, 126, 145, 146].

This report follows the impact assessment approach following that of Standards Australia/Standards New Zealand *Environmental risk management – principles and process HB 203:2006* (the Australia/Standards New Zealand risk assessment guide) [1]. It assumes a wind turbine operational life of 20 years and stochastic boom seasonal conditions every ten years. A qualitative analysis (Table 5 and Table 6) has been used to assess the impacts on fauna. These tables have considered the Australia/Standards New Zealand risk assessment guide) [1], the Mining Proposal Guidance - How to prepare in accordance with Part 1 of the Statutory Guideline for Mining Proposals [147] and have been contextualised for wildlife impact from wind turbines. The analysis is a tool to help derive a measure of risk for each impact from a combination of two elements:

- likelihood that an avian or bat impact with a wind turbine will occur; and
- consequence of the impact.

Table 5. Qualitative measures of likelihood

Level	Descriptor	Description
A	Almost certain	Is expected to occur in most circumstances
B	Likely	Will probably occur in most circumstances
C	Possible/Occasional	Could occur
D	Unlikely	Could occur but not expected
E	Rare	Occurs only in exceptional circumstances

Table 6. Qualitative characterisation of consequence for the five impact levels used

Level	Descriptor	Typical industry definition	Definition relating to wildlife impact and consequence
1	Catastrophic	Environmental: severe environmental damage. Local species destruction and a long recovery period are likely. Extensive clean-up required. Impact on a regional scale. Regulatory: license to operate revoked or suspended. Forced site shutdown to closure.	A significant number (5) of endangered and/or internationally listed species are impacted. Local loss of conservation listed species. A significant number of non-listed species. Loss of control of risk. Systemic failure. Notification to the regulatory bodies. Implementation of a Corrective Action Plan is required.
2	Major	Environmental: serious environmental damage with major environmental impact. Requires large clean-up efforts. Extends beyond lease boundary. Regulatory: regulation breach, action by regulator likely. Penalties, for example, fine or infringement notice issued. Possible or actual prosecution.	Impact on conservation listed species (more than five individuals, more than one occurrence). Major impact on non-listed species (more than ten individuals, regular occurrence). Loss of >50% of the known local population. Notification to the regulatory body. Loss of control of risk. Implementation of a Corrective Action Plan is required.
3	Moderate	Environmental: moderate and reversible environmental damage. Clean up possible by site personnel. Confined within lease boundary. Regulatory: technical compliance issue. Possible regulator action. Field notice issued. Exceed statutory limit.	More than five individuals of non-listed species in a single incident or more than five non-listed individuals in multiple incidents. Loss of <50% known local population. Additional actions are required to address a deficiency.
4	Minor	Environmental: minor environmental damage restricted to lease and within the previously disturbed area. Regulatory: minor technical breach. Internal standard exceeded. An explanation letter to the regulator is required.	Less than five individuals of non-listed or conservation listed species. Isolated incident. Control of risk maintained. No immediate additional action is required to address the impact. The site remains compliant with regulatory authorities if adequate and timely actions are in place.
5	Insignificant	Environmental: no or very low environmental damage and impact confined to a small area. Regulatory: no potential legal action. Standard or limit not exceeded.	Loss of a non-listed or conservation listed individual animal.

A risk matrix is used to calculate the measure of risk using likelihood and consequence (Table 4). As outlined in the risk assessment guide [1], measures of risk are defined as:

E = Extreme risk: immediate action required.
H = High risk: senior management attention needed.
M = Medium risk: management responsibility must be specified.
L = Low risk: managed by routine procedures.

Table 7. Qualitative and quantitative risk analysis matrix: level of risk

	Consequence				
Likelihood	Insignificant (5)	Minor (4)	Moderate (3)	Major (2)	Catastrophic (1)
Almost certain (A)	Medium	High	High	Extreme	Extreme
Likely (B)	Medium	Medium	High	High	Extreme
Possible/ Occasional (C)	Low	Medium	Medium	High	High
Unlikely (D)	Low	Low	Medium	Medium	High
Rare (E)	Low	Low	Low	Medium	Medium

A risk matrix process is not intended to provide definitive answers. However, it is a tool for working through complex matters. Although a matrix may produce a risk rating, this needs to be taken into the situational context. As instructed in the risk assessment guide, the acceptable risk level is specific to the analysed and managed activity [1].

DES considers inherent extreme and high risks require further consideration, monitoring and mitigation. DES considers a moderate risk would require monitoring, and if monitoring data suggests so, targeted mitigation measures. A low risk would require following existing procedures.

A precautionary principle is inherent in this risk assessment by using the definition of flying above the vegetation canopy as a risk factor (and not whether a species flies higher than the rotor blades swept path). For most Australian bird and bat species, flight height is not known, yet whether a species flies above the vegetation is generally known through literature and field observations. The vegetation canopy height is between one and five metres, yet the rotor blade swept path is 59 metres above ground level. Although a species is known to fly above the canopy (5 m), it is not known how high above the canopy, so it is conservatively assumed here, it may be within the swept path of the rotor blades.

Where unknown factors or uncertainty exist, DES has applied a precautionary approach [1]. According to the risk assessment guide, p.69 [1]:

"Where there are threats of serious or irreversible environmental damage, lack of full scientific uncertainty should not be used as a reason for postponing measures to prevent environmental degradation...rather we put appropriate measures in place in advance of more scientific evidence".

In accordance with the risk assessment guide, the worst-case scenario risk rating is applied, that is, if a moderate risk is derived due to favourable seasons but a low risk during dry seasons, then the moderate risk applies.

Mitigation measures may be implemented for those species where an inherent moderate and a high risk have been identified. These mitigation measures, primarily targeted curtailment, are specifically described under the Species Account section of this report. A resident risk rating is also provided under the Species Account section of this report.

Results

Species taxa and threatened status

The combined literature, desktop surveys and field surveys have identified 192 avian taxa from 56 families (Appendix A) as occurring, likely to occur, or may occur within 50 km of the development footprint.

The combined literature, desktop surveys and field surveys have identified 12 bat taxa from 3 families (Appendix A) as occurring, likely to occur, or may occur within 50 km of the development footprint.

A total of 32 avian taxa are listed under the EPBC and BC Acts. Only taxa status of Western Australian subspecies was considered where relevant or recognised taxonomically.

Table 8. Specifically, legislated conservation listed and locally significant fauna taxa recorded or potentially present in the region.

Species	Conservation Status (CS)		Local Records	Preferred Habitat Type	Status in Survey Area	
	Commonwealth status (EPBC Act)	WA status (BC Act)			Habitat Present	Expected Status
	CS1	CS2				
Malleefowl	V	V	Historic	Dense scrub, Acacia, rocky hills	Yes	Vagrant
Musk Duck	MA		Kalgoorlie Sewage ponds (KSP)	Wetlands		Potential
Eastern Great Egret	MI	M, IA	Kalgoorlie Sewage ponds	Wetlands		Potential
Fork-tailed Swift	MI	M, IA	Recorded within development footprint	Aerial	Yes	Vagrant
Black-eared Cuckoo	MI		Locally present	Woodlands	Yes	Migrant
Fan-tailed Cuckoo	MI		Recorded within development footprint	Woodlands	Yes	Migrant
Pallid Cuckoo	MI		Recorded within development footprint	Woodlands	Yes	Migrant
Australian Bustard		L	Few	Grassland with some shrub cover	Yes	Vagrant
Bush Stone-curlew		L		Acacia shrublands, rocky hills	Yes	Resident
Banded Stilt		L	KCGM TSF	Wetlands, salt lakes	No	Nomadic
Grey Plover	MA, MI	M, IA	KSP	Wetlands, salt lakes		Potential
Oriental Plover	MA, MI	M, IA	KCGM TSF	Wetlands, salt lakes		Potential
Hooded Plover	EN	P4		Wetlands, salt lakes		Potential
Sharp-tailed Sandpiper	MA, MI	IA	KSP	Wetlands, salt lakes		Potential
Curlew Sandpiper	MA, MI	IA	KCGM TSF	Wetlands, salt lakes		Potential
Red-necked Stint	MA, MI	IA	KCGM TSF	Wetlands, salt lakes	Yes	Migrant
Common Sandpiper	MA, MI	IA	KCGM TSF	Wetlands, salt lakes		Potential
Grey-tailed Tattler	MA, MI	IA				
Common Greenshank	MA. MI	IA	KCGM TSF	Wetlands, salt lakes		Potential
Wood Sandpiper	MA, MI	IA	KSP	Wetlands, salt lakes	Yes	Migrant

Species	Conservation Status (CS)		Local Records	Preferred Habitat Type	Status in Survey Area	
	Commonwealth status (EPBC Act)	WA status (BC Act)			Habitat Present	Expected Status
	CS1	CS2				
Marsh Sandpiper	MA, MI	IA	KSP	Wetlands, salt lakes	Yes	Migrant
Whiskered Tern	MA, MI	IA	KCGM TSF	Wetlands, salt lakes		Potential
Rainbow Bee-eater	MI		Recorded within development footprint	Woodlands, Aerial	Yes	Migrant
Sacred Kingfisher	MI		Recorded within development footprint	Woodlands	Yes	Migrant
Grey Falcon	V	V		Open grasslands	Yes	Visitor
Peregrine Falcon		S7, OS	Bulong Road powerlines	Shrubland, woodland	Yes	Resident
Carnaby's Black-Cockatoo	EN	CE			No	Vagrant
Western Rosella		P4	Regionally	Woodlands	Yes	Vagrant
Night Parrot	CE	CE	None	Spinifex, chenopod	No	Unlikely
Slender-billed Thornbill		L	Regionally present	Samphire, chenopods	Yes	Resident
Chestnut-breasted Quail-thrush		L	Recorded north of Kalgoorlie	Rocky outcrop, woodlands	No	Not expected
Southern Whiteface	V	V	Recorded in the region	Woodland, mallee	Yes	Resident

*Conservation Status Codes:

CS1: EPBC Act listed species: E = Endangered, V = Vulnerable, M = Migratory, CE = Critically Endangered, MA = Listed Marine;

CS2: BC Act listed species: VU = Vulnerable, OS = Other specially protected fauna, IA = International Agreement, CE = Critically Endangered. M = Migrtory, L = Least Concern;

DBCA Priority Species P1 - 4 = Priority 1 - 4; P3 = Priority 3: Poorly-known species - known from several locations, P4 = Priority 4: Rare, Near Threatened and other species in need of monitoring;

Recorded within the development footprint refers to the species being recorded during this work's field surveys.

Bird Activity

A list of bird species are known or likely to occur within or in the vicinity of the development (see Appendix A).

Field observations recorded only three raptor species within the development footprint; one Brown Falcon, which flew through the area about 20 m above the canopy, a pair of Wedge-tailed Eagles perched in a dead tree, and one Brown Goshawk was observed hunting birds under the canopy. No other raptors were observed. No raptors (although largely silent) were recorded on audio recording device (KWT01).

Raptors were commonly recorded above the adjacent TSFs and waste rock dumps associated with the NSR mining and process infrastructure. Furthermore, raptors including Black-shouldered Kite, Nankeen Kestrel, Wedge-tailed Eagle, Black Kite, Whistling Kite and Peregrine Falcon were all recorded on high voltage powerlines along Bulong Road leading to the development footprint. Ten locations outside the development footprint where raptors were recorded were identified. Raptors are generally absent from within or above the development footprint.

One waterbird (Grey Teal) activity was recorded on the audio recording device (site KWT01) flying overhead at night. Waterbirds are resident at the KWTP. The abundance of waterbirds at these ponds fluctuates enormously depending on the availability of water sources elsewhere. The KWTP acts as a refugia area: when the surrounding landscape dries, waterbirds concentrate at the sewage ponds. There was no evidence (field observations or audio recordings) that identified waterbirds transiting through the area from the KWTP to any nearby lakes, either during the day (field observations) or at night (audio device recordings). Field observations and audio recordings support the notion that the location is not part of a waterbird flyway.

A considerable amount of woodland bird activity, calls (n=62 species), were recorded from one audio recording device (site KWT01). The bird calls were collated and analysed from October 2024 through to May 2025, which provided an understanding of seasonality in bird activity. Most activity (bird calls) were recorded during the summer months, and less so during the cooler months.

Field observations detected species that are largely silent or call softly, but importantly, they recorded those species that fly above the canopy height. Field observations recorded eleven species that flew above and, in a manner not associated with the vegetation canopy. All these species are denoted in Appendix A.

Species of interest, including Regent Parrot, Western Rosella, Scarlet-chested Parrot, and Night Parrot calls, were specifically searched for in the audio recordings because they are vocal and may fly above the canopy. None of these species were detected from site recordings. Purple-crowned Lorikeet, Pallid Cuckoo, Rainbow Bee-eater and Dusky Woodswallow were all recorded from field observations and were high flying and known to be vocal. These species were also specifically searched for on audio recordings. They were found to be common and widespread, as determined by the audio recordings.

WSS detected considerable variation in bird calls (activity) on a daily and weekly basis from site KWT01. This identifies that birds are moving around within the landscape. Of note, WSS detected Common Greenshank, Whimbrel (incorrect identification) and Wood Sandpiper in March 2025 at KWT01, which may represent return migration to the Northern Hemisphere

The bird survey data are not presented numerically here, but the knowledge gained is incorporated into the risk assessment table (Table 13).

Bat activity

Note that data between 22 January and 21 February 2025 is missing due to equipment failure (most likely heat stress on batteries).

Bat activity is presented in numerical detail as the method (bat call collation) lends itself to numerical analysis, and importantly, since mitigation measures are proposed, which are dependent on measurement of bat activity during the night and across seasons.

Bat species activity seasonality

Bat seasonality is presented here as bat calls per hour as recorded by the five Anabat™ Ranger devices for the perceived at-risk species: White-striped Free-tailed Bat (*Austronomus australis*) (Figure 5 and Figure 8), Inland Free-tailed Bat (Ozimops spp.) (Figure 6) and Gould's Wattled Bat (*Chalinolobus gouldii*) (Figure 7).

Note that the zero recording between 22 January 2025 and 21 February 2025 is a data gap and not an absence of bat activity.

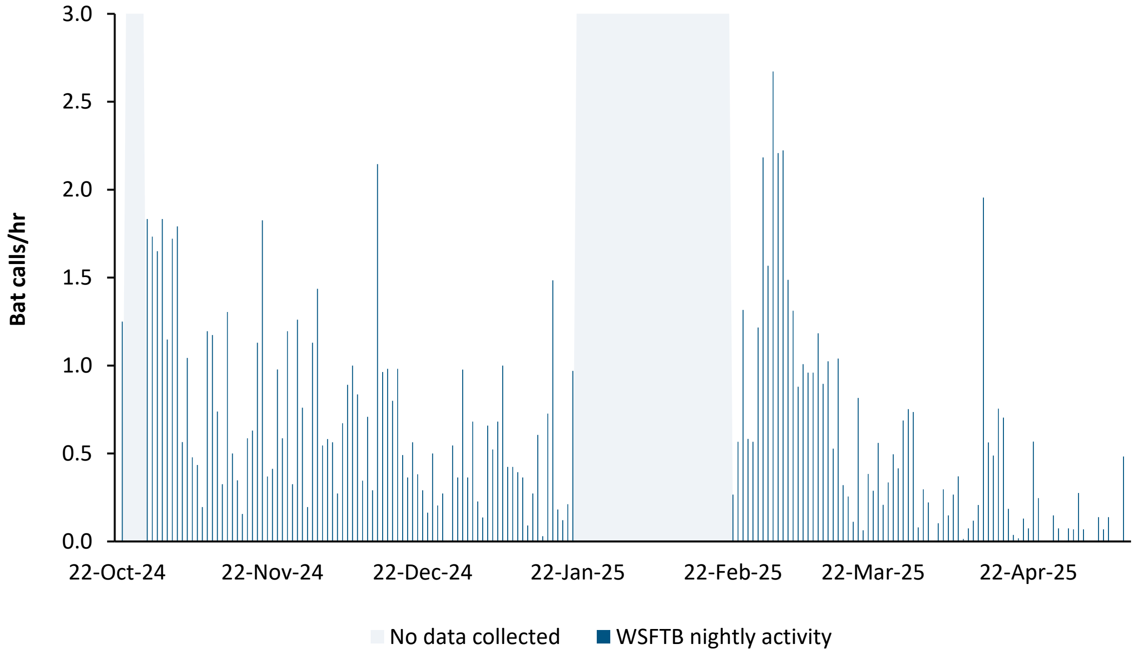

Figure 5. White-striped Free-tailed Bat seasonality (October 2024 to May 2025)

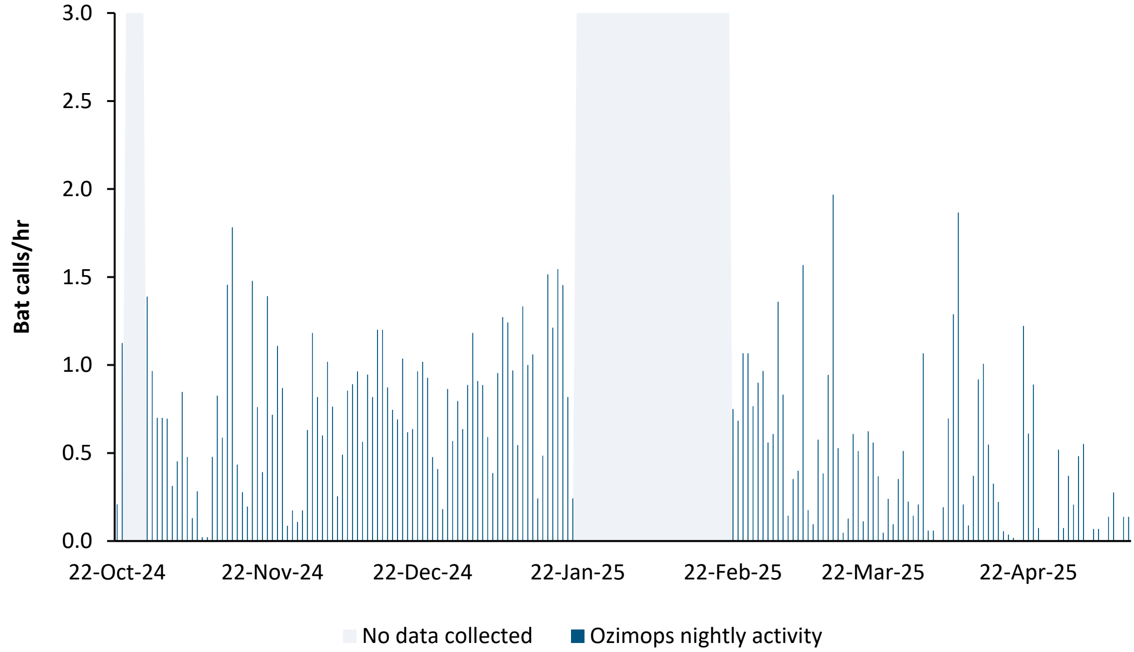

Figure 6. Inland/Southern Free-tailed Bat (Ozimops spp.) seasonality (October 2024 to May 2025)

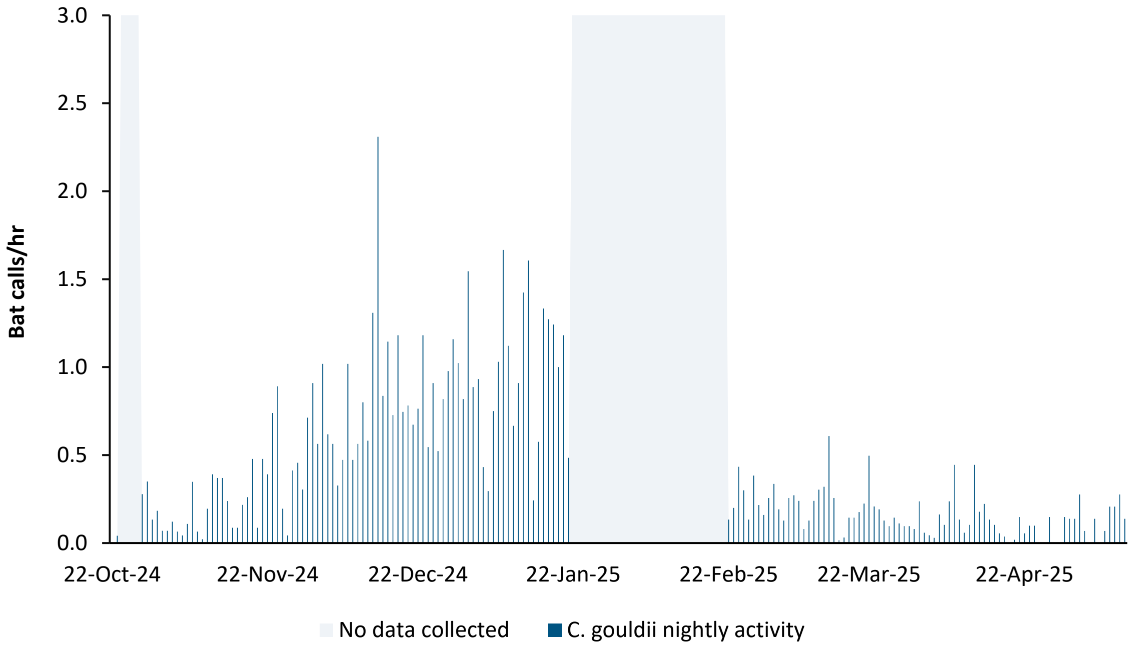

Figure 7. Gould's Wattled Bat seasonality (October 2024 to May 2025)

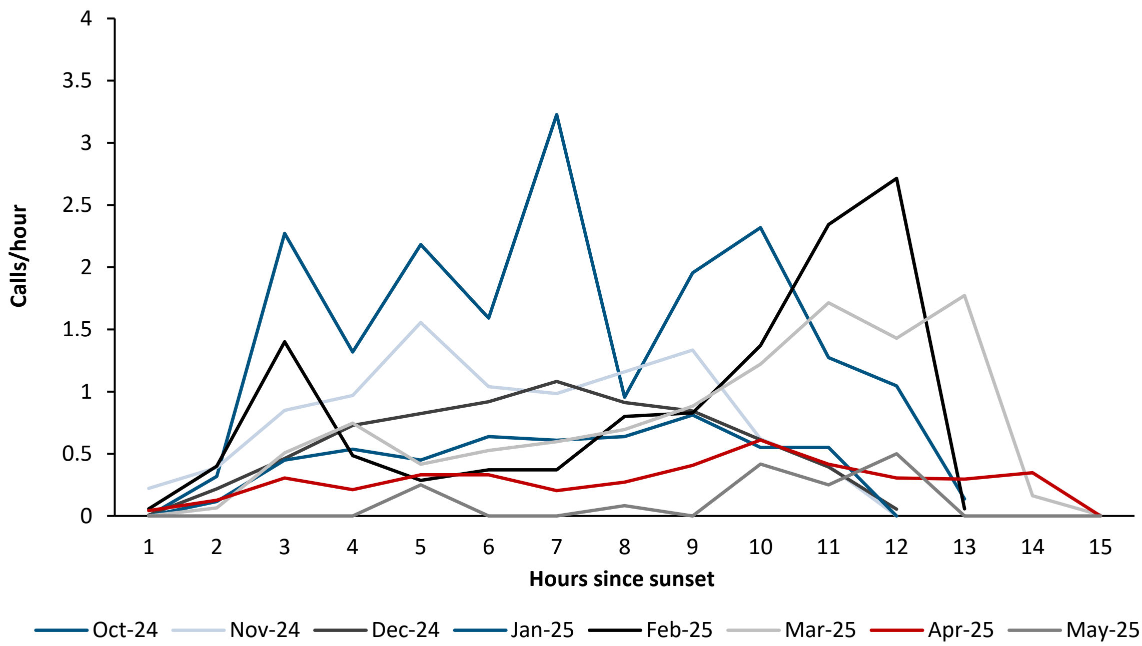

Figure 8. White-striped Free-tailed Bat activity in hourly cohorts (hours after sunset, seasonally adjusted October 2024 to May 2025)

A closer examination of the White-striped Free-tailed Bat (and other species) hourly cohorts on a monthly basis provides further insight into the species' ecology and turbine risk profiles (Figure 8). In October (2024), the species is not exceedingly active (relative abundance); however, it remains constantly active throughout the night. In November and December (2024) and January 2025, the species shows more activity after 4 hours of sunset and diminishes after 11 hours after sunset, and note that the overall activity is higher than for the previous month

The February 2025, graphics demonstrate that overall activity has declined compared to the previous three months. More interesting is that the species' feeding pattern has changed to feed just before dusk. Given the species is known to forage in temperatures below 21° Celsius [13, 148], and its activity is influenced by humidity [148], this is likely a response to high nocturnal temperatures after sunset (and reduced humidity), and the species feeds in the cooler conditions of predawn. This is again replicated in March 2025. However, in March, overall activity is higher, and this may reflect the passage migration as southern populations move north for the winter. By April and May 2025, the species has likely migrated north out of the region.

Table 9. White-striped Free-tailed Bat monthly cumulative (%) percentage activity in hourly cohorts (October 2024 to May 2025)

Month Activity: Cumulative %	Hours																Average calls/Hr
	1630	1730	1830	1930	2030	2130	2230	2330	0030	0130	0230	0330	0430	0530	0630	0730	
October		0	2	14	21	33	41	59	64	74	87	94	99	100			1.4
November		0	2	6	15	26	42	53	63	75	89	96	100	100			0.7
December			0	3	10	20	32	45	60	73	85	94	99	100			0.6
January			0	2	11	21	29	41	52	64	79	90	100	100			0.4
February			0	4	16	20	23	26	29	36	44	55	76	100	100		0.9
March		0	1	5	12	16	21	27	33	41	53	69	82	98	100	100	0.7
April		1	4	11	16	24	32	37	43	53	68	77	85	92	100		0.3
May	0	0	0	0	0	17	17	17	22	22	50	67	100				0.1
Combined %		0	1	6	14	21	31	40	49	59	71	82	91	99	100	100	4.33

Table 9 demonstrates that for most months, 90% of the cumulative bat activity is between 1 and 10 hours since sunset although this does vary between months. The table also demonstrates that the most active months are Spring (October) and Autumn (March).

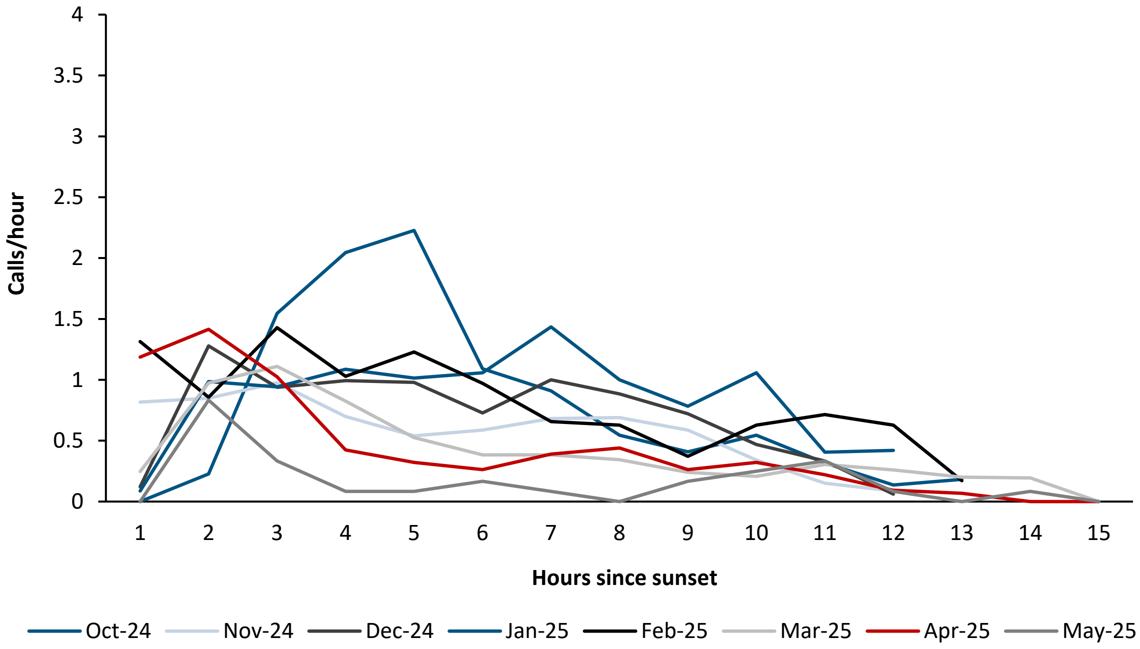

Figure 9. Inland/Southern Free-tailed Bat activity in hourly cohorts (hours after sunset, seasonally adjusted October 2024 to May 2025)

Table 10. Inland/Southern Free-tailed Bat cumulative (%) monthly activity in hourly cohorts (October 2024 to May 2025)

Month Activity: Cumulative %	Hours																Average calls/Hr
	1630	1730	1830	1930	2030	2130	2230	2330	030	0130	0230	0330	0430	0530	0630	0730	
October		0	2	17	38	59	70	79	84	88	94	97	98	100			0.8
November		0	12	24	38	48	55	64	73	83	92	97	99	100			0.5
December			1	16	27	39	51	59	71	81	90	95	99	100			0.7
January			1	10	20	30	40	50	64	74	82	92	96	100			0.9
February			12	20	34	44	55	64	70	76	80	86	92	98	100		0.8
March		4	20	38	51	59	66	72	77	81	85	89	94	97	100	100	0.4
April		18	40	56	63	68	72	78	85	89	94	97	99	100	100		0.5
May	0	33	47	50	53	60	63	63	70	80	93	97	97	100	0		0.2
Combined %		**4**	**13**	**27**	**39**	**49**	**57**	**65**	**74**	**82**	**88**	**94**	**97**	**99**	**100**	**100**	**3.9**

Table 10 demonstrates that for most months, 90% of the cumulative bat activity is between 2 and 12 hours since sunset although this does vary between months. The table also demonstrates that the most active months are summer (December to February).

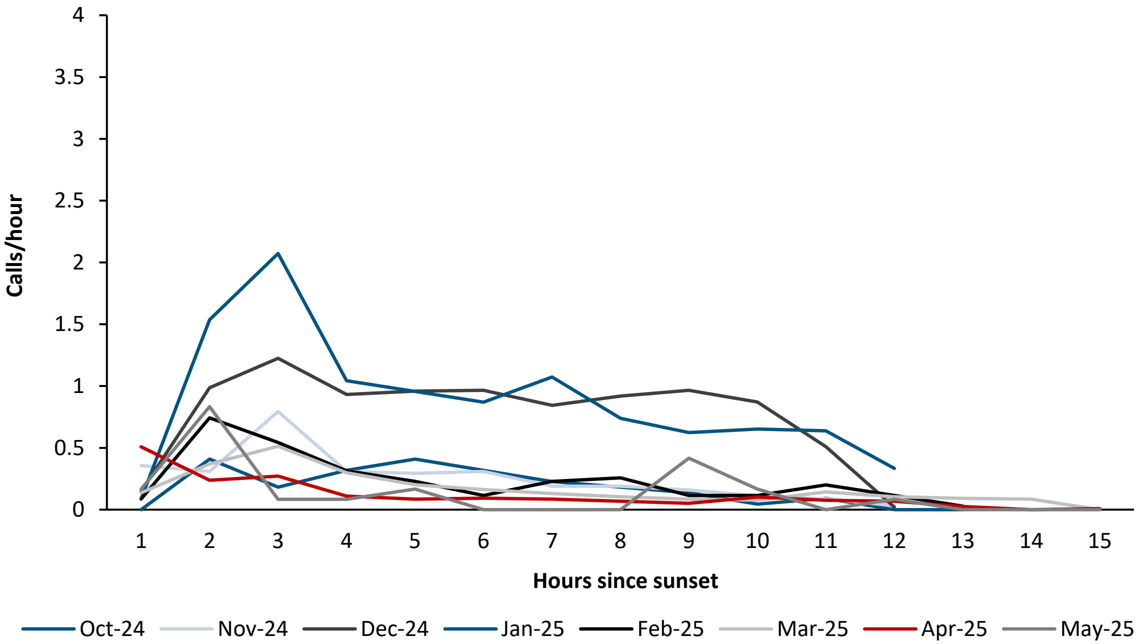

Figure 10. Gould's Wattled Bat activity in hourly cohorts (hours after sunset, seasonally adjusted October 2024 to May 2025)

Table 11. Gould's Wattled Bat cumulative (%) monthly activity in hourly cohorts (October 2024 to May 2025)

Month Activity: Cumulative %	Hours																Average calls/Hr
	1630	1730	1830	1930	2030	2130	2230	2330	0030	0130	0230	0330	0430	0530	0630	0730	
October		0	18	25	39	57	71	80	88	94	96	100	100	100			0.2
November		0	11	21	46	56	66	76	82	88	93	96	99	100			0.2
December			2	12	25	35	45	56	65	75	85	94	100	100			0.8
January			1	15	35	45	54	62	72	79	85	91	97	100			0.9
February			3	27	44	55	62	66	73	81	85	89	95	99	100		0.2
March		5	20	41	53	61	67	72	77	80	83	89	93	97	100	100	0.2
April		28	42	57	63	68	73	78	82	84	90	94	98	100	100	100	0.1
May	8	50	54	58	67	67	67	67	88	96	96	100	100	100	100		0.1
Combined %		**3**	**8**	**21**	**37**	**46**	**55**	**64**	**72**	**79**	**86**	**93**	**98**	**100**	**100**	**100**	**2.2**

Table 11 demonstrates that for most months, 90% of the cumulative bat activity is between 1and 10 hours of sunset, although this does vary between months. The table also demonstrates that the most active months are early summer (December and January).

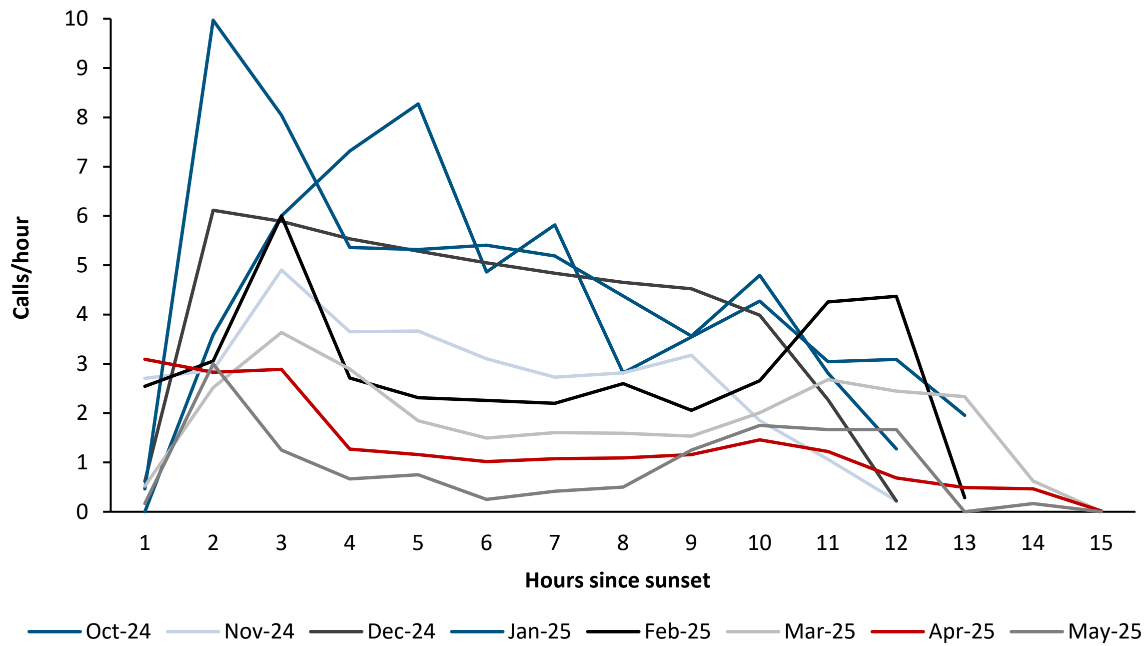

Figure 11. All bat species combined activity in hourly cohorts (hours after sunset, seasonally adjusted October 2025 to May 2025)

Table 12. All Bat species cumulative (%) monthly activity in hourly cohorts (October 2024 to May 2025)

	Hours																Average calls/Hr
Ozimops	**1630**	**1730**	**1830**	**1930**	**2030**	**2130**	**2230**	**2330**	**0030**	**0130**	**0230**	**0330**	**0430**	**0530**	**0630**	**0730**	
October		0.0	79.0	132.0	161.0	182.0	107.0	128.0	62.0	78.0	94.0	67.0	68.0	43.0			
Calls/hour		0.0	3.6	6.0	7.3	8.3	4.9	5.8	2.8	3.5	4.3	3.0	3.1	2.0			4.2
Activity: Cumulative %		0.0	6.6	17.6	31.0	46.1	55.0	65.7	70.9	77.4	85.2	90.8	96.4	100.0			
November		0.0	341.0	362.0	618.0	460.0	462.0	391.0	344.0	355.0	400.0	233.0	134.0	28.0	2.0		
Calls/hour		0.0	2.7	2.9	4.9	3.7	3.7	3.1	2.7	2.8	3.2	1.8	1.1	0.2	0.0		2.3
Activity: Cumulative %		0.0	8.3	17.0	32.0	43.1	54.3	63.8	72.1	80.7	90.4	96.0	99.3	100.0	100.0		
December			91.0	899.0	866.0	814.0	777.0	742.0	711.0	684.0	665.0	586.0	334.0	32.0			
Calls/hour			0.6	6.1	5.9	5.5	5.3	5.0	4.8	4.7	4.5	4.0	2.3	0.2			4.1
Activity: Cumulative %			1.3	13.7	25.8	37.1	47.9	58.2	68.0	77.5	86.8	94.9	99.6	100.0			
January			32.0	688.0	555.0	370.0	367.0	373.0	358.0	302.0	246.0	331.0	194.0	88.0			
Calls/hour			0.5	10.0	8.0	5.4	5.3	5.4	5.2	4.4	3.6	4.8	2.8	1.3			4.7
Activity: Cumulative %			0.8	18.4	32.7	42.1	51.5	61.1	70.3	78.0	84.3	92.8	97.7	100.0			
February			89.0	107.0	210.0	95.0	81.0	79.0	77.0	91.0	72.0	93.0	149.0	153.0	10.0		
Calls/hour			2.5	3.1	6.0	2.7	2.3	2.3	2.2	2.6	2.1	2.7	4.3	4.4	0.3		2.9
Activity: Cumulative %			6.8	15.0	31.1	38.4	44.6	50.6	56.5	63.5	69.0	76.1	87.5	99.2	100.0		
March		80.0	388.0	560.0	446.0	284.0	230.0	247.0	245.0	236.0	309.0	413.0	377.0	360.0	96.0	1.0	
Calls/hour		0.5	2.5	3.6	2.9	1.8	1.5	1.6	1.6	1.5	2.0	2.7	2.4	2.3	0.6	0.0	1.8
Activity: Cumulative %		1.9	11.0	24.1	34.5	41.2	46.5	52.3	58.1	63.6	70.8	80.5	89.3	97.7	100.0	100.0	
April		365.0	334.0	341.0	150.0	137.0	120.0	127.0	129.0	137.0	172.0	144.0	81.0	58.0	55.0	2.0	
Calls/hour		3.1	2.8	2.9	1.3	1.2	1.0	1.1	1.1	1.2	1.5	1.2	0.7	0.5	0.5	0.0	1.3
Activity: Cumulative %		15.5	29.7	44.2	50.6	56.4	61.5	66.9	72.4	78.2	85.5	91.7	95.1	97.6	99.9	100.0	
May	2.0	36.0	15.0	8.0	9.0	3.0	5.0	6.0	15.0	21.0	20.0	20.0	0.0	2.0	0.0		
Calls/hour	0.2	3.0	1.3	0.7	0.8	0.3	0.4	0.5	1.3	1.8	1.7	1.7	0.0	0.2	0.0		0.9
Activity: Cumulative %	1.2	23.5	32.7	37.7	43.2	45.1	48.1	51.9	61.1	74.1	86.4	98.8	98.8	100.0	100.0		
Combined	2.0	481.0	1369.0	3097.0	3015.0	2345.0	2149.0	2093.0	1941.0	1904.0	1978.0	1887.0	1337.0	764.0	163.0	3.0	
Calls/hour	0.2	6.6	16.5	35.2	37.1	28.8	24.4	24.8	21.7	22.4	22.7	21.9	16.6	11.0	1.4	0.0	18.2
Activity: Cumulative %	0.0	2.0	7.6	20.2	32.5	42.0	50.8	59.3	67.2	75.0	83.1	90.8	96.2	99.3	100.0	100.0	

Tables 9, 10, 11 and 12 demonstrate the cumulative percentage of activity. For example, for WSFTB in October 2024, 93.6% of the bats' activity occurred between 1 and 10 hours since sunset. Logic follows that if turbine curtailment were implemented during those hours, WSFTB's impact would be reduced by the same percentage (i.e., approximately 90%).

These activities and seasonal patterns provide insight into risk mitigation through turbine curtailment (stopping turbine rotation) at a particular time of night, at a particular time of year. Furthermore, literature [27, 37, 38, 58] has indicated that turbine curtailment at wind speeds below 5 m/s reduces the impact on this particular species.

Discussion

Likelihood and consequence

As described in the methodology, a qualitative method of describing and assessing risk is used to determine the likelihood and consequence of an event, in this case, the likelihood of collision or near-collision with rotating wind turbines. This is determined by a species' potential flight height, flight behaviour and abundance (including boom bust cycles and nomadism). The consequence of such an event is primarily determined by the number of individuals affected, the threatened status of the species, its legislative protection and flocking behaviour.

Those species determined to fly above the vegetation canopy and those species listed as threatened or specifically listed under legislation were considered in the risk assessment table (Table 13).

Flight height

A critical parameter is flight height in the context of wildlife potential collision risks with wind turbine blades.

As previously mentioned the wind turbine critical parameters are rotor coverage diameter, the rotor coverage area of 26 016m^2, three rotor blades per turbine, and hub (nacelle) height of 150 m (with a rotor of 182 m diameter), equating to a rotor swept path of 59 m above the ground level, and a rotor tip speed of 89 m/s (at 9.3 rpm).

The maximum flight height, proportion of time at various heights, behaviour at those heights (night migration, hunting, courtship and territorial behaviour, etc) is unknown for almost all avian and microbat species considered in this report. But whether species fly above the vegetation canopy is largely known. The ecologies of each species are then described regarding behaviour that may inform flight heights. Species fly well above the vegetation canopy in a manner not directly related to the vegetation for various reasons, such as but not limited to;

- territorial and breeding display;
- soaring, including on thermal and topographical updraughts;
- migration;
- night flight; and
- aerial hunting or feeding.

The vegetation canopy height throughout the development footprint is between one and five metres (however, once construction commences, bare ground and short grassland habitats will exist). The rotor blade swept path is 59 metres. A precautionary principle is inherent in this risk assessment by using the definition of flying above the vegetation canopy as a risk factor (and not whether a species flies higher than the swept path). This takes into account that, although a species flies above the canopy (maximum 5 m), it is not known how high above the canopy, so it is assumed it may be within the swept path of the rotor blades at 59 metres.

From all the avian taxa compiled from the combined desktop surveys, previous field surveys and literature reviews, 120 avian taxa were determined, at least at times, to fly above the vegetation canopy (Appendix A) in a manner described above.

All 12 bat taxa that were compiled from the combined desktop surveys, field surveys and literature reviews, 10 were determined, at least at times, to fly above the vegetation canopy (Appendix A).

Boom and Bust Ecology

Consideration of boom-and-bust seasons of the arid and semi-arid zones is applied to the risk assessment likelihood and consequence.

Although mean annual rainfall for the area is recorded as 266 mm [149], averages can be an inadequate indicator of what occurs in arid and semi-arid environments [25]. The recorded rainfall for June 2024 to May 2025 (the previous 12 months) was 293 mm, which is effectively an average year.

Typically, there are extended periods of drought episodically interrupted by extreme rainfall events, resulting in a boom-bust pattern of avian [25] and bat abundance [139, 150, 151]. The arid Australian environment fluctuates between spectacular boom periods when productivity and diversity are high, and when biotic resources are depleted [13, 112, 152].

Understanding and applying the boom-bust cycle critically influences the abundance of a species and the likelihood of collision or near-collision with rotating turbines. As stated previously during boom seasons, the ecology of species does change; for example, some species, such as the male Pied Honeyeater (*Certhionyx variegatus*), conduct territorial and breeding display flights at a considerable height above the surrounding vegetation canopy. For the purpose of this risk assessment, it is assumed that two boom seasons will occur within the 20-year life of the turbines.

Salt lakes are an additional fauna habitat while predominantly dry, the lakes are a temporary water and food source after flooding and intermittently provide habitat for several migratory taxa listed under the EPBC Act. Importantly, the salt lakes occur within an extensive palaeodrainage system, extending from White Flag Lake (northwest), Hillman River salt lake system to the northeast, Hannan Lake and KWTP to the south. The NSR operational area and development footprint is located adjacent to this temporary habitat, and when flooded, many other, much larger lakes in the region are also likely to provide linkage and habitat, meaning that water birds will travel between temporary and semi-permanent waterbodies.

Waterbirds will travel to flooded lake system from well beyond the Kalgoorlie region. As stated earlier, satellite-tagged Banded Stilts (*Cladorhynchus leucocephalus)* have been recorded flying 1 000 to 2 000 km over several days or weeks through inland Australia to reach flooded salt lakes [113, 114]. Therefore, any waterbird species that occurs in the southern two-thirds of the Australian continent is considered plausible to occur in the Kalgoorlie region during these conditions.

The location of the wind turbines is not between any significant water bodies and, therefore, is not considered a thoroughfare or a known flight path for this guild.

The boom-bust cycle extends beyond waterbirds and occurs amongst seed eaters such as Zebra Finch, Budgerigar, Diamond Dove and Cockatiels and nectar and insectivores [25] and probably bats [139, 150, 151].

Vegetation clearance

The species inventory has been compiled through desktop database searches, physical field observations and the extensive use of audio recording devices (birds and bats). However, the species inventory would be slightly different given the extent of vegetation clearance and likely growth of short grassland. Not only does this change the species inventory, but critically, it changes the relative abundance of species, for example, raptors and some species of bats being more frequent over grasslands than extant mallee woodland vegetation. Furthermore, the habitat change also changes the species' behaviour, with raptors hunting over grasslands, becoming exponentially more vulnerable to turbine strikes. These considerations are considered in the risk assessment presented here.

Risk Assessment

Flying above the vegetation canopy is considered the primary risk contributor. Those species that engage in this behaviour at least at times, either through migration, moving to daily feeding grounds, territorial displays or seeking prey [7, 62], are at risk and are specially considered below (Table 11).

The risk assessment draws from the species' ecologies in the context of wind farms.

The knowledge provided in the risk assessment table is derived from the provided published reports, operational-specific provided reports, specific literature reviews, general known ecologies (such as Handbook of Australian, New Zealand and Antarctic Birds (HANZAB) and Cornell Laboratory Birds of the World), DES site-specific data, field observations and the author experience and carcass monitoring associated with wind turbines in inland Western Australia.

Most species that remain below or close to the vegetation canopy (typically lower than 5 m) are not considered high flying (see Appendix A). These species are at negligible risk of collision with wind turbine blades (with a sweep depth of 59 m above the terrain); therefore, they are no longer considered by this risk assessment or this report.

Table 13. Inherent risk of wind turbine impact for legislatively listed and high-flying taxa recorded as occurring or potentially occurring within the NSR area

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
Emu	Flightless.	E	5	L
Malleefowl [1, 2]	Listed as vulnerable under the EPBC Act and BC Act. Primarily a ground dweller, feeding on seeds, herbs, invertebrates and small vertebrates. Not recorded during field surveys. There are known current and historical mounds in the region, and the species is cryptic; hence, the species is considered likely present in the area. It is capable of flight as an anti-predatory response that can rise vertically into the vegetation canopy. Flies into the vegetation canopy at night to roost in trees. Unable to sustain flight above the vegetation canopy.	E	3	L
Stubble Quail	A ground dweller, nomadic and migratory, moving to suitable habitat after seasonal or erratic rains, otherwise absent. Not recorded during field surveys. Capable of sustained flight and most likely to fly high during migration or nomadism. The species feeds on seeds and herbaceous plants and flowers. Takes small insects, particularly during the breeding season. The species is likely to be more common with the creation of open grasslands from vegetation clearance associated with the development. The species is absent from suitable areas until conditions improve after unseasonal or exceptional rainfall, and then the species can become numerous. Strikes with wind turbine blades have been observed in the field (pers. obs. D. Donato).	D	4	L
Musk Duck [1]	Listed as Marine under the EPBC Act. A deep-water aquatic specialist, resident at the KWTP and recorded there during these field surveys. The species dives from danger and is rarely sighted flying. A poor flyer, but most likely to fly at night, although exceedingly rarely seen. Vocal but not recorded during the field surveys. It is not attracted to saline waterbodies that would be present around the region after substantial rainfall. The species likely confined to the KWTP.	E	4	L
Pink-eared Duck	Common species, resident at the KWTP. Vocal when flying at night, and wing whirl noise clearly audible yet not recorded during field surveys. Flies at considerable height at night. It will fly during the day if disturbed. It inhabits large and small waterbodies, sometimes in enormous flocks, where it feeds on aquatic macroinvertebrates. Confined to permanent water (even artificial) during dry times and will expand to ephemeral and usually fresh waterbodies during boom seasons. Limited habitat available for this species in the area, except after substantial rainfall.	D	5	L
Freckled Duck	Only plausible to inhabit the region during flooded times, where it could breed in vegetated swamps. The species can be in large flocks exceeding 500 birds. Flies at height in a similar manner to the Pacific Black Duck. Absent during dry times. The species is likely a vagrant at the KWTP.	D	4	L
Black Swan	Well-known and familiar. Inhabits inland water bodies, mine water sources, fresh and saline, and can reside in enormous numbers at the KWTP. It feeds on aquatic macroinvertebrates and aquatic vegetation amongst fresh and brackish wetlands. At night, it will graze on short grass. Although seen to fly during the daytime, it more frequently will fly at night at a considerable height. Can be present at times in small numbers, primarily on mine-related water bodies. DES TSF data demonstrates it is a nocturnal flyer between desert water bodies during boom conditions or on the night of rainfall events.	C	5	L
Australian Shelduck	Common, resident duck of saline water bodies. Common at NSR TSFs, resident at the KWTP. Behaviourally, known to inhabit fresh and saline mine water bodies, where it will roost on raised ground, bare ground or loft on large water bodies during the day. It is observed to fly to water sources and graze on grasses and aquatic vegetation. It frequently flies at considerable heights to feeding grounds at night and early morning. Typically flies as pairs, not flocks.	D	5	L
Australian Wood Duck	Rare to common in the region and resident at times at the KWTP. A nocturnal grazer of aquatic vegetation and short grasses. It will sleep and roost by day at water bodies, including mine water sources and fringing lakes. Not tolerant of saline conditions. It flies at height to and from feeding grounds at night.	D	5	L
Hardhead	A deep-water diving species that is not frequently observed in the region, except at the KWTP. It is likely to occur only in large numbers during favourable seasons. An aquatic freshwater specialist, DES TSF data demonstrates it is a nocturnal flyer between desert water bodies. Requires deep waterbodies, which are unlikely to occur in the saline paleodrainage lines even after substantial rainfall.	E	5	L

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
Australasian Shoveler	Rare in the region, only plausible in the region during favourable times, even then, most likely at the KWTP. If present, similar in habits to the Pacific Black Duck. Not tolerant of saline waterbodies and tends to avoid them.	E	5	L
Pacific Black Duck	A common species of arid Australia is frequently heard flying fast at considerable height at night. Observed at the KWTP. It inhabits small and large, permanent, and ephemeral water sources. Can form large flocks. DES TSF data demonstrates it is a nocturnal flyer between desert water bodies during and immediately after rainfall events and boom conditions.	C	5	L
Grey Teal	A common species of arid Australia, is frequently heard flying fast at considerable height at night. Observed at the KWTP. It inhabits small and large, permanent and ephemeral water sources. Can form large flocks. DES TSF data demonstrates it is a nocturnal flyer between desert water bodies during and immediately after rainfall events and boom conditions.	C	5	L
Australasian Grebe	A diving aquatic specialist that only flies at night, when moving from one water body to another. In the arid zones, it appears to move between waterbodies after rain events. Does not fly in flocks. Common on small deep farm dams or mine water sources. Observed at NSR tailings system and at the KWTP.	E	5	L
Hoary-headed Grebe	A diving aquatic specialist that only flies at night, when moving from one water body to another. In the arid zones, it appears to move between waterbodies after rain events. Does not fly in flocks. Common on small deep farm dams or mine water sources. Observed at NSR tailings system and at the KWTP.	E	5	L
Domestic Pigeon	Introduced. Common in urban areas of Kalgoorlie, uncommon in native vegetation. Capable of flight above the canopy.	E	5	L
Laughing Dove	Introduced. Common in urban areas of Kalgoorlie, rare in native vegetation. Capable of flight above the canopy.	E	5	L
Common Bronzewing	A common species, the most common pigeon in the area, although rarely seen. Recorded during field surveys. Crepuscular. Feeds on seeds, including acacia seeds. Flies rapidly to and from its feeding grounds to water sources, almost always below the vegetation canopy. Surprisingly, carcasses have been found struck by wind turbines (pers. obs. D. Donato), hence the species must fly at least 40 m above the ground. Flies singularly or in small groups of less than five or so. Congregates in flocks of up to 60 at water sources after sunset and before dawn, but does not behave as a coherent flock, arriving and departing from water sources mostly as individuals.	C	4	M
Crested Pigeon	Common, sedentary, familiar and adapted to human-modified landscapes in the arid zones. Recorded during field surveys. It has benefited from the provision of water sources, vegetation clearance and weed infestations. Resident and common in the region. Feeds on seeds and leaves on the ground and roosts in trees. Capable of sustained flight but behaviourally remains close, typically within 10 m of vegetation canopy (pers. obs. D. Donato), except during breeding and territorial display when males make brief flights upward at heights up to 20 m (pers. obs. D. Donato). These display flights usually occur in suitable breeding habitats, which include emergent trees and shrubs amongst grasslands in the arid zone. Can fly at height when travelling large distances to and from water. Resident and likely to increase in numbers with the clearance of treed vegetation, being replaced with grasses and weeds as part of the wind turbine infrastructure development.	C	4	M
Diamond Dove	A small dove that is very rare for the region. It feeds on grass seeds. If it were to occur, it would be during favourable seasons after substantial summer rain events. During such conditions, it can occur in loose flocks in their hundreds. It flies close to the vegetation canopy even when travelling long distances to water.	E	4	L
Tawny Frogmouth	Nocturnal, hunts for prey on the ground. Low flying.	E	4	L
Eastern Great Egret [2]	Listed under the EPBC Act as migratory. Associated with wetlands and feeds on the ground on aquatic macroinvertebrates and vertebrates. Usually in ones or twos in arid Australia. Rare in the region. Some movement north in the winter and south in the summer. If disturbed, it will fly well above the vegetation canopy.	E	4	L

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
Spotted Nightjar	Nocturnal and feeds on flying insects. Buoyant in flight as it seeks its prey. Perches on the ground. Migrant; moving to northern Australia in winter, then moving south to breed in the summer months. Movements in the Kalgoorlie region are not understood and probably present as a passage migrant. During favourable environmental conditions, it might be present in large numbers, most likely after summer rain, although the species does not flock. Flies above the vegetation canopy when territorial or feeding. Perches on the ground and rises to capture insects in flight. Nothing is known regarding flight height during migration.	D	4	L
Australian Owlet-nightjar	Recorded in the development footprint. Common and widespread, feeds in open areas and roosts in hollows by day. Does not fly above the canopy.	E	4	L
Fork-tailed Swift [1, 2]	Listed as an EPBC migratory marine species and under international treaties. Recorded during field surveys, although it is probably not present every year. Aerial forager at times at considerable height. Flocks can be of thousands, implying that if collisions were to occur, multiple carcasses would be expected. Seasonal and large flocks are observed prior to storms and cyclones; otherwise, the species is absent. An increase in risk occurs during migration season (October to May), coupled with approaching storms or cyclones.	D	3	M
Horsfield's Bronze-Cuckoo	Part migratory, moving into sub-coastal areas of south-east and south-west of Australia for summer. Recorded during field surveys. This species is low-flying, usually between smaller shrubs and trees. Its flight is swift and direct. This species forages in shrubs and on the ground for insects, mainly caterpillars, beetles and seeds. Although low flying, remaining within the vegetation canopy, the flight height during nocturnal migration is not known and assumed here (precautionary principle) to be above the vegetation canopy.	E	4	L
Black-eared Cuckoo [1]	Listed as Migratory under the EPBC Act. Part migratory, moving into sub-coastal areas of south-east and south-west of Australia for summer. This species is low-flying, usually between smaller shrubs and trees. Its flight is swift and direct. This species forages in shrubs and on the ground for insects, mainly caterpillars, beetles and seeds. Although low flying, remaining within the vegetation canopy, the flight height during nocturnal migration is not known and is assumed here (precautionary principle) to be above the vegetation canopy.	E	4	L
Fan-tailed Cuckoo [1]	Listed as Migratory under the EPBC Act. Present in south-west Western Australia, and migratory to the north of Australia. Rare in the region but could occur during the passage of migration, moving north. Recorded once during field surveys. Follows the canopy when on migration elsewhere.	E	4	L
Pallid Cuckoo [1]	Listed as Migratory under the EPBC Act. Recorded during field surveys, and probably the most common cuckoo in the area. A night migrant that is assumed to fly above the vegetation canopy, otherwise remains in the vicinity of the vegetation canopy and possibly below the swept path of wind turbine blades. A migrant southward in the summer, but not necessarily every year and only likely during favourable seasons.	D	4	L
Purple Swamphen	Common, and recorded at the KWTP. Does fly at night at height, but not in tight flocks.	E	4	L
Dusky Moorhen	Common, and recorded at the KWTP. Does fly at night at height, but not in tight flocks.	D	4	L
Black-tailed Native Hen	Nomadic, arriving in large flocks during favourable environmental conditions. Can be absent for long periods, sometimes years, during dry conditions. Probably considered vagrant to the region. Associated with swamps, wetlands and flooded vegetation. Capable of sustained flight, it moves across the region at night, likely flying above the vegetation canopy and at times in large flocks. It can occur in enormous flocks around wetlands. During the day, it usually runs or flies low to the ground, heading for cover.	D	4	L
Eurasian Coot	The species can cover large distances and is capable of sustained flight. Nomadic and migratory in part, associated with wetlands and waterbodies. Only likely in any significant numbers during favourable environmental conditions. Resident at the KWTP and observed at NSR tailings system. Does not fly in flocks.	E	4	L
Australian Bustard [2]	Australian Bustard is a widespread species found in the northern two-thirds of the continent and southern New Guinea. The species has limited habitat in the region, but vegetation removal associated with wind turbine infrastructure will induce grassland growth, which is favourable to this species. Flies in loose groups, mostly in twos and threes. Mortalities of closely related species at wind turbines have been recorded globally and are a threatening process to those species. Likely a vagrant to the Kalgoorlie region, and only likely present in ones and twos.	E	3	L

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
Yellow-billed Spoonbill	Common, and recorded at the KWTP. Does fly at night at height, but not in tight flocks.	D	4	L
Australian White Ibis	Present in low numbers in the region. The species can fly at height, when travelling long distances, or when flying to roosting sites. Flies at height in loose flocks.	E	4	L
Straw-necked Ibis	Present in low numbers in the region. The species can fly at height, when travelling long distances, or when flying to roosting sites. Flies at height in loose flocks.	E	4	L
Glossy Ibis	Vagrant to the region, and only likely to be present during exceptionally favourable seasons. A freshwater species and closely tied to wetland habitats. The species can fly at height, when travelling long distances, or when flying to roosting sites.	E	4	L
Nankeen Night Heron	Nocturnal, feeds in farm dams and water holes on vertebrates and invertebrates. Present rarely at the KWTP. The species can fly high when travelling from daytime roosts to feeding grounds. No roosts of the species and limited feeding habitat occur within or near the development footprint.	E	4	L
White-necked Heron	It is present in the region most of the year and is suited to environmental conditions where it inhabits artificial water sources. Recorded at the KWTP. Some level of migration north in the winter and south in the summer. Associated with wetlands, flooded vegetation and mine water infrastructure. Occurs in ones or twos, not in flocks. If disturbed, it will fly well above the vegetation canopy.	D	4	L
White-faced Heron	Associated with wetlands of Australia, herons and egrets are the most likely to be commensurate with human infrastructure. It will occur on mine water infrastructure, typically in ones and twos. Recorded at the KWTP. The species does not form large flocks.	D	4	L
Australian Pelican	It is present at times at the KWTP, although likely not resident due to the lack of prey. It feeds on aquatic vertebrates in saline and freshwater systems. It can fly at enormous heights and in flocks. However, given the lack of food resources in the ephemeral water bodies, even if they are inundated, the species is not common in the area. Few carcasses have been reported from coastal turbines where the species is more common.	E	4	L
Little-pied Cormorant	Associated with wetlands, usually semipermanent or permanent. Not associated, in the long term, with mine water infrastructure. Usually in small flocks, travelling at considerable height in typical V-formation flocks. Rare in the region and the KWTP, except during boom conditions. Surrounding lakes systems, even after substantial rainfall, are not suitable habitats for this species.	E	4	L
Great Cormorant	Associated with wetlands, usually semipermanent or permanent. Not associated, in the long term, with mine water infrastructure. Usually in small flocks, travelling at considerable height in typical V-formation flocks. Resident at the KWTP. Otherwise, it is rare in the region, except during boom conditions. Surrounding lakes systems, even after substantial rainfall, are not suitable habitats for this species.	E	4	L
Little-black Cormorant	Associated with wetlands, usually semipermanent or permanent. Not associated, in the long term, with mine water infrastructure. Usually in small flocks, travelling at considerable height in typical V-formation flocks. Resident at the KWTP. Otherwise, it is rare in the region, except during boom conditions. Surrounding lakes systems, even after substantial rainfall, are not suitable habitats for this species.	E	4	L
Bush Stone-curlew [3]	Bush Stone Curlew is patchily distributed across mainland Australia, but is more common in the north. Vagrant to Kalgoorlie districts. A large nocturnal ground forager feeding on invertebrates and small vertebrates, generally in open areas, avoiding closed habitats. Sedentary, including in arid Australia, with a population estimate of 150 000 individuals. It will fly at heights between foraging grounds, at times in family groups up to 12. Given the aridity of the area, the number of individuals is likely to be extremely low or largely absent.	E	3	L

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
Banded Stilt [2]	Nomadic and episodic. Appearing in a region in enormous numbers after an absence of years. Associated with saline lakes that have been inundated by significant rainfall events and have a brine shrimp population. Can breed in enormous numbers on selected saline lakes. As an example, a flock estimated at 20 000 bred on Lake Carey in 2017 (pers. obs. D. Donato). Can appear on tailings systems in large flocks arriving at night, usually after rainfall the previous day or night. Travels at night across the landscape. Flight is well above the vegetation canopy when travelling long distances. The species is likely to be absent for years during dry conditions. The location of the turbines away from lakes and NSR TSFs significantly reduces the likelihood of impact.	E	3	L
Red-necked Avocet	Nomadic and episodic. Associated with fresh ephemeral wetlands and flooded vegetation. It can occur in large, tight flocks. Likely only in the region after substantial rain has been observed at NSR tailings system and at the KWTP, otherwise absent, other than. Nomadic long-distance flights are likely to occur at night.	D	4	L
Black-winged Stilt	Associated with wetlands and flooded vegetation. Usually in smaller flocks compared to the Red-necked Avocet. Can inhabit mine water infrastructure dams and has been observed at the NSR tailings system. Flies above the vegetation canopy. During favourable conditions, the species can be present in large numbers, but is generally absent, other than at the KWTP.	D	4	L
Grey Plover [1, 2, 3]	Listed under the EPBC Act as a migratory wetland species and is protected under international treaties and the Bonn Convention. Under the BC Act of Western Australia, its listing is IA, representing its international protection and migratory status. The Australian subspecies breeds in northern Siberia and migrates as a non-breeding migrant to Australia during the summer. It is a rare inland passage migrant, having been recorded on tailings systems in September and October. It spends the summer in coastal Australia. Its return migrations are believed to be coastal as it moves north. Migrates at night and is likely well above the vegetation canopy. Exceedingly rare inland.	E	3	L
Red-capped Plover	Resident and nomadic. Associated with tailings systems and saline lakes, where they occur in loose flocks. Frequently recorded at NSR TSFs. Feeds on bare ground associated with wetlands and artificial water bodies, feeding on insects and seeds. Stays close to the ground during the day. At night, when travelling long distances, it is heard well above the vegetation canopy. Travels in a loose flock of 10s. Although common in the area, the turbines are not placed between suitable habitat for the species.	E	4	L
Oriental Plover [1, 2]	Listed under the EPBC Act as a migratory wetland species and is protected under international treaties and the Bonn Convention. Under the BC Act of Western Australia, its listing is IA, representing its international protection and migratory status. It breeds in central Asia and migrates as a non-breeding migrant to Australia during the summer. Its primary distribution during the summer is in extreme northern Australia, and it is a vagrant further south. It preys on insects taken from the ground and in flight. It is very common in large flocks in northern Australia during October and November; hence, it disperses southward in smaller flocks. Its tendency to fly at height does make the species susceptible to wind turbine collision, although there are no records of such in the literature. The species has been recorded at the KCGM tailings facilities (per. obs. W. Gursansky DES Pty Ltd). It is almost certain to avoid the area during boom conditions, preferring dry bare ground; however, the species is vagrant to the region. The total population was estimated at 2 800 000.	E	3	L
Hooded Plover [3]	Listed under the BC Act as Endangered (WA taxa). Never sighted on saline tailings systems in 20 years of DES TSF observations. Endemic shorebird that will frequent inland saline lake shorelines. When disturbed stays low to the vegetation and alights back on the shoreline. Little is known regarding the population movement between lakes and between lakes and the coastal habitats. Presumably, long flights are at night and above the vegetation canopy. Not recorded in large flocks. The population is believed to be declining.	E	3	L
Black-fronted Dotterel	Associated in wetlands typically in twos and threes, but can be in large flocks in arid Australia after cyclonic events. Associated with mine camp sewage ponds and resident at KWTP. During the day, it does not fly above the vegetation canopy but could do so at night when travelling long distances.	D	4	L
Banded Lapwing	Uncommon to the region, and only likely after substantial summer rainfall. It feeds on grass plains and bare ground on insects and seeds. It can fly above the vegetation canopy, including during the day when travelling long distances. Likely absent except during boom conditions. Vegetation clearance associated with wind turbine infrastructure would favour the species. Otherwise, there is limited suitable habitat for the species.	D	4	L

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
Red-kneed Dotterel	Behaviourally associated in wetlands typically in twos and threes, but can be in large flocks in arid Australia after cyclonic events. During the day, it does not fly above the vegetation canopy but could do so at night when travelling long distances. Present at times at the KWTP.	D	4	L
Inland Dotterel	Nomadic and episodic. Rare to the region, and only likely after substantial summer rainfall. It feeds on grass plains and bare ground on insects and seeds. It can fly above the vegetation canopy, including during the day when travelling long distances.	D	4	L
Sharp-tailed Sandpiper [1, 2]	Listed under the EPBC Act as a migratory wetland species and is protected under international treaties and the Bonn Convention. A common wetland species to southeast Australia, which feeds on the water edge for seeds and invertebrates, but is rare inland. Regularly recorded in the region in ones and twos in September and October as a passage migrant (pers. obs. D. Donato), remaining for a few days, so likely a passage migrant. Return migration (March and April), the species is absent from the region and is believed to follow the coast northward. Flight behaviour on feeding grounds is fast and close to the ground or water surface. On migration or when disturbed, will fly at heights greater than 100 m.	E	3	L
Curlew Sandpiper [1, 2]	Listed under the EPBC Act as a migratory wetland species and is protected under international treaties and the Bonn Convention. Now a Critically Endangered wetland species. Exceedingly rare to inland and arid Australia, where it may feed on the water edge for seeds and invertebrates. Flight behaviour on feeding grounds is fast and close to the ground or water surface. On migration or when disturbed, will fly at heights greater than 100 m. Has been recorded once on NSR tailings systems (pers. obs. D. Donato), presumably as a passage migrant in September and October.	E	2	M
Red-necked Stint [1, 2]	Listed under the EPBC Act as a migratory wetland species and is protected under international treaties and the Bonn Convention. An exceedingly rare wetland species to arid Australia that feeds on the water edge for seeds and invertebrates. Flight behaviour on feeding grounds is fast and close to the ground or water surface. On migration or when disturbed, will fly at heights greater than 100 m. Has been recorded on the NSR tailings systems, usually as a passage migrant in September and October.	E	3	L
Common Sandpiper [1, 2]	Listed under the EPBC Act as a migratory wetland species and is protected under international treaties and the Bonn Convention. A rare wetland species to arid Australia that feeds on the water edge for seeds and invertebrates. Exceedingly rare to the region. Flight behaviour on feeding grounds is fast and close to the ground or water surface. On migration or when disturbed, will fly at heights greater than 100 m.	E	3	L
Grey-tailed Tattler	Coastal species, vagrant to the region.	E	3	L
Common Greenshank [1, 2]	Listed under the EPBC Act as a migratory wetland species and is protected under international treaties and the Bonn Convention. Under the BC Act of Western Australia, its listing is IA, representing its international protection and migratory status. It breeds in central Asia and migrates as a non-breeding migrant to Australia during the summer. Associated with fresh and saline wetlands, where it preys on insects and aquatic macroinvertebrates. Only a rare passage migrant to the region (August to October) and absent on return migration, although stray individuals can, at times, remain at the KWTP. It flies high when disturbed.	E	3	L
Wood Sandpiper [1, 2]	Listed under the EPBC Act as a migratory wetland species and is protected under international treaties and the Bonn Convention. The most common migrant wader species recorded to arid Australia that feeds on the water edge for seeds and invertebrates. Recorded annually (August to October) at the KWTP, where it occurs in ones and twos, staying for a few days. Absent for the rest of the year, although stray individuals can, at times, remain at the KWTP. Flight behaviour on feeding grounds is fast and close to the ground or water surface. On migration or when disturbed, will fly at heights greater than 100 m.	E	3	L
Marsh Sandpiper	Listed under the EPBC Act as a migratory wetland species and is protected under international treaties and the Bonn Convention. A common migrant wader species recorded to arid Australia that feeds on the water edge for seeds and invertebrates. Recorded annually (August to October) at the KWTP, where it occurs in ones and twos, staying for a few days. Absent for the rest of the year, although stray individuals can, at times, remain at KWTP. Flight behaviour on feeding grounds is fast and close to the ground or water surface. On migration or when disturbed, will fly at heights greater than 100 m.	E	3	L

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
Little Button-quail	The most common migrant wader species recorded to arid Australia that feeds on the water edge for seeds and invertebrates. Recorded annually (August to October) at the KWTP, where it occurs in ones and twos, staying for a few days. Absent for the rest of the year, although stray individuals can, at times, remain at the KWTP. Flight behaviour on feeding grounds is fast and close to the ground or water surface. On migration or when disturbed will fly at heights greater than 100 m.	D	4	L
Australian Pratincole	Feeds aerial and on the ground. Prefers dry country next to wetlands. Vagrant to the region and not expected during wet conditions. It will fly above the vegetation canopy in loose flocks.	E	4	L
Silver Gull	Present at times at mining operations in arid Australia, where it persists on mine water infrastructure such as tailings systems, and decant and process ponds. Probably some resident birds at KWTP. Usually present for a few days, then departs. Typically, in ones or twos. It does fly at considerable height when travelling long distances. Gulls, in the northern hemisphere, are susceptible to collision with wind turbines in coastal areas and near breeding colonies.	D	4	L
Whiskered Tern [1, 2]	Listed under the EPBC Act as a migratory wetland species and is protected under international treaties and the Bonn Convention. Under the BC Act of Western Australia, its listing is IA, representing its international protection and migratory status. Migratory in and beyond Australia, moving north in winter and to southern Australia in summer. Usually absent during dry conditions, sometimes for years. It can be present in large flocks during favourable, post-cyclonic weather conditions. Rarely present on mine infrastructure water sources, where it feeds on aquatic macroinvertebrates. Present at times at the KWTP, during favourable conditions, it is associated with flooded vegetation and can breed on shore and islands within freshwater ephemeral lakes. It will travel at height above the vegetation canopy when travelling to and from nesting and feeding sites. Risk only plausible during boom conditions.	D	3	M
Eastern Barn Owl	Rodent specialist. Roosts in hollows or dense vegetation. Likely to be episodic in the region, appearing after years of absence when rodent populations increase. At other times, absent. It does fly above the vegetation canopy when disturbed, travelling long distances or occasionally hovering when hunting.	E	4	L
Southern Boobook	Mainland subspecies is not a listed species. Nocturnal and roosts in dense foliage in shrubs and trees. Capable of flight at height but rarely does, remains in the vicinity of vegetation.	E	4	L
Black-shouldered Kite	Resident in the Kalgoorlie township and surrounding cleared vegetation, would only be common during extremely favourable conditions. The species feeds on small vertebrates and invertebrates captured by hovering and quartering over grasslands. Hovering heights are generally below 20 m (pers. obs. D. Donato). However, male territorial or display flights and couple courtship flights can be 20 m above the vegetation canopy (pers. obs. D. Donato). Absent from the development footprint but would colonise the area once vegetation has been cleared. Resident along Bulong Road where frequently observed perched on powerlines. Does not occur in flocks.	C	4	M
Letter-winged Kite	Vagrant, nocturnal and flies and hunts at height. Presence is only plausible after boom times, when the species migrates to more coastal regions.	D	4	L
Black-breasted Buzzard	A soaring species within the height of typical wind blade swept paths, carrion feeder and mainly active hunter of nesting and ground birds, mammals and reptiles. Rare but probably vagrant to the region, and is territorial. Shy of human disturbance.	E	4	L
Square-tailed Kite	Quarters low over the vegetation canopy where searches for nestlings in the nest. Rarely soars at height like other raptors. Likely a few resident pairs in the region, and if present, usually in ones or twos. Vegetation clearance associated with wind turbine infrastructure is likely to disadvantage the species.	D	4	L

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
Wedge-tailed Eagle	Recorded during field surveys within the development footprint. Aquila species are globally susceptible to wind turbine collision. They will fly at height and search for carcasses under wind turbines. In inland Australia, the Wedge-tailed Eagle is a common raptor, usually in territorial pairs, with a floating population (presumably subadult and adult birds without territories). In the Perth region, the territory size was determined at 36 km^2, 9 to 50 km^2, and 39 km^2 in semi-arid NSW. Territories would be expected to be 30 to 50 km^2 in the NSR region. The population is not likely to fluctuate with boom-and-bust conditions because of the territorial nature of resident pairs. Numerous deaths for this species associated with wind turbines have been recorded elsewhere (including pers. obs. D. Donato). A territorial pair travels around the development footprint but is usually seen on the NSR tailings system and waste dumps soaring on associated updrafts.	C	3	M
Little Eagle	Soars at considerable height on updrafts and thermals, easily within the height of typical wind turbine blade swept paths and over 50 m above the surrounding terrain. Feeds on live prey, birds, mammals, and reptiles and is not a scavenger like the Wedge-tailed Eagle. Uncommon in the region, even less so when Wedge-tailed Eagle is present.	D	4	L
Swamp Harrier	Hunts for live prey in ground vegetation. Quarters close to grassland vegetation, usually within 5 m and rarely soars at height. Currently absent from the development footprint, but will colonise with vegetation removal and establishment of grasslands. It is likely to be present during favourable summer conditions. Migratory to northern Australia in winter.	E	4	L
Spotted Harrier	Hunts for live prey in ground vegetation. Quarters close to grassland vegetation, usually within 5 m and rarely soars at height. Currently absent from the development footprint, but will colonise with vegetation removal and establishment of grasslands. It is likely to be present during favourable summer conditions. Migratory to northern Australia in winter.	D	4	L
Brown Goshawk	Common in the region, and maybe partially migratory. Active hunter of bird prey, small mammals and reptiles. Will take birds in ambush/pursue from amongst or near vegetation. Frequently soars on thermal and updraughts over 50 m above the surrounding terrain.	D	4	L
Collared Sparrowhawk	Common in the region and maybe partially migratory in the region. Active hunter of bird prey and small mammals. Will take birds in ambush/pursue from vegetation. Frequently soars on thermal and updraughts over 50 m above the surrounding terrain. Recorded during field observations within the development footprint.	D	4	L
Whistling Kite	Terrestrial but frequents wetlands and frequently soars on thermals and quarters in search of carcasses. Soars on updraughts and thermals at heights over 50 m. Likely only present during favourable conditions and during the summer.	C	4	M
Black Kite	Terrestrial, common, frequently soars on thermals and quarters in search of carcasses. Soars on updraughts and thermals at heights over 50 m. Likely only present during favourable conditions and during the summer.	C	4	M
Rainbow Bee-eater [1]	Recorded during field surveys, being widespread and common. Listed as a migratory marine species. Aerial forager above the vegetation canopy. Present within the development footprint, but more numerous during favourable conditions associated with higher-than-average rainfall and flying insect activity. During dry times, they are absent or rare and are associated with permanent artificial water sources. Flies at height during migration. Migrates north during the winter.	D	3	M
Sacred Kingfisher [1]	Recorded during field surveys. Listed as migratory under the EBPC Act, this species mostly migrates north after breeding. Not common, and a passage migrant to the region. Perches from a vantage point and swoops to take food from the ground, water surface, foliage, mudflats or via hovering. The only migratory kingfisher in the region, and may travel long distances at night, flying well above the vegetation canopy.	E	3	L
Red-backed Kingfisher	Recorded during field surveys. Perches from a vantage point and swoops to take food from the ground, water surface, foliage, mudflats or via hovering. Not migratory. Capable of sustained flight above vegetation but rarely does so. More likely to be present with the clearing of vegetation for the development infrastructure. Frequently perches on power lines. Uncommon, occurs in ones and twos.	E	4	L
Nankeen (Australian) Kestrel	Recorded during field surveys. Resident and breeding within the area. They hover while searching for prey, where they are susceptible to wind turbine collision. More likely to be present with the clearing of vegetation for the development infrastructure. Not a scavenger species.	C	4	M

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
Australian Hobby	Partly migratory, mostly females migrating north. Will fly at considerable heights. Uncommon to the region, and only expected during favourable conditions, but resident in Kalgoorlie township, where it feeds on feral pigeons.	D	4	L
Brown Falcon	One of the three raptor species recorded within the development footprint. Resident in the area but in low numbers. Territorial calls are detected, which are usually made when flying at height. Will scavenge carcasses if present, and presumably under wind turbines.	C	4	M
Grey Falcon [1, 2, 3]	Listed as Vulnerable under the EPBC Act. Exceptionally fast flying. Soars and hunts for avian prey from above the vegetation canopy. The habitat of the region is not suitable for this species, and the presence of the Peregrine Falcon, which is resident in the open pit infrastructure, deters the Grey Falcon. Exceedingly rare.	E	3	L
Black Falcon	Exceedingly rare in the region. Only likely present during boom times when granivorous flocking species are abundant, primarily Crested Pigeon, Budgerigar and Zebra Finch. Capable of and often soars high. Chases bird prey in open areas in swooping dives. Needs an open habitat.	E	4	L
Peregrine Falcon [2]	Listed under the BC Act. Soars and hunts for avian prey above the vegetation canopy. Resident in the area and recorded at the NSR tailings systems. There is an expected larger floating population of non-territorial birds. Nevertheless, the species is uncommon and could be counted as twos or threes in the broader area at any one time.	D	4	L
Cockatiel	Cockatiel is a common species in Australia and has been recorded in the NSR area. It feeds on half-ripened and ripened seeds from the ground. It travels in loose flocks. In arid Australia, it is nomadic, appearing in numbers during favourable conditions and absent, at times for years, when conditions are not favourable. It does fly to feeding grounds at a reasonable height, but usually within 5 m of the vegetation canopy. Not a nocturnal flying species.	D	4	L
Carnaby's Black-Cockatoo	Vagrant, reported in the gardens of Kalgoorlie, but found south and west of Norseman. Capable of flying at turbine height and does so when travelling long distances, which occur daily when travelling to feeding grounds.	E	3	L
Galah	Recorded during field surveys. Common. Will fly at height when travelling long distances to and from feeding grounds. Does not appear in carcass counts at wind farms elsewhere in Australia, despite being common in those areas. Appears to have an uncanny knack for avoiding rotating turbines.	D	4	L
Major Mitchell's Cockatoo [3]	Widespread in semi-arid and arid Australia, but at low population densities. Can form feeding flocks, rarely more than 2 birds. A low-flying species even when travelling long distances. A few pair are resident in the broader region, otherwise scarce.	E	4	L
Little Corella	Common in semi-arid Australia associated with grasslands, chenopods, and saline lake edge vegetation, but absent in the region. Occurs in reasonably sized flocks and will travel above the vegetation canopy.	E	4	L
Mulga Parrot	Recorded during field surveys. Resident. Considered here since wind turbine mortalities have been recorded for the related congener (Blue-winged Parrot *Neophema chrysostoma*). The Blue-winged Parrot is migratory in Tasmania and south-eastern mainland Australia, where it flies well above the vegetation canopy on migration and at these times is susceptible to wind turbine collision. The Mulga Parrot flies at or below the vegetation canopy and is residential in its behaviour.	E	4	L
Western Rosella[4]	Two records in the region in 2013 and 2014 near the development footprint, the next closest records are at a bird feeder in Coolgardie; otherwise, multiple records to the south of the region. Given the inland distribution, it is likely to be the inland subspecies *xanthogenys*. The species remains close to the vegetative canopy and is not high-flying.	E	4	L
Australian Ringneck	Recorded during field surveys. Common resident. The Australian Ringneck flies at or below the vegetation canopy and is residential in its behaviour.	D	4	L
Night Parrot [1, 2, 3]	Listed as critically endangered under the EPBC Act and BC Act. Nocturnal. Known to fly below or just above vegetation. Could fly at height, and the Ground Parrot (*Pezoporus wallicus*), supposedly of similar habits, has collided with wind turbines in Tasmania. The habitat of the region is not suitable for the species and was not recorded using acoustic monitoring.	E	3	L

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
Bourke's Parrot	Rare to the region. Flies below the vegetation canopy. Considered here since wind turbine mortalities have been recorded for the related congener (Blue-winged Parrot *Neophema chrysostoma*). The Blue-winged Parrot is migratory in Tasmania and south-eastern mainland Australia, where it flies well above the vegetation canopy on migration and at these times is susceptible to wind turbine collision. Bourke's Parrot flies at or below the vegetation canopy and is residential in its behaviour. It does not take long-distance flights or migrates; hence, no plausible risk exists. Known to travel a long distance to water after dark but below the vegetation canopy, usually within 2 m of the ground (pers. obs. D. Donato).	E	4	L
Scarlet-chested Parrot [3]	Listed as Local under the BC Act. Probably rare in the region. Considered here since wind turbine mortalities have been recorded for the congener (Blue-winged Parrot *Neophema chrysostoma*). The Blue-winged Parrot is migratory in Tasmania and south-eastern mainland Australia, where it flies well above the vegetation canopy on migration and at these times is susceptible to wind turbine collision. Scarlet-chested Parrot flies at or below the vegetation canopy and is residential in its behaviour. It does not take long-distance flights or migrates; hence, no plausible risk exists.	E	4	L
Purple-crowned Lorikeet [3]	Recorded during field surveys. Moves into the district after favourable rain and profuse flowering by eucalypts. Capable of long-distance flight in loose flocks at considerable height. Does not fly at night.	D	4	L
Budgerigar	Granivores, migratory and nomadic. Likely to be present only during favourable environmental conditions, otherwise absent. When flying to feeding grounds or on migration, the species flies at heights within the path of wind turbines (pers. obs. D. Donato). When in exceptionally large flocks, it may fly higher when wheeling around water sources and being pursued by birds of prey. Will gather in enormous flocks during boom conditions at water sources, and the likelihood of risk is only associated with these circumstances. Multiple carcasses recorded at wind turbines (pers. obs. D. Donato). Does not fly at night.	C	4	M
Regent Parrot [3]	Only eastern subspecies are listed under the EPBC Act. Uncommon to the region. The species can fly above the vegetation canopy. Rare north of Kalgoorlie.	D	4	L
Western Bowerbird	Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
White-browed Treecreeper	Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
Rufous Treecreeper	Common and recorded through the development footprint. Feeds on tree trunks and often on the ground. Remains under the tree canopy.	E	4	L
Blue-breasted Fairy-wren	Common and recorded within the development footprint. Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
Variegated Fairy-wren	Common and recorded within the development footprint. Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
Splendid Fairy-wren	Common and recorded within the development footprint. Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
White-winged Fairy-wren	Habitat not present within the development footprint, but may be present with development clearing. Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
Western Grasswren[4]	Weak flyer. Incapable of sustained flight.	E	4	L
White-cheeked Honeyeater	More associated with health and replaced by other honeyeaters in mallee and woodland habitats. More likely in the winter months if understorey Eremophila's are in profuse flowering. Remains close to the vegetation and usually within a few meters of the ground.	E	4	L

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
New Holland Honeyeater	More common in the gardens of Kalgoorlie, particularly in winter, and rare this far north in Western Australia. Remains close to flowering vegetation.	E	4	L
Brown Honeyeater	Common and widespread within the development footprint. Associated with the eucalypts and does not sustain flight above the canopy.	D	4	L
Brown-headed Honeyeater	Common and widespread within the development footprint. Associated with the eucalypts and does not sustain flight above the canopy.	E	4	L
White-eared Honeyeater	Recorded, common and widespread development in the development footprint. Forages amongst branches, searching for insects and closely associated with the vegetation canopy.	E	4	L
Black Honeyeater	Episodic, present during favourable post-cyclonic or heavy rainfall that causes flowering events amongst eucalypts, corymbiums or grevilleas. Male display flights, more rarely than Pied Honeyeater, are well above the vegetation canopy. Limited habitat is present for the species. Expected to be absent except during boom conditions.	D	4	L
Western Spinebill	More associated with health and replaced by other honeyeaters in mallee and woodland habitats. More likely in the winter months if understorey Eremophila's are in profuse flowering. Remains close to the vegetation and usually within a few meters of the ground.	E	4	L
Pied Honeyeater	Episodic, present during favourable post-cyclonic or heavy rainfall that causes flowering events amongst eucalypts, corymbiums or grevilleas. Male display flights are well above the vegetation canopy. Limited habitat is present for the species. Expected to be absent except during boom conditions.	D	4	L
Tawny-crowned Honeyeater	More associated with heath and replaced by other honeyeaters in mallee and woodland habitat. More likely in the winter months if understorey Eremophila's are in profuse flowering. Remains close to the vegetation and usually within a few meters of the ground.	E	4	L
Crimson Chat	Episodic, present during favourable post-cyclonic or heavy rainfall, inhabits flourishing grasslands and shrubs where it feeds on the ground. It can take flight above the surrounding vegetation canopy if flushed, but usually quickly drops to the canopy. Limited habitat is present for the species. Expected to be absent except during boom conditions.	E	4	L
White-fronted Chat	Common during favourable conditions, typically inhabiting saline lake edge and chenopod vegetation. Recorded at the KWTP. If disturbed, it will fly high above the vegetation canopy but only until out of range of danger. Rare during dry times.	E	4	L
Orange Chat	Nomadic. Prefers low salt bush and forbs habitat. Does not sustain flight above the canopy.	E	4	L
Spiny-cheeked Honeyeater	Common and recorded within the development footprint. Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
Western Wattlebird	More associated with heath and replaced by Red Wattlebird in woodland and mallee. More likely in the winter months. The species remains closely associated with the vegetation canopy.	E	4	L
Red Wattlebird	Recorded within the development footprint. Strongly associated with the vegetative canopy and undergrowth. Does not sustain flight above the canopy, although a diurnal migrant.	E	4	L
Singing Honeyeater	Commonly recorded within the development footprint. Strongly associated with the vegetative canopy and undergrowth. Does not sustain flight above the canopy.	E	4	L
Yellow-plumed Honeyeater	Commonly recorded within the development footprint. Strongly associated with the vegetative canopy and undergrowth. Does not sustain flight above the canopy.	E	4	L
Grey-fronted Honeyeater	Uncommon. Associated with the vegetation and does not sustain flight above the canopy.	E	4	L

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
White-fronted Honeyeater	Common and widespread within the development footprint. Associated with the eucalypts and does not sustain flight above the canopy.	E	4	L
Purple-gaped Honeyeater	Rare, cryptic. Associated with dense mallee or woodland, remains in the vegetative cover. Rarely more than a few meters from the vegetation.	E	4	L
Yellow-throated Miner	Common and recorded within the development footprint. Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
Spotted Pardalote	Recorded within the development footprint, usually in loose association with other insectivorous species in loose flocks in winter. Remains associated with the vegetative canopy, although capable of flight, high only usually when being pursued by aggressive honeyeaters, otherwise remains in the eucalypt canopy.	E	4	l
Striated Pardalote	Common and recorded within the development footprint. Closely associated with the vegetation and does not sustain flight above the canopy. Somewhat migratory.	E	4	L
Western Gerygone	Common and recorded within the development footprint. Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
Weebill	Common and recorded within the development footprint. Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
Redthroat	Recorded within the development footprint. Remains close to vegetation and does not sustain flight above the canopy.	E	4	L
Shy Heathwren	Remains close to the ground within vegetation cover. Cryptic. More common south and west of Kalgoorlie.	E	4	l
Western Fieldwren	Habitat is not extensive for this species in the development footprint, preferring treeless or scattered treed chenopod shrubland. Replaced by Redthroat in treed chenopod shrubland. Remains close to ground level.	E	4	L
Rufous Fieldwren	Prefers low salt bush and forbs habitat. Does not sustain flight above the canopy.	E	4	L
Spotted Scrubwren	Present in the region where there is thick undergrowth in the better watered gullies. Remains close to the ground in vegetative cover.	E	4	L
Southern Whiteface	Prefers low vegetation, open ground to forage. Does not sustain flight above the canopy.	E	4	L
Yellow-rumped Thornbill	Common and recorded within the development footprint. Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
Inland Thornbill	Recorded within the development footprint. Strongly associated with the vegetative canopy and undergrowth. Does not sustain flight above the canopy.	E	4	L
Slaty-backed Thornbill	Habitat of large, thick Mulga stands is not present in the development footprint.	E	4	L
Slender-billed Thornbill [3]	Habitat: lake fringed saltbush, not present in the development footprint.	E	4	L

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
Chestnut-rumped Thornbill	Recorded within the development footprint. Strongly associated with the vegetative canopy and undergrowth. Does not sustain flight above the canopy.	E	4	L
Western Thornbill	More likely in the south-west of Western Australia, and rarely into mallee dry woodland of the Kalgoorlie region. Remains close to the vegetation canopy.	E	4	L
White-browed Babbler	Common and recorded within the development footprint. Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
Varied Sittella	Common and recorded within the development footprint. Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
Crested Bellbird	Recorded within the development footprint. Strongly associated with the vegetative canopy and undergrowth. Does not sustain flight above the canopy.	E	5	L
Chestnut-breasted Quail-thrush [2]	Common and recorded within the development footprint. Ground dweller and has strong flight, but remains under the canopy.	E	4	L
Gilbert's Whistler	Resident, common in pairs throughout the development footprint. Remains within the vegetation canopy.	E	4	L
Rufous Whistler	Recorded within the development footprint. Strongly associated with the vegetative canopy and undergrowth. Does not sustain flight above the canopy, although a diurnal migrant.	E	4	L
Golden Whistler	More likely to occur in the winter within the region; otherwise uncommon. The species remains closely associated with the vegetation canopy.	E	4	L
Grey Shrike-thrush	Recorded within the development footprint. Strongly associated with the vegetative canopy and undergrowth. Does not sustain flight above the canopy.	E	4	L
Chiming Wedgebill	Vagrant and not likely present. Secretive and remains close to vegetation.	E	4	L
Ground Cuckoo-shrike	Rare in the region. Nomadic insectivorous and granivorous ground feeding species of the understorey and bare ground. When travelling some distance, the species flies at height; otherwise, it stays close to the ground.	D	4	L
Black-faced Cuckoo-shrike	Recorded during field surveys. Migratory, frugivorous, insectivorous and granivorous generalist feeding species of the understorey and vegetation canopy ground. Flight behaviour is usually within less than 20 m of the vegetation canopy when travelling some distance; otherwise it stays close to the vegetation canopy.	D	4	L
White-winged Triller	Passage migrant and assumed that when on migration, it flies above the vegetation canopy, otherwise closely associated with the vegetation. Rare in the region, more likely to be common after high rainfall.	D	4	L
Grey Currawong	Recorded during field surveys. Common. Sedentary insectivorous and granivorous species of bare ground, the understorey and the vegetation canopy. Flight behaviour is always within the vegetation structure.	D	4	L
Australian Magpie	Recorded during field surveys. Nomadic and sedentary insectivorous and granivorous species primarily of bare ground, the understorey and vegetation canopy. Flight behaviour is usually within the vegetation canopy, but also well above the vegetation canopy, probably at the heights of typical wind turbine blade swept paths, when in territory defence. Can occur in loose flocks. Susceptible to turbine collisions where the species is common.	D	4	L

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
Pied Butcherbird	Recorded during field surveys. Sedentary, feeds on invertebrates and small vertebrates on bare ground, the understorey and the vegetation canopy. Flight behaviour is always within the vegetation structure. Occurs in family groups.	D	4	L
Grey Butcherbird	Sedentary, feeds on invertebrates and small vertebrates on bare ground, the understorey and the vegetation canopy. Flight behaviour is always within the vegetation structure. Occurs in family groups.	D	4	L
Masked Woodswallow	Nomadic and migratory, depending on environmental conditions. Will feed on aerial insects, but also a generalist, feeding on nectar, pollen and terrestrial insects on the ground. On migration or when travelling long distances, flies at considerable height, almost beyond sight, in large loose flocks.	D	4	L
White-browed Woodswallow	Part migratory, arriving in southern regions in summer. Vagrant to the region. It does fly above the vegetation canopy in pursuit of aerial insects. Can be in large flocks.	D	4	L
Dusky Woodswallow	Recorded during field surveys. Migratory from the south and may be present in small numbers during the winter, but under some conditions, it can be in large flocks.	D	4	L
Black-faced Woodswallow	Recorded during field surveys on Bulong Road. Sedentary and part migratory depending on environmental conditions. Will feed on aerial insects, but also a generalist, feeding on nectar, pollen and terrestrial insects on the ground. Flight behaviour is always within vegetation structure or within a few metres of the vegetation canopy. Will colonise the area with vegetation clearance, creating grassland habitats over which it forages.	D	4	L
Little Woodswallow	Recorded during field surveys. Sedentary and part migratory, depending on environmental conditions and the provision of topographical habitat features. Will feed on aerial insects, but also a generalist, feeding on nectar, pollen and terrestrial insects on the ground. Flight behaviour is always within the vegetation structure or within 20 m of the vegetation canopy. Can be in large flocks.	D	4	L
Willie Wagtail	Common and recorded within the development footprint. Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
Grey Fantail	Recorded within the development footprint. Strongly associated with the vegetative canopy and undergrowth. Migratory and flight may be nocturnal. Does not sustain flight above the canopy diurnally at least.	E	4	L
Restless Flycatcher	A typical flycatcher, becoming increasingly rare. Remains within the vegetation canopy.	E	4	L
Magpie-lark	Recorded within the development footprint. Does not sustain flight at height, part migratory.	E	4	L
Torresian Crow	Most likely sedentary and territorial, depending on environmental conditions. Omnivorous and a generalist. Flying behaviour is usually within vegetation structure, but when travelling long distances can be at heights (50 m) typical of wind turbine blade swept paths.	D	4	L
Little Crow	Most likely nomadic, regionally and only present during favourable environmental conditions. Omnivorous and a generalist. Flying behaviour is usually within vegetation structure, but when travelling long distances can be at heights (50 m) typical of wind turbine blade swept paths. Travels in loose flocks.	E	4	L
Australian Raven	Recorded during field surveys. Pairs and often associated with mining infrastructure. Can fly well above the vegetation canopy when travelling long distances. Usually in pairs or family parties.	D	4	L
Red-capped Robin	Recorded within the development footprint. Remains close to vegetation and does not sustain flight above the canopy.	E	4	L
Jacky Winter	Recorded within the development footprint. Strongly associated with the vegetative canopy and undergrowth. Does not sustain flight above the canopy.	E	4	L

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
Hooded Robin	Uncommon. Associated with the vegetation and does not sustain flight above the canopy. Maybe some migratory movements.	E	4	L
Brown Songlark	Locally common, nomadic species following rains across the arid interior and roosting on the ground. Foraging for invertebrates on the ground by walking, running and rapidly hopping. Typically flies low, although males do fly high (probably up to 50 m) during mating and territorial displays. Absent during dry conditions. Likely to colonise the development footprint during favourable conditions associated with vegetation clearance.	D	4	L
Rufous Songlark	Probably a diurnal migrant. Recorded within the development footprint. Remains close to vegetation and does not sustain flight above the canopy.	D	4	L
White-backed Swallow	Common in the region. Will soar for insect prey on the wing, but below 10 m above the ground level. Nests in ground cavities. Loose flocks.	D	5	L
Fairy Martin	Passage migrant, moving north in summer and south in winter. Can associate with mine infrastructure and often breeds in culverts. Artificial water sources are utilised by this species, although only resident if flying insects are common, which only occurs during favourable environmental conditions.	D	4	L
Tree Martin	Passage migrant, moving north in summer and south in winter. Can associate with mine infrastructure. Artificial water sources are utilised by this species, although only resident if flying insects are common, which only occurs during favourable environmental conditions.	D	4	L
Welcome Swallow	Consummate with humans, and usually resident on mining operations and common at NSR. Migrant, moving north in summer and south in winter. Can associate with mine infrastructure. Artificial water sources are utilised by this species. Rare in the region.	D	4	L
Silvereye	Rare in the region, but more likely in the gardens of Kalgoorlie. Remains very close to vegetative canopy and foliage. Although the species can be nomadic and travel large distances, it does not fly high and only marginally above the canopy.	D	4	L
Mistletoebird	Recorded within the development footprint. Strongly associated with the vegetative canopy and undergrowth. Does not sustain flight above the canopy.	E	4	L
Zebra Finch	Habitat not present within the development footprint, but may be present with development clearing. Closely associated with the vegetation and does not sustain flight above the canopy.	E	4	L
Australasian Pipit	Recorded within the development footprint. Strongly associated with the short grasslands and bare ground. Does not sustain flight above the canopy.	E	5	L
Central Long-eared Bat[3]	Listed as P3 under the BC Act. Nocturnal. Fly and hunt close to vegetation, gleaning prey from foliage and at times from the ground. Not likely to fly above the vegetation canopy, but included here because of uncertainty associated with bat mortality associated with wind turbines and conservation status. Preys by perch and pounce, where it hangs from vegetation, pouncing on prey on nearby vegetation or the ground. Mortalities were rarely reported for this genera by Moloney [50].	E	4	L
Chocolate Wattled Bat	Not recorded in the development footprint but expected to be more common during winter. This species is found inland and in southern Australia. It is colonial at roosts. Recorded by field surveys. They prey on winged insects in open, unobstructed areas. They feed above the vegetation canopy in a fast not manoeuvrable flight [13]. A proportion of bat mortalities have been attributed to this genera elsewhere [50], but not expected to be common this far from the coast.	D	4	L
Gould's Wattled Bat	Common and recorded throughout the development footprint. This species is found inland and in southern Australia. It is colonial at roosts. Recorded by field surveys. They prey on winged insects in open, unobstructed areas. They feed above the vegetation canopy in a fast not manoeuvrable flight [13]. A high proportion of bat mortalities have been attributed to this species elsewhere [50], but not so far in inland Australia (pers. obs. D. Donato).	C	4	M

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
Hill's Sheathtail Bat	Nocturnal aerial forager remaining close to the vegetation canopy. Exceedingly rare to the region.	E	4	L
Inland Broad-nosed Bat	Recorded in the development footprint. The genera were recorded during on-site surveys, but the limitations of audio recorders do not allow accurate identification to species taxa level. Inland Broad-nosed Bat, typical of the genera, roosts in tree hollows, often colonially. They forage in a diverse range of habitats but stay within 15 m of the ground and do not forage above the vegetation canopy [13].	D	4	L
Inland Cave Bat	Cave dweller found close to rocky outcrops. Nocturnal aerial forager remaining close to the vegetation canopy. Not known from the immediate vicinity.	E	4	L
Inland Forest Bat	Nocturnal aerial forager occurring above the vegetation canopy. Probably the common species of this genera in the region. Mortality amongst these genera comprises less than 5% of bat mortalities as recorded elsewhere [50]. Probably low flying, which will be determined once baseline field data is analysed.	D	4	L
Inland Free-tailed Bat	Ozimops spp. recorded within the development footprint, either O. petersi (Inland Freetail Bat) or O. kitcheneri (Southern Freetail Bat). The species taxa are ubiquitous throughout the development footprint. Taxonomically confused if this actual species occurs in the region. Ozimops certainly does occur and is common in the development footprint. This species is found inland and south of the Tropic of Capricorn. Typical of the genera, its flat head allows it to squeeze into small roosts such as cracks and fissures in trees and small hollows. It is colonial at roosts. They are common in arid woodlands, treelined creeks, mallee, mulga and chenopod shrublands and have been recorded by field surveys. They prey on winged insects in open, unobstructed areas. They feed above the vegetation canopy in a fast not manoeuvrable flight [13]. Mortalities were rarely reported for this genera by Moloney [50], where surveys were conducted in coastal and south-eastern Victoria, but recorded as the most common genera to comprise mortalities elsewhere [50]. Mortalities from wind turbine strikes observed in inland Western Australia (pers. obs. D. Donato). Females are likely to be pregnant from August and lactating females expected through to December. Possible ecological release in the absence of White-striped Free-tailed Bat, where Ozimops spp. may fly higher to occupy the niche, where they are at higher risk of collision with wind turbines. Some uncertainty with the likelihood of relative abundance throughout the year in the development footprint. A precautionary principle is considered here.	A	4	H
Lesser Long-eared Bat	The more common of the Nyctophilus species. Nocturnal. Fly and hunt close to vegetation, gleaning prey from foliage and at times from the ground. Preys by perch and pounce, where it hangs from vegetation, pouncing on prey on nearby vegetation or the ground. Mortalities were rarely reported for these genera by Moloney [50].	D	4	L
Southern Forest Bat	Nocturnal aerial forager occurring above the vegetation canopy. Mortality amongst these genera has been recorded elsewhere [50]. Likely less common in the region than V. baverstocki. More likely in the winter. Probably low flying, which will be determined once baseline field data is analysed.	D	4	L
Southern Free-tailed Bat	As for Inland Free-tailed Bat.	A	4	H

Species	Flight Profile/ecology	Likelihood	Consequence	Risk
White-striped Free-tailed Bat	Common species not legislatively listed as threatened. The most common recorded bat species in the development footprint. Ubiquitous throughout the development footprint. Some seasonal movements are expected, but not fully determined by this study until winter surveys are completed. Literature provides limited information on migration patterns, and no information is specific to the Kalgoorlie district. Expected to be absent during the winter season. Also, likely to go into torpor during cold winter nights. Nocturnal aerial forager, feeding by flying high, at the height of the turbine swept path. Prey includes moths and other flying prey, although somewhat surprisingly, may come to the ground to feed on terrestrial macroinvertebrates. Susceptible to wind turbine collision, making up 95% of all bat mortalities at some inland Western Australian wind farms (pers. obs. D. Donato), and up to 60% of all bat mortalities recorded at one wind farm in coastal Victoria. Mortalities from wind turbine strikes for this species are almost certain, and considerable mortalities are expected. In a simplistic extrapolation of data from another inland Western Australian wind turbine operation, mortalities are expected to be several hundred, if not thousands, annually between August and May. Some uncertainty exists about the migration movements, so the high-risk season is still undetermined. Colonial roosting in hollows in small groups. In maternal hollows, larger groups of females roost and give birth. Numerous hollows and possibly maternal hollows may occur within the developmental footprint. Adult females are expected to be pregnant in late August and continue lactating through to May. Pregnant and lactating females and associated pups are expected to comprise 50% of mortalities between August and May. If hundreds or up to thousands of mortalities are to occur annually, it will likely diminish the population size within the district. Mortalities are expected to reduce as the population declines due to the impact.	A	3	H

Wildlife deaths

As previously stated, wildlife deaths are almost certain to occur at all commercial wind turbines [4]. There is no information to suggest this proposed development would be any different. Only those species that fly above the vegetation canopy in a manner not directly related to the vegetation, either as part of migration, travelling to feeding or roosting grounds, hunting techniques, territorial displays, searching for carcasses or have soaring habits are at risk from wind turbine strikes. These species are marked in Appendix A under the column labelled 'Flying above vegetation canopy'. All these species were described and risk assessed in Table 11.

NSR wind turbine is being located in a semi-arid zone, rather than a coastal or sub-coastal area. Wildlife presence and absence in this semi-arid zone are not predictable on an annual seasonal basis, as expected in southern coastal regions of Australia. Australia's semi-arid and arid zones are defined by exceptional wet months or years followed by several consecutive dry years. Wildlife diversity and abundance follow a similar pattern, with high abundance and diversity during wet conditions. Wildlife behaviour also changes during these times, for example, aerial courtship displays by eagles, which can also increase risks. Wildlife mortalities for some species will follow a similar pattern with low or no mortalities during very dry conditions, followed by relatively higher mortalities during favourable conditions. Some species will follow a more migratory set pattern, although abundance from year to year will vary.

Considering the Birds Australia guidelines [9], NSR is not along a known migratory flyway for migrants, nor near significant wetlands, nor has a high abundance of threatened species or the only known location for any threatened species.

Mitigation measures

Mitigation measures are specified here for those species with an inherent high (H) or medium (M) risk.

The literature review has identified mitigations that may be applicable to this proposed development, that of:

- curtailment (stopping rotation of turbines) during high migration seasons has been effective for birds and bats;
- curtailment during low wind speeds (<5 m/s) reduces the impact on bats;
- installing ultrasonic deterrents; and
- curtailment of specific turbines contributing a disproportionately high number of bird and bat carcasses.

This report demonstrates that the nightly activity patterns of high-risk bat species (White-striped Free-tailed Bat, Inland Free-tailed Bat and Southern Free-tailed Bat) have partially been identified, providing opportunities to implement risk mitigation through turbine curtailment at a particular time of night, and at a particular time of year. Cumulative bat activity tables are provided and logic follows that curtailment of turbine rotation during these hours reduces the impact proportional to the bat activity.

Species account

The impact of wind turbines on wildlife species varies considerably and is affected by [17, 56, 61, 62, 153]:

- number of rotor blades per wind turbine (three and four blades per turbine cause more wildlife deaths than two-bladed wind turbines);
- sweep depth of the blades (wildlife deaths increase with a decrease in the height the blades sweep relative to ground level);
- bird and bat species inventory and flight heights;
- presence of wind farms on migratory flight paths;
- weather conditions (overcast and foggy conditions disproportionally contribute to bird strikes);
- local topography (where raptors follow ridge lines as navigational aids or seeking updraughts);
- prey availability below the wind turbines;
- species abundance;

- species behaviour; and
- carcasses present below the wind turbines.

An inherent High (H) risk has been generated for three bat taxa species.

The risk assessment process generated an inherent Moderate (M) risk for a number of species. The risk assessment tables are a tool for evaluating inherent risks in complex settings; they are not the definitive outcome or measure of risk. Therefore, these specific species are further considered and discussed below, considering mitigation measures and the residual risk rating is assigned.

Additional species that did not generate a High (H) or Moderate (M) rating are also further considered here, due to;

- the species or genera have comprised a reasonable proportion of mortalities elsewhere, including globally; or
- uncertainty.

Australian Bustard (*Ardeotis australis*) Low Risk

Australian Bustard is a widespread species found in the northern two-thirds of the continent and southern New Guinea. It is a large ground foraging species, feeding on foliage, seeds, flowers, invertebrates and small vertebrates. It is nomadic in the arid zone, appearing during good or favourable seasons after rains, where it feeds on invertebrates (particularly grasshoppers) and small vertebrates. Although a ground forager, it can sustain flight at height when travelling to and from roosting and feeding grounds. The species can gather in loose flocks on tropical savannah feeding grounds, but less so in the arid zone. Australian Bustard's presence in the area would be rare and stochastic: being absent for years and then present due to favourable seasons after rainfall, possibly in loose flocks. Birds in northern Australia are more sedentary than those in arid Australia. Being nomadic and therefore not habituated, Bustards are susceptible to collision with infrastructure, including wind turbines. Elsewhere in the world, wind turbine collision is a known threat to the closely related Great Indian Bustard (*Ardeotis nigriceps*) [15, 16].

The open, usually grassy habitats, this species prefers is largely absent from the region, and even during high rainfall conditions, the species will likely remain a vagrant. With the exceedingly low occurrence of the species, the species not occurring in flocks (multiple deaths are not likely), the likelihood of a collision with wind turbines is plausible, but only in exceptional circumstances. Consequently, a Low (L) risk is retained (E/3) without the need for mitigation measures.

Common Bronzewing (*Phaps chalcoptera*) Low Risk

Common Bronzewing is common, although rarely seen in the region. Males call frequently at dusk and dawn, which is how the species is primarily detected. The species has been recorded within the development footprint by call, and is expected to be common. One carcass of this species has been recorded at an inland wind turbine operation in Western Australia, after only three months operation, yet the species is uncommon there. Literature and field observations suggest this species does not fly at wind turbine height. Field observations within the development footprint have been in open areas, along roads and the edge of clearings. The species calls from thick woodland and scrub. Primarily feeds on acacia seeds, but not exclusively. The species' general shy behaviour, except when habituated with humans at mining operation camps, would reduce the species' presence well above the vegetation canopy and within the swept path of turbines. Although a carcass has been recorded for this species, it is likely a rare event. The species gathers at water sources after sunset and before dawn, but does not travel in flocks, rarely more than three individuals, and even then loosely together, usually tens of meters apart; consequently, wind turbine strikes are likely to be of individuals, although rarely or exceptionally. The species is not legislatively listed as threatened. A Low (L) risk is now determined (E/4) without the need for mitigation measures.

Crested Pigeon (*Ocyphaps lophotes*) Low Risk

Common and adapted to human-modified landscapes. The species is not found within the development footprint, but is common in surrounding cleared landscapes. The species will colonise the cleared vegetation areas associated with the wind turbine infrastructure. It is predicted to be the most common pigeon in the vicinity of the proposed wind turbines. The species is not shy and occurs in loose flocks up to 10 or 20 birds, but usually fewer than five birds. They would rarely fly at the turbine rotor swept path height but could do so rarely. Being resident and familiar with human landscapes, the species is likely to habituate to the turbines and may avoid them. The species is not legislatively listed as threatened. A Low (L) risk is now determined (E/4) without the need for mitigation measures.

Fork-tailed Swift (*Apus pacificus*) (MA, MI) Moderate risk

Fork-tailed Swift is a non-breeding visitor to Australia between September and April [154, 155]. This species is primarily observed foraging for insects in proximity to cyclonic weather [154]. The species is listed as migratory and protected under international treaties (Appendix A) and has an extensive range and population that appears to be stable. This species has been recorded in desktop or field surveys.

The species does not land in Australia and sleeps on the wing at night. It is extremely fast-flying foraging for aerial insects from almost ground level up to hundreds of metres. Considering the flight speed and agility of the species, it could be considered probable that a collision with wind turbine blades could occur. The White-throated Needletail (*Hirundapus caudacutus*), a migrant to eastern Australia, has similar flight patterns, is extremely fast and agile in the air, also sleeps on the wing at night, and has suffered considerable mortalities at wind farms in Tasmania [76]. There is no information to conclude otherwise that the Fork-tailed Swift is not as susceptible as the White-throated Needletail. However, the occurrence in the region for Fork-tailed Swift is expected, but usually for a few days as they follow summer storms and low-pressure cells. There may be an occasional risk during these storm events; otherwise, the risk is exceedingly low. Seasonally, there is a possible likelihood of collision with turbines, and given the species is legislatively listed as a Moderate (M), a value of (C/3) is now determined.

No proactive mitigation measures are considered for avian species, and as a consequence, an inherent Moderate (M) risk is determined.

Curlew Sandpiper (*Calidris ferruginea*) (MA, MI) Low Risk

The critically endangered Curlew Sandpiper is a summer migrant and is listed under the EPBC Act as a migratory wetland species and is protected under international treaties and the Bonn Convention. Under the BC Act of Western Australia, its listing is IA, representing its international protection and migratory status.

In Australia, the species is a coastal wader; however, it is rarely recorded on mine tailings systems in September and October, as a passage migrant to southern coasts. Inland, it has only been recorded on individual days and always departed during the night by the following day. The species would fly at height during the night on migration. It has not been recorded at the KWTP.

It occurs in such low numbers, inland, that the likelihood of collision with wind turbines is not plausible. A Low (L) risk rating is now determined (E/3) without the need for mitigation measures.

Whiskered Tern (*Chlidonias hybrida*) (M, M) Low Risk

Whiskered Tern is listed under the EPBC Act as a migratory wetland species and is protected under international treaties and the Bonn Convention. Under the BC Act of Western Australia, its listing is IA, representing its international protection and migratory status.

Migratory in and beyond Australia, moves north and to southern Australia in summer. Usually absent during dry conditions, sometimes for years. It can be present in large flocks during favourable, post-cyclonic weather conditions. Rarely present on mine infrastructure water sources, where it feeds on aquatic macroinvertebrates. It has not been recorded in the vicinity of Kalgoorlie Consolidated Gold Mine.

It is associated with flooded vegetation during favourable conditions and can breed on shores and islands within ephemeral freshwater lakes. It will travel above the vegetation canopy to and from nesting and feeding sites. In a presumably suitable habitat, even in favourable conditions, a species can remain absent. However, the species is exceedingly rare in the region, low flying when not breeding, and a Low (L) risk is now determined (E/5) without the need for mitigation measures.

Banded Stilt (*Cladorhynchus leucocephalus*) (L) Low Risk

Considered here because of its flocking nature at saline lakes and perceived potential for risks. Banded Stilt is nomadic and episodic, appearing in the region in enormous numbers after an absence of many years or decades. They are closely associated with saline lakes that have been inundated by significant rainfall events and have a brine shrimp population. The species can breed in massive colonies on selected saline lakes. As an example, a flock estimated at 20 000 bred on the northern shores of Lake Carey in May 2017 (pers. obs. D. Donato. See also Birdlife Australia Birdata) after a significant rain event several months before. The breeding location (20 000 birds) was at the lake's northern end, with the population extending down the eastern shore for 20 km. This breeding event demonstrates that the species can occur in enormous numbers, which needs to be considered in any risk assessment. The species was closely associated with the lake's shallow waters and shoreline. No adult birds were observed more than metres away from the lake itself.

This species has been recorded on TSFs in large flocks arriving at night, usually after a previous day or night rainfall, thereby evidently travelling at night across the landscape. Since tailings systems have no brine shrimp, they usually leave the tailings systems the following night. Flight is well above the vegetation canopy when travelling long distances. They are closely linked to saline lakes, although none are in the vicinity of the proposed wind turbines, nor are the turbines on a pathway between wetlands. The likelihood of collision is determined as rare, even during boom conditions. A risk of Low (L) risk is now determined (E/4) without the need for mitigation measures.

Black-shouldered Kite (*Elanus axillaris*) Moderate Risk

Resident in the district feeding over modified grasslands and semiurban habitats. It feeds on small vertebrates and larger macroinvertebrates by scanning or hovering in flight over suitable habitat. The species is resident in and around Kalgoorlie but not recorded within the development footprint. It is common on cleared grasslands surrounding the development footprint and is expected to colonise the wind turbine infrastructure once vegetation has been cleared and converted to bare ground or grassland. Its habit of hovering and flying at height, while searching for prey, makes it susceptible to wind turbine strikes. The species does not occur in flocks, at most as a territorial pair with their young, but is usually seen as individuals. Being territorial, and not in flocks, it is not plausible to have a considerable number of deaths, albeit in low numbers (probably a few a year). However, their population does fluctuate, and in favourable conditions, when rodent numbers are high, the number of mortalities is expected to be higher. A Moderate (M) risk is retained here (C/4).

No proactive mitigation measures are considered for avian species, and as a consequence, an inherent Moderate (M) risk is determined.

Wedge-tailed Eagle (*Aquila audax*) Moderate Risk

The Wedge-tailed Eagle is Australia's largest eagle. Bird strikes by wind turbines for this species have been observed in the field (pers. obs. D. Donato) for the genera and are widely reported [3, 18]. The mainland subspecies is not listed under the EPBC Act or the BC Act. Given the species' habit of carcass searching, including under wind turbines, soaring and flight patterns make the species susceptible to wind turbine strikes. The species is present in the locality as a resident territory pair, although no nests could be found within 20 km of the turbines, irrelevant for environmental boom/bust cycles [156]. The territorial pair is believed to exclude other eagles from entering the area. Collision with turbines could substantially (temporarily) reduce the local population (consequence Moderate 3). Anecdotal evidence suggests that the surviving individual quickly (within days) replaces its partner's death, thereby maintaining its territorial dominance and a resident pair in the locality.

Aquila species are globally susceptible to wind turbine collision [46]. They will fly at height and search for carcasses under wind turbines. In inland Australia, the Wedge-tailed Eagle is a common raptor, usually in territorial pairs, with a floating population (presumable subadult and adult birds without territories). In the Perth region, the territory size was determined at 36 km^2 [157], and 9 to 50 km^2 [158], and 39 km^2 [159] in semi-arid NSW. Territories would be expected to be 30 to 50 km^2 at the NSR region. Population is not likely to fluctuate with boom-and-bust conditions because of the territorial nature of resident pairs [156]. Numerous deaths for this species have been recorded elsewhere [3] (including pers. obs. D. Donato). It would be reasonable to presume that territories would be expected to be 30 to 50 km^2 at NSR.

The likelihood of a collision is determined as 'could' (C rating); therefore, a risk rating of Moderate (C/4-M) is concluded for this species. Mortalities of this species are expected for the life of the wind turbines, albeit in low numbers (probably a few per year). The risk profile is not deemed to be any different during favourable conditions.

No proactive mitigation measures are considered for avian species, and as a consequence, an inherent Moderate (M) risk is determined.

Whistling Kite (*Haliastur sphenurus*) Moderate risk

It is common in northern Australia and is becoming less frequent in southern Australia. If conditions are favourable, the species population probably increases during the summer and declines in the winter. A scavenger, the species soars and glides for long periods of time well above the vegetation canopy, with the height of the swept path of turbines. The species is not territorial except around its nests; otherwise, it gathers in loose flocks. Mortalities amongst this species are expected, being one of the more common raptor species and a Moderate (M) risk is retained here (C/4).

No proactive mitigation measures are considered for avian species, and as a consequence, an inherent Moderate (M) risk is determined.

Black Kite *(Milvus migrans)* Moderate Risk

As for the whistling kite, it is common in northern Australia and is becoming less frequent in southern Australia. If conditions are favourable, the species population probably increases during the summer and declines in the winter. A scavenger, the species soars and glides for long periods of time well above the vegetation canopy, with the height of the swept path of turbines. The species is not territorial except around its nests; otherwise, it gathers in loose flocks. Mortalities amongst this species are expected, being one of the more common raptor species and a Moderate (M) risk is retained here (C/4).

No proactive mitigation measures are considered for avian species, and as a consequence, an inherent Moderate (M) risk is determined.

Rainbow Bee-eater (*Merops ornatus*) (MA, MI) Moderate Risk

Rainbow Bee-eater is listed as marine under the EPBC Act. It is migratory and moves south over inland Australia in the summer and north to northern Australia and eastern Indonesia in the winter. Aerial when foraging and using a still-hunting technique from an exposed perch. It feeds on flying invertebrates, including bees and dragonflies. On migration, it occurs in loose flocks of up to 20, flying high following topographical features if present. The species is common, and the population is stable [23].

The species is common and has been recorded within the development footprint, typically in clearings amongst woodlands.

The species remains in the vicinity of the vegetation, making sudden attacks less than 10 m above the vegetation canopy. During migration, it can fly at considerable height, and at these times, it may be susceptible to turbine strikes. It is not known to be a passage migrant through the locality, and hence a precautionary principle is used here. The species is rare or absent in the winter. A risk rating of C/4 is now determined.

No proactive mitigation measures are considered for avian species, and as a consequence, an inherent Moderate (M) risk is determined.

Nankeen Kestrel (*Falco cenchroides*) Moderate Risk

Nankeen Kestrel is a common small falcon, feeding primarily on invertebrates by still-hunting from an exposed perch or hovering [160]. It is not known to be attracted to carrion and hence would not trap line under wind turbines. It frequently hovers, particularly over low ridges providing an updraught, which may bring it into the swept path of wind turbines. It feeds over open areas, short grasslands or chenopods. Clearing around the foot of the turbines may favour the presence of the species. Given the precedent of wind turbine impact on kestrels elsewhere [76] and the species' habit of hovering on topographical updraughts, wind turbine strike likelihood is possible and could occur. A risk rating of Moderate (M) for Nankeen Kestrel is retained (C/4).

No proactive mitigation measures are considered for avian species, and as a consequence, an inherent Moderate (M) risk is determined.

Brown Falcon (*Falco berigora*) Moderate Risk

Brown Falcon is a large raptor, feeding on small mammals, reptiles, small birds, and invertebrates during dry conditions. Vocal, recorded through the NSR area and observed during field surveys [161], has a global population estimate of 225 000 pairs [162]. A sedentary species [162], it forages mostly by still-hunting from an exposed perch, but less so by hovering, quartering and soaring, it will also feed on carrion [163]. [162]. The species' territorial display consists of high-flying dives, stoops and calling loudly.

Consistent with raptors elsewhere in Australia [3, 62] and in Europe and North America [75], this species' habit of feeding on carrion, soaring and hovering makes this species susceptible to wind turbine strikes. However, its referred hunting method is perched on exposed branches where it is searched for reptiles. Clearing around the foot of the turbines may favour the presence of the species. The species occurs in low numbers in the region, along with its preferred hunting behaviour (perch and pounce on ground prey), which reduces the likelihood of collision with wind turbines. A risk of Low (L) is now determined (D/4) without mitigation measures.

Peregrine Falcon (*Falco peregrinus*) (Other BC Act) Moderate Risk

A resident pair are present at NSR TSFs, where they inhabit the open pit for roosting and presumably breeding. It is also presumed that a floating population of non-territorial birds would sometimes frequent the area. The resident pair hunts across the landscape, but particularly upon waterbirds at the NSR TSF. The species seems closely associated with these wetlands. The species is known to suffer mortalities from a collision with wind turbines, but the likelihood here is deemed unlikely due to the low population density. The low population density will be maintained during boom times because of the territorial nature of the resident pair. The species appears less susceptible to wind turbine strikes than slow-flying raptors. The likelihood is not considered as high as for the Wedge-tailed Eagle, because its prey is associated with wetlands and not grasslands or shrublands. A Low (L) risk is derived for the species (D/4) without mitigation measures.

Night Parrot (*Pezoporus occidentalis*) (Critically Endangered EPBC Act) Low Risk

Night Parrot calls were not detected within the development footprint.

Night Parrot is listed as endangered under the EPBC Act and critically endangered under the BC Act of Western Australia. It has a population estimate of 50 to 250 individuals, although it is acknowledged [164] as no more than an educated guess. Historical records indicate that the night parrot, before European settlement, inhabited most of central Australia [165]. Still, today it is only known from a few secluded populations in south-west Queensland and northern inland Western Australia. [166].

The development footprint and surrounding landscape vicinity lack the spinifex-dominated vegetation types, and it is assumed that the habitat is not suitable for the Night Parrot.

A summary of their rationale to support their conclusion is as follows:

> *"Roosting and breeding habitats in Queensland and Western Australia are characterised by Triodia species with a ring-forming growth habit. The parrots only occur in patches of this Triodia that are long unburnt and have formed large, complex hummocks (Murphy et al.2017; Jackett et al. 2017)"*
>
> *"All contemporary Night Parrot locations in QLD and WA are in exclusively open landscapes with few, if any, trees and/or shrubs. Night Parrots have never been recorded in any of the woodland types that occur at the QLD site, including lancewood (Acacia shirleyi) woodlands with sparse Triodia longiceps on plateaus, and A. cambagei/A. aneura with sparse T. longiceps along drainages. habitat."*

In QLD, Night Parrots feed on a suite of annual and perennial grasses and forbs in floristically diverse run-on areas" [167]. Most habitat records for Night Parrot are within *Triodia* (Spinifex) grasslands and/or chenopod shrublands in the arid and semi-arid zones [164], and Higgins [168] lists *Astrebla* spp. (Mitchell grass), shrubby samphire and chenopod associations, scattered trees and shrubs, *Acacia aneura* (Mulga) woodland, treeless areas and bare gibber as being associated with sightings of Night Parrot [169]. The habitat has also been described as areas of old-growth spinifex (*Triodia*) for roosting and nesting, together with foraging habitats that are likely to include various native grasses and herbs and may or may not contain shrubs or low trees [146] [170]. These habitats are not evident in the vicinity of the proposed wind turbines.

GPS-tagged Night Parrots have been shown to move a distance of 29.9 km per night, with a minimum 9.4 km in a straight line from their roosts. They were also recorded to travel 9 km in a round trip to drink. The nightly mean convex polygon for a tagged male was 783 ha, meaning the species is mobile and can traverse large distances [10]. They have also been known to travel up to 40 km at night when foraging [10].

Two Night Parrots have been captured for radio and GPS-tag work and were captured in mist-nets 0.6 m and 1.5 m above the ground [10]. Three individuals observed using night vision equipment flew at fast speeds akin to Common Bronzewing (*Phaps chalcoptera*) or Australian Hobby (*Falco longipennis*) [10]. A photograph taken of a flushed Night Parrot shows the bird flying just above the ground vegetation [11]. This may indicate that the flight of Night Parrot is typically low over ground vegetation, similarly to ground parrots (*Pezoporus wallicus*).

The flight pattern and the ability to detect obstacles in the landscape are important to determine how likely a bird species is to be impacted by wind farms. When it comes to the Night Parrot, we are limited by very sparse information. Night parrots have been known to fly over 40 km in one night and move up to 10 km (measured in a straight line) away from the roosting site. They can likely fly much further with a minimum measured speed of up to 38 km per hour [167]. There is no available data on how high the parrots fly, which is critical information to determine whether they get up into the rotor swept area and are likely to collide with the rotor blades. The rotor blades may, however, not be the only risk to the parrots. Ley and Tynan [171] found a night parrot as one of 18 bird species that died following collisions with barbed wire fencing. A 3D scan of the only complete night parrot skull specimen in existence revealed relatively small optical lobes and optic foramina compared to closely related species [172]. Similar adaptations in other night-active birds meant better low-light vision but less visual acuity [172]. This is unlikely to be a problem for the night parrot as it prefers habitats with very few trees [173]. It could, however, render it susceptible to colliding with human-made obstacles such as fences, wind turbine towers, powerlines etc [172].

Eastern Ground Parrot (*Pezoporus wallicus*) is of the same genera as Night Parrot and has some wind farms within its distribution.

Although Eastern Ground Parrots fly low over vegetation, one mortality has been reported [76] at the Studland Bay Wind Farm in Tasmania. The Studland Wind Farm is located in northwest Tasmania and comprises 25 v90 wind turbines with 45 m long blades and 80 m high towers situated on elevated terrain. From these dimensions, it is assumed the swept path of the blades approaches 35 m above the ground. The surveys commenced in 2007, ceased in 2010 and were conducted about twice weekly in spring and autumn and then fortnightly for the rest of the year. Only 25% of the turbines were selected to be surveyed. Given such a survey frequency, effort, and lack of quality assurance and quality control, the carcass count, as reported, including for Eastern Ground Parrot, could be argued as a gross underestimation, possibly by orders of magnitude. However, given the lack of quality assurance and quality control of the field survey methodology, the Eastern Ground Parrot (*Pezoporus wallicus*) could have been a misidentified Blue-winged Parrot (*Neophema chrysostoma*), Orange-bellied Parrot (*N. chrysogaster*) or Green Rosella (*Platycercus caledonicus*), species all known to fly at wind turbine heights. Nevertheless, it will be considered here that Pezoporus species, typically known to remain close to vegetation in its flight behaviour, does not exclude it from a collision with wind farm blades at heights of 35 m above the surrounding terrain.

Night Parrot has a high species profile in the scientific and broader community. Given the species' conservation status, extremely low population, limited knowledge of the species' flight behaviour, compounded by its nocturnal behaviour and with the presumably ecologically similar Eastern Ground Parrot (*Pezoporus wallicus*) species being struck by wind turbine blades, a risk of collision with wind turbine blades exists. However, given the lack of historical occurrence of Night Parrot within the NSR region, lack of detection after audio surveys [174] for the species and minimal habitat present, a collision with wind turbine blades is not plausible, and hence a risk rating of Low (L) has been derived (E/3) without mitigation measures.

Budgerigar (*Melopsittacus undulatus*) Moderate Risk

Budgerigar is granivorous, migratory and nomadic. It is only likely to be present in the locality during favourable environmental conditions; otherwise, it is absent. It will gather in enormous flocks at water sources during and towards the end of exceptionally favourable conditions. When in vast flocks, it may fly higher than usual when wheeling around water sources and being pursued by birds of prey. These conditions rarely occur, and water sources are not present near the proposed wind turbines. When flying to feeding grounds or on migration, the species flies at heights close to but probably not exceeding 30 m (pers. obs. D. Donato). The species do not fly at night.

Other than under favourable environmental conditions, the species is expected to be absent.

Collision with wind turbines is unlikely, although the species occurs in flocks means that considerable mortality events can occur. Water sources are not present in the vicinity of the development footprint. Grasslands (seed sources) are expected to be present in the vicinity of the proposed wind turbines, once the infrastructure has been built. A Medium (M) risk is retained (C/4), since during rare favourable conditions when large flocks could be present, specific actions and management may need to be implemented to reduce mortality events.

No proactive mitigation measures are considered for avian species, and as a consequence, an inherent Moderate (M) risk is determined.

White-striped Free-tailed Bat (*Austronomus australis*) Moderate Risk

White-striped Free-tailed Bat is a common species, not listed as threatened under legislation, with a range covering most of central and southern Australia. Most individuals migrate north for winter and return to southern Australia for summer [175]. This species is a nocturnal aerial forager, preferring to fly at considerable height for moths and other prey [175] above the vegetation canopy. The species is common and ubiquitous within the development footprint and is expected to remain so when the wind turbines are operational.

White-striped Free-tailed Bats can commute 50 km between roost and feeding areas. It has been known to form small groups within large colonies covering several hundred kilometres. This species was the most common carcass recorded and comprised nearly 60% (n=296) of bat mortalities at Victorian wind farms [50]. Ongoing monitoring (D. Donato unpublished data 2025) of wind turbine wildlife strikes at other inland Western Australian operations has recorded nightly multiple mortalities until remedial actions have been taken. The number of mortalities is considerable at the wind turbine operations, which have 10% of the number of turbines compared to this development. The experiences elsewhere cannot be directly extrapolated to the development; however, the bat activity data recorded at this proposed development is comparable to that at the turbine operations that experience considerable deaths amongst this species.

This bat species' activity within the development footprint is known. When simplified and directly extrapolated to the number of reported carcasses at a comparable operation, thousands of carcasses are expected to be recorded between September and March if no mitigation is implemented.

Maternal colonies, which can be up to 300 individuals, roost in hollows of old eucalypts with large trunk cavities, which are numerous with the development footprint. Copulation occurs in late August, with a single pup born between mid-December and late January and weaned by May. Lactating females are expected in the population between December and May, which are the seasons that the species is present throughout the development footprint. Assuming, between August and May, that pregnant and lactating females are 50% of the population (with the other 50% of the population made up of males), then it follows that these females will make up 50% of mortalities. Being a slow-reproducing species (for its size), producing one pup per year, the removal of adult females from the population to the expected extent would likely impact the regional population size, and continue to do so.

A precautionary principle has been taken here; the species, although migratory, may not be present in the Kalgoorlie district annually, or the population size may vary annually due to climatic variability (boom-bust or part boom-bust).

The night activity and migration patterns have partly been described here. This information provides insight into implementing targeted turbine curtailment (stopping turbine rotation) at particular times of night, particular times of year and under wind speed conditions.

A considerable number of mortalities are expected amongst pregnant and lactating females if no remedial actions are taken. Therefore, the risk rating of High (H) is retained (A/3).

If a mitigation measure is turbine curtailment for 90% of this species' nightly activity during the breeding period (August to May), then the numerical impact is presumed to be reduced to 10% of the predicted impact. Nevertheless, 50% of the carcasses would be pregnant or lactating females, which almost certainly will result in the death of their pup. Any turbine curtailment mitigation should be implemented as an adaptive management process, where the impact is constantly assessed (number of carcasses), and consequently, the turbine curtailment time is amended to reduce the impact to an acceptable level. Such adaptive management could, if successfully implemented, substantially reduce impacts.

It is assumed that, at least, some curtailment will be implemented for some time, that an articulated management or mitigation plan will be implemented, wildlife carcasses will be accurately monitored, and bat activity will be monitored. However, a precautionary principle is followed here, on the basis that such adaptive management has not been documented (publicly available literature) and successfully implemented elsewhere. In essence, this has not been done before, other than on a trial basis, but not as part of standard operational procedure. A Moderate (M) residual risk is determined.

Inland Free-tailed Bat (*Ozimops petersi*)/Southern Free-tailed Bat (*Ozimops kitcheneri*) Moderate Risk

Audio recorders used to detect bat species are unable to differentiate species taxa within this genus. Given the taxonomic disarray of the Ozimops genus, these two species are considered together.

The taxa are common and ubiquitous throughout the development footprint.

Pregnant and lactating females are present from August to March [13].

Ongoing monitoring (D. Donato unpublished data 2025) of wind turbine wildlife strikes at other inland Western Australian operations has recorded several mortalities of species of this genus. The number of carcasses is few, although elsewhere, when the White-striped Free-tailed Bat is absent, the number of carcasses reported for this species increases. This is probably related to ecological release, when the White-striped Free-tailed Bat is absent, Ozimops may feed at higher altitudes, thereby placing it at risk of wind turbine strikes. Anecdotal evidence (pers. comm. to D. Donato) has revealed that this taxa comprise the majority of mortalities reported at an opportunistically monitored wind turbine operation in inland Western Australia. Along with general information on bat mortality associated with wind turbines elsewhere [2, 5, 13, 22, 27, 66, 68-70, 97, 139, 150, 176]. This needs to be considered, and a precautionary approach is taken here, and a High (H) risk is retained for this species (A/4).

If a mitigation measure is turbine curtailment for 90% of this species' nightly activity during the breeding period (August to May), then the numerical impact is presumed to be reduced to 10% of the predicted impact. Nevertheless, 50% of the carcasses would be pregnant or lactating females, which almost certainly will result in the death of their pup. Any mitigation turbine curtailment should be implemented as an adaptive management process, where the impact is constantly assessed (number of carcasses), and consequently, the turbine curtailment time is amended to reduce the impact to an acceptable level. Such adaptive management could, if successfully implemented, substantially reduce impacts.

It is assumed that, at least, some curtailment will be implemented for some time, that an articulated management or mitigation plan will be implemented, wildlife carcasses will be accurately monitored, and bat activity will be monitored. However, a precautionary principle is followed here, on the basis that such adaptive management has not been documented (publicly available literature) and successfully implemented elsewhere. In essence, this has not been done before, other than on a trial basis, but not as part of standard operational procedure. A Moderate (M) residual risk is determined.

Central Long-eared Bat (*Nyctophilus major tor*) (P3 BC Act) Low Risk

The Central Long-eared Bat is nocturnal, although the species does use sight for hunting to some degree. Data specific to this species is limited because audio recorders do not allow accurate identification of species taxa levels of this genera. It is known to fly and hunt close to vegetation, gleaning prey from foliage and, at times, from the ground. Preys by perch and pounce, where it hangs from vegetation, pouncing on prey on nearby vegetation or the ground. It is reported not likely to fly above the vegetation canopy [13]. However, mortalities amongst this genera have been recorded at Victorian wind farms, where they comprise less than 1% (n=7) of bat mortalities [50]. The presence of the species in the locality is unknown, but its conservation status would suggest it is less common than *N. geoffroyi*. Given the genera' low mortality compared to other bats and this species' presumed rarity, the likelihood of collision is deemed rare; hence, a Low (L) is derived (E/4).

Gould's Wattled Bat (*Chalinolobus gouldii*) Moderate Risk

Gould's Wattled Bat is probably the region's most common bat and mammal. This species is found inland and in southern Australia, where it roosts in colonies. They prey on winged insects in open, unobstructed areas that would occur around wind turbines. They feed above the vegetation canopy in a fast, not manoeuvrable flight [13]. A high proportion (10%, n=49) of bat mortalities have been attributed to this species elsewhere [50]. Given the species is common and susceptible to wind turbine collision, a Moderate (M) risk (C/4) is retained for this species.

If a mitigation measure is turbine curtailment for 90% of this species' nightly activity during the breeding period (August to May), then the numerical impact is presumed to be reduced to 10% of the predicted impact. Nevertheless, 50% of the carcasses would be pregnant or lactating females, which almost certainly will result in the death of their pup. Any mitigation turbine curtailment should be implemented as an adaptive management process, where the impact is constantly assessed (number of carcasses), and consequently, the turbine curtailment time is amended to reduce the impact to an acceptable level. Such adaptive management could, if successfully implemented, substantially reduce impacts.

It is assumed that, at least, some curtailment (at least 90% of the cumulative nightly activity) will be implemented for some time, that an articulated management or mitigation plan will be implemented, wildlife carcasses will be accurately monitored, and bat activity will be monitored. A precautionary principle is followed here, as the species although is less active in the airspace at turbine height compared to WSFTB and Ozimops spp., they comprise a significant proportion of fatalities elsewhere and a Moderate (M) residual risk is determined.

Limitations

Flight height and the frequency of such flights are primary risk factors. Influences of site-specific factors contributing to the flight behaviour of many species are not known but are inferred from literature, field observations, database searches and field experience. This may equate to a measure of subjectiveness in the assessments in this report. Complexity is added here, with long-term climatic conditions that can be described as boom and bust. The risk assessment framework used here considers uncertainties, and a precautionary principle has been used. Nevertheless, if significant new information becomes available, such a risk assessment should be reassessed.

If the height of the blade swept path above the ground changes from the height path stated in this report (59 m), then that can significantly change the species risk profiles.

Site-specific field surveys have been collected, which commenced in October 2024 and are to be completed after two years of field surveys (October 2026). The current dataset considered here extends from October 2024 to mid-May 2025. The winter season has not been surveyed. The field survey data, although assessed for this risk assessment, will need to be reassessed once field data surveys are completed.

Data from two of the five audio recording devices (SM4s) has been analysed (KWT01 and KWT04). This limits the understanding of avian inventory and, more importantly, the changes in relative bird abundance across the landscape, if any. This report assumes that there are no significant differences in bird relative abundance and diversity across the development footprint. However, on a temporal basis, there was considerable variation in bird activity from day to day and week to week, which may represent migration or landscape-scale movements.

Raptors, a known guild at risk from turbines, are largely silent and, therefore, are best surveyed through opportunistic driving surveys. These surveys are to identify hunting areas and any nesting sites. These surveys are limited in extent and should be conducted more comprehensively.

Bat relative abundance and activity through the winter season are unknown. This information may provide insight into bats' annual migratory patterns in the specific region. This will be important when implementing bat monitoring (bat activity and bat carcass counts) regimes and possible mitigation measures to reduce bat impacts.

The lack of comparative data from season to season, that is, one year to the next, is required to determine if the relative bat and bird abundance and activity changes from year to year. For example, it is not known if the bat relative abundance between October 2024 and May 2025 is unusually high compared to other years, especially for the recognised high-risk species, White-striped Free-tailed Bat. This again will have implications for monitoring and mitigation regimes.

Maternity roosts may exist in the area, although the vegetation being primarily regrowth with limited hollows and microhabitats. No specific searches for maternity roosts have been conducted which may provide insight into some turbine disproportionately contributing to carcasses.

Nocturnal flight surveys for WSFTB should be conducted. This is the only microbat species that emits calls audible to humans, and hence can be heard in the field and surveyed. These surveys should be conducted with spotlights and night-vision optics. These surveys can also be used to identify any maternity roosts.

Conclusion

In simplistic terms, most of the inherent risk associated with the proposed wind turbines to wildlife is some typical bush birds, birds of prey (raptors), bats and some migratory species. This is no different to other wind turbine operations globally [2-28].

As described in the Australian Standards, risk assessments [1] and subsequent considerations by DES medium and high risks as requiring further consideration, monitoring and mitigation.

No proactive mitigation measures are provided for avian species and a residual Medium exists for a number of species; namely:

- Fork-tailed Swift
- Black-shouldered Kite
- Wedged-tailed Eagle
- Whistling Kite
- Black Kite
- Rainbow Bee-eater
- Nankeen kestrel
- Brown Falcon
- Peregrine Falcon
- Budgerigar

With the successful implications of bat mitigation measures of nightly curtailment at high activity times (at least 90% of cumulative activity), risks to White-striped Free-tailed Bat, Inland Free-tailed Bat and Southern Free-tailed Bat are reduced to Medium (M).

If mitigation actions are not implemented, residual high-risk species are predicted to suffer considerable mortalities, which would reduce their population size and continue to do so.

If mitigation actions are not implemented, residual medium-risk species are predicted to suffer considerable mortalities, which would not likely reduce their population size.

High or moderate risks would require considered monitoring to detect and measure the impact, if any, on at least these species. To reduce the expected impact, mitigation measures will need to be implemented and amended according to monitoring data and metadata.

This qualitative risk assessment has not identified risks to any species populations that meet the criteria for referral under the EP Act or EPBC Act.

Recommendations

It is recommended that the operation develop, articulate and implement a wind turbine wildlife impact monitoring and mitigation plan that:

- detects and quantifies any impact;
- is amended to address the unacceptable impacts;
- is amended to address the perceived increase in risk during favourable environmental conditions;
- records and retains data in a manageable format;
- directs implementation of mitigation measures; and
- is reviewed and amended accordingly.

References

1. Standards Australia, *HB 203:2006 Environmental risk management - Principles and process*. 2006, Standards Australia/Standards New Zealand Third Edition: Canberra.

2. Hull, C.L. and S. Muir, *Search areas for monitoring bird and bat carcasses at wind farms using a Monte-Carlo model.* Australian Journal of Environmental Management, 2010. **17**: p. 77–87.

3. Hull, C.L., et al., *Avian collisions at two wind farms in Tasmania, Australia: taxonomic and ecological characteristics of colliders versus non-colliders.* New Zealand Journal of Zoology, 2013. **40**(1): p. 47–62.

4. Erickson, W.P., et al., *Avian Collisions with Wind Turbines: A Summary of Existing Studies and Comparisons to Other Sources of Avian Collision Mortality in the United States*, National Wind Coordinating Committee (NWCC) Resource Document, Editor. 2001, Western EcoSystems Technology Inc.: Washington DC.

5. Barclay, R.M.R., E.F. Baerwald, and J.C. Gruve, *Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size andtower height.* Canadian Journal of Zoology, 2007. **85**: p. 381–387.

6. Barrios, L. and A. Rodríguez, *Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines.* Journal of Applied Ecology, 2004. **41**(1): p. 72–81.

7. Barrios, L. and A. Rodriguez, *Spatiotemporal patterns of bird mortality at two wind farms of southern Spain*, in *Birds and Wind Farms: Risk Assessment and Mitigation*, M. de Lucas, G. Janss, and M. Ferrer, Editors. 2007, Quercus/Libreria Linneo: Madrid. p. 229 – 239.

8. Biosis Research Pty Ltd, *Wind farm collision risk for birds: Cumulative risks for threatened and migratory species*. 2006, Department of Environment and Energy: Canberra.

9. Birdlife Australia, *Wind Farms and Birds Policy*. 2012, Birdlife Australia: Victoria.

10. Burbidge, A. *Movements of the Night Parrot: Assumptions and predictions concerning movements of Night Parrots, as discussed by the Night Parrot Recovery Team*. 2016 [cited 2019 May]; Available from: https://nightparrot.com.au/index.php/resources/movements-of-the-night-parrot/.

11. Burbidge, A. *Leading Night Parrot Conservation*. 2016 [cited 2019 May]; Available from: https://nightparrot.com.au.

12. Cabrera-Cruz, S.A.V.-P., R., *Response of migrating raptors to an increasing number of wind farms.* Journal of Applied Ecology, 2016. **53**(6).

13. Churchill, S., *Australian Bats*. 2nd ed. 2008, Sydney: Jacana Books, Allen and Unwin.

14. Clean Energy Council: Melbourne, V., *Best Practice Guidelines For Implementation of Wind Energy Projects in Australia*. 2018, Clean Energy Council: Melbourne, Victoria.

15. Collar, N., G.M. Kirwan, and C.J. Sharpe, *Great Indian Bustard (Ardeotis nigriceps)*, in *Handbook of the Birds of the World Alive*, J. del Hoyo, Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E., Editor. 2019, Lynx Edicions: Barcelona.

16. Collar, N.J., P.S. Patil, and G.S. Bhardwaj, *What can save the Great Indian Bustard Ardeotis nigriceps?* Birding Asia, 2015. **23**: p. 15 –24.

17. de Lucas, M., G. Janss, and M. Ferrer, *Wind farm effects on birds in the Strait of Gibraltar*, in *Birds and Wind Farms: Risk Assessment and Mitigation*, M. de Lucas, G. Janss, and M. Ferrer, Editors. 2007, Quercus/Libreria Linneo: Madrid. p. 219 – 227.

18. de Lucas, M., et al., *Collision fatality of raptors in wind farms does not depend on raptor abundance.* Journal of Applied Ecology, 2008. **45**: p. 1695–1703.

19. Environment, D.o. *SPRAT EPBC Migratory Lists in Species Profile and Threats Database*. 2019 [cited 2019 August]; Available from: www.environment.gov.au/sprat.

20. Energy, D.o.t.E.a., *EPBC Act Policy Statement 3.21 Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species*, D.o.t.E.a. Energy, Editor. 2017, Commonwealth of Australia: Canberra.

21. Drewitt, A.L. and R.H.W. Langston, *Collision Effects of Wind-power Generators and Other Obstacles on Birds.* Annals of the New Academy of Science, 2008. **1134**: p. 233–266.

22. Edkins, M.T., *Impacts of Wind Energy Development on Birds and Bats: Looking into the Problem. Prepared for FPL Energy*. 2014, University of Oxford: England.

23. Fry, H. and P. Boesman, *Rainbow Bee-eater (Merops ornatus)*, in *Handbook of the Birds of the World Alive.*, J. del Hoyo, Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E., Editor. 2019, Lynx Edicions: Barcelona.

24. Garcia, D.A., G. Canavero, and F.Z. Ardenghi, M., *Analysis of wind farm effects on the surrounding environment: Assessing population trends of breeding passerines.* Renewable Energy, 2015. **80**: p. 190–196.

25. Robbins, L., R. Heinsohn, and L. Joseph, *Boom and Bust: bird stories for a dry country*. 2009, Canberra: CSIRO Publishing.

26. Smallwood, K.S., *Estimating wind turbine-caused bird mortality.* Journal of Wildlife Management, 2007. **71**(8): p. 2781–2791.

27. Smallwood, K.S. and D.A. Bell, *Effects of Wind Turbine Curtailment on Bird and Bat Fatalities.* The Journal of Wildlife Management, 2020: p. 1–12.

28. Smallwood, S.K., *The Challenges of Addressing Wildlife Impacts When Repowering Wind Energy Projects*, in *Wind Energy and Wildlife Interactions*, J. Köppel, Editor. 2017, Springer, Cham.

29. Goldwind, *Goldwind GWH182-6.2/7.2 V12R04C100 Wind Turbine Specifications, Edition: B No.: GW-24CP.0024*. n.d., Xinjiang Goldwind Science & Technology Co., Ltd.

30. Cowan, M., *Coolgardie 3 (COO3 – Eastern Goldfields subregion). In; A Biodiversity Audit of Western Australia. Eds McKenzie, N.L., May, J.E. and McKenna, S. Department of Conservation and Land Management, Perth.* 2001.

31. Thackway, R. and I.D. Creswell, *An Interim Biogeographic Regionalisation for Australia: a framework for establishing a national system of reserves, Version 4*. 1995, Australian Nature Conservation Agency: Canberra.

32. Bureau of Meteorology. *Climate Data Online: Monthly Climatic Data*. 2025 [cited 2025 June].

33. Wells, G., *Reconnaissance flora and vegetation for the Kalgoorlie Operations Project, Prepared for Northern Star Resources Ltd*. 2023, Phoenix Environmental Sciences.

34. American Wind Wildlife Institute. *Wind turbine interactions with wildlife and their habitats - a summary of research results and priority questions*. 2021 20/8/2024]; Available from: https://rewi.org/resources/summary-of-wind-power-interactions-with-wildlife/pdf.

35. Anderson, A.M., et al., *Effects of turbine height and cut-in speed on bat and swallow fatalities at wind energy facilities.* FACETS 7, 2022. **7**: p. 1281–1297.

36. Arnett, E.B., W. Brown, and W. Erickson, *Patterns of fatality of bats at wind energy facilities in North America.* J. Wildl. Manag., 2008. **72**: p. 61–78.

37. Arnett, E.B., et al., *Effectiveness of changing wind turbine cut-in speed to reduce bat fatalities at wind facilities. An annual report submitted to the Bats and Wind Energy Cooperative*. 2009, Bat Conservation International: Austin, USA.

38. Arnett, E.B., et al., *Altering turbine speed reduces bat mortality at wind-energy facilities.* Frontiers in Ecological Environment, 2010. **9**(4): p. 209–214.

39. Arnett, E.B. and E.F. Baerwald, *Impacts of Wind Energy Development on Bats: Implications for Conservation*, in *Bat Evolution, Ecology, and Conservation*. 2013. p. 435–456.

40. Baerwald, E.F., et al., *Barotrauma is a significant cause of bat fatalities at wind turbines.* Current Biology, 2008. **Volume 18**(Issue 16).

41. Baerwald, E.F. and R.M.R. Barclay, *Patterns of activity and fatality of migratory bats at a wind energy facility in Alberta, Canada.* Journal of Wildlife Management, 2011. **75**: p. 1103–1114.

42. Barclay, R.M.R., E.F. Baerwald, and J.C. Gruve, *Variation in bat and bird fatalities at wind energy facilities: assessing the effects of rotor size and tower height.* Canadian Journal of Zoology, 2007. **85**: p. 381–387.

43. Baerwald, E.F., G. H. D'Amours, B. J. Klug and R. M. R. Barclay *Barotrauma is a significant cause of bat fatalities at wind turbines. .* Current Biology Volume 18(Issue 16). 2008.

44. Behr, O., R. Brinkmann, and K. Hochradel, *Mitigating bat mortality with turbine-specific curtailment algorithms: a model based approach* Wind Energy and Wildlife Interactions. 2017.

45. Foo, C.F., et al., *Increasing evidence that bats actively forage at wind turbines.* PeerJ 5:e3985 http://doi.org/10.7717/peerj.3985, 2017.

46. Hunt, G., *Golden Eagles In A Perilous Landscape: Predicting The Effects Of Mitigation For Wind Turbine Blade-Strike Mortality*. 2002, PIER Environmental Area, California Energy Commission.

47. May, R., et al., *Paint it black: Efficacy of increased wind turbine rotor blade visibility to reduce avian fatalities.* Evolution and Ecology, 2020. **10**(16).

48. McClure, C.J.W., et al., *Eagles enter rotor-swept zones of wind turbines at rates that vary per turbine.* Ecol Evol, 2021. **11**(16): p. 11267–11274.

49. Miao, R., et al., *Effect of wind turbines on bird abundance: A national scale analysis based on fixed effects models.* Energy Policy, 2019. **132**: p. 357–366.

50. Moloney, P.D., L.F. Lumsden, and I. Smales, *Investigation of existing post-construction mortality at Victorian wind farms to assess its utility in estimating rates*. 2019, Arthur Rylah Institute for Environmental Research Technical Report Series No. 302.

51. National Wind Coordinating Collaborative, *Wind Turbine Interactions with Birds, Bats, and their Habitats: A Summary of Research Results and Priority Questions*, American Wind Wildlife Institute, Editor. 2010, U.S. Department of Energy (DOE) and the National Renewable Energy Laboratory (NREL).

52. Cryan, P.M., et al., *Behavior of bats at wind turbines PNAS*. 2024.

53. Pearce-Higgins, J.W., et al., *Greater impacts of wind farms on bird populations during construction than subsequent operation: results of a multi-site and multi-species analysis.* Journal of Applied Ecology, 2012. **49**(2): p. 386–394.

54. Schaub, M., *Spatial distribution of wind turbines is crucial for the survival of red kite populations.* Biological Conservation, 2012. **155**: p. 111–118.

55. Select Committee on Wind Turbines. 2015, Australian Parliament.

56. Senate Select Wind Turbines Committee Secretariat, *The Senate Select Committee on Wind Turbines Final Report*, C.o. Australia, Editor. 2015, Senate Printing Unit Parliament House: Canberra.

57. Smales, I., *Impacts of avian collisions with wind power turbines: an overview of the modelling of cumulative risks posed by multiple wind farms*, for Department of Environment and Heritage, Editor. 2006, Biosis Pty Ltd,: Canberra.

58. Smallwood, K.S., *Estimating wind turbine-caused bird mortality.* Journal of Wildlife Management 2007. **71(8): 2781-2791.**

59. Sterner, D., S. Orloff, and L. Spiegel, *Wind turbine collision research in the United States*, in *Birds and Wind Farms, Risk Assessment and Mitigation*, M. de Lucas, G.F.E. Janss, and M. Ferrer, Editors. 2007, Quercus: Madrid. p. 81–100.

60. Straka, T.M., et al., *Urban bat communities are affected by wetland size, quality, and pollution levels.* Ecol Evol, 2016. **6**(14): p. 4761–74.

61. Thelander, C.G. and K.S. Smallwood, *The Altamont Pass wind resource area's effects on birds: a case history*, in *Birds and Wind Farms: Risk Assessment and Mitigation*, M. de Lucas, G. Janss, and M. Ferrer, Editors. 2007, Quercus/Libreria Linneo: Madrid. p. 21–23.

62. Lekuona, J.M. and C. Ursua, *Avian mortality in wind power plants of Navarra (northern Spain)*, in *Birds and Wind Farms: Risk Assessment and Mitigation.*, M. de Lucas, G. Janss, and M. Ferrer, Editors. 2007, Quercus/Libreria Linneo: Madrid. p. 177 – 192.

63. Meek, E.R., *Wind farms in the Orkney Islands, Scotland: environmental impact, past, present and future*, in *Birds and Wind Farms: Risk Assessment and Mitigation*, M. de Lucas, G. Janss, and M. Ferrer, Editors. 2007, Quercus/Libreria Linneo: Madrid. p. 193 –199.

64. del Hoyo, J., et al., *Handbook of the Birds of the World Alive.*, in *Handbook of the Birds of the World Alive.* 2019, Lynx Edicions: Barcelona.

65. Woodall, P.F. and G.M. Kirwan, *Sacred Kingfisher (Todiramphus sanctus)*, in *Handbook of the Birds of the World Alive*, J. del Hoyo, Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E., Editor. 2019, Lynx Edicions: Barcelona.

66. Ellison, L., A. Everette, and M. Bogan, *Examining patterns of bat activity in Bandelier National Monument, New Mexico, by using walking point transects.* The Southwester Naturalist, 2005. **50**(2): p. 197–208.

67. Ellison, L.E., *Bats and wind energy: A literature synthesis and annotated bibliography*. 2012, US Department of the Interior, US Geological Survey.

68. Marques, A.T., et al., *Understanding bird collisions at wind farms: An updated review on the causes and possible mitigation strategies.* Biological Conservation, 2014. **179**: p. 40–52.

69. Bennett, V., *Texturizing Wind Turbine Towers to Reduce Bat Mortality*. 2018: Texas Christian University.

70. Hötker, H., K. Kai-Michael Thomsen, and H. Jeromin, *Impacts on biodiversity of exploitation of renewable energy sources: the example of birds and bats; Facts, gaps in knowledge, demands for further research, and ornithological guidelines for the development of renewable energy exploitation*. 2005, Michael-Otto-Institut im NABU, Bergenhusen.

71. Pearce-Higgins, J.W., et al., *The distribution of breeding birds around upland wind farms.* Journal of Applied Ecology, 2009. **46**(6).

72. Sterner, D., S. Orloff, and L. Spiegel, *Wind turbine collision research in the United States*, in *Birds and Wind Farms, Risk Assesment and Mitigation*, M. de Lucas, G.F.E. Janss, and M. Ferrer, Editors. 2007, Quercus: Madrid. p. 81–100.

73. Stienen, E.W.M., J. Van Waeyenberge, and E. Kuijken, *Trapped within the corridor of the Southern North Sea: the potential impact of offshore wind farms on seabirds*, in *Birds and Wind Farms, Risk Assessment and Mitigation*, M. de Lucas, G.F.E. Janss, and M. Ferrer, Editors. 2007, Quercus: Madrid. p. 71–80.

74. Percival, S.M., *Predicting the effects of wind farms on birds in the UK: the development of an objective assessment method*, in *Birds and Wind Farms: Risk Assessment and Mitigation.*, M. de Lucas, G. Janss, and M. Ferrer, Editors. 2007, Quercus/Libreria Linneo: Madrid. p. 137 – 152.

75. Johnson, G.D., et al., *Use of data to develop mitigation measures for wind power development impacts to birds*, in *Birds and Wind Farms: Risk Assessment and Mitigation.*, M. de Lucas, G. Janss, and M. Ferrer, Editors. 2007, Quercus/Libreria Linneo: Madrid. p. 241 –257.

76. Roaring 40's Renewable Energy Pty Ltd, *Bluff Point Wind Farm and Studland Bay Wind Farm Annual Environmental Report*. 2009, Roaring 40's: Hobart, Tasmania.

77. Thaxter, C.B., et al., *Bird and bat species' global vulnerability to collision mortality at wind farms revealed through a trait-based assessment*. 2017, Proceedings of the Royal Society.

78. McClure, C.J.W., et al., *Eagles enter rotor-swept zones of wind turbines at rates that vary per turbine.* Ecology and Evolution, 2021(11(16)).

79. OECD, *Mainstreaming Biodiversity into Renewable Power Infrastructure, OECD Publishing, Paris, https://doi.org/10.1787/357ac474-en.* 2024.

80. Richardson, S., *Peaks in bat activity at turbines and the implications for mitigating the impact of wind energy developments on bats.* Scientific Reports, 2021. **11/1**.

81. Guest, E.E., et al., *An Updated Review of Hypotheses Regarding Bat Attraction to Wind Turbines.* Animals, 2022. **12**: p. 343.

82. Bennett, E.M., et al., *Curtailment as a successful method for reducing bat mortality at a southern Australian wind farm.* Austral Ecology, 2022(47): p. 1329–1339.

83. Bellebaum, J., et al., *Wind turbine fatalities approach a level of concern in a raptor population.* Journal for Nature Conservation, 2013. **21**(6): p. 394–400.

84. Schippers, P., et al., *Mortality limits used in wind energy impact assessment underestimate impacts of wind farms on bird populations.* Ecology and Evolution, 2020. **10**: p. 1.

85. Hayes, M., *Bats Killed in Large Numbers at United States Wind Energy Facilities,.* BioScience, 2013. **Vol. 63/12,**: p. pp. 975–979,.

86. Rodhouse, T.J., et al., *Evidence of region-wide bat population decline from long-term monitoring and Bayesian occupancy models with empirically informed priors.* Ecology and Evolution, 2019. **9**(19): p. 11078–11088.

87. Rodrigues, L., L. Bach, and M.J. Dubourg-Savage, *Guidelines for Consideration of Bats in Wind Farm Projects – Revision 2014. EUROBATS publication series no. 6 (English version)*. 2015, UNEP/EUROBATS Secretariat: Bonn.

88. Ferrer, M., et al., *Weak relationship between risk assessment studies and recorded mortality in wind farms.* Journal of Applied Ecology, 2012. **49**: p. 38–46.

89. Arnett, E.B., W. Brown, and W. Erickson, *Patterns of fatality of bats at wind energy facilities in North America.* Journal of Wildlife Management, 2008. **72**: p. 61–78.

90. Behr, O., Brinkmann, R., Hochradel, K.,. *Mitigating bat mortality with turbine-specific curtailment algorithms: a model based approach. . in In: Wind Energy and Wildlife Interactions (ed J. Koppel) pp 135–60. Springer, Cham. .* 2017.

91. Martin, C.M., Arnett, E. B., Stevens, R. D., Wallace, M. C., , *Reducing bat fatalities at wind facilities while improving the economic efficiency of operational mitigation. J. Mammal. 98: p. 378–85.* 2017.

92. Whitby, M.D., Schirmacher, M. R., Frick, W. F., *The State of the Science on Operational Minimization to Reduce Bat Fatality at Wind Energy Facilities. A Report Submitted to the National Renewable Energy Laboratory, Bat Conservation International, Austin.* 2021.

93. Hein, C., Schirmacher, M. R., *Impact of wind energy on bats: a summary of our current knowledge. .* Hum.-Wildl. Interact, 2016. 10: p. 19–27., 2016.

94. Bennett, E.M., et al., *Curtailment as a successful method for reducing bat mortality at a southern Australian wind farm*, in *Austral Ecology*. 2022. p. 1329–1339.

95. Langston, R.H.W. and J.D. Pullan, *Windfarms and Birds : An analysis of the effects of windfarms on birds, and guidance on environmental assessment criteria and site selection issues*, B. International, Editor. 2003, Convention on the Conservation of European Wildlife and Natural Habitats.

96. Arnett, E.B., Hein C.D., and S. M.R., *Evaluating the effectiveness of an Ultrasonic Acoustic Deterrant for Reducing Bat Fatalities at Wind Turbines*. 2013.

97. Romano, W.B., Skalski, R.R., Townsend, R.L., Kinzie, K.W., Coppinger, K.D., Miller, M.F.,, *Evaluation of an acoustic deterrent to reduce bat mortalities at an Illinois wind farm.* Wildlife Society Bulletin, 2019. **43**(4): p. 608–618.

98. Weaver, S.P., et al., *Ultrasonic acoustic deterrents significantly reduce bat fatalities at wind turbines.* Global Ecology and Conservation, 2020. **24**.

99. Jones, G. and E.C. Teeling, *The evolution of echolocation in bats.* Trends in Ecology & Evolution, 2006. **21**: p. 149–156.

100. Corcoran, A.J., J.R. Barber, and W.E. Conner, *Tiger moth jams bat sonar.* Science 2009. **325**: p. 325–327.

101. Corcoran, A.J. and W.E. Conner, *Sonar jamming in the field: effectiveness and behavior of a unique prey defense.* Journal of Experimental Biology, 2012. **215**: p. 4278–4287.

102. Sharma, A. and Z. Zeng, *Passive Ultrasonic Deterrents to Reduce Bat Mortality in Wind Farms*. 2022, Iowa State University: Ames, IA, USA.

103. Fritts, S.R., Guest, E. E., Weaver, S. P., Hale, A. M, Morton, B.P., Hein, C. D.,, *Experimental trials of species-specific bat flight responses to an ultrasonic deterrent.* Peer J, 2024., 2024.

104. Kinzie, K., *Ultrasonic Bat Deterrent Technology*, U.D.o.E. (DOE), Editor. 2018, General Electric Company.

105. Cryan, P.M., et al., *Behavior of bats at wind turbines. PNAS*. 2024.

106. Arnett, E.B. and E.F. Baerwald, *Impacts of wind energy development on bats - implications for conservation*. 2013: Springer, New York.

107. Kohler, A.E., R.E. Marsh, and T.P. Salmon, *Frightening Methods and Devices/stimuli to Prevent Mammal Damage - Review*, in *Proceedings of the Fourteenth Vertebrate Pest Conference* 1990, University of Nebraska.

108. Schakner, Z.A., Blumstein, D. T.,, *Behavioural biology of marine mammal deterrents: A review and prospectus C.* Biological Conservation, 2013, 2013. **167**: p. p. 380–389.

109. Young Jr, D.P., et al., *Comparison of Avian Responses to UV-Light-Reflective Paint on Wind Turbines - Subcontract Report* 2003, Western EcoSystems Technology, Inc.: Cheyenne, Wyoming

110. Griffiths, S.R., *Echolocating bats emit terminal phase buzz calls while drinking on the wing.* Behav Processes, 2013. **98**: p. 58–60.

111. Kingsford, R.T., A.L. Curtin, and J. Porter, *Water flows on Cooper Creek in arid Australia determine `boom' and `bust' periods for waterbirds.* Biological Conservation, 1999. **88**(2): p. 231–248.

112. McEvoy, R., R.F.H., Wingfield, J.C., Bennett, A.T.D., *Heavy rainfall triggers increased nocturnal flight in desert populations of the Pacific Black Duck (Anas superciliosa).* Scientific Reports, 2017. **7**: p. 17557.

113. Pedler, R.D., R.F.H. Ribot, and A.T.D. Bennett, *Long-distance flights and high-risk breeding by nomadic waterbirds on desert salt lakes.* Conserv Biol, 2018. **32**(1): p. 216–228.

114. Kingsford, R.T., Roshier, D.A., Porter, J.L., *Australian waterbirds-time and space travellers in dynamic desert landscapes.* Marine and Freshwater Research, 2010. **61**: p. 875–884.

115. Griffiths, S.R., et al., *Hypersalinity reduces the risk of cyanide toxicosis to insectivorous bats interacting with wastewater impoundments at gold mines.* Ecotoxicology and Environmental Safety, 2014. **99**: p. 28–34.

116. Office of Parliamentary Counsel, *Environment Protection and Biodiversity Conservation Act 1999 Authorised Version C2016C00777 registered 12 July 2016*, Office of Parliamentary Counsel, Editor. 2016: Canberra.

117. Government, A. *About the EPBC Act: Objectives of the EPBC Act. Department of the Environment and Energy*. 2018 [cited 2018 June]; Available from: http://www.environment.gov.au/epbc/about.

118. Government, A., *Matters of National Environmental Significance: Significant impact guidelines 1.1, Environment Protection and Biodiversity Conservation Act 1999*, Department of Environment, Editor. 2013, Australian Government: Canberra.

119. Office of Parliamentary Counsel, *Environment Protection and Biodiversity Conservation Act 1999 Sect 528 Definitions*, in *91. Compilation No. 52*, Office of Parliamentary Counsel, Editor. 2018: Canberra.

120. **Convention, B.**, *Convention on the Conservation of Migratory Species of Wild Animals Appendices I and II*. 1983: Bonn Germany.

121. Department of Biodiversity Conservation and Attractions, *Biodiversity Conservation Act 2016*, Department of Biodiversity Conservation and Attractions, Editor. 2016: Western Australia.

122. Department of Biodiversity Conservation and Attractions, *Biodiversity Conservation Regulations 2018: Biodiversity Conservation Act 2016*, Department of Biodiversity Conservation and Attractions, Editor. 2018: Western Australia.

123. Parks and wildlife service, *Threatened and priority fauna list, December* Department of Biodiversity Conservation and Attractions, Editor. 2018: Western Australia.

124. Australian Government, *EPBC Act Policy Statement 2.3; Wind Farm Industry*, W. Department of the Environment, Heritage and the Arts, Editor. 2009: Canberra.

125. Department of Planning Lands and Heritage, *Position Statement: Renewable energy facility*. 2020, Western Australian Planning Commission: Perth.

126. Western Australian Planning Commission, *Planning Bulletin 67: Guidelines for Wind Farm Development*, Department of Planning Lands and Heritage, Editor. 2004, Western Australian Planning Commission: Western Australia.

127. Phoenix Environmental Sciences, *Terrestrial fauna assessment for the Fimiston Gold Mine Operations (Revised) Prepared for Kalgoorlie Consolidated Gold Mines Pty Ltd*. 2024, Phoenix Environmental Sciences.

128. Phoenix Environmental Sciences, *Basic and Targeted Terrestrial Fauna Survey for the Kalgoorlie Operations Project, Prepared for Northern Star Resources Ltd*. 2023, Phoenix Environmental Sciences Pty Ltd: Osborne Park.

129. Phoenix Environmental Sciences, *Basic and Targeted Terrestrial Fauna Survey for the Kalgoorlie Operations Project, (Final),Prepared for Northern Star Resources Ltd*. 2024, Phoenix Environmental Sciences Pty Ltd: Osborne Park.

130. Phoenix Environmental Sciences, *Terrestrial Fauna Survey for the Kalgoorlie Operation Avian Memo*. 2023, Phoenix Environmental Sciences.

131. Strickland, P., *Targeted Malleefowl survey for the Kalgoorlie Regional Renewable Energy Project, Prepared for Northern Star Resources Ltd*. 2025, Phoenix Environmental Services.

132. Jacks, A., *Basic and targeted terrestrial fauna survey for the Black Flag Pastoral Lease, Prepared for Northern Star Resources Limited*. 2025, Phoenix Environmental Services.

133. Consulting, B., *Tailings Storage Facility Expansion Desktop Fauna Assessment*. 2014: Botanica Consulting.

134. Harewood, G., *Proposed Tailings Storage Facility Expansion, KCGM Pty Ltd, Kalgoorlie,*. 2015, Botanica Consulting.

135. Holm, A., *Assessment of Malleefowl Activity and Habitat for the Fimiston South Project, Kalgoorlie Consolidated Gold Mines Pty Ltd*. 2023, Alexander Holm and Associates, Natural Resource Management Services.

136. Kalgoorlie Consolidated Gold Mines, *Hypersaline Tailings Management Plan*. 2022: KCGM.

137. Donato, D.B. and G.B. Smith, *Hypersaline tailings and International Cyanide Management Code compliance: pre-discharge assessment and compliance. Report to ICMI peer reviewers on behalf of Kalgoorlie Consolidated Gold Mines, V6.* 2016, Donato Environmental Services: Darwin.

138. Smith, G.B., et al., *Ecology of a hypersaline goldmining tailings facility in the Eastern Goldfields of Western Australia: A case study.* International Journal of Mining, Reclamation and Environment, 2008. **2**(22): p. 154–173.

139. Griffiths, S.R., et al., *High levels of activity of bats at gold mining water bodies: Implications for compliance with the International Cyanide Management Code.* Environmental Science and Pollution Research, 2014. **21**(12): p. 7263–7275.

140. Griffiths, S.R., et al., *Factors influencing the risk of wildlife cyanide poisoning on a tailings storage facility in the Eastern Goldfields of Western Australia.* Ecotoxicology and Environmental Safety, 2009. **72**: p. 1579–1586.

141. Wildlife Acoustics Inc, *Song Meter SM4 Bioacoustics Recorder User Manual,*. 2018, Wildlife Acoustics, Inc.: MA, USA.

142. Pennay, M., B. Law, and K. Reinhold, *Bat calls of New South Wales: Region based guide to the echolocation calls of Microchiropteran bats*. 2004, NSW Department of Environment and Conservation: Hurstville.

143. Milne, D.J., *Key to the Bat Calls of the Top End of the Northern Territory, Technical Report 71*. 2002, Parks and Wildlife Commission of the Northern Territory: Darwin.

144. Band, W., M. Madders, and D.P. Whitfield, *Developing field and analytical methods to assess avian collision risk at wind farms*, in *Birds and Wind Farms, Risk Assessment and Mitigation*, M. de Lucas, G.F.E. Janss, and M. Ferrer, Editors. 2007, Quercus: Madrid. p. 259 –275.

145. Department of the Environment, W., Heritage and the Arts, *EPBC Act Policy Statement 2.3: Wind Farm Industry*. 2009, Department of the Environment Water Heritage and the Arts: Canberra.

146. Department of Parks and Wildlife, *Interim guideline for preliminary surveys of night parrot (Pezoporus occidentalis) in Western Australia*, Department of Parks and Wildlife, Editor. 2017: Western Australia.

147. Department of Mines Industry Regulation and Safety, *Mining Proposal Guidance- How to prepare in accordance with Part 1 of the Statutory Guidelines for Mining proposals*. 2020, Government of Western Australia.

148. Bullen, R.D. and N.L. McKenzie, *Seasonal range variation of Tadarida australis (Chiroptera : Molossidae) in Western Australia: the impact of enthalpy.* Australian Journal of Zoology, 2005. **53**(3): p. 145–156.

149. Bureau of Meteorology, *Climate data online: Monthly mean maximum temperature, Laverton Airport (12305).* 2022.

150. Griffiths, S.R., *Activity of insectivorous bats at gold mining water bodies: risks associated with consumption of cyanide-bearing waste solutions, Masters Research Thesis*, in *Department of Zoology*. 2013, University of Melbourne.

151. Donato, D.B., W. Gursansky, and D.M. Madden-Hallett, *Sunrise Dam Gold Mine central-thickened discharge tailings system: Re-evaluation of Recommendation 1 (salinity parameter). Report to Sunrise Dam Gold Mine V4.* 2015, Donato Environmental Services: Darwin.

152. Kingsford, R.T. and C.J. Porte, *Water flows on Cooper Creek in arid Australia determine 'boom' and 'bust' periods for waterbirds.* Biological Conservation, 1999. **88**(2): p. 231–248.

153. Strickland, D., et al., *Selecting study designs to evaluate the effect of windpower on birds*, in *Birds and Wind Farms: Risk Assessment and Mitigation.*, M. de Lucas, G. Janss, and M. Ferrer, Editors. 2007, Quercus/Libreria Linneo: Madrid. p. 117 – 136.

154. Boehm, E.F., *Perching Birds (Passeriformes) of the Mount Mary Plains, South Australia.* EMU, 1957. **57**: p. 311–324.

155. Johnstone, R.E. and G.M. Storr, *Handbook of Western Australian Birds*. 2004, Perth: WA Museum.

156. Cherriman, S.C., et al., *Climate influences productivity but not breeding density of wedge-tailed eagles Aquila audax in arid and mesic Western Australia.* Austral Ecology, 2021. **47**(2): p. 261–277.

157. Cherriman, S.C., *Territory size and diet throughout the year of the Wedge-tailed Eagle Aquila audax in the Perth region, Western Australia*, in *Bachelor of Science (Environmental Biology)*. 2007, Curtin University: Perth.

158. Sharp, A., M. Norton, and A. Marks, *Breeding activity, nest site selection and nest spacing of wedge-tailed eagles, Aquila audax, in western New South Wales.* Emu, 2011. **101**(4): p. 323–328.

159. Collins, L., Croft, D. B.,, *Factors influencing chick survival in the Wedge-tailed Eagle Aquila audax,.* Corella, 2007. **31**: p. 32–40.

160. Collar, N., E. de Juana, and C.J. Sharpe, *Night Parrot (Pezoporus occidentalis)*, in *Handbook of the Birds of the World Alive*, J. del Hoyo, Elliott, A., Sargatal, J., Christie, D.A. & de Juana, E., Editor. 2019, Lynx Edicions: Barcelona.

161. Western Wildlife, *West Musgrave Project: Level 2 Vertebrate Fauna Survey October - Draft report. Prepared for OZ Minerals Limited*. 2019, Western Wildlife: Mahogany Creek, Western Australia.

162. Ferguson-Lees, J.C., D. A., *Raptors of the world. Christopher Helm, London.* 2001, London: Christopher Helm.

163. Hatton, F., *Brown Goshawk and Brown Falcon scavenging.* Boobook, 2013. **31**(2): p. 41.

164. Garnett, S.T., J.K. Szabo, and G. Dutson, *The action plan for Australian Birds 2010*. 2011, Collingwood: CSIRO Publishing Victoria.

165. Leseberg, N.P., et al., *Using anecdotal reports to clarify the distribution and status of a near mythical species: Australia's Night Parrot (Pezoporus occidentalis).* Emu-Austral Ornithology, 2021. **121**(3): p. 239–249.

166. DAWE Department of Agriculture, W.a.t.E. *Night parrot*. 2021 3/10–2021 4/6-2022]; Available from: https://www.awe.gov.au/environment/biodiversity/threatened/species/20-birds-by-2020/night-parrot#:~:text=Presumed%20extinct%20for%20a%20century,Queensland%20and%20northern%20inland%20WA%20.

167. Murphy, S.A., et al., *Movements and habitat use of the night parrot Pezoporus occidentalis in south-western Queensland.* Austral Ecology, 2017. **42**(7).

168. Higgins, P.J., *Handbook of Australian, New Zealand and Antarctic Birds: Volume 4 Parrots to Dollarbird*. Vol. 4. 1999, Melbourne: Oxford University Press.

169. Environment Australia, *Conservation Advice Pezoporus occidentalis (Night Parrot)*, Department of Sustainability Environment Water Populations and Communities, Editor. 2016, Threatened Species Scientific Committee: Canberra.

170. Warden, J., G. Cockerton, and D. Leach, *Detailed Flora and Vegetation Survey, West Musgraves Project December. Prepared for: OZ MInerals Limited*, in *Report Ref: WB897*. 2018, Western Botanical: Western Australia

171. Ley, A.J. and B. Tynan, *Birds Killed by Fences in Diamantina National Park, Queensland.* 2008.

172. Iwaniuk, A.N., et al., *The endocast of the Night Parrot (Pezoporus occidentalis) reveals insights into its sensory ecology and the evolution of nocturnality in birds.* Scientific Reports, 2020. **10**(1): p. 9258.

173. Leseberg, N.P. and S.A. Murphy, *Potential impacts on night parrots of habitat disturbance relating to powerline construction for Tropicana Gold Mine*. 2018.

174. Turpin, J. and J. Riley, *Fauna assessment of Tropicana gold Mine; Operational area (M39/1096), prepared for AngloGold Ashanti Limited*. 2020, Kingfisher Environmental: Mundaring.

175. Van Dyck, S. and R. Strahan, *The Mammals of Australia*. 3rd ed. 2008, Australia: Reed New Holland.

176. Moloney, P.D., L.F. Lumsden, and I. Smales, *Investigation of existing post-construction mortality monitoring at Victorian wind farms to assess its utility in estimating mortality rates.* 2019, Arthur Rylah Institute for Environmental Research Technical Report Series No. 302.