

Chapter 6: Flora and Fauna Assessment

Flora and Fauna Assessment

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6. Flora and Fauna Assessments

Comprehensive flora and fauna surveys were carried out at the site by EBS Ecology comprising of the following three (3) separate assessments:

- Flora and Fauna Assessment (provided as Appendix B)
- Avifauna and Raptor Nest Assessment (Appendix C)
- Bat Utilisation Report (Appendix D)

Each of the surveys involved an initial desk top assessment followed by on-site surveys. The desk top assessment for each of the studies included searching the Biological Database of SA (BDBSA) (DEH 2009) and the EPBC Protected Matters online database (DEWHA 2009). The BDBSA is comprised of an integrated collection of corporate databases which meet DEH standards for data quality, integrity and maintenance. In addition to DEH biological data, the BDBSA also includes data “dumps” from a range of external organisations. The *Environment Protection and Biodiversity Conservation Act 1999* (EPBC) online database was used to identify any matters of national and state environmental significance protected by the EPBC Act 1999.

The results of the initial desk based assessment informed the site surveys. Based on these surveys an assessment of likely effects was conducted and appropriate mitigation measures recommended. EBS worked closely with Pacific Hydro to inform the site design process and a number of amendments to turbine and infrastructure location were made as a result of their recommendations.

The following legislation is applicable to the protection of flora and fauna in South Australia:

- *Environment Protection and Biodiversity Conservation Act 1999*: The Commonwealth EPBC Act protects nationally and internationally significant flora, fauna, ecological communities and heritage places. Any action that is likely to have a significant impact on matters of national environmental significance requires referral under the EPBC Act.
- *Native Vegetation Act 1991*: Clearance of vegetation is prohibited unless approved by the Native Vegetation Council (NVC) or the activity requiring the clearance is exempt under the Native Vegetation Regulations 2005. In most circumstances approval to clear vegetation is subject to the provision of a management plan demonstrating a suitable Significant Environmental Benefit (SEB) such as a set aside area of land or payment to the Native Vegetation Fund.
- *National Parks and Wildlife Act 1972*: The Act provides for the protection of native plants, within reserves, and native animals throughout SA.

This chapter provides a summary of the three studies outlined above. The full survey should be referenced for details of EBS Ecology’s assessment.

6.1 Flora and Terrestrial Fauna

6.1.1 Methodology

An initial search of both the BDBSA and EPBC Protected Matters databases was conducted followed by two site surveys carried out in Spring 2008 and Spring 2009.

During the surveys, undertaken on foot and by vehicle, the locations of all vegetation associations and dominant flora species were determined and recorded along with all fauna species observed. The quality of the vegetation was recorded as per the condition ratings and Significant Environmental Benefit (SEB) ratios^{1,2} and a flora species list compiled for each vegetation association.

Following the site visit, the vegetation associations, the vegetation conditions and site layout were mapped in order to establish and assess the extent of impacts on vegetation. The vegetation mapping was then referred to during the project design and in particular used to identify constraints to turbine locations.

6.1.2 Results

The BDBSA search identified a total of 884 native flora species and 40 native fauna species as having been previously recorded within 20 km of the site. Of these, 42 flora and two fauna species have State conservation significance (NPW Act 1972). 13 flora and 13 fauna (including two fish) species of national significance were identified from the EPBC search as potentially occurring within the project site.

During the site surveys twelve vegetation associations were defined across the site and a total of 118 flora species were recorded. Of these, 59 were native and 59 were exotic species. No EPBC listed flora species of national conservation significance were identified on site, however one species of state conservation significance (Annual Fern) was recorded.

Based on the spring 2008 survey, it was considered possible that the project site may contain two critically endangered, Threatened Ecological Communities (TEC): Peppermint Box, Grassy Woodland of South Australia and Iron-grass Natural Temperate Grassland of South Australia. However, during the spring 2009 survey, the vegetation associations within which the species could be expected to occur were found to be in poor condition and therefore do not qualify as critically endangered under the EPBC Act, 1999.

No areas of Iron-grass Natural Temperate Grassland were found within the project site. Only isolated patches of Iron-grass were recorded within two particular vegetation associations. These patches do not qualify as the critically endangered TEC under the EPBC Act 1999.

Two of the recorded vegetation associations contain River Red Gum woodland that is listed as a TEC (Vulnerable) under the Provisional List of Threatened Ecosystems of South Australia (DEH, in progress). The proposed turbine layout completely avoids these vegetation associations.

¹ Adapted from 'Guide to Roadside Vegetation Survey Methodology for South Australia', (Stokes et al. 1998) and 'Guidelines for a Native Vegetation Significant Environmental Benefit Policy', (DWLBC 2005)- Full methodology outlined in Appendix A

² Native Vegetation Council's 'Guidelines for Native Vegetation Significant Environmental Benefit Policy for the Clearance of Scattered Paddock Trees' (DWLBC, 2007)

Many areas of woodland within the site contain trees either with existing hollows or the ability to develop hollows in the future. These trees provide important breeding and feeding sites for a range of arboreal fauna including the state listed Rare Common Brushtail Possum, which potentially inhabits the proposed wind farm site.

Three reptile species were recorded during this survey; the Eastern Bearded Dragon, Sleepy Lizard and Eastern Bluetongue. A further 24 reptile species were listed in this area from the BDBSA database search and may use habitat in the area, including: the Red-bellied Black Snake; Eastern Brown Snake; Marbled Gecko and Spotted Slider.

6.1.3 Assessment of Potential Impacts

The majority of the vegetation within the proposed project site comprises exotic grassland/ herbs with areas of scattered South Australia Blue Gum and Peppermint Box woodlands. None of the woodlands with Peppermint Box, (vegetation associations 4, 5 and 10) will be impacted. Vegetation association 1 which is characterised by South Australian Blue Gum over exotic grasslands is considered suitable for turbine placement providing the removal of any mature South Australian Blue Gums is avoided. The site generally has poor fauna habitat value due to the lack of intact native vegetation and extensively modified understorey vegetation.

The vegetation survey findings significantly influenced the project's proposed layout as the turbine layout has been re-designed to avoid areas of conservation significance. Access tracks and infrastructure will follow existing tracks and avoid areas of conservation significance wherever possible.

Where impacts are unavoidable, they will be minimised. To this extent, the only potential impacts upon areas of conservation significance occur at the site entry/exit points along Pine Hut Road. At these locations, existing site access points to site will be utilised, however some minor impacts to existing native vegetation may be necessary if these points are to be widened.

Where removal of native vegetation is unavoidable, any such areas will be assessed to calculate an appropriate SEB and calculate offset requirements.

6.1.4 Mitigation Measures

The following measures have been adopted within the design of the turbine layout in order to firstly avoid then minimise impacts to native vegetation:

- All locations within the project site identified as containing Threatened Ecological Communities (or potential Threatened Ecological Communities), listed species and/or areas of significance have been avoided by the turbine layout.
- Turbine locations have been sited so as to avoid the removal of any mature South Australian Blue Gums.
- Preferable fauna habitat including riparian habitats and rocky outcrops has been avoided.

The following additional mitigation measures have been recommended to further minimise potential impacts on native flora and fauna:

- Areas containing Peppermint Box woodland may be suitable and targeted for consideration as part of any SEB offset required.
- Minimise disturbance of other areas of SEB condition rating of 2:1.

- Following the completion of detailed design, the level of native vegetation clearance associated with the project can be confirmed to ensure any native vegetation approvals and SEB obligations are met.
- Any SEB obligations may include:
 - the protection of remnant habitat within the survey area (i.e. heritage agreements)
 - the protection of remnant vegetation on suitable properties in the region (i.e. heritage agreements)
 - the establishment of an exotic flora control program in the survey area complimented by the bush-regeneration of native vegetation remnants
 - the establishment of a revegetation program in degraded parts of the survey area
 - the establishment of a vertebrate pest control program in the survey area to reduce the effect of pest animals, such as foxes and rabbits, on the native fauna in the region, or
 - a payment to Native Vegetation Fund administered by the Native Vegetation Council
- Any micro-siting of turbines, roads and other infrastructure during detailed design will further avoid the clearance of any isolated trees, vegetation patches and fauna habitat features.
- Appropriate environmental management practices and procedures for the construction and operation of the wind farm will be developed and implemented.
- Implement appropriate weed and pathogen controls.

6.2 Birds

6.2.1 Methodology

In accordance with the *AUSWind Best Practice Guidelines* (2006) (AUSWind guidelines) an initial desk top assessment was carried out, to assess the species likely to be present at site, followed by field survey work. The desk based assessment involved consultation of the Environment Protection and Biodiversity Conservation (EPBC) Protected Matters online database to identify birds of national environmental significance or matters protected by the EPBC Act 1999. The Biological Database of South Australia (BDBSA) was used to determine species of national and state significance that have been recorded within the vicinity of the project site.

Species were identified as being of regional conservation significance based on the Regional Plan for Threatened Species and Ecological Communities of Adelaide and the Mount Lofty Ranges, South Australia 2009-2014. Regional ratings do not carry any specific approval requirements.

The following field surveys included fixed point count surveying, opportunistic observations and targeted surveying for the Peregrine Falcon and Wedge-tailed Eagle:

- **Spring 2008:** initial survey across eight different habitat types at a total of 25 survey sites, and opportunistically across the project site and surrounding region. Survey in accordance with the AusWind Guidelines level One bird survey.
- **Winter 2009:** 13 survey points across a range of habitat types, focussing on the areas where turbines are proposed.
- **Spring 2009:** 52 point count surveys and a Wedge-tailed Eagle breeding success evaluation.
- **Summer 2010:** focussed on determining the activity and breeding success at twelve potential Wedge-tailed Eagle nests. Possible breeding locations for the Peregrine Falcon were also searched. Three of the twelve potential Wedge-tailed Eagle nests were subsequently to be of raven or kite origin).

Following the surveys a risk assessment matrix was used to qualitatively define the risk of the proposed Wind Farm on birds that performed at-risk movements within the project site as well as those species defined as likely to occur within the project site (based on the BDBSA search). The assessment is an adaptation of the qualitative measures of likelihood and consequence used in the Australian Defence Risk Management Framework (DRMF)³. Use of this risk matrix was accepted when previously used by EBS Ecology during Environment, Resources and Development (ERD) Court hearings.

Results

Database Search

The EPBC search identified eleven listed bird species as potentially occurring within the project site, including nine migratory bird species of national significance. Although none were observed during the field surveys, three migratory species were recognised as possibly utilising the project site due to availability of suitable habitat.

23 species of state conservation significance were identified as possibly occurring within the site from the BDBSA database search. Three State rare birds (listed under the NPW Act) were recorded during the site survey: Peregrine Falcon, Elegant Parrot and White-winged Chough. Ten of the 23 species listed were considered likely to utilise the project site

³ Gaidow, S. & Boey, S. (2005) *Australian Defence Risk Management Framework: A comparative study*. Commonwealth of Australia - DSTO Systems Sciences Laboratory

Field Surveys

- **Spring 2008:** A total of 744 bird observations from 43 different species were recorded during the two day survey. The most commonly recorded species was Galah, accounting for 19% of all observations. Other commonly recorded species were Common Starling and Australian Magpie, with 92 (12%) and 90 (12%) observations recorded respectively. 10% of all birds recorded were Adelaide Rosella (74 observations) and 9% were Tree Martins (69 observations). Together, these five common species accounted for 62% of all bird observations.

No birds of national conservation status were detected. One bird of state conservation status was detected, the White-winged Chough which is listed as State rare under the NPW Act 1972 with 13 observations (2% of all observations) recorded on site. The regionally vulnerable Brown Treecreeper, and regionally uncommon Musk Lorikeet and Red-rumped Parrot were also recorded.

- **Winter 2009:** A total of 1,362 bird observations of 27 species were recorded during 52 point count surveys. The most commonly recorded species was the Australian Magpie, accounting for 47% of all observations. Other commonly recorded species were the Common Starling, Galah and Little Raven, each with over 100 observations. Together these four most common species accounted for nearly 80% of all bird observations.

No birds of national conservation significance were recorded. Three species of state conservation status were recorded: the rare Peregrine Falcon and Elegant Parrot were recorded during point counts whilst a single Jacky Winter was recorded opportunistically. A total of 27 Elegant Parrot observations were recorded and on one occasion a flock of 18 birds were sighted flying low over the ridge top in the southern sector of the wind farm. Due to a high number of hollows in trees within the project site, it is possible that they may breed on site.

A total of four Peregrine Falcons observations were recorded indicating this species was resident at the project site. It is not known whether all records of this species were of a single individual, four different individuals, or a number in between.

- **Spring 2009:** A total of 1712 observations of 34 bird species were recorded during 52 point count surveys across the site. The most commonly recorded species was the Australian Magpie, accounting for 35% of all observations. Other commonly recorded species were the Little Raven and Galah, each with over 300 observations. Together, these three common species accounted for just over 80% of all bird observations. 22 species were recorded less than 10 times during point count surveys. This is possibly due to being less common throughout the site during the spring 2009 survey period and/or inhabiting the site in relatively low densities. The Brown Falcon was recorded in low numbers at two out of the thirteen point count sites.

No birds of national conservation significance were recorded during the survey. Two species of state conservation status were recorded; a Peregrine Falcon and two Elegant Parrot observations were made within the northern section.

Opportunistic Records

- **Winter 2009:** The Jacky Winter was the only species of state conservation status recorded opportunistically and a further 368 observations of 24 bird species were made. These included observations of eight species not recorded during point count surveys. This included three waterbirds, Australasian Grebe, Grey Teal and White-faced Heron recorded on farm dams to the west of the major ridge line and Brown Thornbill, Grey Butcherbird and the Red-rumped Parrot recorded in areas of woodland habitat or in scattered paddock trees, at locations across the site. The Banded Lapwing was only recorded opportunistically, and was seen in an area of open pasture paddocks when driving between survey sites.
- **Spring 2009:** 99 observations of six different bird species were recorded, the majority of which were Little Raven with the lowest numbers being Nankeen Kestrel and Peregrine Falcon.

Wedge-tailed Eagle nest locations

A total of twelve potential Wedge-tailed Eagle nests were located across the site. Three of the twelve potential Wedge-tailed Eagle nests were subsequently to be of raven or kite origin). Most nests were located during a targeted search of all suitable nesting habitats (woodland and scattered South Australian Blue Gum). During the spring 2009 survey three Wedge-tailed Eagle nests were recorded as active. Two nests were found to be active during the 2010 breeding season and one showed signs of breeding activity although no fledged chick was apparent.

Targeted Peregrine Falcon surveys

A targeted Peregrine Falcon survey was undertaken during summer 2010. One nest location was identified as well as a number of flight movements recorded for this species. Additional to this survey two breeding locations have been previously identified to the south of the project area.

6.2.2 Assessment of Potential Impacts

Potential direct and indirect impacts of wind farms to birds include direct collision, barrier to flights, habitat loss and disturbance.

Avoidance behaviour refers to how a bird may respond when they encounter a wind turbine, or as Smales and Muir (2005) define 'avoidance', the rate at which birds attempt to avoid colliding with a structure. Avoidance behaviour by raptors and other species has been well documented⁴.

The potential loss or alteration of habitat associated with construction of wind farms can result in the loss of feeding and breeding habitat for a range of other birds. For example, numerous bird species identified in the spring 2008 survey require tree hollows for nesting. Some of the large old Eucalyptus on site have numerous tree hollows of a range of different sizes. These eucalypts are also likely to be heavily utilised by nectar feeding birds such as parrots and honeyeaters when they are in flower.

The grassland habitat on site and in the surrounding area may also provide suitable habitat for numerous bird species. Clearing of habitat during the construction of access tracks and infrastructure associated with the development of wind farms has the potential to directly impact native grasslands via habitat removal.

⁴ Barrios, L. and Rodriguez, A. (2004) *Behavioural and environmental correlates of soaring-bird mortality at on-shore wind turbines*. Journal of Applied Ecology 41:72-81

Collision risk was assessed based on species with flights above 40m deemed to be at risk. Galahs, parrots, rosellas, and honeyeaters were observed flying from tree to tree at relatively low heights. A number of waterfowl were recorded using small farm dams scattered across the wind farm site. It is highly likely that small flocks of waterfowl fly through the area on a regular basis as they move between these farm dams. Flight heights of these species were not recorded during survey, so it is difficult to conclude whether they flew at heights deemed at risk (above 40 m).

A number of raptor species were recorded including the Brown Goshawk, Brown Falcon, Wedge-tailed Eagle and Black-shouldered Kite. These birds are commonly observed flying over hilltops and steep sided gullies as they use the updrafts created by this topography. These birds are attracted to these areas as they employ hovering, gliding and soaring modes of flight when foraging⁵. The foraging behaviour of raptors, places them at risk of colliding with turbines.

Wedge-tailed Eagle activity may be concentrated across many areas of the ridge line and surrounding hills within a their foraging territory however it is certain that ridges within close proximity to active nest sites will be heavily used. With respect to Wedge-tailed Eagles, it is understood that young birds, before they are adept flyers, are at greater risk of collision than adult eagles. However successful breeding has been recorded in a Wedge-tailed Eagle nest located at Chalicum Hills Wind Farm in Victoria. As such it has been observed that Wedge-tailed Eagles can continue to use a wind farm site successfully during operation. Nevertheless, whilst avoidance behaviour has been demonstrated and successful breeding observed on an operational wind farm in Victoria, the risk of Wedge-tailed Eagle collision with turbines cannot be entirely eliminated. As such it is prudent that nest buffers are adopted to minimise the potential for impacts at the more highly utilised areas near nests, and those same areas which are more likely to be frequently utilised as young birds leave the nest.

It is possible that during the construction phase of the proposed wind farm, raptors and other species may incur some level of temporary disturbance. Wedge-tailed Eagles are known to be fussy nesters and may abandon nests if disturbed. The recommended 500 m buffer around eagle nests will assist with lessening disturbance levels to this species during the construction phase.

A barrier effect is a term used to describe how birds alter their migration flyways to avoid wind farm infrastructure and may be an issue for local birds who regularly traverse a ridge line when moving between foraging, roosting and/or breeding sites or along migration paths. The current design has two distinct clusters of turbines with a spacing of 5 km between them. Spacing between turbines in the current layout is generally in order of 400-500 m. The distance between turbine clusters and also the distance between individual turbines, is likely to allow for safe bird passage between turbines for birds that utilise "avoidance" behaviour.

When considering the potential impacts on birds associated with wind farms, it is also important to consider the existing and on-going impacts on all forms of wildlife from other energy sources. Sovacool (2009)⁶ attempted to ascertain the relative impacts on birds of various forms of electricity generation. Wind power has one of the lowest impacts on birds and that they are more than an order of magnitude lower than fossil-fuelled power generation⁴.

An assessment was conducted of known and documented effects of electricity generation on vertebrate wildlife in the New York/New England region by Newman and Zillioux (2009). Results were used to construct a Comparative Ecological Risk Assessment in order to make objective comparisons amongst six types of electricity generation important to the region. Overall, non-

⁵ Debus, S. (1998) *The birds of prey of Australia: a field guide*. Oxford University Press, Melbourne.

⁶ Sovacool, B.K. (2009) Contextualizing avian mortality: A preliminary appraisal of bird and bat fatalities from wind, fossil-fuel, and nuclear electricity. *Energy Policy* 37 (2009): 2241-2248.

renewable electricity generation sources, such as coal and oil, pose significantly higher risks to wildlife than renewable electricity generation sources, such as hydro and wind⁷.

6.2.3 Risk Assessment

The risk assessment determines the potential impact of the proposed wind farm on bird species which have the potential to undertake at-risk movements (above 40m) on site including the conservation rated species Peregrine Falcon, Elegant Parrot, White-winged Chough and Jacky Winter. The Wedge-tailed Eagle is not a listed species however was also included. The risk assessment assesses the likelihood and consequence of a mortality from collision.

Table 6.1: Qualitative measures of likelihood and consequence (adopted from AS/NZS 4360:1999).

Likelihood (How likely is mortality from collision to occur)		Consequence (Significance of associated impact on species viability)	
Rating	Definition	Rating	Definition
A Chronic:	The event is expected to occur in most circumstances	5 Catastrophic Disaster:	potential to lead to collapse of species
B Frequent:	The event probably will occur in most circumstances (e.g. weekly to monthly).	4 Major:	Critical event, very likely to have significant impact on species
C Likely:	The event should occur at some time i.e. once in a while	3 Moderate:	likely to have impact on population, potential to impact on long term viability under some scenarios
D Unlikely:	The event could occur at some time	2 Minor:	may have impact on local population, no impact on species
E Rarely:	The event may occur only in exceptional circumstances	1 Insignificant:	individuals may be affected, but viability of local population not impacted

⁷ Newman, J. and Zillioux, E. (2009). *Comparison of reported effects and risks to vertebrate wildlife from six electrical sources in the New York/New England Region*. Albany: New York State Energy Research and Development Authority

Table 6.2: Qualitative Risk Analysis Matrix – Level of Risk (adopted from AS/NZS 4360:1999 and HB 143:1999)

Likelihood	Consequences				
	Insignificant 1	Minor 2	Moderate 3	Major 4	Catastrophic 5
A (chronic)	High	High	Extreme	Extreme	Extreme
B (frequent)	Medium	High	High	Extreme	Extreme
C (likely)	Low	Medium	High	Extreme	Extreme
D (unlikely)	Low	Low	Medium	High	Extreme
E (rarely)	Low	Low	Medium	High	High

Following EBS Ecology’s assessment of the likelihood and consequence of a mortality, the overall level of risk for all species was determined as low. The likelihood of collision causing mortality was determined as **likely** for one species, the Australian Magpie. The likelihood of collision causing mortality was determined as **unlikely** for four raptor species: Wedge-tailed Eagle, Brown Falcon, Nankeen Kestrel and Peregrine Falcon. The matrix above defines **unlikely** as an event that could occur at some time. The likelihood of collision causing mortality was determined as rare for 14 species, where the event may occur in exceptional circumstances.

The consequence of mortality at a species/population level was determined as **minor** for two species, the Peregrine Falcon and Elegant Parrot. The consequence was determined as **insignificant** for 17 species; individuals may be affected, but viability of a local population for these species is not impacted upon.

6.2.4 Mitigation

Several mitigations have been embedded within design and resulted in modifications to the wind farm layout (e.g. to buffer nest sites or avoid areas of high activity, or additional mitigation measures such as scheduling in proximity of active Wedge-tailed Eagle nests to reduce potential disturbance).

Taking into consideration the survey results, the following mitigation measures have been included within the design or will be adopted during construction or operation to avoid and reduce impacts on birds:

- 1000 m buffer around the Peregrine Falcon nesting site – established within the site design.
- 500 m buffer around Wedge-tailed Eagle nests – established within the site design.
- Avoid removal of any mature Blue Gums
- None of the woodlands with Peppermint Box, (vegetation associations 4, 5 and 10) will be impacted.

- Where native vegetation impacts are unavoidable, they will be minimised. To this extent, the only potential impacts upon areas of conservation significance occur at the site entry/exit points along Pine Hut Road. At these locations, existing site access points to site will be utilised, however some minor impacts to existing native vegetation may be necessary if these points are to be widened. Where removal of native vegetation is unavoidable, any such areas will be assessed to calculate an appropriate SEB and calculate offset requirements.
- Monitor breeding activity at all known nest locations. No turbines are proposed within 500m of a Wedge-tailed Eagle nest. However in addition where any construction (i.e. of an access track) is planned within 500 of a known Wedge-tailed Eagle nest checks will be employed to determine their breeding status and if necessary construction within these distances be undertaken outside of the peak breeding times (egg-laying and chick fledging) for.
- Wedge-tailed Eagle and Peregrine Falcon breeding surveys during and post construction.
- Regular long-term bird-strike monitoring program – to identify any bird mortalities. Programs should be conducted by suitably trained, on-ground staff. A formal reporting procedure to an external environmental agency is also recommended to allow data collection to help inform the development of future mitigation measures at wind farm sites across South Australia / Australia.
- Scavenger and detectability trials will be carried out prior to construction to account for the influence of scavenging activity and the detectability of bird carcasses when determining bird strike impacts.

6.3 Bats

6.3.1 Methodology

The assessment included an initial desktop assessment and database search followed by site based monitoring using both AnaBat detectors and trapping methods.

AnaBat ultrasonic bat detectors detect bat presence by recording calls (which are mostly beyond the range of human hearing) and storing recordings for later analysis. The analysis of calls involves plotting sound frequency against time and using the shape of the resulting signature on this graph to identify the species or group of species to which the call belongs.

Three bat assessment surveys were carried out in November 2009, January 2010 and December 2010 with total of 47 AnaBat nights, 19 harp trap nights and two mist net nights completed. During the first two survey campaigns, likely bat habitat such as woodlands and open water sites (such as creeks and dams) were targeted for bat call activity. The third survey focused on comparing bat activity between the open exotic grassland across the ridgeline where turbines are proposed and established bat habitat. Two of the open grassland sites were at a meteorological mast (one placed 1 m off the ground and one up the mast at approximately 30 m high).

The monitoring was carried out using passive and active AnaBat detector surveys as well as identifying bats following trapping with Harp traps and mist netting. Captured bats were identified and then tagged using small glow sticks which were temporarily attached to the bat fur with medical glue. The glow sticks eventually fall or are preened off within a few days. This allows the bat's flight path to be followed for a short time and observations such as flight direction and height to be made. Active survey transects involved walking slowly walking along a transect with a handheld AnaBat detector. These transects were located within suitable bat roosting/foraging habitat to maximise the number species identified.

6.3.2 Results

The EPBC Protected Matters Search identified one nationally threatened bat species as potentially occurring within the project area, the South-eastern Long-eared Bat. Whilst the BDBSA search

has no records of threatened bat species for the area, there are previous records of bats within 10km of the site of the following four species:

- Gould's Wattled Bat
- Chocolate Wattled Bat
- Southern Free-tail-bats
- Southern Forest Bat

The following eight bats species were detected on site during surveys:

- White-striped Free-tail Bat
- Gould's Wattled Bat
- Chocolate Wattled Bat
- Free-tail Bat
- Inland Free-tail Bat
- Southern Free-tail Bat
- Lesser Long-eared Bat
- Large Forest Bat
- Southern Forest Bat
- Forest Bat

Additional species may have been recorded, as a proportion of the calls were not able to be identified to species level.

No threatened species were detected during the surveys and all bats identified were expected to be present within the region. Most of the species detected by passive and active AnaBat survey methods were also confirmed by captures during the surveys. Only one species, recorded by AnaBat, the Large Forest Bat, was not confirmed by capture. The Inland Free-tail Bat and Southern Free-tail Bat were captured during the surveys but were not able to be distinguished from each other in passive or active AnaBat recordings.

There were no confirmed calls of Little Forest Bat (*Vespadelus vulturnus*) but some calls identified as *Vespadelus* sp. may in fact be this species. The Inland Broad-nosed Bat is likely to be in the area but no single call could be confirmed as this species. The Inland Forest Bat (*Vespadelus baverstocki*) was not detected but could also be in the region, however this species is mainly found within semi-arid to arid landscapes and the project site is on the southern edge of its known distribution.

In order to allow a comparison of average bat activity across the site each passive survey site was assigned a habitat type:

- Near open or free-standing water (foraging habitat for bats)
- Woodlands (foraging and roosting habitat)
- Very open woodlands (foraging and roosting habitats)
- Open grasslands (foraging habitats)

Very open woodland habitat registered the highest levels of activity, moderately high levels of activity were also registered at woodland habitats and open water sites. In contrast, open grassland habitats (where the majority of turbines will be) had the lowest activity levels with an average of 66 bat calls per detector night.

A comparison of Anabat detectors at the met mast site, with one at ground levels and on elevated on the mast showed greater numbers of calls at ground level than at height.

Seven White-striped Free-tail Bats were caught which is quite unusual as this species is a high-flyer and is rarely caught or seen, even though it is commonly heard (one of the few bat calls in SA audible to humans). White-striped Free-tail Bats use an open space aerial foraging strategy and since these captures were made within woodland areas it is likely that these individuals were caught close to their roosting location within these woodland areas.

Following capture flight heights of released bats ranged between 5 and 20 metres from ground level, commonly around 10 m and many flew into or just above the canopy of nearby trees. From the active survey observations made along Pine Hut Road, it is clear that bats are using this corridor as edge habitat for foraging and transit. Bats were observed at approximately 5-10 m in height flying along the road and along the outer edges of the roadside vegetation. The majority of the bats detected along this active survey transect were identified as Chocolate Wattled Bats. This species is known to forage in the gap between understorey and canopy and along forest trails (Churchill 2008).

The site assessment identified ample suitable roosting and foraging habitat such as mature eucalypts, buildings, fence posts and rock walls. The site also provides suitable habitat for bats with a range of foraging strategies such as open water, scattered and dense woodland vegetation and strips of roadside vegetation. These habitats provide good foraging for open space aerial foragers, edge space aerial foragers, trawlers and gleaners.

6.3.3 Assessment of Potential Impacts

Habitat clearance is one of the primary threats to bats when considering the impact of a development. The turbine layout avoids the removal of any native vegetation, and hence will avoid any significant clearance of bat roosting and foraging habitat. Minimal impacts to provide site entry / exit points along Pine Hut Road is the only impact proposed to vegetation identified as preferred bat habitat. Bat strikes are most likely if turbines are positioned where there are concentrations of bat activity, i.e. within roosting habitat, foraging habitat and movement corridors. In addition to direct strikes North American wind farm studies have also suggested that bats may be impacted by a sudden change in localised air pressure created by turbines a phenomenon known as *Barotrauma*⁸.

The majority of bat species detected within the project site are expected to utilise the habitat features (wooded areas and open water) that have been avoided by the turbine layout, hence based on our current understanding of how these species use the site, impacts would only be expected infrequently when commuting between foraging and roosting habitat. A minimum buffer distance of 100 m will be established around all relevant bat habitat features to minimise the risk of bat collisions with turbines at the site.

Four bat species (White-striped Free-tail Bat, Inland Free-tail Bat, Southern Free-tail Bat and Yellow-bellied Sheath-tail Bat) have been outlined as most likely to use the open space habitat where turbines will be positioned. Bats are only at risk of striking a turbine blade when within close proximity of the rotor swept area (i.e. flying above approximately 40 m in height, subject to the turbine configuration. Although limited information is known about how these species behave at

⁸ Baerwald E , D'Amours G H, Klug B J and Barclay R M R (2008) Barotrauma is a significant cause of bat fatalities at wind turbines *Current Biology* 18:16

these heights within open areas, it is expected that they would have some interactions with the turbines. Three of the bat species most likely to use the potential rotor swept areas (White-striped Free-tail Bat, Inland Free-tail Bat and Southern Free-tail Bat) are considered to be common species. However considering that these species' preferred foraging habitat is open areas (particularly the White-striped Free-tail Bat) the impacts will be biased towards them. The state rare Yellow-bellied Sheath-tail Bat is considered to have a very low potential use of the site and hence the impacts to this species are expected to be unlikely.

6.3.4 Mitigation Measures

A number of mitigation measures have been built into the design of the proposed Keyneton Wind Farm infrastructure, in particular the adoption of exclusion zones (or buffers) around identified bat habitat.

- Vegetation that may provide bat roosting or foraging habitat will not be cleared
- A minimum 100m buffer zone has been adopted around all identified woodlands, roadside vegetation movement corridors (particularly Pine Hut Road and Angaston-Sedan Road) and river movement corridors (Figure 24). Open water will be buffered by a minimum of 250 m due to the increased activity of a number of species at open water habitat.
- Turbines (KE-02, KE-03, KE-04, KE-06 and KE-08) are proposed within an area of scattered Blue Gums over exotic grasslands/crops in the north-west corner of the project site. Given the very sparsely scattered nature of the Blue Gums within this area, it is considered that turbines located within this area are able to suitably avoid bat foraging and roosting habitat. Each of these turbines has been specifically sited within the layout to avoid the large trees that remain in this area. In addition to this, during detailed design, the suitability of these turbines can be confirmed as appropriate (or further micro-sited) by a qualified ecologist) close to their proposed locations so as to confirm avoidance of the foraging habitat within this area.
- In addition to the above mitigation measures the following monitoring measures are recommended to measure the impact of the wind farm on bats utilising the site:
- Establish bat-strike monitoring to measure actual impacts of the wind farm on bats utilising the project site.
- Bat-strike monitoring methods should be adopted and searches conducted on a regular basis to identify bat mortalities as a result of the proposed wind farm. Bat-strike monitoring programs should be conducted by suitably trained on-ground staff, however a formal reporting procedure to an external environmental agency is recommended. The level of bat activity across the Keyneton project site denotes that some impacts will be likely (even when mitigation measures are taken into account) but measuring the actual impacts will help to assess whether the mitigation measures have been appropriate.
- Perform scavenger and detectability trials to correct bat-strike monitoring results. It is recommended that scavenger and detectability trials are performed at the proposed Keyneton wind farm prior to the construction and operation of turbines. These trials measure the influence of scavenging activity and the detectability of bat carcasses at the Keyneton site. Results from bat-strike monitoring programs conducted during the operation of a wind farm would not be accurate without pre-construction determination of the detectability of carcasses (in certain landscapes) and the extent of scavenging activity at the site. These rates of detectability and scavenging are factored into the bat-strike monitoring results to form an accurate picture of bat mortalities.
- Establish long-term monitoring of bat diversity and activity at the project site. A long-term monitoring program is recommended to assess the ongoing utilisation of the wind farm by bats. Activity levels and species diversity within and surrounding the site would provide valuable information about how bats react to wind farms and form part of the assessment of mitigation measures employed at this site. Monitoring could also include the study of turbine avoidance behaviour, bat flight paths, and bat flight heights in relation to the rotor swept area.

- It is recommended that a Bat (and Bird) Monitoring Plan is prepared for the approval of Department of Environment and Natural Resources prior to the commencement of construction. The methodology, parameters and timeframes for a monitoring program could be established through this plan.
- It is not identified in EBS Ecology's report however the Mid-Murray Local Action Planning (LAP) Committee has identified its previous experience and capability monitoring bats. There is an opportunity, if the project is approved, to engage the Mid Murray LAP to undertake any bat monitoring requirements associated with the project.

6.4 Summary

Assessments of flora, terrestrial and avifauna were carried out at the proposed Keyneton Wind Farm. Following these assessments and in accordance with recommendations by EBS Ecology, a number of modifications to the proposed turbine layout were made. These included removing or relocating turbines in order to avoid habitat or respect buffer zones around bat and bird habitat and nests.

The majority of the vegetation within the proposed project site is exotic grassland/ herbs with some areas of scattered South Australian Blue Gum (Vegetation Association 1) and Peppermint Box (Vegetation Associations 4, 5 and 10). Areas of South Australian Blue Gum are considered suitable for turbine placement providing the removal of mature Blue Gums is avoided. No turbines are proposed in Peppermint Box woodlands.

Two nationally threatened ecological communities were identified within the project site: Peppermint Box Grassy Woodland of South Australia and Iron-Grass Natural Temperate Grassland of South Australia, all patches were however found to be in poor condition and therefore did not qualify as critically endangered under the EPBC Act 1999.

The site generally has poor fauna habitat value due to the lack of intact native vegetation and extensively modified understorey vegetation.

During the bird survey four state rare species were recorded however no EPBC listed bird species were recorded. The EPBC Protected Matters Online Search Tool did however list three EPBC listed migratory bird species as likely to occur in the project area, although they were not recorded during any of the survey periods. A nest survey was carried out and nine nests were identified as belonging to at least two breeding pairs of Wedge-tailed Eagles. One nest, partially utilised by a pair of Peregrine Falcons, was located adjacent to a rocky ledge that was identified as a Peregrine Falcon breeding site. Buffers around nest sites as recommended by EBS Ecology have been incorporated within the site design.

The project site provides roosting and foraging habitat suitable for a range of common bat species, including mature eucalypts, dwellings, old sheds, fence posts and rock walls. The site also contains suitable foraging habitat for bats such as open water, scattered and dense woodland vegetation, roadside vegetation (native and exotic) and creeks/rivers. Activity was concentrated around these habitat features for the majority of species detected onsite. AnaBat detectors within the vicinity of woodland areas, open water, main roads and river corridors recorded a higher level of activity overall across the surveys, compared to open areas.

Eight bat species were positively identified on site and although not detected, five other species are likely to occur on site. Of those undetected species two are listed as threatened. It is possible that these threatened species would occur, although only infrequently and in low numbers. Hence the potential risk of impact to these species is considered to be very low.

The potential impacts of the proposed development have been identified as clearing of vegetation resulting in loss of native vegetation and suitable fauna habitat, collision of birds and bats, disturbance (particularly during construction) and barotrauma (affecting bats only).

Mitigation measures have been embedded within the project design. These design measures seek to avoid impacts in the first instance. Where complete avoidance is not likely, further mitigations are appropriate to minimise potential impacts such that any impacts are deemed acceptable when considered against the overall benefits of the project. Significantly the proposed development will result in minimal native vegetation impacts and buffers from preferred bat habitat and identified Peregrine Falcon and Wedge-tailed Eagle nests as recommended by EBS Ecology have been adopted.