7. Bird Utilisation Surveys

7.1. Bird utilisation surveys methodology

Two pre-construction bird utilisation surveys were carried out by experienced ornithologists in 2020 and 2021; the first in spring and the second in autumn to account for seasonal differences in bird activity and relative abundance. The dates and surveyors are detailed below.

Spring: 14th – 17th October 2020 (Peter Lansley, Eamon O'Meara)

Autumn: 20th – 23rd April 2021 (Khalid Al-Dabbagh, Peter Lansley)

The bird utilisation survey (BUS) was undertaken consistent with the requirements for a "Level One" bird risk assessment in accordance with Best Practice Guidelines for Wind Energy Developments in Australia issued by the Clean Energy Council (2018).

The pre-construction bird utilisation survey was undertaken by experienced zoologists and was designed to set up basic data of bird use of the wind farm site, and to be use for bird utilisation comparisons with post-construction data (BACI [before-after, control-impact] model).

The bird utilisation survey (BUS) is the most commonly used method for generating quantitative data on bird use of a potential wind farm site. This can be used to provide a ranked abundance of species use of the site at varying heights, including turbine rotor swept area (RSA) height. The method provides the following information:

- Bird species (diversity) utilising the wind farm site;
- The relative abundance and/or density of birds on site;
- Flight patterns and heights in relation to the wind turbine heights;
- The distribution of bird species across the wind farm site.

7.1.1. Fixed-point bird count

The fixed-point bird count method involved an observer stationed at a survey point for 15 minutes, during which time all birds observed within a 200-metre radius were recorded. The period of 15 minutes used in the formal bird utilisation surveys was considered adequate to generate representative data on the bird species in the area during the survey.

During this period, all bird species and number of individual birds observed within 200 metres were recorded. The species, the number of birds and the height of the bird when first observed were documented.

Flight height is presented as below, at or above rotor swept area height (RSA height):

- **A =** Below RSA (< 84 metres above ground)
- **B =** At RSA (84 – 246 metres above ground)
- **C =** Above RSA (> 246 metres above ground)

A total of 12 fixed survey points were established. Ten were considered impact points and were located within the wind farm area, and two were considered reference points and were located outside the wind farm site in habitat that, as closely as possible, resemble those of the impact points (Figure 3). During the survey, eight counts were taken at each survey point. Counts were taken at different times of the day to allow for time-of-day differences in bird movements and activity. The number of impact points surveyed varied between the two seasons. In spring 2020

BUS, eight impact and two reference points were surveyed, but later, during autumn 2021 BUS, the number increased to ten impact and the two reference points in order to better represent the various habitats at the wind farm site. The slight change in observation points involved removing one and adding three new points and changing the location of two more in autumn.

The wind farm was divided into two sections: the western section which runs along the ridge to the west of Barkly Gap and the Eastern section running on the other ridge east of Bolangum Inn Road (Figure 3). The eastern section included the points 1, 2, 3, 9, R1 and R2; and the western section, including the points 4, 5, 6, 7, 10 and 11.

Two zoologists executed the survey by working concurrently and dividing the effort between them. Surveys at each section lasted four days, with a total effort of eight days by the two zoologists.

Table 9 below provides an example of when each point was counted during autumn survey period; similar arrangement was followed during spring surveys. Scheduling ensured that all points were visited equally at different times of day to allow for time-of-day differences in bird movements and activity. However, the schedule was not literally followed as changes had to be made due to access limitation when severe rain resulted in flooding of some access tracks.

Table 9: Times when points were counted for each fixed-point bird count survey day (autumn survey)

Western Section						
14-Oct	1	2	3	9	R1	R2
15-Oct	3	9	R1	R2	1	2
16-Oct	R2	1	2	3	9	R1
17-Oct	2	3	9	R1	R2	1
Date	13:30	14:15	15:00	15:45	16:30	17:00
14-Oct	1	2	3	9	R1	R2
15-Oct	3	9	R1	R2	1	2
16-Oct	R2	1	2	3	9	R1
17-Oct	2	3	9	R1	R2	1

Eastern Section						
14-Oct	4	5	6	7	10	11
15-Oct	6	7	10	11	4	5
16-Oct	10	11	4	5	6	7
17-Oct	5	6	7	10	11	4
Date	13:30	14:15	15:00	15:45	16:30	17:00
14-Oct	4	5	6	7	10	11
15-Oct	6	7	10	11	4	5
16-Oct	10	11	4	5	6	7
17-Oct	5	6	7	10	11	4

Note: The prefix 'R' refers to reference points.

7.1.2. Locations of survey points

Over the survey period, ten fixed survey points were established in spring (8 impact, 2 reference) and later increased to 12 survey points in autumn (10 impact, 2 reference). Impact points were located near proposed turbine locations, and reference points, where feasible, were located at least 1000 metres away from turbines in areas of similar habitat outside the wind farm footprint.

The survey points were distributed as evenly as possible (subject to access constraints) across the wind farm to maximise coverage in areas where wind turbines are likely to be sited (Figure 3). Impact points were positioned as far as possible on elevated ground, allowing a clear view in all directions.

Table 10 below provides a description of the habitats associated with each impact and reference point.

Table 10: Habitat associated with each bird survey point

Survey Point	Habitat/landscape description
1	Hilltop / ridge – cleared grazing paddocks to the north-east, partly cleared wooded slope of mainly Bundy *Eucalyptus goniocalyx* and other mature eucalypts such as yellow Gum and Yellow Box.
2	Upper part of hill slope. Partly cleared with introduced pasture grasses dominant. Scattered woodland remnants to the west and lower down the slope to the north-east. Bundy *Eucalyptus goniocalyx* is the dominant overstorey tree, with other large eucalypt trees such as Yellow Gum.
3	Mostly cleared ridgeline. A few scattered eucalypts mostly Bundy, including some saplings. Grazed by sheep. Wooded on south- and west-facing slopes.
4	Rocky hilltop, low grass, grazing for sheep.
5	Immediately adjacent to mine shaft and remnant/revegetated box ironbark woodland.
6	30m West of fence line on cleared spot height. Revegetated and remnant trees to the east of fence.
7	Cleared hilltop, grass only.
8	Cleared hilltop, low veg, sparsely scattered acacia sp. Used only during spring survey.
9	Roadside on lower slope of hills. Cleared paddocks to the south; wooded road reserve mostly supporting Grey Box *Eucalyptus microcarpa*. Further north and east are cleared paddocks. Used as R1 during spring but later changed to point 9 during autumn survey.
10	On small hill with regrowth Red Ironbark, and scattered Yellow Box and Yellow Gum, understorey grazed.
11	Open paddock, with line of Red Ironbark along road and two dams nearby.
R1	Roadside at northern end of the eastern section of study area. Mostly cleared grazing paddocks, Road reserve vegetated mostly with River Red-gum *Eucalyptus camaldulensis* woodland and grassy ground cover. Trees mostly over 30 metres heigh. Added to the points during autumn survey.
R2	Roadside at northern end of the eastern section of study area. Mostly cleared grazing paddocks, Road reserve vegetated mostly with River Red-gum *Eucalyptus camaldulensis* woodland and grassy ground cover. Trees mostly over 30 metres heigh.

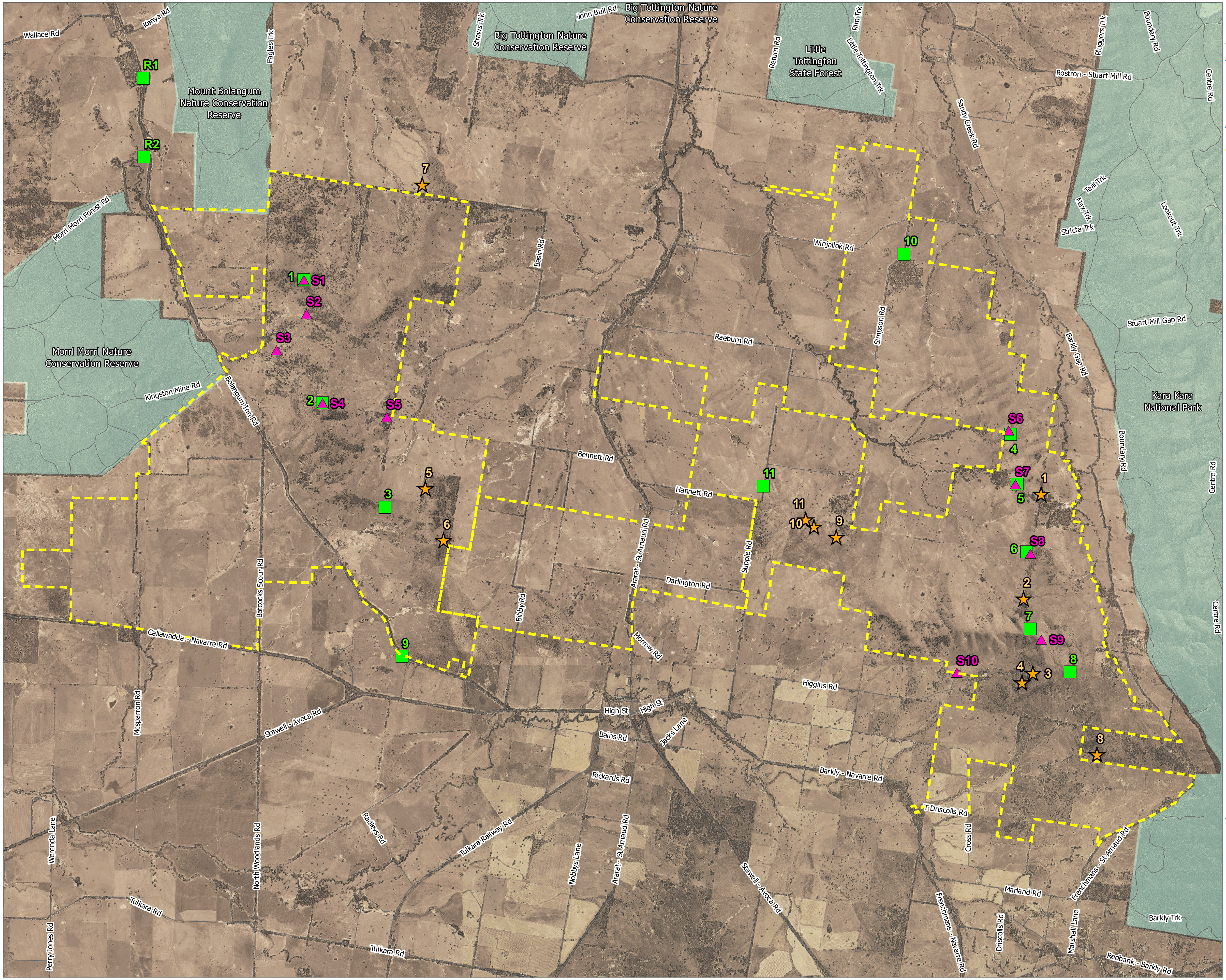

Figure 3: BUS and Bat Survey Points and Wedge-tailed Eagle Nests

Project: Navarre Wind Farm
Client: Aurecon Australasia Pty Ltd
Date: 27/03/2023

- Wind farm boundary
- Wedge-tailed Eagle nest
- Bat survey site
- BUS points
- Conservation area

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7.1.3. Incidental observations

In addition to the observations during formalised, fixed-point counts, incidental observations of birds of concern (threatened species, raptors, waterbirds) were made whilst travelling throughout the proposed wind farm site. Particular attention was paid to raptors flying at RSA (rotor-swept area) height. Notes were also made of birds observed in remnant woodlands, open country and dams whilst travelling between the observation points.

7.1.4. Limitations

The bird utilisation survey was undertaken over two seasons (spring 2020, autumn 2021). This was undertaken to collect a range of data and include migratory birds that may only occur at certain times of the year.

The timing of the two surveys coincides with highest possible bird activities, such as during the breeding season and after the maximum recruitment following breeding. Additionally, most migratory bird species, would be present in the region.

The utilisation rates and species abundances recorded during the survey are considered to be representative of the site. They are also considered to provide a reasonable basis from which to assess the bird risks associated with the proposed Navarre Wind Farm.

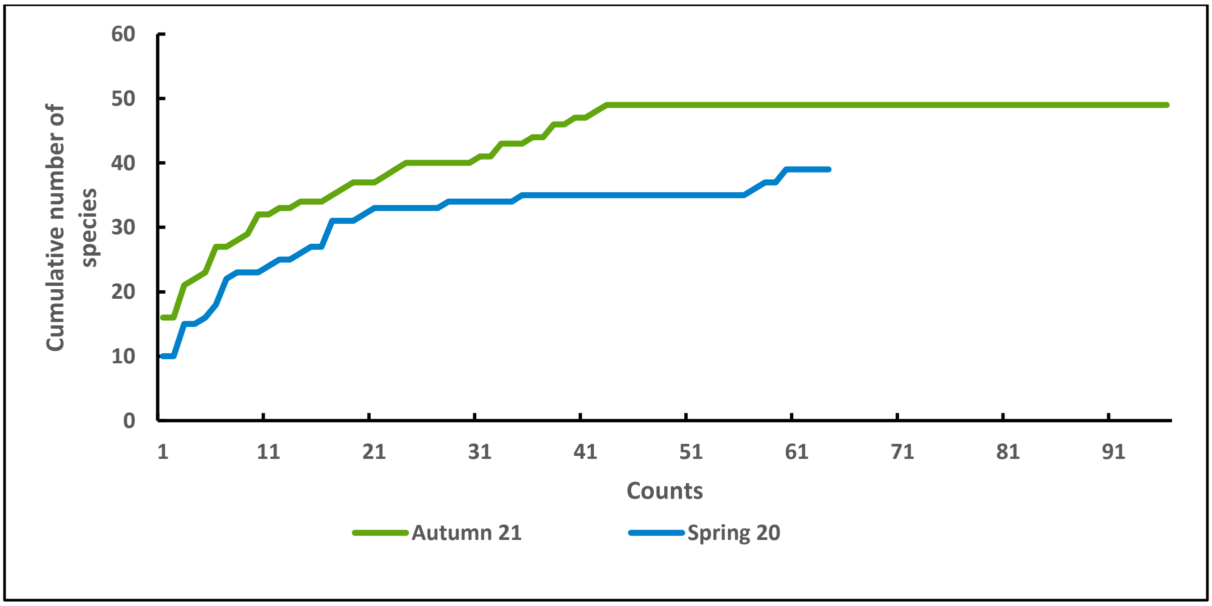
7.2. Results of bird utilisation surveys

7.2.1. Survey Suitability

The cumulative number of species observed from the consecutive fixed-point bird counts conducted at the impact points during the two surveys period have been plotted (Figure 4).

This revealed that the number of new species observed at the wind farm sites almost levelled off at approximately 40 counts, after which the occasional new species was found. Over 95% of species were found in autumn and over 85% in spring after 50% of the replicates were counted. This suggested that the surveys collectively provided a representative picture of the diversity of bird species flying over the wind farm site during the two survey periods.

Figure 4: The cumulative number of species of birds recorded during consecutive counts at the combined (East and West) impact points on the Navarre Wind Farm



7.2.2. Species diversity and composition

A total of 217 species of birds (seven introduced) were recorded for the general region encompassing the wind farm site (within 10km radius of -36.8399 °S, 143.1342 °E; DELWP 2019). Of these, 63 species (30 percent of all birds in area) were seen at the wind farm site during the formal counts in both the spring and autumn BUS, including impact and reference points. The number of species recorded at each of the two seasons was similar (47 and 50, respectively), but composed of slightly different species depending on the season and presence and absence of seasonal migratory species (Table 11). Additional species were also recorded as incidental observations on the wind farm outside of the formal surveys during both seasons.

Table 11: Number of species recorded during BUS at the impact and reference sites.

Season	No. of species at impact sites	No. of species at reference sites	All species
Spring 2021	39	25	47
Autumn 2021	49	18	50
Both seasons	53	28	63

Species recorded were predominantly common farmland or woodland species with some records of raptors and waterbirds.

Bird diversity (species richness) was moderate in value and reflected the nature of habitats at the wind farm observation points. The number of species recorded at each of the impact observation points varied between 5 to 21 and 3 to 24 species during spring and autumn, respectively. Notwithstanding the differences in number of species between observation points, the actual species diversity value was statistically not significant, demonstrating the comparative homogeneity of habitats and its use by birds at the impact points, both within or between the two sections of site (Table 12). Similarly, and despite the difference in species composition between the two seasons, diversity was not significantly different, probably since resident birds were the dominant part of the bird fauna (Table 13).

Birds were somewhat more diverse at the reference points as the habitat included more treed habitats. There were 19 and 16 species in spring, and 18 and 12 species in autumn recorded at R1 and R2, respectively. Diversity was not different between the two reference sites and similarly, diversity was similar between the two seasons.

Table 12: Statistical differences between species diversity (species richness) at the impact observation points

Comparisons (Single factor ANOVA)	F value	DF	Probability
Between spring observation points	1.75	7, 102	$P < 0.05$ **Not significant**
Between autumn observation points	1.408	9, 155	$P < 0.05$ **Not significant**

Comparisons (Single factor ANOVA)	F value	DF	Probability
Between spring and autumn observation points (seasonal difference)	1.425	20, 286	$P < 0.05$ **Not significant**

7.2.3. Relative abundance of birds

The species observed utilising the impact and two reference observation points, their abundance and height distribution for the spring (eight impact points) and autumn (10 impact points) seasons are detailed in Appendix 8. A summary of the data from the two seasons is presented below in Table 13 for the impact points and Table 14 for the reference points.

The relative abundance of birds varied between the eight impact points in spring, the ten impact points in autumn, or between the two seasons. Relative abundance fluctuated between 56 and 253 and between 18 and 357 birds in spring and autumn, respectively. The high number of certain birds at certain impact points is probably related to the presence of the abundant Australian Magpie and some of the flocking birds such as cockatoos and galahs. In general, more birds were recorded in autumn (average of 165 birds per impact point, n= 10 points) compared to spring (120.3 birds per impact point, n= 8 points).

Notwithstanding the apparent variations in bird numbers at the impact points; there were no significant differences between these numbers (relative abundance) among the impact points in both of the spring and autumn counts. Likewise, relative abundance was not significantly different between the two seasonal counts (Table 15). The results from above analysis were anticipated since most of the impact points were located at similar habitats, being mostly on top of ridges in cleared agricultural land with scattered mature eucalypts trees (see Table 10).

Trends in relative abundance at the reference points were similar to those at the impact points, however, numbers recorded at both of the reference points (average of 242 and 537 birds per points at R1 and R2, respectively) were higher than those at the impact points. Habitats at the two reference points included a large section of mature eucalypt woodland (nature strip) and surrounded by farming land.

The five most common species at the impact and reference survey points are presented below in a tabulated form, from most to least abundant (Table 16). The five most common species recorded at the impact survey points comprised over half the number of all birds at impact survey points both during any of the two seasons or when combined together. At the reference points leading species were less apparent, and dominance was almost shared by several species (Table 16).

The bird fauna composition and its dominant species were different between the impact and reference points. Bird species at the impact points were mainly those forms adapted to habitats at ridge lines (mostly cleared with scattered woodland patches or isolated trees), while birds at the reference points were mainly nectar feeders adapted to habitats with large mature eucalypts as those found along wooded road reserves.

Following from above analysis and conclusion, bird data was further used to calculate density of birds at each of the observation points during both seasons (Table 17). Density of birds (numbers per hectare per hour) calculated from data of both seasons was similar between the observation points with only little variation reflecting the habitat of the observation point, particularly the number of mature trees associated with the counting area of the points, however, density at the reference points was higher than that at the Impact points due to differences in vegetation cover, topography of the point and bird species composition.

The Navarre Wind Farm comprised a healthy and diverse bird population comparable to many other wind farms built in similar habitats.

Table 13: Count and height distribution of bird species at impact survey points at Navarre Wind Farm

Species	Spring (8 points)				Autumn (10 points)				Totals				% Imp.
	A	B	C	Total	A	B	C	Total	A	B	C	Total	
Australian Magpie	248	0	0	248	280	0	0	280	528	0	0	528	20.2
Galah	42	0	0	42	212	0	0	212	254	0	0	254	9.7
Australian Wood Duck	210	0	0	210	0	0	0	0	210	0	0	210	8.0
Red Wattlebird	32	0	0	32	157	0	0	157	189	0	0	189	7.2
Long-billed Corella	70	0	0	70	79	6	0	85	149	6	0	155	5.9
Sulphur-crested Cockatoo	87	0	0	87	38	4	0	42	125	4	0	129	4.9
Welcome Swallow	59	0	0	59	55	0	0	55	114	0	0	114	4.4
Yellow-rumped Thornbill	69	0	0	69	24	0	0	24	93	0	0	93	3.6
Raven sp.	25	0	0	25	60	2	0	62	85	2	0	87	3.3
Buff-rumped Thornbill	7	0	0	7	66	0	0	66	73	0	0	73	2.8
Red-rumped Parrot	20	0	0	20	41	0	0	41	61	0	0	61	2.3
White-plumed Honeyeater	3	0	0	3	52	0	0	52	55	0	0	55	2.1
Straw-necked Ibis	0	0	53	53	0	0	0	0	0	0	53	53	2.0
Superb Fairywren	24	0	0	24	28	0	0	28	52	0	0	52	2.0
Striated Pardalote	36	0	0	36	11	0	0	11	47	0	0	47	1.8
White-winged Chough	0	0	0	0	45	0	0	45	45	0	0	45	1.7
White-browed Woodswallow	0	40	0	40	0	0	0	0	0	40	0	40	1.5
Australian Pipit	32	0	0	32	2	0	0	2	34	0	0	34	1.3
Eastern Rosella	4	0	0	4	27	0	0	27	31	0	0	31	1.2
Noisy Miner	2	0	0	2	27	0	0	27	29	0	0	29	1.1
Willie Wagtail	4	0	0	4	23	0	0	23	27	0	0	27	1.0
Crimson Rosella	5	0	0	5	20	0	0	20	25	0	0	25	1.0
Yellow-faced Honeyeater	9	0	0	9	14	0	0	14	23	0	0	23	0.9
Wedge-tailed Eagle	9	1	0	10	9	3	0	12	18	4	0	22	0.8
White-throated Treecreeper	17	0	0	17	5	0	0	5	22	0	0	22	0.8
Black-faced Cuckoo-shrike	13	0	0	13	8	0	0	8	21	0	0	21	0.8
Brown-headed Honeyeater	2	0	0	2	18	0	0	18	20	0	0	20	0.8
Rainbow Bee-eater	17	0	0	17	0	0	0	0	17	0	0	17	0.6

Species	Spring (8 points)				Autumn (10 points)				Totals				% Imp.
	A	B	C	Total	A	B	C	Total	A	B	C	Total	
Grey Shrike-thrush	6	0	0	6	10	0	0	10	16	0	0	16	0.6
Musk Lorikeet	0	0	0	0	15	0	0	15	15	0	0	15	0.6
White-browed Babbler	0	0	0	0	14	0	0	14	14	0	0	14	0.5
Crested Pigeon	0	0	0	0	11	0	0	11	11	0	0	11	0.4
Australian Shelduck	0	0	0	0	9	0	0	9	9	0	0	9	0.3
Striated Thornbill	0	0	0	0	9	0	0	9	9	0	0	9	0.3
Grey Fantail	2	0	0	2	7	0	0	7	9	0	0	9	0.3
Brown Treecreeper	0	0	0	0	8	0	0	8	8	0	0	8	0.3
Magpie-lark	0	0	0	0	8	0	0	8	8	0	0	8	0.3
Scarlet Robin	4	0	0	4	4	0	0	4	8	0	0	8	0.3
Rufous Whistler	8	0	0	8	0	0	0	0	8	0	0	8	0.3
Fuscous Honeyeater	0	0	0	0	5	0	0	5	5	0	0	5	0.2
Spotted Pardalote	0	0	0	0	5	0	0	5	5	0	0	5	0.2
Diamond Firetail	0	0	0	0	4	0	0	4	4	0	0	4	0.2
Southern Whiteface	0	0	0	0	4	0	0	4	4	0	0	4	0.2
Nankeen Kestrel	4	0	0	4	0	0	0	0	4	0	0	4	0.2
Hooded Robin	0	0	0	0	3	0	0	3	3	0	0	3	0.1
Restless Flycatcher	0	0	0	0	3	0	0	3	3	0	0	3	0.1
Brown Falcon	2	0	0	2	1	0	0	1	3	0	0	3	0.1
Dusky Woodswallow	3	0	0	3	0	0	0	0	3	0	0	3	0.1
Laughing Kookaburra	0	0	0	0	2	0	0	2	2	0	0	2	0.1
Common Bronzewing	0	0	0	0	2	0	0	2	2	0	0	2	0.1
Purple-crowned Lorikeet	0	0	0	0	2	0	0	2	2	0	0	2	0.1
Weebill	0	0	0	0	2	0	0	2	2	0	0	2	0.1
Australian Owlet-nightjar	1	0	0	1	1	0	0	1	2	0	0	2	0.1
Mistletoebird	0	0	0	0	1	0	0	1	1	0	0	1	0.0
Golden Whistler	1	0	0	1	0	0	0	0	1	0	0	1	0.0
Peregrine Falcon	1	0	0	1	0	0	0	0	1	0	0	1	0.0
Sacred Kingfisher	1	0	0	1	0	0	0	0	1	0	0	1	0.0

Species	Spring (8 points)				Autumn (10 points)				Totals				% Imp.
	A	B	C	Total	A	B	C	Total	A	B	C	Total	
Crested Shriketit	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Grand Total	**869**	**41**	**53**	**963**	**1641**	**15**	**0**	**1656**	**2510**	**56**	**53**	**2619**	100.0

Table 14: Count and height distribution of bird species at reference survey points at Navarre Wind Farm

Species	Spring				Autumn				Totals				% Imp.
	A	B	C	Total	A	B	C	Total	A	B	C	Total	
Musk Lorikeet	126	0	0	126	72	0	0	72	198	0	0	198	18.4
Long-billed Corella	67	0	0	67	92	28	0	120	159	28	0	187	17.4
Australian Magpie	100	0	0	100	64	0	0	64	164	0	0	164	15.3
Noisy Miner	26	0	0	26	72	0	0	72	98	0	0	98	9.1
White-plumed Honeyeater	25	0	0	25	72	0	0	72	97	0	0	97	9.0
Red Wattlebird	0	0	0	0	80	0	0	80	80	0	0	80	7.4
White-winged Chough	29	0	0	29	31	0	0	31	60	0	0	60	5.6
Galah	29	0	0	29	4	0	0	4	33	0	0	33	3.1
Sulphur-crested Cockatoo	8	0	0	8	23	0	0	23	31	0	0	31	2.9
Raven	14	0	0	14	11	0	0	11	25	0	0	25	2.3
Eastern Rosella	2	0	0	2	23	0	0	23	25	0	0	25	2.3
Willie Wagtail	9	0	0	9	3	0	0	3	12	0	0	12	1.1
Striated Pardalote	9	0	0	9	0	0	0	0	9	0	0	9	0.8
Red-rumped Parrot	8	0	0	8	0	0	0	0	8	0	0	8	0.7
Magpie-lark	6	0	0	6	2	0	0	2	8	0	0	8	0.7
Welcome Swallow	5	0	0	5	0	0	0	0	5	0	0	5	0.5
Grey Shrike-thrush	4	0	0	4	1	0	0	1	5	0	0	5	0.5
Laughing Kookaburra	2	0	0	2	3	0	0	3	5	0	0	5	0.5
Australian Shelduck	4	0	0	4	0	0	0	0	4	0	0	4	0.4
Little Lorikeet	4	0	0	4	0	0	0	0	4	0	0	4	0.4

Species	Spring				Autumn				Totals				% Imp.
	A	B	C	Total	A	B	C	Total	A	B	C	Total	
Fuscous Honeyeater	0	0	0	0	4	0	0	4	4	0	0	4	0.4
Brown Treecreeper	3	0	0	3	0	0	0	0	3	0	0	3	0.3
Common Bronzewing	0	0	0	0	3	0	0	3	3	0	0	3	0.3
Yellow-faced Honeyeater	0	0	0	0	2	0	0	2	2	0	0	2	0.2
Australian Owlet-nightjar	1	0	0	1	0	0	0	0	1	0	0	1	0.1
Black-faced Cuckoo-shrike	1	0	0	1	0	0	0	0	1	0	0	1	0.1
Crested Shriketit	1	0	0	1	0	0	0	0	1	0	0	1	0.1
Dusky Woodswallow	1	0	0	1	0	0	0	0	1	0	0	1	0.1
Crimson Rosella	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Grey Fantail	0	0	0	0	0	0	0	0	0	0	0	0	0.0
White-throated Treecreeper	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Yellow-rumped Thornbill	0	0	0	0	0	0	0	0	0	0	0	0	0.0
Grand Total	**484**			**484**	**562**	**28**	**0**	**590**	**1046**	**28**	**0**	**1074**	**100.0**

Table 15: Statistical differences between species numbers (relative abundance) at the impact observation points

Comparisons (Single factor ANOVA)	F value	DF	Probability
Between spring observation points	2.43	7, 56	0.05 < P < 0.025 **Not significant**
Between autumn observation points	1.05	7, 72	P < 0.05 **Not significant**
Between spring and autumn observation points (seasonal difference) *	1.40	15, 120	P < 0.05 **Not significant**

*Points compared were those counted in both seasons. The new added points or those with altered positions were excluded from ANOVA analysis.

Table 16: The five most abundant (dominant) species at the impact and reference observation points at Navarre Wind Farm.

		Combined seasons	% Imp.	Spring	% Imp.	Autumn	% Imp.
Impact Points	1	Australian Magpie	20.2	Australian Magpie	25.8	Australian Magpie	16.9
	2	Galah	9.7	Australian Wood Duck	21.8	Galah	12.8
	3	Red Wattlebird	8.0	Sulphur-crested Cockatoo	9.0	Red Wattlebird	9.5
	4	Long-billed Corella	7.2	Long-billed Corella	7.3	Long-billed Corella	5.1
	5	Sulphur-crested Cockatoo	5.9	Yellow-rumped Thornbill	7.2	Buff-rumped Thornbill	4.0
Total importance of dominant species			51.0		71.1		48.3
Reference points	1	Musk Lorikeet	18.4	Musk Lorikeet	11.7	Long-billed Corella	11.2
	2	Long-billed Corella	17.4	Australian Magpie	9.3	Red Wattlebird	7.4
	3	Australian Magpie	15.3	Long-billed Corella	6.2	Musk Lorikeet	6.7
	4	Noisy Miner	9.1	White-winged Chough	2.7	Noisy Miner	6.7
	5	White-plumed Honeyeater	9.0	Galah	2.7	White-plumed Honeyeater	6.7
Total importance of dominant species			**69.3**		**32.7**		38.7

Table 17: Summary of the numbers and density of bird at the impact and reference points

Impact and Reference points	Number of birds Spring	Density*	Number of birds Autumn	Density*	Number of birds Both seasons	Density*
1	112	4.5	221	8.8	333	6.6
2	56	2.2	141	5.6	197	3.9
3	68	2.7	175	7.0	243	4.8
4	112	4.5	57	2.3	169	3.4
5	197	7.8	83	3.3	280	5.6
6	253	10.1	71	2.8	324	6.4

Impact and Reference points	Number of birds Spring	Density*	Number of birds Autumn	Density*	Number of birds Both seasons	Density*
7	57	2.3	18	0.7	75	1.5
8	108	4.3	0	0.0	0	0.0
9	0	0.0	184	7.3	0	0.0
10	0	0.0	357	14.2	0	0.0
11	0	0.0	349	13.9	0	0.0
Averages	**87.5**	**4.8**	**165.6**	**6.6**	**231.6**	**4.6**
			Reference points			
R1	174	6.9	258	10.3	432	8.6
R2	310	12.3	332	13.2	642	12.8
Averages	242	9.6	295	11.7	537	10.7

***Density is number of birds per hectare per hour**

7.2.4. *Flight Heights*

Bird heights were classified as below (< 84 metres), at (84–246 metres), and above (> 246 metres) Rotor Swept Area height (RSA height).

The majority of birds were recorded flying below RSA heights. The percentage of birds recorded flying below, at, and above RSA heights at the impact sites were as follows:

Spring: 90.0% (below), 4.6% (at), 5.4% (above) RSA height

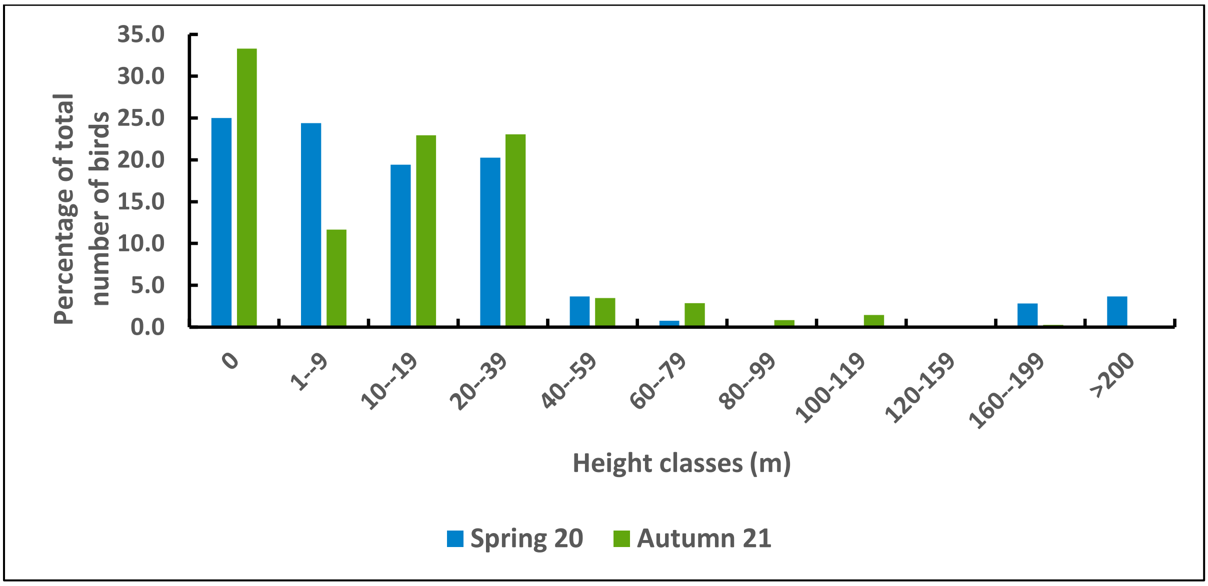
Autumn: 99.0% (below), 1.0% (at), 0% (above) RSA heights

Combined seasons: 95.8% (below), 2.1% (at), 2.1 (above) RSA heights

Modern wind turbine models allow for an extensive area below turbines, which can accommodate the majority of flying birds or those moving between high trees. This was the case in autumn season when 99% of birds observed at wind farm site were below RSA heights; however, occasionally some few high-flying raptors or flocking birds may ascend to RSA heights and become exposed to collision with turbines. The latter case was observed in spring season when two groups of birds (Straw-necked Ibis and White-browed Woodswallow) were seen flying at or above RSA heights.

The detailed height distribution of birds over the wind farm site (impact and reference points together) is shown in Figure 5. The height distribution confirms that most birds flew below RSA height, or were either on the ground or in trees (from 1 to 30 metres height), therefore reducing collision risks between birds and operational wind turbines.

Figure 5: The height distribution of birds at the impact points.



In general, there were five species of birds observed flying at RSA heights; two species in spring, and four species in autumn (Table 18). The number of birds recorded flying at RSA heights comprised 4.3% and 0.9% of all birds utilising the impact points in spring and autumn surveys, respectively.

At the reference points, no birds were recorded flying at the RSA heights during spring BUS and only one species (Long-Billed Corella) was recorded flying at RSA heights in autumn.

Table 18: Species flying at rotor swept area (RSA) at the impact sites during BUS.

Birds at RSA heights	Spring				Autumn			
	Birds at RSA	Birds at all heights	% at RSA	% RSA of all birds	Birds at RSA	Birds at all heights	% at RSA	% RSA of all birds
Long-billed Corella	0	0	0.0	0.0	6	85	7.1	0.4
Sulphur-crested Cockatoo	0	0	0.0	0.0	4	42	9.5	0.2
Wedge-tailed Eagle	1	10	10.0	0.1	3	12	25.0	0.2
Raven	0	0	0.0	0.0	2	62	3.2	0.1
White-browed Woodswallow	40	40	100.0	4.2	0	0	0.0	0.0
All birds at impact points	**41**	**963**	**4.3**	**4.3**	**15**	**1656**	**0.9**	**0.9**

7.2.5. Threatened Species

The majority of birds found to utilise the proposed wind farm site were common birds. Of the species recorded during the bird utilisation surveys, the following species were listed under the *Environment Protection and Biodiversity Conservation* (EPBC) *Act 1999* and/or the *Flora and Fauna Guarantee* (FFG) *Act 1988*:

- Brown Treecreeper (EPBC Act: vulnerable);
- Hooded Robin (EPBC Act: endangered; FFG Act: vulnerable); and
- Diamond Firetail (EPBC Act: Vulnerable; FFG Act: vulnerable).

These three species were recorded during BUS.

The Brown Treecreeper was recorded during the formal surveys at both the reference and impact points. It is dependent on woodland communities, often with a grassy ground layer and plentiful coarse woody debris (fallen trees, logs and branches) (Tzaros 2005). The species appears restricted to lower areas in the landscape.

The Hooded Robin was recorded at the ridge on point 1 (see Figure 3). The robin is not common and usually inhabits Grey Box, Ironbark or Yellow Gum woodlands with pockets of saplings or tall shrubs with open shrubby understorey and grassy or bare ground. Occurs singly or in pairs and often seen perches on low branches (Tzaros 2005).

The Diamond Firetail is another box-Ironbark bird, usually seen singly, in pairs or as small groups of 3–4 birds. Often feed on the ground with other small ground-feeding birds (Tzaros 2005). Recorded during BUS at point 6 (see Figure 3).

The above threatened woodland species are usually recognised as members of the Victorian Temperate Woodland Bird Community, which is defined as a suite of bird species (24 species), mainly associated with drier woodlands on the slopes and plains north of the Great Dividing Range (Victorian FFG Act).

The above three species are unlikely to be impacted by turbines as they spend most of their time foraging on or near the ground or perching in trees of heights of no more than 20 metres, and rarely fly above tree top height.

7.2.6. Raptors

Four raptor species (Wedge-tailed Eagle, Brown Falcon, Peregrine Falcon and Nankeen Kestrel) were recorded during the spring survey, comprising 17 raptors in total (or 1.8% of all birds); and two species (Wedge-tailed Eagle and Nankeen Kestrel) comprising 13 raptors in total (or 0.8%) in autumn (Table 19). None of these species is listed as a threatened species; however, Wedge-tailed Eagle is considered as a raptor of special interest and special consideration is given to its presence and protection.

Wedge-tailed Eagle was the most abundant raptor species at the impact sites. They were often seen soaring at critical heights and become vulnerable to collision with operating turbines. One of ten eagle sightings (10%), and 3 of 12 sightings (25%) were observed at RSA height during the spring and autumn formal surveys, respectively (Table 18). The Wedge-tailed Eagle is the most vulnerable species to collision with operating turbines because of their soaring habits while foraging.

Nature Advisory field zoologists recorded 11 eagle nests during earlier fauna surveys of the wind farm site and at times when eagles were most likely engaged with breeding activities. At the time of discovery, some of the nests seemed active but others did not show signs of being used in 2020 season. Wedge-tailed Eagles are known to build more than one nest within their breeding territory and use them alternatively between years (Table 19).

Based on Table 19 and the scatter of nest locations within the wind farm site (Figure 3), nests could be assigned to three territories. Two of the scatter points were at the eastern section, and the third on the western section of the wind farm site. It can therefore be concluded that Navarre WF could possibly support a minimum of three pairs of eagles. This is an unexpectedly high density of nesting territories in a certain area, but habitat characteristics over the high hills and continuous ridges produce up-lifting air currents that might favour the eagle's soaring and foraging habits.

The utilisation rate of the Wedge-tailed Eagle at Navarre Wind Farm was estimated at 0.95 and 0.80 eagles per hectare per hour in spring and autumn respectively. This rate is higher than rates recorded at a range of wind farms (0.01 – 0.44 eagle/ha/hr) studied by Nature Advisory in south-east Australia (Nature Advisory; Unpubl. Data). The utilisation rate at Navarre Wind Farm is therefore relatively high, but the expected impact on the eagle's population is much reduced, since few eagles were recorded flying at RSA heights (Table 18). In addition, a 300-metre turbine-free buffer has been applied around nesting sites to minimise impacts.

Other raptors, including Nankeen Kestrel, Brown Falcon and Peregrine Falcon, were recorded on fewer occasions and their utilization rates were low, suggesting minimal impact to their populations (Table 18).

No raptor species were recorded at the reference sites in either of the two seasonal surveys.

Other diurnal raptor species that may occur regularly in the area include Black-shouldered Kite, Whistling Kite, Little Eagle, Brown Goshawk and Australian Hobby. Most of these were seen incidentally within the wind farm boundary while moving between impact sites and none was recorded during formal BUS.

7.2.7. Waterbirds

Few waterbird species were recorded during the surveys. These comprised Straw-necked Ibis, Australian Shelduck and Australian Wood Duck (Table 19).

The Ibis was the only waterbird recorded at impact sites during the spring survey and was recorded on one occasion as a single flock flying high over the site (at 300 m above ground).

Australian Shelduck was recorded on two occasions during autumn survey with numbers comprising 0.5% of all birds recorded during the survey.

The presence of the Wood Duck was restricted to one observation point, which included a farm dam within its counting area.

None of the waterbirds observed at Navarre Wind Farm were threatened species, either under national or state conservation legislation. Any impacts on water birds that may arise from the wind farm are likely to be negligible in relation to their overall populations or their utilization rates.

Table 19: Raptor and waterbird species recorded at impact survey points at Navarre Wind Farm

Raptors	Spring			Autumn		
	Total	% of Raptors/ waterbirds	% all birds	Total	% of Raptors/ waterbirds	% all birds
Wedge-tailed Eagle	10	58.8	1.0	12	92.3	0.7
Nankeen Kestrel	4	23.5	0.4	1	7.7	0.1
Brown Falcon	2	11.8	0.2		0.0	0.0
Peregrine Falcon	1	5.9	0.1		0.0	0.0
Total raptors	**17**		**1.8**	**13**		**0.8**
Waterbirds						
Australian Shelduck	0	0.0	0.0	9	4.1	0.5
Australian Wood Duck	0	0.0	0.0	210	95.9	12.7
Straw-necked Ibis	53	100.0	5.5	0	0.0	0.0
Total waterbirds	**53**		**5.5**	**219**		**13.2**
Grand Total	**963**			**1656**		

Table 20: Details of Wedge-tailed Eagle nests found at Navarre WF

Nest No.	GPS position			Description	12-16 July 2021	10-12 Aug. 2021	24-26 Aug. 2021
	Zone	easting	northing				
1	54H	696381	5918365	15m up in 25m high Grey Box on lower slopes - valley (near BUS 5)	Neat nest but no WTE activity @16:10 12/7.	Checked 13:30 10/8. No WTE activity.	Possibly active nest - fresh branches and twigs observed on 25/8.
2	54H	696014	5916313	12m high in 20m high Grey Box, in gully west of ridge line (near BUS 7)	Neat nest but no WTE activity @11:27 13/7.	Checked 11:23-11:30 10/8, through binoculars from ridge. No WTE present.	No WTE activity observed.
3	54H	696156	5914877	15m up in fork of 25m high, dead Grey Box near SWP 15. 2m high stack of sticks.	Adult male flew off from near nest when approach to within~200 m	No WTE present @ 10:45 10/8.	No WTE activity observed.
4	54H	695996	5914683	15m up in fork of 22m high Grey Box near SWP 15.	Unoccupied. Originally mapped nest co-ordinates were outside the margin of error for hand held GPS - corrected co-ordinates quoted here	Adult male standing on nest @ 10:58, 10/8 (not there 10:55). Likely active.	No WTE activity observed.
5	54H	684319	5918471	10m high in 20m high Grey Box	Unoccupied but fresh white wash indicative of recent presence - possibly renovating	Checked 11:34-11:42, 12/8. Second, smaller nest seen in same tree. 2 WTE flying nearby over vicinity. Likely to be in use this year.	No WTE activity observed 25/8.
6	54H	684705	5917466	Two nests in Yellow Box in gully with southerly aspect; 15m high in 25m high tree.	No WTE activity, no white wash. Apparently disused.	Checked 12:25-12:30, 12/8. No apparent WTE activity.	No WTE activity observed 25/8.
7	54H	684219	5924451	15m up in 25m high Grey Box - paddock tree just beyond northern edge of wester parcel.	No WTE activity, no white wash. Apparently inactive.	Checked 16:00-16:15, 12/8. No apparent WTE activity.	No WTE activity observed 25/8.

Nest No.	GPS position			Description	12-16 July 2021	10-12 Aug. 2021	24-26 Aug. 2021
	Zone	easting	northing				
8	54H	697451	5913275	10m up in 15 m high Red Stringybark. Not accessible from wind farm but visible from viewpoint - 54H/697162/5913504	No WTE activity, no white wash. Apparently inactive.	Checked 10:08-10:23, 11/8 through binoculars from viewpoint. No WTE activity.	No WTE activity observed.
9	54H	692350	5917554	12m high in 18m high Grey Box. Well-formed nest	No white wash but adult WTE flying nearby. Likely that one of #9, 10 or 11 will be active this year.	Checked 15:50-15:55, 11/8. White-wash under nest but no WTE activity.	No WTE activity observed 24/8.
10	54H	692039	5917715	12m high in 15m high Grey Box, northerly aspect	No white wash but adult WTE flying to the south-east. Likely that one of #9, 10 or 11 will be active this year.	Checked 15:57-16:03, 11/8. White-wash nearby ~10 m from nest otherwise no WTE activity.	Active (incubating) 24/8.
11	54H	691746	5917893	10m high in 20m high Red Stringybark.	No WTE activity, no white wash. Apparently inactive but WTE seen earlier not far to the east.	Checked 16:10-16:15, 11/8. No sign under nest, no WTE activity	No WTE activity observed 24/8.

7.2.8. Conclusions

The conclusions from the bird utilisation survey of the proposed Navarre Wind Farm are presented below:

- The study area is mostly cleared ridges and valleys with scattered remnant woodland patches. Treeless areas supported a low diversity and abundance of common, predominantly farmland birds, while woodland areas supported more diverse and abundant woodland species.
- Species richness at the impact survey points was relatively consistent and characterised by reasonable diversity with a total of 47 species recorded during the spring and 50 species during autumn BUS surveys.
- Relative abundance of birds was moderate and dominated by large flocking birds such as cockatoos and corellas. Relative abundance fluctuated between 56 and 253 and between 18 and 357 in spring and autumn, respectively.
- There were no significant differences between abundance (relative bird numbers) at the impact points between spring and autumn or between spring and autumn seasons.
- Flight heights at rotor swept area (84 to 246 metres above ground) were restricted to 4.3 percent and 0.9 percent of number of all birds at impact survey points during spring and autumn, respectively. No birds observed at RSA heights at the reference sites at both seasons, except for a number of corellas in autumn, and Ibises seen flying over RSA heights in spring.
- Three listed threatened species (Brown Treecreeper, Hooded Robin and Diamond Firetail,) were recorded during the bird utilisation surveys in woodland habitat. The three species were recorded at the observation points during formal BUS surveys. These species are generally confined to areas in or adjacent to woodland and they are not expected to fly at RSA height. Impacts to threatened woodland birds from the development and construction of Navarre Wind Farm are unlikely to be significant.
- Four species of raptors were seen at the impact points in spring, comprising 1.8 percent, and two species in autumn comprising 0.8 percent of all birds at impact points.
- The Wedge-tailed Eagle was the most common species and was recorded on 10 occasions during spring and 13 occasions during autumn BUS. Eagles were mostly flying below RSA heights (90% and 75% of eagles' sightings in spring and autumn, respectively).
- In a previous survey by Nature Advisory during October and November, 2020, 11 Wedge-tailed Eagle nests were discovered, some of which were active. These nests may potentially belong to a minimum of three pairs utilising the wind farm site as a breeding territory. A 300-metre buffer has been applied around all nesting sites to minimise impacts.
- The utilisation rate of the Wedge-tailed Eagle was estimated at 0.95 and 0.80 eagles per hectare per hour in spring and autumn seasons, respectively. This rate is higher than rates recorded at a range of wind farms (0.01 – 0.44 eagle/ha/hr) studied by Nature Advisory in south-east Australia.
- Three species of waterbirds were seen at the impact points; two duck species recorded in autumn and an Ibis in spring. Waterbirds forms small portion of all birds due to their restricted use of the wind farm site and lack of proper habitats.
- The results from the bird utilisation surveys are statistically robust and support a Before-After-Control-Impact (BACI) design.

8. Bat Assessment

8.1. Bat survey methodology

Automated SongMeter® bat detectors were used to record the species-specific echolocation calls of free-flying bats at ten sites that were representative of the habitat types of Navarre Wind Farm and mostly located near proposed wind turbine locations (see Figure 3). The detectors were programmed to commence operation approximately 30 minutes before dusk, and to cease approximately 30 minutes after dawn. Each SongMeter unit used a 64GB SDHC card that recorded bat echolocation calls, along with the date and time of each call.

Calls from the units were downloaded and sent to Rob Gration (Australian Bat Specialist, Melbourne, Victoria) for identification. The files from the recording sites were viewed in Kaleidoscope software (Supplied by Wildlife Acoustics Inc., USA), which provides a sonogram display of frequency versus time. Call identification was based on a key developed by comparing the characteristics of bat calls with reference calls from known species recorded across Australia. Identification is largely based on changes to frequency patterns over time, especially as the characteristic frequency changes. Only those recordings that contained at least two definite and discrete calls were classified as bat calls. For most species, a call sequence of several seconds in duration is required before identification can be made confidently.

8.1.1. Timing of the surveys

- **Spring 2020 survey**: Ten Songmetres were deployed at ten sites over 48 consecutive nights from 13th October to the 30th November 2020, totalling 480 detector nights;
- **Autumn 2021 survey**: Ten Songmetres were deployed at the same sites as the spring 2020 surveys over 49 consecutive nights from the 11th March to the 29th April 2021, totalling 490 detector nights.

8.1.2. Location of bat survey sites

The location and characteristics of the recording sites are described in Table 21 and their locations are shown in Figure 3.

Recording sites 1 through to 5 were located at the western section and sites 6 through to 10 were located at the eastern section of the wind farm.

Table 21: Description of the bat recording site characteristics

Survey Site	Habitat/landscape description
1	Hilltop / ridge – cleared grazing paddocks to the north-east, partly cleared wooded slope of mainly Bundy *Eucalyptus goniocalyx* and other mature eucalypts such as yellow Gum and Yellow Box
2	Upper part of hill slope. Partly cleared with introduced pasture grasses dominant. Scattered woodland remnants to the west and lower down the slope to the north-east. Bundy *Eucalyptus goniocalyx* is the dominant overstorey tree, with other large eucalypt trees such as Yellow Gum.
3	Small cleared hill with scattered trees and open grassy paddocks
4	Upper part of hill slope. Partly cleared with introduced pasture grasses dominant. Scattered woodland remnants to the west and lower down the slope to the north-east. Bundy *Eucalyptus goniocalyx* is the dominant overstorey tree, with other large eucalypt trees such as Yellow Gum.
5	In a paddock on small eucalypt with stripped bark, next to dam and surrounded by scattered trees

Survey Site	Habitat/landscape description
6	Rocky hilltop, low grass, grazing for sheep
7	Immediately adjacent to mine shaft and remnant/Immediately adjacent to mine shaft and remnant/revegetated box ironbark woodland
8	30m West of 30 m West of fence line on cleared spot. Revegetated and remnant trees to the east of the fence.
9	Cleared hill top, grass only
10	Revegetated and remnant trees surrounding the recording location

8.1.3. Bat call analysis

Calls from the songmeter units were downloaded and sent to Rob Gration (EcoAerial, Newport, VIC) for identification. The recoded call files were viewed in Kaleidoscope Pro analysis software (Wildlife Acoustics, USA), which provides a sonogram display of frequency versus time. Call identification was based on a key developed by comparing the characteristics of bat calls with reference calls from known species recorded across Australia. Identification is largely based on changes to frequency patterns over time, with such changes being characteristic of individual species for most genera. Only those recordings that contained at least two definite and discrete calls were classified as bat calls. For most species, a call sequence of several seconds in duration is required before identification can be made confidently.

For the spring 2020 survey only calls from threatened species and those considered at higher risk of collision with a wind turbine due to them flying at RSA heights were analysed. This involved species such as, Yellow-bellied Sheathtail Bat (threatened), White-striped Freetail Bat, Southern Freetail Bat and Gould's Wattled Bat.

In the Autumn 2021 surveys a broader analysis was undertaking looking at the presence and absence of all possible species know to inhabit the area. Particular focus was placed on threatened species that may occur such as the Eastern Bent-wing Bat and Yellow-bellied Sheathtail Bat, with all calls from such species counted.

8.1.4. Limitations

The identification of echolocation calls from microbats in south-eastern Australia is facilitated by the fact that many calls are species-specific. Calls that could not be identified definitively were allocated to species complexes comprising a group of species with similar sonogram characteristics.

A significant limitation in the use of this technique is that it is not possible to census bat numbers. For example, 10 calls of a particular species may be recorded but it is not known if this represents 10 individuals of that species or one individual of that species flying past the bat recorder 10 times. Therefore, it is not possible to determine utilisation rates, only activity levels.

Occasionally, recording devices such as those used in the survey experience technical difficulties, which are not uncommon. As a result, short periods of time may not be recorded and total hours of recording varies between the different recorders. Weather conditions including severe storms during the recording period may at time interfere with the recording process.

The bat detectors used during this survey sample a limited airspace to approximately 20-30 metres.

Finally, bat activity levels may vary in response to weather variables such as air temperature, relative humidity, barometric pressure, wind speed, direction and gusts and rain, as well moonlight. Typically, bats are found to be less active during the following circumstances:

- During periods of full moon, and when the moon is high in the sky;
- At higher wind speeds over 10 metres per second; and
- During moderate to heavy rainfall.

The identification of echolocation calls from microbats in south-eastern Australia is facilitated by the fact that many calls are species-specific; however, not all species can be consistently or reliably identified using this technique. The identification of Eastern Bent-winged Bat (EBWB) calls using ultrasonic bat detectors is difficult and often key salient call characters may not feature prominently in all sonograms. This leaves open the possibility that the call may belong to one of the forest bat species (*Vespadelus* spp.). Calls that could not be identified definitively as either were allocated to the category Bent-winged Bat/Forest Bat species complex.

The ultrasonic calls of Long-eared Bats (*Nyctophilus* spp.) are difficult to distinguish to species level, and hence are grouped under their generic name. The species that are likely to occur at the wind farm site are *Nyctophilus geoffroyi* and *N. gouldi*, these have been grouped in to Long-eared Bat Complex. These species are not listed as threatened.

Separating calls from the species, such as, Gould's Wattled Bat, Southern Freetail Bat and Ride's Freetail Bat can be problematic if calls are not of high quality. In this analysis two species complexes have been made to overcome this issue, Gould's/freetail Bat Complex (containing all three of these species) and Freetail Bat Complex (containing the Southern and Ride's Freetail bat). These species are not listed as threatened.

Similarly, calls of species of Forest Bats (*Vespadelus* spp.) can be difficult to differentiate and, therefore, some of their calls have been combined into the Forest Bat Complex for the purposes of analysis. None of these species are threatened.

8.2. Bat survey results

Across the two survey periods from 2020 - 2021 at least nine species were positively identified, together with three species complexes (Table 22). However, species recorded during spring survey were not representative, as only bats of concern, such as those known to fly over 50 metres high, or threatened species were considered for analysis in spring.

Eight of these were common, widespread and secure bat species that occur in farmland and other habitats throughout eastern and south-eastern Australia. These common species were positively identified to occur on the wind farm site.

One FFG Act listed species, Eastern Bentwing Bat was recorded during the autumn 2021 survey with two calls being positively attributed to this species and a further 21 calls assigned to the species complex. No EPBC Act listed bat species were recorded at the Navarre Wind Farm site.

The bat call images (sonographs) are shown in Appendix 9 for further confirmation of the identity of bats.

Table 22: Bat species recorded during both spring and autumn surveys

Common name	*Scientific name*	Conservation status	Recorded 2020-2021
Gould's Wattled Bat*	*Chalinolobus gouldii*	Common, secure	All sites
White-striped Freetail Bat*	*Austronomous australis*	Common, secure	All sites
Chocolate Wattled Bat	*Chalinolobus morio*	Common, secure	All sites
Southern Freetail Bat*	*Ozimops planiceps*	Common, secure	All sites
Inland Broad-nose Bat	*Scotorepens balstoni*	Common, secure	Site 2
Large Forest Bat	*Vespadelus darlingtoni*	Common, secure	All sites
Little Forest bat	*Vespadelus vulturnus*	Common, secure	All sites
Long eared Bat complex	*Nyctophilus spp.*	Common, secure	All except 8
Eastern Bentwing Bat	*Miniopterus orianae oceanensis*	Listed FFG Act	Sites 1 & 4
Eastern Bentwing Bat/ Large Forest Bat complex	*M. o. oceanensis / V. darlingtoni*	FFG act listed and Common, secure	Sites 1-3, 6, 9
Freetail bat complex*	*Ozimops sp: planiceps / ridei*	Common, secure	All except 8
Forest Bat complex	*Vespadelus sp; darlingtoni, regulus and vulturnus*	Common, secure	All sites

*Bat species recorded only during spring survey.

8.2.1. Spring 2020

Data was collected from eight recorders. Recorders at sites 2 and 6 failed to record valid data. Of the eight sites from which data was recorded, all units recorded over the full duration of 48 days and five had recordings of bat species of concern.

During the spring 2020 survey at least three species were detected including one species complex (Table 22). All of these were common, widespread and secure bat species that occur in farmland and other habitats throughout eastern and south-eastern Australia.

Few calls were recorded from bat species of concern. There was a total of 23 calls, mainly from the White-striped Freetail Bat (13 calls), Gould's Wattled Bat (9 calls), and one call from Gould's Wattled Bat/Southern Freetail Bat complex. No threatened bat species was recorded during the spring survey.

8.2.2. Autumn 2021

During the Autumn 2021 survey, nine positively identified species were recorded, together with three species complexes (Table 22). Identification of bats was obtained from over 66,000 calls recorded during the survey period from the 10 recording sites.

Eight of these were common, widespread and secure bat species that occur in farmland and other habitats throughout eastern and south-eastern Australia. These common species were positively identified to occur on the wind farm site.

One threatened species, Eastern Bent-wing Bat (EBWB) was positively recorded at two sites across the proposed wind farm, and at further four sites as part of a species complex (Table 22). This species is listed as *Critically endangered* under the FFG Act.

In addition to the species positively identified to species level, three multi-species complexes were also identified; however, two of these complexes comprised common species and one complex potentially included a threatened species (Table 24).

8.3. Bat activity

The relative abundance of bats when measured as number of calls per recording night was not possible due to the very large number of calls recorded from the common species. Instead, the percentage occurrence was used as measure for the purpose of evaluating bat activity over the wind farm study site.

The relative activity of bats was then measured in terms of percentage of detector nights each species was recorded across the nine recoding sites (site 3 failed to record). These are shown in Table 23. The most common species were as follows:

- Gould's wattled Bat 93.9%
- White-striped Freetail Bat 85.2%
- Chocolate Wattled Bat 67.9%
- Freetail Bat Complex 65.2%
- Forest Bat Complex 63.4%

With all other species being detected less than 60% of the nights during the survey period.

Bats that are most likely to fly at RSA heights appear to be highly active across the proposed wind farm site. The high call rates from the 2020 survey and high proportion of night recorded during the 2021 survey indicate that these species are likely to be utilising the site for foraging and roosting.

Bat Activity was rather similar across the nine recording sites, with the dominant species recorded at each of these sites, indicating the homogenous nature of habitats across the study sites. Seasonally, judging by the number of calls recorded in spring (over 67000 calls) or autumn (66000), imply that there was little difference between bat use of the site between the two seasons. However, more detailed comparison was not possible since only bats of concern were analysed in spring.

Bats of concern, including mainly the White-striped Freetail Bat, and to a lesser extent Gould's Wattled Bat were very common on the wind farm site and might possibly cause some concern as they are known to fly at RSA heights, however, the newly used turbine models with their minimum blade height above ground extending to over 70 metres is likely to reduce impacts on bat species.

8.3.1. Threatened bat species

Across 340 detector nights (Table 22) only two positively identified calls from a threatened species, namely **Eastern Bent-wing Bat (EBWB**) were detected, indicating that this species was very uncommon within the proposed wind farm site.

The two calls were detected on the same night from sites no. 1 and 4. In addition to above, possible calls from EBWB were also recorded as part of a complex comprising Large Forest Bat (LFB) on 21 occasions from five sites across the wind farm. The importance of the EBWB calls among those of the other members of the species complex that combine them is highly diminished, since the latter complex, including Large Forest Bat, and the three other species of forest bats, were very common on the wind farm area.

The Eastern Bent-winged Bat (EBWB), occurs widely across the eastern seaboard of Australia from Cape York to central-western Victoria (Churchill 2008). Its natural roosting habitat is caves; however, it has adapted to use derelict mines, storm water tunnels and disused buildings. At night this bat disperses over a range of habitats. It usually forages over forested areas above treetop height and in more open habitats it flies at lower heights, up to six metres above the ground (Churchill 2008).

The EBWB is a migratory species. During the non-breeding season, the species congregates in smaller colonies in caves and other man-made structures. These sites are referred to roosting sites. The bats will then migrate to maternity sites where they gather in larger numbers and the females give birth and raise the young.

The non-breeding season is generally from late March to September. During this time bats will congregate in smaller colonies with a good mix of half females and half males. Conditions in these roosting sites are usually cool, which enables individuals to enter torpor. Females will emerge from torpor in August. Females remain at these roosting sites until September when they begin to move to maternity caves (Hoye and Spencer 2004).

The migratory period where the bats move from roosting sites to maternity sites is from September to November. During these migrations, females have been recorded moving at least 70 kilometres overnight between roosts (Dwyer 1965) and may travel several hundred kilometres between roosting sites and maternity sites (Hoye and Spencer 2004).

The only known maternity sites in Victoria is Nargun's cave near lakes Entrance (Dwyer and Hamilton Smith 1965), However, it is likely more maternity sites exist within Victoria.

The proposed Navarre windfarm site lays approximately 70km west of the current know range of the EBWB (AUSBAT) however with a long history of mining in the region there is an unknown number of disused mine shafts in the vicinity. It is likely that EWBW may be utilising such mine shafts as roosting site, although it is unlikely that they would use these sites as maternity roosts.

Births occur from early December to early January, during which lactating young are left at a creche while females emerge from the cave at dusk to feed. These maternity sites are used year after year.

During March adult females leave the maternity sites once juveniles become independent. Shortly after, in late March, a mass exodus of juveniles occurs and maternity sites are deserted by early April (Dwyer 1963). The bats disperse over a larger region, usually up to 300 kilometres or so (once as far as 1,300 kilometres) from maternity sites (Churchill 2008).

The annual roost pattern of males differs slightly from that of females. Up to fifty percent of the male population is present at maternity sites during the breeding season, with the remainder forming male colonies at roosting sites used for other purposes at other times of the year. Following the breeding season, males will join colonies at roosting sites where females and males are present in similar numbers of both sexes (Hoye and Spencer 2004).

When juvenile bats disperse from maternity sites, they form separate juvenile colonies. Juvenile bats occupy these roosting sites until they are one year of age before joining adult roosts (Hoye and Spencer 2004).

Only two calls could be positively attributed to the EBWB and 21 calls with potential of being from EBWB but could not be reliably distinguished from the Large Forest Bat. Average calls per night across all sites range from 0.005 to 0.06 if all potential calls are assumed to be made by EBWB's.

The two confirmed EBWB calls were detected 53 and 237 minutes after sunset, suggesting that their roosting location is at some distance from proposed wind farm.

Survey site 7 was located next to a disused mine shaft, none of the confirmed or potential EBWB calls were recorded at this site, giving firm evidence that this mine was not being used by the bats as a roost during the survey period.

The results from this survey indicate that the Eastern Bent-wing Bat is extremely rare across the site and is unlikely to utilise the proposed Navarre Wind farm site.

Table 23: Percentage (%) of detector nights each species was recorded across the ten survey sites during Autumn 2021

Sites	Percentage of nights the species was recorded out of the nine nights of recordings*												Detector Nights
	GWB	Ws FB	CWB	SFB	IBnB	La FB	LiFB	EBwB	EB wB	Le BC	FBC	Freetail Bat Complex	
1	100	97	79	62	0	38	59	9	3	50	68	74	34
2	94	89	89	81	4	13	66	2	0	77	89	68	47
4	92	100	69	67	0	23	44	13	3	56	67	92	39
5	97	100	89	60	0	17	80	0	0	26	77	66	35
6	92	95	46	49	0	32	62	5	0	59	46	57	37
7	100	92	67	71	0	48	58	0	0	88	54	81	48
8	73	0	17	0	0	20	30	0	0	0	27	0	30
9	97	97	66	59	0	50	34	3	0	53	59	56	32
10	100	97	89	58	0	50	42	0	0	53	84	95	38
Average	93.9	85.2	67.9	56.2	0.4	32.4	52.8	3.6	0.6	51.3	63.4	65.4	38

* No recordings were made at site 3 due to technical error in the songmeter.

Abbreviations: GWB, Gould's Wattled Bat; WsFB, White-striped Freetail Bat; CWB, Chocolate Wattled Bat; SFB, Southern Freetail Bat; IBnB, Inland Broad-nosed Bat; LaFB, Large Forest Bat; LiFB, Little Forest Bat; EBwB, Eastern Bentwing Bat; LeBC, Long-eared Bat Complex; FBC, Forest B complex; FBC, Freetail Bat Complex.

Table 24: Eastern Bent-wing Bat complex calls

Date	Site	Eastern Bent-wing Bat/ large Forest Bat Complex	Eastern Bent-wing Bat	Large Forest Bat	Forest Bat Complex
12/03/2021	1	1		x	x
14/03/2021	1	6		x	x
16/03/2021	1	1		x	x
29/03/2021	1	2		x	x
17/04/2021	1		1		
30/03/2021	2	1			x
11/03/2021	4	1		x	x
12/03/2021	4	1	1	x	x
16/03/2021	4	1			x
26/04/2021	4	1			
27/04/2021	4	1			x
17/03/2021	6	1			x
19/03/2021	6	1		x	x
2/04/2021	9	3		x	x

Notes: x= confirmed at the same site and night

9. Swift Parrot surveys

9.1. Introduction

This investigation was commissioned to provide information on the presence of the threatened Swift Parrot in the study area and outline any implications under various national, state and local legislation and policy.

Specifically, the scope of the investigation included surveys of suitable habitat as mapped in Nature Advisory's initial investigations (Nature Advisory 2019), monthly from April to August 2021, together with a search (half-day) of key reference sites in conservation reserves in the area.

9.2. Species Biology

9.2.1. Legislative protection

The species is listed as Critically Endangered on both the Commonwealth EPBC Act and Victorian FFG Act (DAWE 2019; DELWP 2022f).

9.2.2. Description

The Swift Parrot (*Lathamus discolor*) is a medium sized migratory bird about 25 centimetres in length and is mostly green in colour. It weighs approximately 65 grams. Crown and ear coverts are dark blue and the face is red with yellow margins. Shoulder and underwing coverts are red, eye yellow and bill a horn colour (DSE 2003).

9.2.3. Habitat

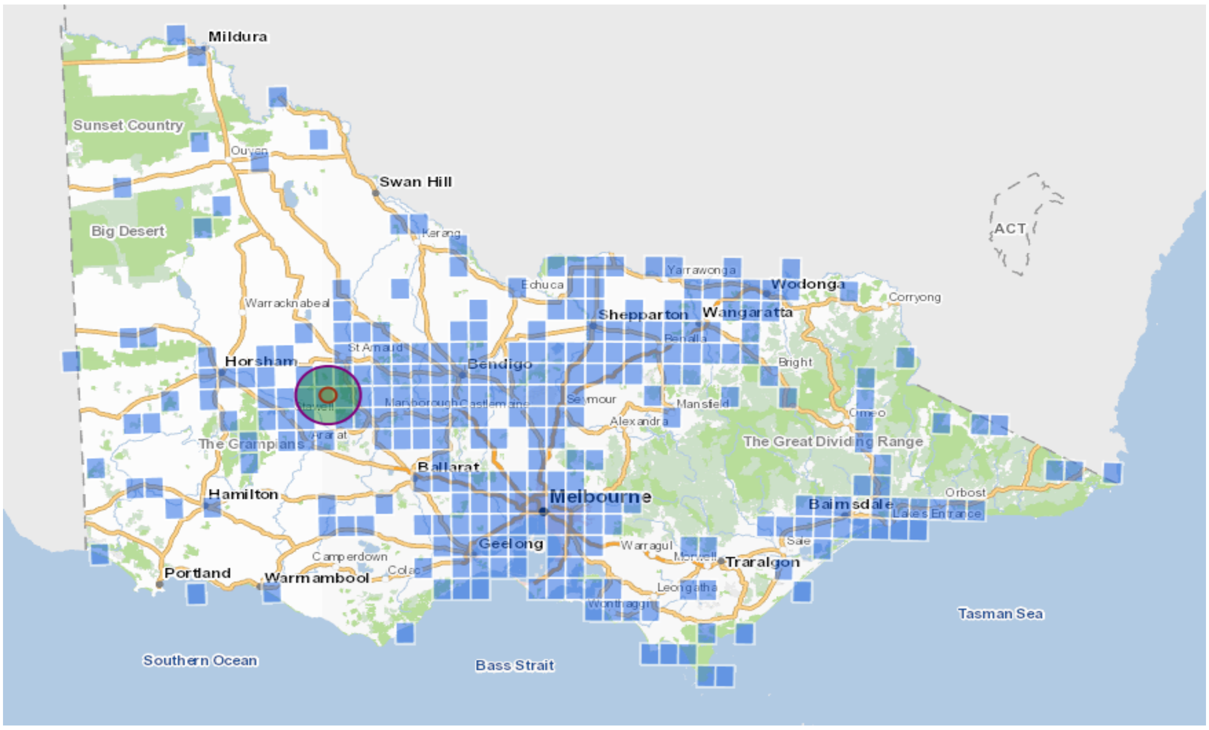
Typical Swift Parrot wintering habitat is dry open eucalyptus forests and woodlands, usually box-ironbark communities, especially those with Red Ironbark, Mugga Ironbark, Grey Box, Coast Grey Box, White Box and Yellow Gum. This species has also been recorded in River Red-gum, Blakely's Red-gum, Yellow Box, Spotted Gum and Swamp Mahogany (Higgins 1999). On the mainland they occur in areas where eucalypts are flowering profusely or where there are abundant lerp infestations (from the sugary exudations of scale insects [Psylllids] (DECC 2005). Swift Parrots prefer to forage in large trees, defined as those greater than 60 centimetres diameter at breast height by Kennedy and Tzaros (2005).

9.2.4. Distribution

The Swift Parrot is endemic to south-eastern Australia. It is restricted as a breeding species to Tasmania during spring and summer, and migrates to spend autumn and winter in mainland south-eastern Australia. It breeds mainly in areas of dry grassy Blue Gum Forest in south-eastern Tasmania, with a smaller population breeding in shrubby stringybark forest in coastal northern Tasmania (Swift Parrot Recovery Team 2001).

Once on the mainland, this species undertakes semi-nomadic movements to take advantage of the richest areas of eucalypt nectar production and lerp infestation (Higgins 1999). Until recently it was believed that in NSW, Swift Parrots forage mostly in the western slopes region along the inland slopes of the Great Dividing Range but are patchily distributed along the northern and southern coasts, including the Sydney region. However, evidence is gathering that the forests on the coastal plains from southern to northern NSW are also extremely important (Swift Parrot Recovery Team 2001). In Victoria, the Swift Parrots are mainly found in Box-Ironbark woodlands throughout central region of the state (Figure 25).

Figure 6: Distribution of Swift Parrot in Victoria (10' cells), showing search region - 25km radius of Navarre (Source: Victorian Biodiversity Atlas: DELWP 2021a).



9.2.5. Population

The total population of the Swift Parrot was thought to be 2000 mature birds in 2010 (Garnett et al. 2011). Recently, the population is believed to be in sharp decline however, due to the presence of the introduced (to Tasmania) Sugar Glider (Petaurus breviceps) which causes a high failure rate of nests on the main island of Tasmania leaving only the populations breeding on the smaller Bruny and Maria Islands offshore currently having sufficient breeding success to bolster the Swift Parrot population (Stojanavic et al. 2014 cited in Commonwealth of Australia 2019). Genetic evidence was cited to estimate the population as low as 300 individuals in the wild (Heathcote, 2020). Most recently it has been estimated that 750 Swift Parrots remain in the wild and certainly less than 1000 (Roderick 2021).

More detailed work remains to be completed to bring estimates of the Swift Parrot population up to date.

9.2.6. Threats

The range of the Swift Parrot has contracted, and its population has declined as result of;

- On the mainland the main threat is loss of habitat through clearing for agriculture, and urban and industrial development; and
- Collisions with wire netting fences, windows and cars, during the breeding season and winter migration (especially where such obstacles are in close proximity to suitable habitat) (DECC 2005).

9.3. Methods

9.3.1. Existing information and habitat assessment

Existing information on the status of the Swift Parrot was obtained from the Victorian Biodiversity Atlas (VBA), a public database held by the Department of Energy, Environment and Climate Action

(DEECA). These records were obtained from a wider area, termed the 'search region' defined for this assessment as an area with radius 25 kilometres around the settlement of Navarre: latitude 36˚ 54 00" S and longitude 143˚06' 49" E.

The likelihood of suitable habitat in the study area for nationally threatened species (i.e., Swift Parrot) was ascertained through a search of the online *Environment Protection and Biodiversity Conservation Act 1999* Protected Matters Search Tool (DAWE 2019) using the same search region.

At each survey site, the vegetation type, structure and habitat quality were examined at the commencement of survey. These habitat components, considered important in influencing the distribution of the respective threatened species, were assessed for each survey site (Figure 7).

All field work undertaken in reserves was conducted in accordance with the Wildlife Act 1975 and Crown Land (Reserves) Act 1978.

9.3.2. Field methods

Swift Parrot surveys included one habitat survey undertaken in April 2021 and four targeted Swift Parrot surveys from 12th to 15th April 2021, 10th to 13th May 2021, 14th to 18th June 2021, 12th to 16th July 2021 and 9th to 13th August 2021.

Swift Parrot surveys were undertaken using methods consistent with the DSE Biodiversity Precinct Planning Kit (DSE 2010) and the EPBC survey guidelines for Australia's threatened birds (DEWHA 2010), modified according to habitat patch size (i.e., less time required in smaller patches or those with limited flowering of the key species of eucalypts). These consisted of roaming surveys for up to one hour in each suitable patch of habitat, mapped earlier by Nature Advisory (2019).

Swift Parrot targeted surveys were conducted in Box Ironbark Forest (EVC 61) remnants within the wind farm footprint, dominated by Grey Box (*Eucalyptus macrocarpa*), Red Ironbark (*E. tricarpa*) and Yellow Gum (*E. leucoxylon*), which are indicator species for Swift Parrot habitat. Swift Parrots are known to use several other species of eucalypt but at much lower frequencies (Kennedy and Tzaros, 2005); some of these are found at Navarre Wind Farm. Spotted Gum (*Corymbia maculata*) was added as a habitat species, because it is known to be used by Swift Parrot in New South Wales, and in suburban Melbourne where extensively planted. Several sites in larger blocks of Box Ironbark Forest in surrounding conservation reserves were also sampled, since these areas were known historical hot-spots for the species.

A total of 21 habitat patches were mapped for Swift Parrot initially, and two added subsequently (Figure 7). Two of these patches contained planted Spotted Gum (*Corymbia maculata*), a known winter-flowering foraging resource of Swift Parrot but not indigenous to the local area.

Competitive bird species of Swift Parrot where present in groups of five or more may indicate the presence of Swift Parrot. Aggressive competitors that occur in the Navarre region were the Musk Lorikeet and Red Wattlebird, but in this assessment smaller, non-aggressive competitors, characteristic of the Box Ironbark Forests of Victoria have been used as indicator species for the potential presence of Swift Parrot, together with two species of lerp foragers (Spotted Pardalotes *Pardalotus punctatus* and Striated Pardalotes *P. striatus*).

9.3.3. Limitations of field assessment

The timing of the Swift Parrot surveys, their duration and the weather conditions under which surveying was undertaken, were considered suitable for detecting the respective species.

During the surveys conditions were mostly fine with light to moderate winds. On one occasion when moderate rainfall was experienced (i.e., afternoon of 10th May 2021), surveying was paused (for a maximum of 15 minutes) then resumed when conditions again became favourable; otherwise, surveying was unaffected by the weather.

The overall survey effort was considered sufficient to detect significant populations of Swift Parrot in the study area.

Wherever appropriate, a precautionary approach has been adopted in the discussion of implications. That is, where insufficient evidence is available on the occurrence or likelihood of occurrence of a species, it is assumed that it could be in an area of habitat, if suitable, and the implications under legislation and policy are considered accordingly.

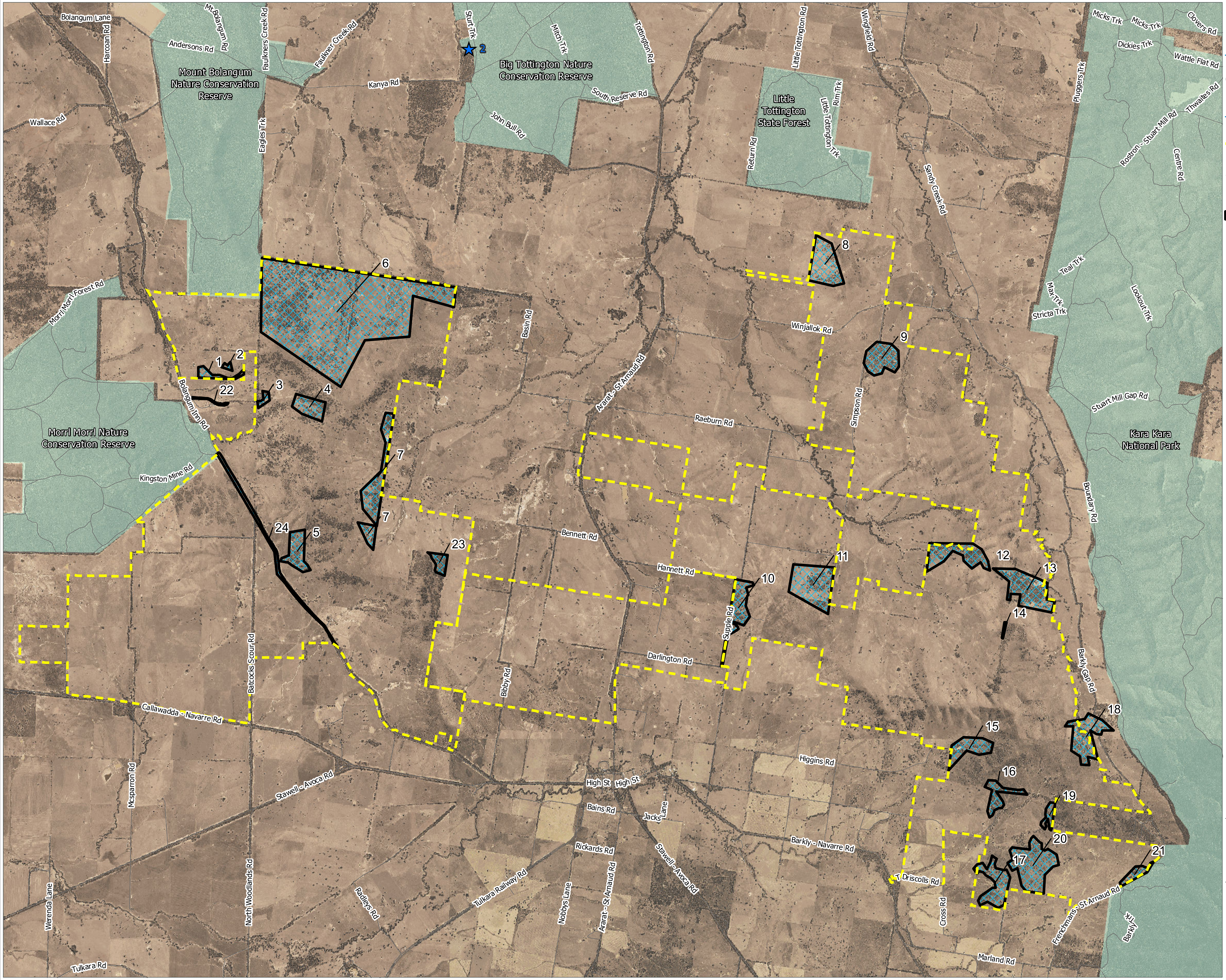


Figure 7: Swift Parrot Survey Areas

Project: Navarre Wind Farm
Client: Aurecon Australasia Pty Ltd
Date: 27/03/2023

Wind farm boundary
Swift Parrot records (number of birds labelled)
Swift parrot survey area

N

Metres
0 1,000

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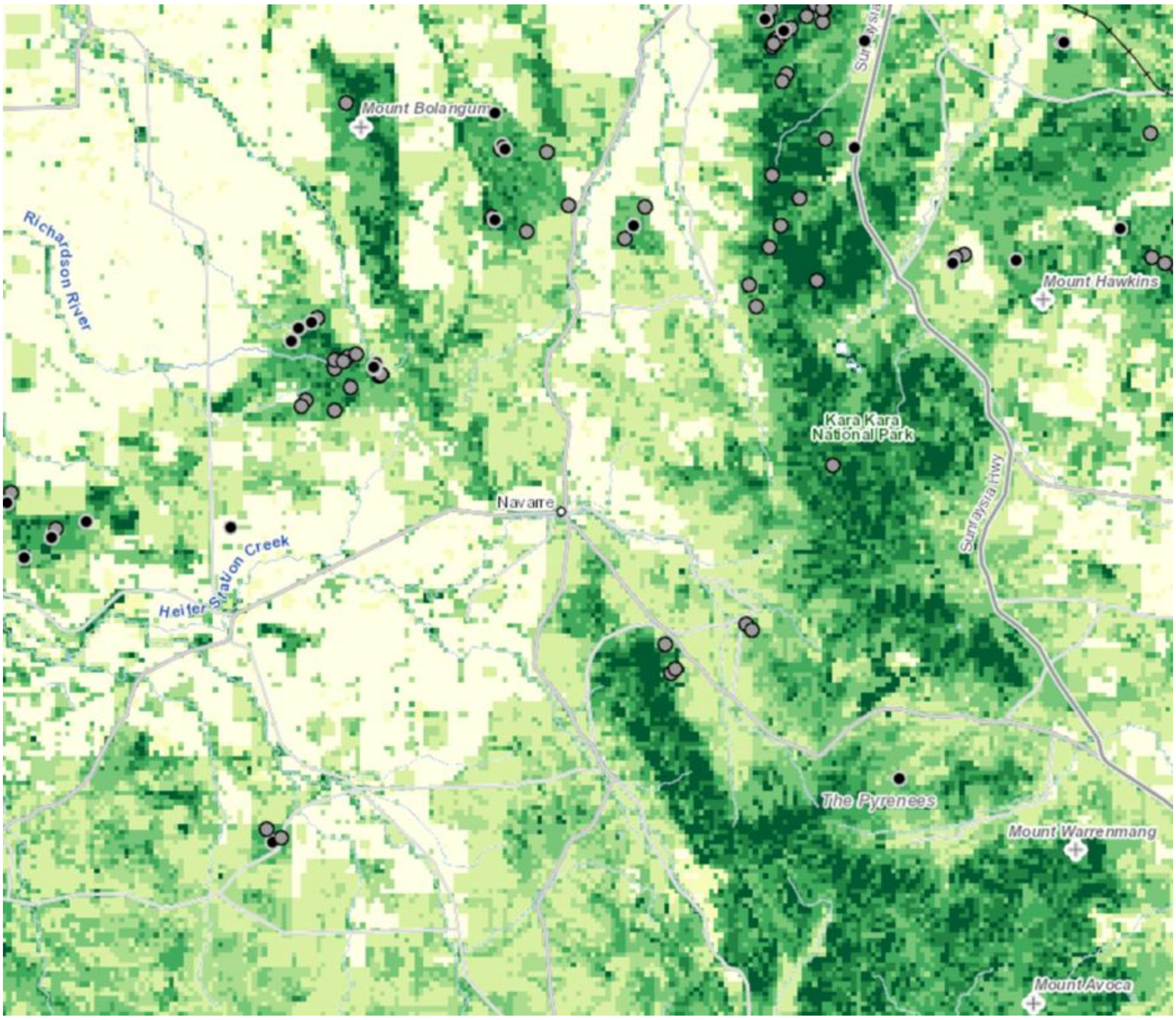
9.1. Results of Swift Parrot Surveys

9.1.1. Existing information

The VBA holds 70 records of Swift Parrot within approximately 15km of the study area, dated from 1978 to 2019 (Appendix 3). Figure 8 shows the location of records from a 25km radius of Navarre. The records show concentrations of records from nature conservation reserves surrounding Navarre Wind Farm, such as Kara Kara National Park (to the east), Landsborough Nature Conservation Reserve (NCR) to the south/south-east, Mt Bolangum NCR (north), Morrl Morrl NCR (north-west), Big Tottington NCR (north) and Little Tottington State Forest (north). There are no records from the area of the proposed Navarre Wind Farm, but a few scattered to the west and south-east of Navarre outside of conservation reserves, likely either roadsides or on private land.

Table 25 below details the habitat descriptions and survey results of the Swift parrot surveys. No Swift Parrot were recorded at the wind farm site, but one pair was observed within the Big Tottington Nature Reserve to the northwest of the wind farm site in April 2021.

Figure 8: Historical records of Swift Parrot within 25km of Navarre (NatureKit 2023)



9.1.2. Habitat assessment

This habitat assessment was based on field inspection of all potential habitat sites within the Navarre Wind farm site and surrounding conservation reserves (Table 25).

Table 25: Swift Parrot habitat assessment of potential habitat on the Navarre Wind Farm (April 2021) and April to August 2021 survey results

site	Habitat description (potential foraging resource in bold)	Assessed quality for Swift Parrot	flowering/lerp present	indicator nectar or lerp feeders - April or *May	Swift Parrot count – April	Swift Parrot count - May	Swift Parrot count - June	Swift Parrot count - July	Swift Parrot count - Aug.
	Navarre Wind farm footprint								
1	Along creek line. Mostly revegetated. River Red-gum, **Grey Box**, Red Box, Yellow Box, Lightwood, Silver Wattle.	Low-moderate	Not observed		0	0	0	0	0
2	Isolated hillside patch. Mature **Grey Box.** Understorey absent. Ground layer mostly Mediterranean Wheat-grass, grazed. Some fallen timber. A few Red Stringybark nearby.	Moderate	Not observed		0	0	0	0	0
3	Hillside (eroded gully). Mature **Grey Box**. Understorey absent. Ground layer mostly Mediterranean Wheat-grass, some Wallaby-grass, Kangaroo-grass nearby. Grazed. Some fallen timber. A line of Grey Box, Yellow Box to north and mostly Bundy to north-east.	Moderate	Yes (2x Grey Box)		0	0	0	0	0
4	Mostly Bundy, some mature **Grey Box**, Yellow Box with mistletoe (Amyema sp.). Mixed grass cover, grazed by sheep.	Low-moderate	Yes (Bundy)		0	0	0	0	0
5	Predominantly a revegetation site. **Spotted Gum**, Yellow Box, **Ironbarks,** River Red-gum, Sugar Gum, Stringybarks. Couple of remnant **Grey Box.** Some planted shrubs - Gold-dust Wattle, Golden Wattle, Totem-poles. Mixed graminoid ground cover including some Kangaroo-grass, Wattle Mat-rush.	High	Yes (a few Spotted Gum)	Little Lorikeet, Black-chinned Honeyeater, Fuscous Honeyeater, Yellow-tufted Honeyeater,	0	0	0	0	0
6	Partly cleared Box Ironbark woodland. **Grey Box, Yellow Gum.** Some Yellow Box. A few **Red Ironbark** along northern boundary. Some **Golden Wattle** understorey. Mixed pasture ground cover, grazed (sheep). Contiguous (in north-west) with Mt Bolangum NCR.	Moderate	Not observed	Yellow-tufted Honeyeater, Fuscous Honeyeater	0	0	0	0	0
7	**Yellow Gum, Red Ironbark, Grey Box** mostly intermediate aged trees but some mature. A few Red stringybark. Shrubby understorey including some revegetation: Gold-dust Wattle, Golden Wattle, Spreading Wattle, Hedge Wattle and other shrubs, herbs. Partly fenced from domestic stock but grazed	High	Yes (Yellow Gum)	Yellow-tufted Honeyeater, Purple-crowned Lorikeet, Little Lorikeet, Fuscous Honeyeater	0	0	0	0	0

site	Habitat description (potential foraging resource in bold)	Assessed quality for Swift Parrot	flowering/lerp present	indicator nectar or lerp feeders - April or *May	Swift Parrot count – April	Swift Parrot count - May	Swift Parrot count - June	Swift Parrot count - July	Swift Parrot count - Aug.
	by macropods. Ground layer of bryophytes and lichen, leaf-litter.								
8	Isolated patch, mostly cleared. Mature **Grey Box**, Red Stringybark, **Yellow Gum, Red Ironbark** at low density. Couple of Yellow Box. No understorey. Short grazed exotic pasture, some fallen branches. Grazed (sheep)	Low-moderate	Not observed		0	0	0	0	0
9	Isolated patch. Overstorey **Red Ironbark, Yellow Gum, Grey Box**, Red Stringybark. Understorey scattered Spreading Wattle, Hedge Wattle. Rocky outcrops on hillside, leaf litter, scatterd grass, bryophytes - lichen ground cover, grazed by macropods and sheep.	Moderate	Not observed	Purple-crowned Lorikeet	0	0	0	0	0
10	Regenerating patch with some mature **Red Ironbark** especially along roadsides. Also **Grey Box** and Red Box, scattered; a few **Yellow Gum**, Red Stringybark. Spreading Wattle common in understorey, and a few Golden Wattle.	Moderate	Not observed	Little Lorikeet, Yellow-tufted Honeyeater	0	0	0	0	0
11	Mainly Bundy. Some **Yellow Gum** stands, mostly along east, west and north edges. Understorey of Spreading Wattle, Hedge Wattle. Wallaby-grass/Spear Grass present. Stony substrate, garzed (sheep).	Low-moderate	Yes (Bundy)		0	0	0	0	0
12	Eastern upper section mainly small DBH **Grey Box, western** lower end mainly **Yellow Gum**. Some Yellow Box, Bundy, Red Stringybark, Red Box.	Moderate	Not observed		0	0	0	0	0
13	Dominated by **Yellow Gum** of intermediate age. **Grey Box,** Yellow Box, River Red-gum also present. Former gold mine site, many holes from old workings. Many stumps signify previous thinning of eucalypts. Sparse understorey of a few Golden Wattle. Grazed (sheep), gully erosion evident.	Moderate to high	Yes (Yellow Gum)	Little Lorikeet, Black-chinned Honeyeater	0	0	0	0	0
14	Remnant vegetation on ridge line. Revegetation in valley to east. Several mature Yellow Box. Red Stringybark, Bundy, **Red Ironbark**, Red Box, **Grey Box,** Buloke, Drooping Sheoak. Fallen timber, dead trees present. Mixed pasture ground cover including native Wallaby-grass and Kangaroo Grass, small rock outcrops.	Low-moderate	Not observed		0	0	0	0	0

site	Habitat description (potential foraging resource in bold)	Assessed quality for Swift Parrot	flowering/lerp present	indicator nectar or lerp feeders - April or *May	Swift Parrot count – April	Swift Parrot count - May	Swift Parrot count - June	Swift Parrot count - July	Swift Parrot count - Aug.
15	In valley - eroded gully. **Grey Box**, mostly regrowth. **Yellow Gum** at western end. Some Yellow Box, Red Box. Golden Wattle, Hedge Wattle in understorey. Kangaroo-grass in paddock to north but grazed (sheep).	Moderate	Yes (Yellow Gum)	Fuscous Honeyeater	0	0	0	0	0
16	Semi-isolated patch. **Grey Box, Yellow Gum**, Red Stringybark, Bundy, Yellow Box. Mostly leaf-litter ground cover, some fallen timber, Wallaby-grass. Paddocks with mixed pastures to west, south, north. Narrowly connected with woodland of site 19 to east.	Moderate	Not observed	Fuscous Honeyeater	0	0	0	0	0
17	Mostly **Yellow Gum** overstorey but scattered. Good shrub layer, 4 spp. Acacia including Golden Wattle. Native Wallaby-grass ground cover along western edge.	Moderate	Yes	Purple-crowned Lorikeet	0	0	0	0	0
18	Yellow Gum, River Red-gum, Yellow Box. Some mature trees. Partly cleared. Mixed pasture, or leaf litter on ground. Contiguous with high-quality SP habitat on eastern side via private land (**Yellow Gums**) to Kara Kara NP.	Moderate	Not observed		0	0	0	0	0
19	Contiguous with Box Ironbark forest on private block to east and then to Kara Kara NP. Scattered small stands included **Yellow Gum**, Yellow Box, Red Stringybark. Some regenerating **Grey Box**. Understorey mostly cleared, grazed.	Low-moderate	Not observed		0	0	0	0	0
20	Mostly **Yellow Gum** overstorey but scattered. A few mature Red Box, some young **Grey Box**. Four spp. Acacia including Golden Wattle as understorey. Native grass ground cover with shrubs along eastern edge.	Moderate	Not observed	Fuscous Honeyeater	0	0	0	0	0
21	**Yellow Gum**, Yellow Box. Cleared understorey, grazed (sheep). Old mine diggings prevalent. Contiguous with high-quality SP habitat on eastern side - Kara Kara NP.	Moderate	Not observed	Purple-crowned Lorikeet	0	0	0	0	0
22	Planted Eucalypts along driveway. **Spotted Gum** predominant.	Moderate to high	Not observed		0	0	0	0	0
23	Isolated hillside patch. Mostly regrowth **Grey Box**. Some mature trees along lower northern edge. Sparse ground layer (mostly leaf litter); rock outcrops on higher ground.	Low-moderate	Not observed		0	0	0	0	0

site	Habitat description (potential foraging resource in bold)	Assessed quality for Swift Parrot	flowering/lerp present	indicator nectar or lerp feeders - April or *May	Swift Parrot count – April	Swift Parrot count - May	Swift Parrot count - June	Swift Parrot count - July	Swift Parrot count - Aug.
24	Bolangum Inn Road reserve. Mostly **Grey Box**. Some **Yellow Gum**, Red Stringybark; River Red-gum at northern end. Fallen branches common. Understorey and ground cover sparse.	Moderate	Yes (Yellow Gum)		0	0	0	0	0
	Nearby public land								
1	Morrl Morrl NCR. Large block mostly comprising Box Ironbark forest, good shrub layer including **Golden Wattle**, fallen timber and scattered large hollow-bearing trees. **Grey Box and Red Ironbark** dominate across most of the area. **Yellow Gums** along northern edge and River Red-gums along creek lines.	High	Lerp	Spotted Pardalote, Striated Pardalote, Dusky Woodswallow, Fuscous & Yellow-tufted Honeyeaters	0	0	0	0	0
2	Mt Bolangum NCR. Large block mostly comprising Box Ironbark forest, good shrub layer including **Golden Wattle**, fallen timber and scattered large hollow-bearing trees. **Grey Box, Red Ironbark** and **Yellow Gum** dominate.	High	Yes (Yellow Gum)	Little Lorikeet, Dusky Woodswallow, Black-chinned Honeyeater	0	0	0	0	0
3	Big Tottington NCR. Large block mostly comprising Box Ironbark forest, good shrub layer including **Golden Wattle**, fallen timber and scattered large hollow-bearing trees. **Grey Box, Red Ironbark** and **Yellow Gum** dominate.	High	Lerp (Grey Box)	Black-chinned & Fuscous Honeyeaters	2	0	0	0	0
4	Little Tottington SF. Isolated block. Mostly regrowth **Grey Box**, with a few mature trees at northern end. Also **Yellow Gums** and shrub layer including **Golden Wattle**.	Moderate - high	Not observed	*Purple-crowned Lorikeet, *Dusky Woodswallow, *Black-chinned & *Fuscous Honeyeaters	0	0	0	0	0
5	Kara Kara NP. Very large block of Box Ironbark forest. **Grey Box, Yellow Gum** and **Red Ironbark** dominant. Good shrub layer including **Golden Wattle**.	High	Yes (Vic. Blue Gum)	n/a **	0	0	0	0	0

**Note: Kara Kara NP was checked incidentally in May 2021 along its western edge (roadside only)

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9.1.3. Field survey results

Table 25 presents the results for the total number of Swift Parrots that were recorded during the roaming survey from April to August 2021.

A total of two Swift Parrots were recorded within the study area during the current investigation. The two Swift Parrots were recorded on public land north of Navarre Wind Farm at Big Tottington Nature Conservation Reserve, at its western end along Kanya Road, on 12 April 2021. No Swift Parrots were observed within any of the 24 habitat zones surveyed within the wind farm footprint, despite the presence of suitable habitat in these zones, and some degree of flowering of Yellow Gums in particular, at many of these zones (Table 25).

Flowering was reasonably sparse in April (Yellow Gum) and moderate in May (also Yellow Gum). The two Swift Parrots were initially detected at Big Tottington NCR on 12 April 2021 by call. One bird was then seen feeding on lerp in Grey Box. Interestingly Swift Parrot were not seen at Morrl Morrl NCR in April, despite large numbers of pardalotes gathered there, presumably feeding on lerp.

It seems that a small number of Swift Parrots were present in larger block(s) of Box Ironbark Forest on public land around Navarre during April, based on the one observation reported here. A few Swift Parrots were recorded in Victoria, from 1st March 2021 onwards. Many more were reported during the early survey period from observations in the Greater Melbourne area from mid-April to early June (maximum numbers of 60, 70 and 90 birds at Plenty, Lysterfield and Fawkner respectively, fewer elsewhere), and the Canberra region (up to 65 birds at Callum Brae and 75 at Kambah) in May and early June 2021, and smaller numbers elsewhere e.g. up to 49 at Port Macquarie, NSW, as far north as southern Queensland (12 birds at Durukai State Forest (BirdLine NSW 2021, BirdLine Victoria 2021, eBird 2021).

Even allowing for the high observer numbers in areas close to capital cities, there appears to be a paucity of records in the 2021 wintering season in the so-called traditional areas (Kennedy and Tzaros 2005) of the Box Ironbark forests of the inland slopes of Victoria, including the St Arnaud - Stawell area which includes Navarre. In the early part of the 2021 wintering season at least, a significant proportion of Swift Parrots appear to be using resources, including planted Spotted Gums, available close to or within the major capital cities or coastal centres. This may account for approximately 200 birds in Melbourne, 100 birds in Canberra and 60 at Port Macquarie, in the order of almost 50% of the estimated total population.

9.2. Conclusions and recommendations

The Swift Parrot was not confirmed as occurring within the Navarre Wind Farm study area during the targeted survey, conducted from April to August 2021. The species was however found in a public land reserve to the north of the wind farm, on 12th April 2021 (2 birds at Big Tottington Nature Conservation Reserve).

Owing to the lack of high-quality or extensive habitat on the wind farm site that would support these species, it is not anticipated that regular movements of the Swift Parrot would occur across the wind farm site. Instead, it may be expected that the occasional individuals of Swift Parrot may visit the wind farm temporarily when food resources may attract them into the site. Such occasional visits by the species are considered unlikely to have a significant impact on their overall populations.

9.3. Mitigation recommendations

A turbine free buffer of 1 km from nature reserves adjacent to the wind farm site that provide habitat potential for Swift Parrot (see Figure 14) has been adopted to avoid impacts to the threatened Swift Parrot.

To maximise the effectiveness of mitigation measures to avoid impact on the threatened Swift Parrot, the following should also be considered:

- Habitat management methods during construction, i.e., avoid or minimise removal of potential forage trees, particularly large trees >60cm DBH of Grey Box, Red Ironbark and Yellow Gum.
- Planting of key foraging tree species (e.g., Grey Box, White Box, Mugga Ironbark, Red Ironbark, Yellow Gum and Spotted Gum), in areas away from the wind farm.

Ongoing monitoring as part of a Bird and Bat Adaptive Management Plan (BBAMP) is recommended. This is usually implemented once construction of the wind farm is complete.

10. Barking Owl and Powerful Owl surveys

10.1. Introduction

This investigation was commissioned to provide information on the presence of the threatened Powerful Owl and/or Barking Owl in the study area and outline any implications under various national, state and local legislation and policy.

Specifically, the scope of the investigation included surveys of suitable habitat in autumn 2021 and repeat surveys in late winter 2021.

10.2. Powerful Owl – species information

10.2.1. Legislative protection

The Powerful Owl is considered is listed as vulnerable under the state FFG Act (State of Victoria 2021).

10.2.2. Description

The Powerful Owl (Ninox strenua) is characterised by bright-yellow, large, forward directed eyes. It is the largest owl found in Australia, with an overall head-tail length of 60- 65cm (Webster et al. 1999). The male is larger than the female. Adults are mottled dark grey-brown above and white below with bold grey-brown chevrons (chest barrings); legs are feathered to the tarsus (shins), with dull yellow feet (Hollands 1991).

10.2.3. Habitat

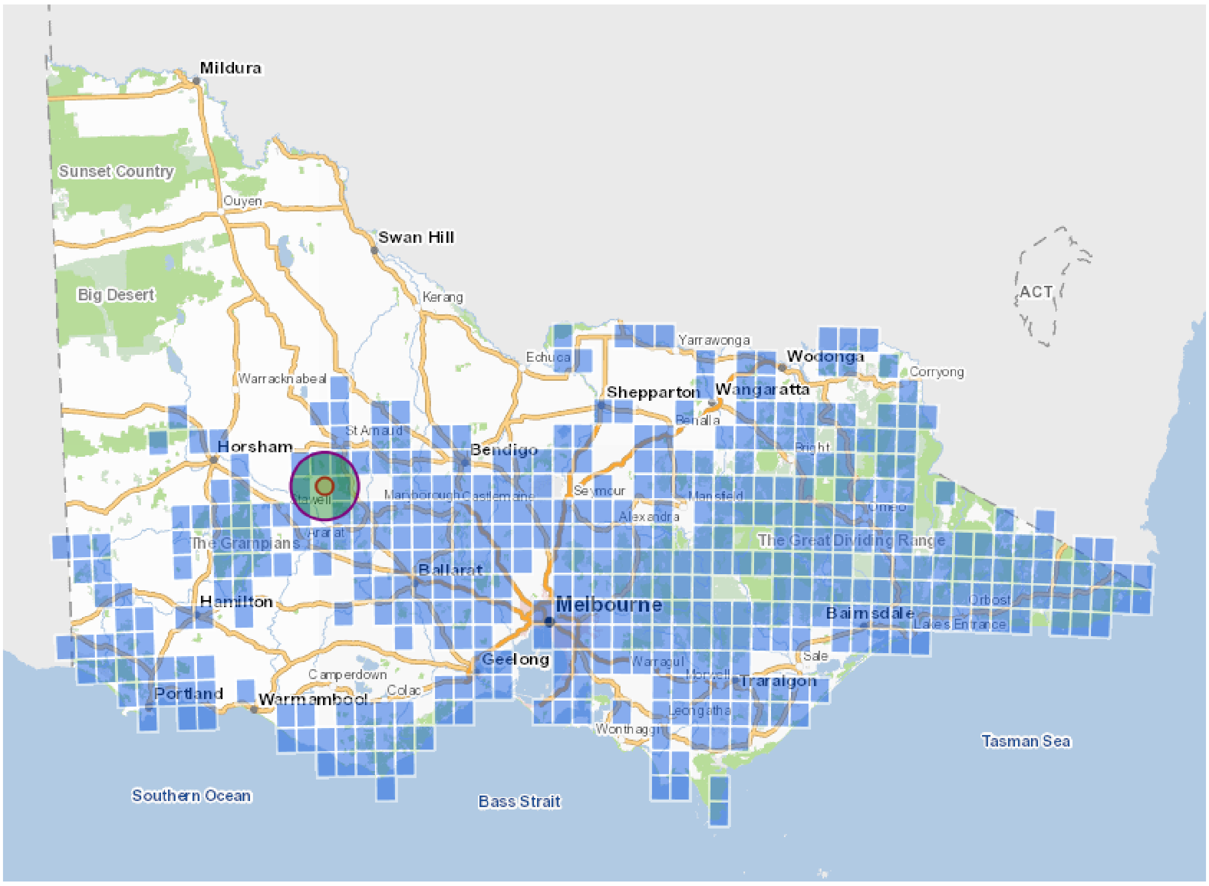
The Powerful Owl prefers open and tall wet sclerophyll forests with sheltered gullies and old growth forest with dense understorey (Higgins 1999). They are also found in dry forests with box and ironbark eucalypts and River Red Gum. Large old trees with hollows are required by this species for nesting.

10.2.4. Distribution

The species occurs on mainland Australia in the eastern and south-eastern coastal forests (Webster et al. 1999), and its distribution extends from Victoria to southern Queensland (Higgins 1999).

In Victoria (Figure 4), the Powerful Owl is widespread, having been recorded from most of the state (Higgins 1999, Webster et al. 1999). Powerful Owls select home ranges with more large trees containing hollows rather than the forest at large, and have a range radius up to nine kilometres (Soderquist and Gibbons 2007). Within the home range, the Powerful Owl generally has one nest tree and several roost trees (Webster et al. 1999, Kavanagh 2002).

Figure 9: Distribution of Powerful Owl in Victoria (10' cells), showing search region - 25km radius of Navarre (Source: Victorian Biodiversity Atlas: DELWP 2021a).



10.2.5. Threats

The habitat and population size of the Powerful Owl has declined mainly due to the clearing of forests for agricultural and forestry purposes (Garnett and Crowley 2000). This includes the loss of hollow-bearing trees which provide suitable nest sites or prey species (Webster et al. 1999).

10.3. Barking Owl – species information

10.3.1. Legislative protection

The Barking Owl is considered to be critically endangered in Victoria where it is listed on the state FFG Act (State of Victoria 2021).

10.3.2. Description

The Barking Owl (*Ninox connivens*) has large, brilliant yellow, forward-directed eyes in an indistinct facial mask. It is a medium-sized brown owl with white spots on the wings and a streaked breast (Clemann and Loyn 2003). The species attains a length of 35-45cm, a wing span of 85-100cm, and a weight of 425- 510g (Hollands 1991).

The species has a dog-like barking call, and will occasionally emit a blood-curdling screech, likened to that of a 'screaming' or 'wailing' woman (Hollands 1991, T. Lay pers. comm.). It breeds between July and October (Robinson 1994) and usually produces two or three eggs that take approximately 36 days to hatch (Hollands 1991).

10.3.3. Habitat

Barking Owls inhabit eucalypt dominated forests and woodlands, commonly near water-bodies, such as streams and rivers, and requires hollow trees for nesting and trees with dense foliage for roosting (Higgins 1999). They appear to prefer edge habitats to the interior of forests, with riparian vegetation through farmland supporting the species most regularly (Taylor et al. 2002a, 2002b).

It occurs also in open communities on plains and foothills, often dominated by eucalypts, such as Manna Gums or Angophora, and including remnant patches of forest or woodlands, or clumps of trees in partly cleared land, such as farmlands (Higgins 1999).

The Barking Owl occurs in dry forest and woodland dominated by eucalypts and is known to inhabit riparian vegetation dominated by species such as River Red-gum and Red Box. The species has been recorded more frequently in edge habitats such as the interface between woodlands and wooded farmland, than in forest interiors. This perceived preference is likely to be due to the foraging behaviour of the species, the abundance of European Rabbit (a common prey item during breeding season), and possibly the predominance of old large hollow-bearing trees on freehold land compared with public forests.

It requires large trees for roosting and hollows for nesting. Hydrological features, such as rivers and swamps are often a conspicuous component of Barking Owl habitat (Kavanagh et al. 1995). Clemann and Loyn (2003) established that live hollow-bearing trees are favoured for nesting over dead ones in Victoria. Nesting hollows are usually large with entrance diameters of 25 – 45 cm. The Barking Owl breeds between July and October (Robinson 1994) and usually produces two or three eggs that take approximately 36 days to hatch (Hollands 1991).

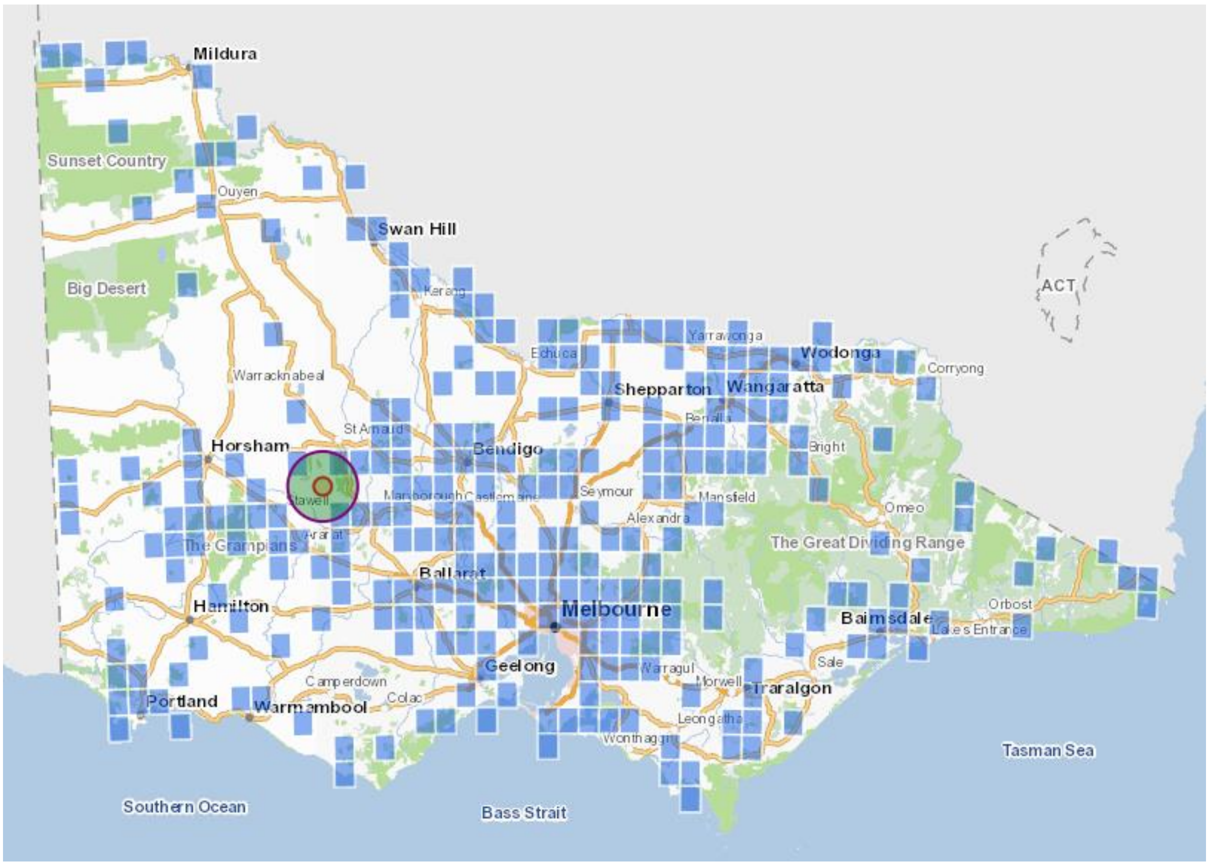
The species has been recorded more frequently in edge habitats such as the interface between woodlands and wooded farmland, than in forest interiors (Robinson 1994). This perceived preference is likely to be due to the foraging behaviour of the species, the abundance of European Rabbit (a common prey item during breeding season), and possibly the predominance of old large hollow-bearing trees on freehold land compared with public forests. (Robinson 1994).

Insects form a main part of their diet during the non-breeding season (Taylor et al. 2002b). The Barking Owl hawks for insects either by flying low over ground, looping up to catch insects, or above the tree canopy in wooded areas, looping up to catch larger flying insects (e.g., Christmas Beetle swarms) (N. Schedvin; pers. comm. 2009). Schedvin (2007) documented that nightly movements involve 'stepping stone' movements between trees and woodland remnants to productive foraging areas, followed by a more direct, return flight at dawn to the traditional roost tree. These movements can be distances of over ten kilometres over open ground (via trees) to remnant forest blocks.

10.3.4. Distribution

It has been recorded from scattered localities throughout Victoria (Figure 5), although it is largely absent from unforested areas such as the volcanic plains and the semi-arid northwest (Clemann and Loyn 2003). The species predominantly occurs in the 400 – 700 mm rainfall zone north of the Great Dividing Range (Emison et al. 1987).

Figure 10: Distribution of Barking Owl in Victoria (10' cells), showing search region - 25km radius of Navarre (Source: Victorian Biodiversity Atlas: DELWP 2021a)



10.3.5. Threats

The Barking Owl is the most threatened owl in Victoria and has undergone a significant decline in numbers with an estimated 50 to 100 pairs remaining in Victoria (N. Schedvin pers. comm. 2009). The primary threat to the Barking Owl in Victoria is loss of habitat, particularly the deterioration or loss of the large, hollow-bearing trees on which the species depends for nesting (Clemann and Loyn 2003).

10.3.6. Population

The Barking Owl has undergone a significant decline in numbers and is estimated that between 50 and 100 pairs exist in Victoria (N. Schedvin pers. comm. 2009). The species predominantly occurs in the 400 – 700 mm rainfall zone north of the Great Dividing Range (Emison et al. 1987). It has been recorded from scattered localities throughout Victoria, although it is largely absent from unforested areas such as the volcanic plains and the semi-arid northwest; the main concentration is now in the north-east of the state (Clemann and Loyn, 2003).

10.4. Methods

10.4.1. Existing information and habitat assessment

Existing information on the status of the Powerful Owl and Barking Owl was obtained from the Victorian Biodiversity Atlas (VBA), a public database held by DEECA. These records were obtained from a wider area, termed the 'search region' defined for this assessment as an area with radius 25 kilometres around the settlement of Navarre: latitude 36˚ 54 00" S and longitude 143˚06' 49" E.

At each survey site, the vegetation type, structure and habitat quality were noted and habitat components, considered suitable for the respective threatened owl species, were assessed for each survey site.

All field work undertaken in reserves was conducted in accordance with the Wildlife Act 1975 and Crown Land (Reserves) Act 1978.

10.4.2. Field methodology

Two owl surveys were undertaken, one from 26th to 29th April 2021 and the second from 23rd to 26th August 2021. The threatened owl survey was undertaken using methods consistent with the DSE Biodiversity Precinct Planning Kit (DSE 2010). This consisted of call playback, listening and spotlighting surveys for up to 45 minutes in each site with suitable habitat, as assessed by earlier reconnaissance by Nature Advisory. A total of six overall sites comprising 18 sub-sites (Figure 12) were sampled by two observers separately over four nights.

Several sites in larger blocks of Box Ironbark Forest in surrounding conservation reserves were included in those sampled. Each site was surveyed twice (except where the target species was found, in which case there was no need for follow-up).

At each site, an alternating process of call playback and listening followed by spotlighting within 200 metres of the survey point was employed as per the table below:

Table 26: Call playback and spotlighting methodology employed to survey for owls

Species	Action
Powerful Owl	3 minutes call playback then 3 minutes listening
Barking Owl	3 minutes call playback then 3 minutes listening
Powerful Owl	3 minutes call playback then 3 minutes listening
Barking Owl	3 minutes call playback then 3 minutes listening
Powerful Owl + Barking Owl	15 minutes spotlighting

10.4.3. Limitations of field assessment

The timing of the Powerful Owl and Barking Owl surveys, their duration and the weather conditions under which surveying was undertaken, were considered suitable for detecting the respective species.

Weather conditions were fine with light winds during the owl surveys, with the exception of one survey at ridgeline site 2b where the wind was moderate to fresh for part of one survey where exposed along the ridgeline (but calmer in the wooded slope/gully searched nearby).

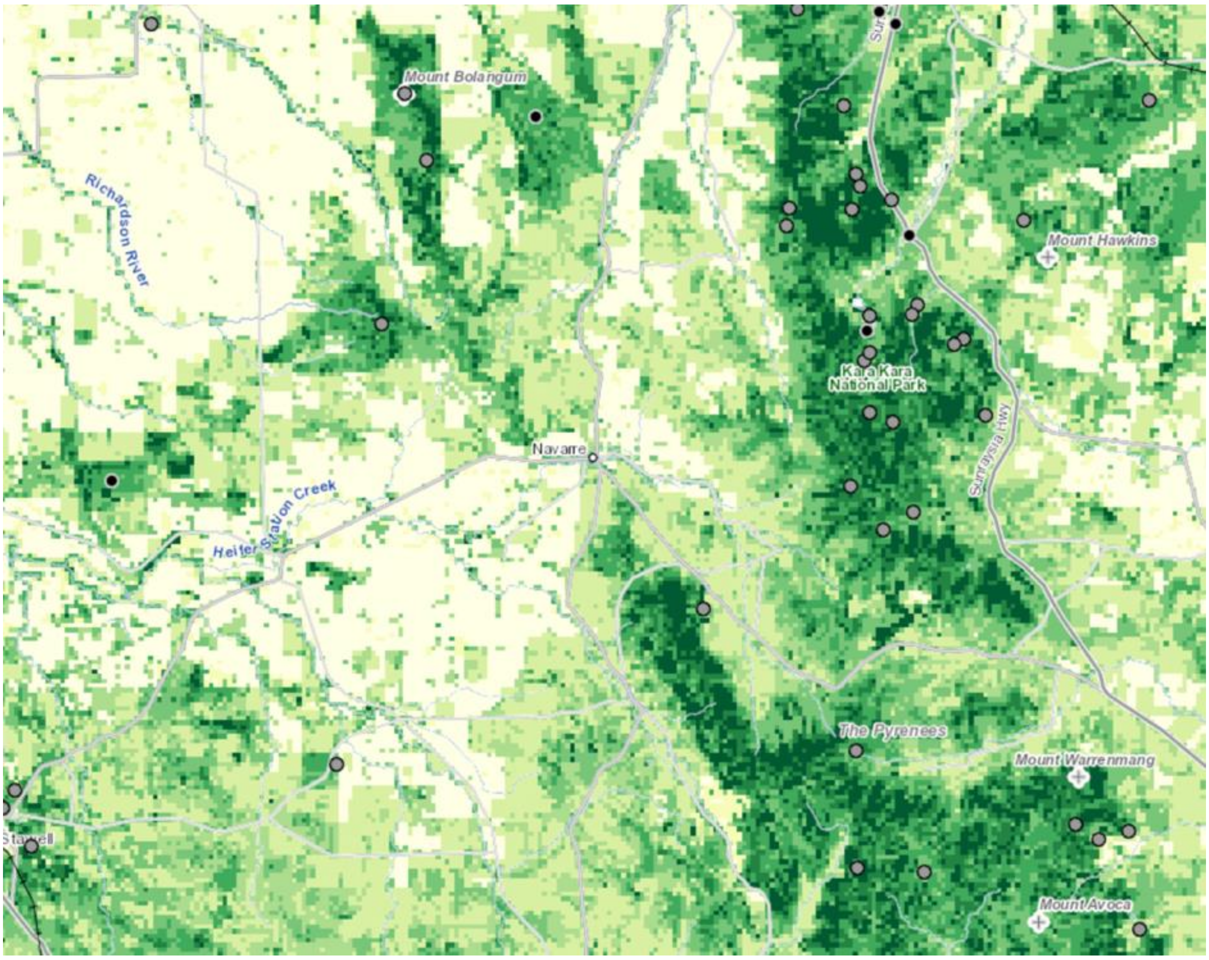
The overall survey effort was considered sufficient to detect significant populations of Powerful Owl and Barking Owl in the study area.

Wherever appropriate, a precautionary approach has been adopted in the discussion of implications. That is, where insufficient evidence is available on the occurrence or likelihood of occurrence of a species, it is assumed that it could be in an area of habitat, if suitable, and the implications under legislation and policy are considered accordingly.

10.5. Powerful Owl - results

The VBA holds 25 records of Powerful Owl within approximately 25km of Navarre, dated from 1977 to 2010 (Appendix 3). Figure 33 shows the location of records in the surrounding area. The existing records show that almost all of the Powerful Owls in the Navarre district inhabit public land reserved for nature conservation. Records were from Kara Kara National Park (to the east), Landsborough Nature Conservation Reserve (NCR) to the south/south-east, Mt Bolangum NCR (north), Morrl Morrl NCR (north-west), and Big Tottington NCR (north).

Figure 11: Historical records of Powerful Owl, within 25km of Navarre (NatureKit 2023)



Hillcrest Herb-rich Woodland (EVC 70), Box Ironbark Forest (EVC 61) and Heathy Dry Forest (EVC 20) comprise the main habitat types remaining on wind farm that could be Powerful Owl habitat (Nature Kit 2.0, DELWP 2021b). Historical records of Powerful Owl in the region surrounding Navarre Wind farm are presented in Figure 11.

In the region surrounding Navarre, habitat for Powerful Owl occurs mainly in larger disconnected blocks of forest and woodland on public land, most of which lie within nature conservation reserves and the Kara Kara National Park. Habitats in these blocks are summarised in Table 25. A key feature of these areas of public land is their relatively large extent of habitat, sufficient to support a permanent population of Powerful Owls, which in box-ironbark forests of Victoria occupy home ranges measured from 1,382 ha to 4,774 ha (Soderquist and Gibbons 2007). Sufficient large hollow-bearing trees and arboreal marsupial prey species (possums) are present in most of these blocks (perhaps not including Little Tottington State Forest) to support nesting of the species.

Powerful Owl was recorded at three sites, all on large blocks of box-ironbark forest, on public land southeast of the wind farm site in the Kara Kara National Park (Figure 12. No Powerful Owl was detected in the wind farm site, despite surveying in potential habitat under conditions suitable for detection. The details of the survey findings are shown in Figure 12.

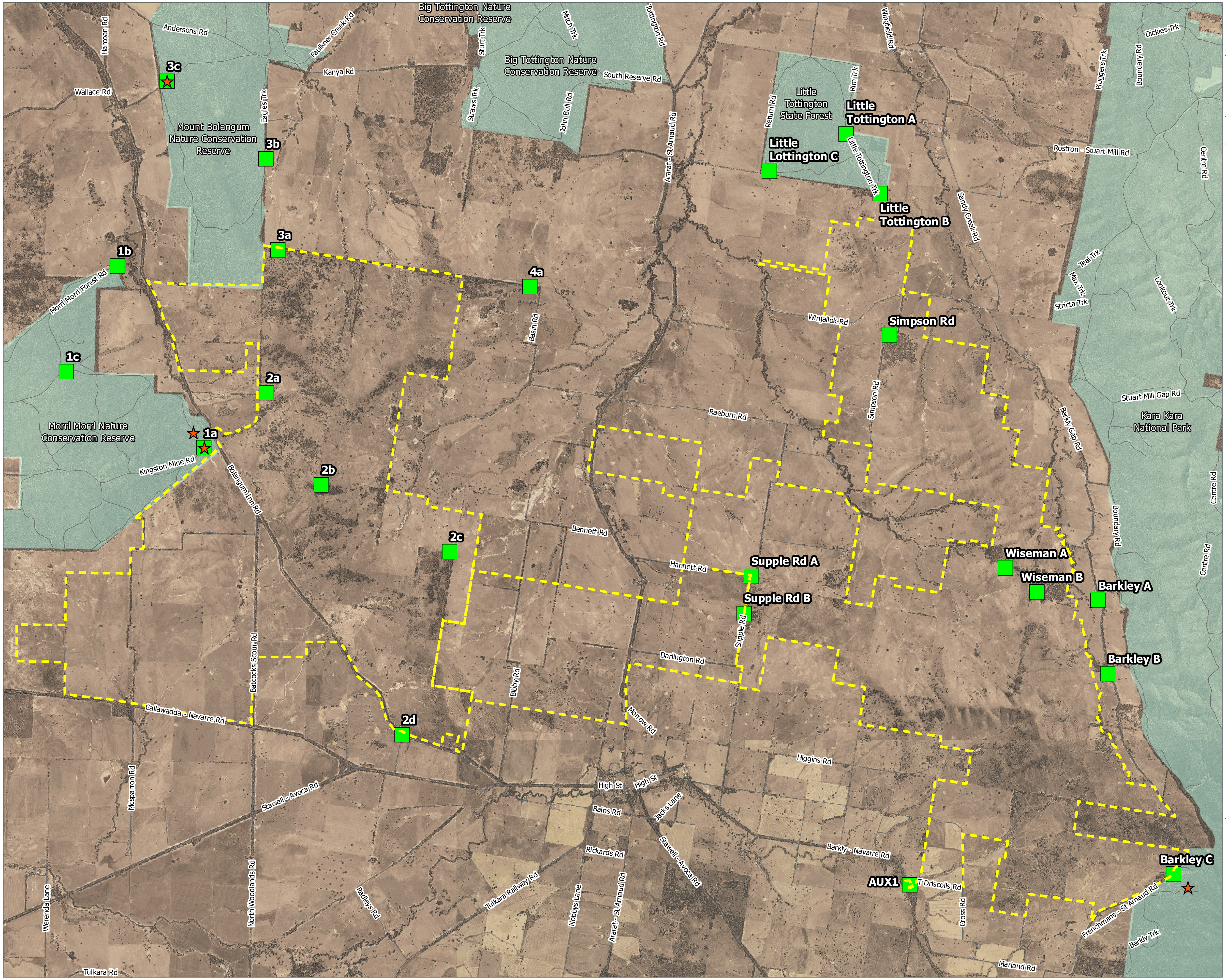


Figure 12: Owl Survey Points and Observations

Project: Navarre Wind Farm
Client: Aurecon Australasia Pty Ltd
Date: 27/03/2023

- Wind farm boundary
- Owl survey points
- Powerful Owl record

N

Metres
0 1,000

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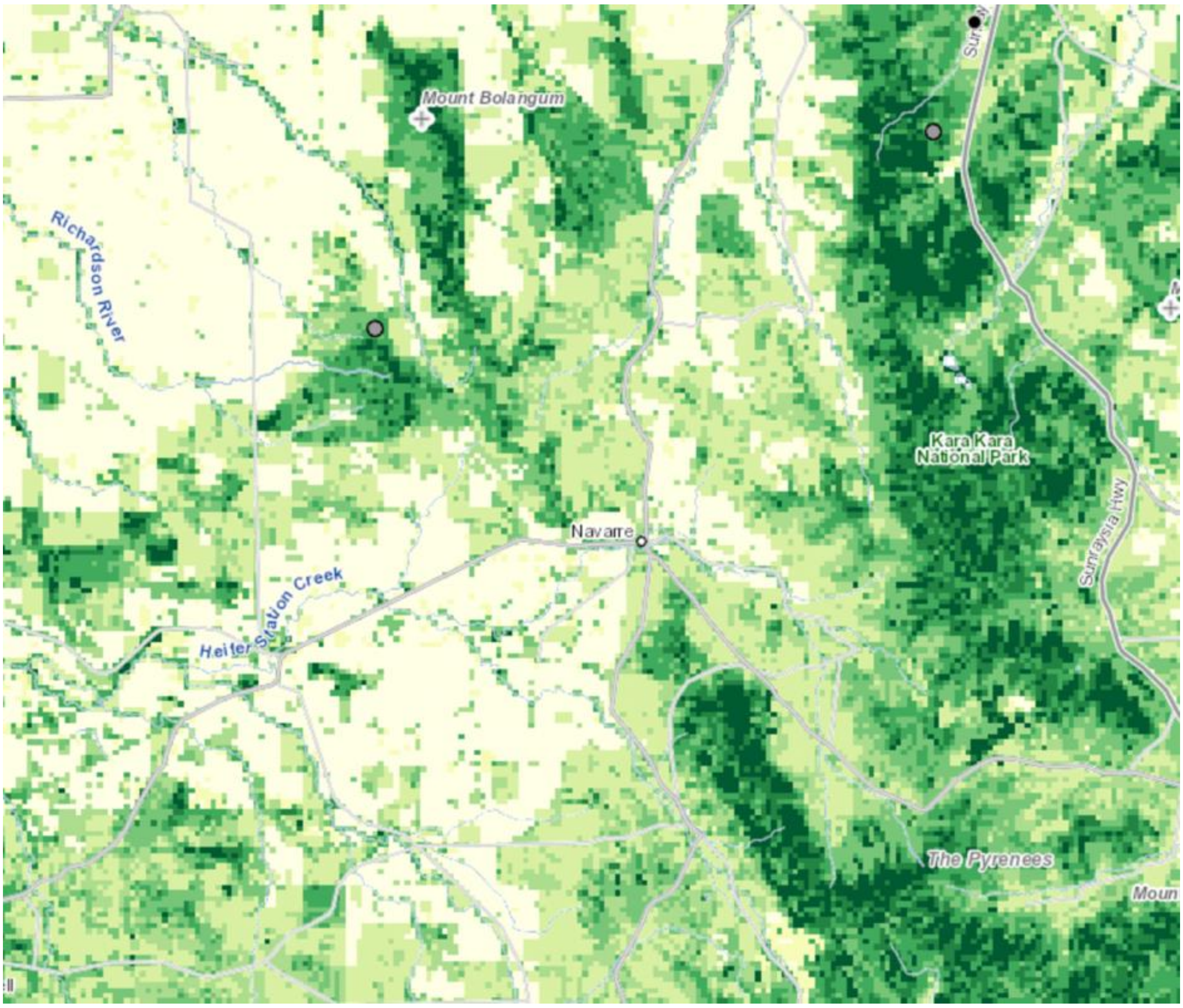
10.6. Barking Owl - Results

The VBA holds records of Barking Owl within approximately 25km of Navarre, dated 1975 and 1994. A third record was found within 25km radius of Navarre (Figure 13). The three records shown are from the northern part of Kara Kara National Park (Carapooee West) in 1975, Morrl Morrl NCR in May 1994 and from Wild Dog Track, Warrenmang (south of Moonambel) in July 2002. There are no records from the wind farm footprint.

Figure 13: Historical records of Barking Owl within 25km of Navarre (NatureKit 2023)



Hillcrest Herb-rich Woodland (EVC 70), Box Ironbark Forest (EVC 61) and Heathy Dry Forest (EVC 20) comprise the main habitat types remaining on wind farm that could be Barking Owl habitat (Nature Kit 2.0, DELWP 2021b). The species may also occur in semi-cleared country, especially riverine in nature. Navarre district has a number of low-lying areas where River Red-gum is dominant (Clemann and Loyn 2003), including a few sites around the edge of the wind farm (e.g., Navarre to Barkly Road). Barking Owls may plausibly occur in such areas. Historical records of Barking Owl in the region surrounding Navarre Wind farm are few and presented in Figure 13. Many of the wooded habitats on the wind farm footprint are described in Table 25, however a number of these were considered too small or to contain too few large hollow-bearing trees to be optimal Barking Owl habitats.

The Barking Owl was not recorded during any of the targeted surveys at Navarre Wind Farm and surrounds conducted in April and August 2021, despite surveying in potential habitat under conditions suitable for detection.

On current information, it was considered unlikely for Barking Owls to be resident in or close to Navarre Wind farm.

10.7. Conclusions and recommendations

The Powerful Owl was not confirmed as occurring within the Navarre Wind Farm study area during the targeted survey, conducted in late April 2021. The species was however found in small numbers in public land reserves to the north-west, north and south-east of the wind farm, as follows:

- 28th April 2021: 1 heard in Mt Bolangum NCR;
- 29th April 2021: 1 seen and heard at Morrl Morrl NCR;
- 29th April 2021: pair seen and heard at Kara Kara National Park, close to the eastern edge of the proposed wind farm (Barkly Gap Road)

The Barking Owl was not confirmed as occurring within the Navarre Wind Farm study area or in the surrounding public lands or roadsides, during the targeted survey, conducted in late April and August 2021.

None of the two threatened owl species were found on the proposed wind farm footprint. It is not expected there would be any regular movement of Powerful Owl from surrounding areas onto the wind farm site, owing to a lack of high-quality or extensive habitat that would support these species. Instead, it may be expected that the occasional individual may visit the wind farm temporarily when food resources may attract them into the site. Such occasional visits by the two species are considered unlikely to have a significant impact on their overall populations.

The Barking Owl appears unlikely to occur regularly in the Navarre area, based on paucity of recent records and negative survey result in April and August 2021.

10.8. Mitigation recommendations

A 300m turbine free buffer from Powerful Owl habitat is recommended (Figure 14). Other mitigation measures for Powerful Owl and Barking Owl are not considered necessary at this stage but may include avoiding removal of any large hollow-bearing trees on site. Ongoing monitoring as part of a Bird and Bat Adaptive Management Plan (BBAMP) is recommended.

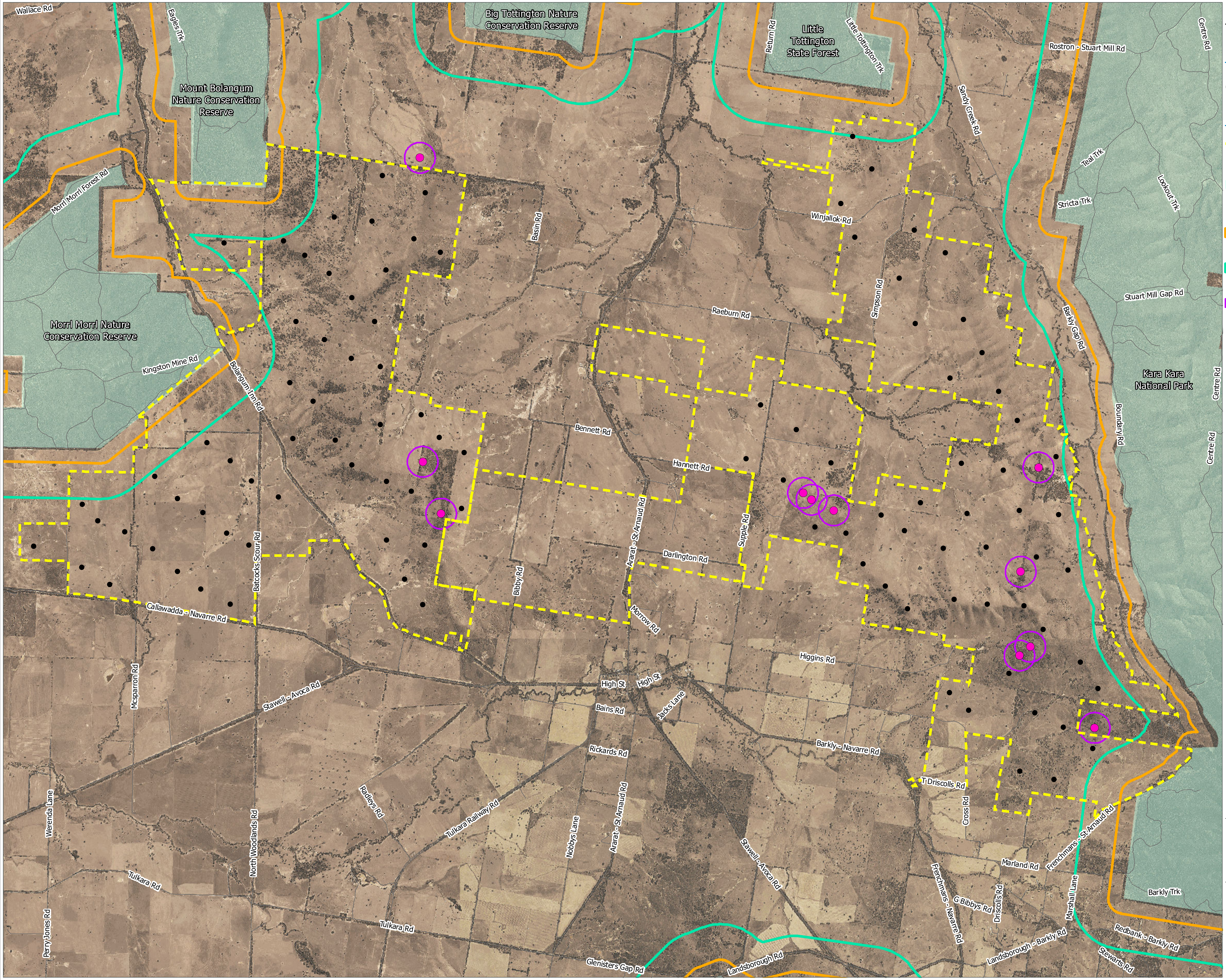


Figure 14: Recommended Threatened Species Habitat buffers

Project: Navarre Wind Farm
Client: Aurecon Australasia Pty Ltd
Date: 27/03/2023

- Wind farm boundary
- Turbines
- Conservation area
- Wedge-tailed Eagle nest
- Powerful Owl habitat - 300m buffer
- Swift Parrot habitat - 1km buffer
- Wedge-tailed Eagle nest buffer - 300m

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11. Pink-tailed Worm-lizard surveys

11.1. Introduction

This investigation was commissioned to provide information on the presence of the threatened Pink-tailed Worm-lizard in the study area and outline any implications under various national, state and local legislation and policy.

Specifically, the scope of the investigation included surveys of suitable habitat as mapped in our initial investigations. This report presents the findings of the assessment, identifies issues and provides recommendations and mitigation options.

11.2. Species biology

11.2.1. Legislative protection

The Pink-tailed Worm-lizard (*Aprasia parapulchella*) is recorded as Vulnerable under the EPBC Act, and listed as Endangered under the FFG Act.

11.2.2. Description

The Pink-tailed Worm-lizard (also known as the Pink-tailed Legless Lizard) is small worm-like, with a dark-brown head and nape, gradually merging with the pale grey or grey-brown body. They lack limbs and have their hind limbs reduced to small inconspicuous vestigial flaps (Cogger 2014). The tail, nearly as long as its body, is pink or reddish-brown towards the tip. Its snout and tail are both rounded. There are no external ear openings. Dark longitudinal marks (dots or bars) on each dorsal scale give the appearance of faint longitudinal lines running down the body and tail. Adults reach a total length of about 240 mm (Jones 1999).

11.2.3. Habitat

The Pink-tailed Worm-lizard is an unusual species because it lives in the burrows of ant nests in soil beneath rocks, where it feeds on the eggs and larvae of ants within these nests (Jones 1999).

Inhabits sloping, open woodland areas with predominantly native grassy ground layers, particularly those dominated by Kangaroo Grass. Sites are typically well-drained, with rocky outcrops or scattered, partially-buried rocks (Figure 15). Commonly found beneath small, partially-embedded rocks and appear to spend considerable time in burrows below these rocks; the burrows have been constructed by and are often still inhabited by small ants and termites. Usually feeds on the larvae and eggs of the ants with which it shares its burrows.

Figure 15: Examples of potential Pink-Tailed Worm-lizard habitat at Navarre wind farm

11.2.4. Distribution

Pink-tailed Worm-lizard is largely confined to rocky landscapes and prior to European settlement is likely to have been patchily distributed in south-eastern Australia, mainly along the western slopes of the Great Dividing Range in NSW through to central Victoria. Recent records of the species are from near Bendigo in Victoria.

11.2.5. Threats

The following threats could lead to habitat loss and degradation as well as danger to the species itself.

- Habitat loss and fragmentation.
- Habitat degradation through rock removal.
- Habitat degradation through pasture improvement including slashing, ploughing and sowing of non-native species.
- Habitat degradation through intensive grazing by stock.
- Habitat degradation through invasion of habitat by weeds or escaped pasture species.
- Lack of knowledge of how habitat management practices influence site occupancy and species persistence.
- Predation by feral or domestic cats and foxes
- Changed fire regimes that result in changes to vegetation structure and composition.

11.3. Methods

11.3.1. Existing information

Existing information on the status of the Victorian threatened fauna is usually obtained from the Victorian Biodiversity Atlas (VBA), a public database held by the Department of Energy, Environment and Climate Action (DEECA).

Based on habitat characteristics, the EPBC Act Protected Matters Search Tool (DAWE 2019) predicted the potential for the species to occur in some parts of the wind farm study area.

11.3.2. Field methodology

This investigation was commissioned to provide information on the presence of the threatened Pink-tailed Worm-lizard in the study area and outline any implications under various national, state and local legislation and policy.

Specifically, the scope of the investigation included surveys of suitable habitat as mapped in Nature Advisory's initial investigations (Nature Advisory 2019).

Areas of suitable habitats were identified, particularly those with rocky outcrops or scattered, partially buried rocks on open areas with grass cover. Seven potential suitable habitats were selected (Figure 16) and searched by overturning rocks. Search sites were scattered within the wind farm boundaries and provided a good coverage of the possible habitats that could harbour the threatened worm lizards.

The Pink-tailed Worm-lizard can be found throughout the year by searching under rocks. Peak activity is likely to be late spring and early summer under warm, but not overly dry, conditions.

The survey method used in this investigation was adopted from Osborne *et al* (1991) and recommendations itemised below by the *Survey Guidelines for Australia's threatened Reptiles* (DSEWPaC 2011).

- Searches restricted to an area of relatively homogeneous habitat within each site and a search beneath all rocks that can be turned is made.
- Rock cover density rather than fixed area size determines a plot, and 150–200 rocks need to be turned to be reasonably confident of determining the species' presence.
- Search success appears to be highest in spring and early summer on warm but not hot days, after a period of rainfall extending over several days.
- During summer months surveys are carried out in the mornings or on cloudy days when soil temperatures beneath the rocks are not too high.

Two surveys were undertaken, first in late spring (25-26 October 2021) and the second in early summer (1-3 December 2021). Two sites were searched in the first, and six sites in the latter surveys. A minimum of 280 rocks were overturned in search of the lizard in each of the surveys (Table 27).

Weather conditions during the spring survey was acceptable with partly cloudy and cool temperatures between 16–18 ^{o}C. In summer conditions were more suitable and warmer (20–32^{o}C), mostly partly cloudy with gentle winds.

11.4. Survey Results

No Pink-tailed Worm-lizards were observed during the targeted surveys. Table 27 provides details on survey timing, survey effort and other species found.

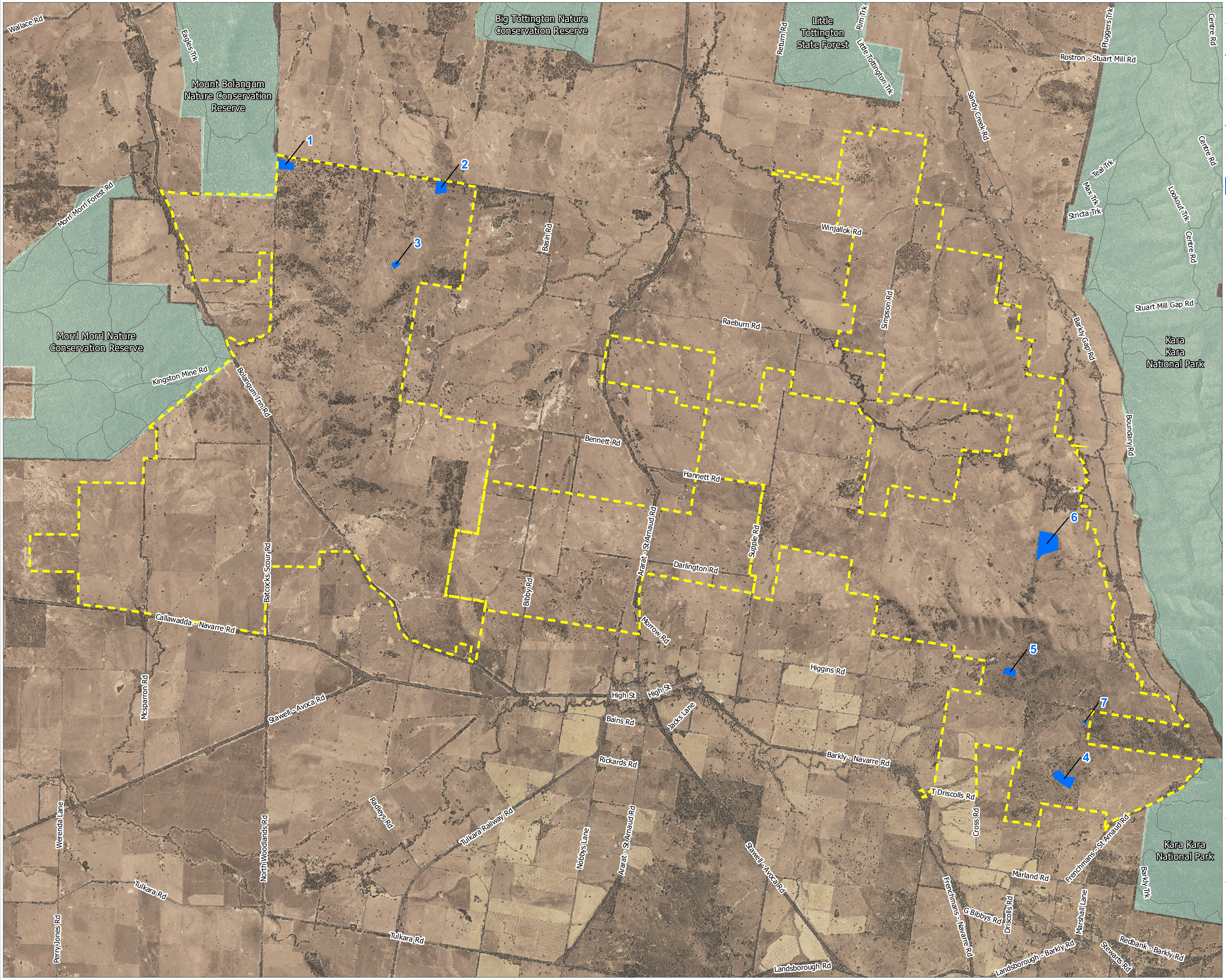
Table 27: Pink-tailed Worm-lizard survey results

<table>
<tr><th>Date</th><th>Site Number</th><th>Search Effort*</th><th>Survey time</th><th colspan="2">Species found</th><th>Surveyor</th></tr>
<tr><td>25/10/2021</td><td>2</td><td>300</td><td>1300 - 1500</td><td>Little Whip Snake</td><td>Parasuta flagellum</td><td rowspan="4">CD</td></tr>
<tr><td rowspan="3">26/10/2021</td><td rowspan="3">4</td><td rowspan="3">300</td><td rowspan="3">900 - 1100</td><td>Large Striped Skink</td><td>Ctenotus robustus</td></tr>
<tr><td>Three-toed Skink</td><td>Hemiergis decresiensis</td></tr>
<tr><td>Bouganville's Skink</td><td>Lerista bougainvillii</td></tr>
<tr><td>1/12/2021</td><td>1</td><td>300</td><td>1412 - 1554</td><td></td><td></td><td rowspan="6">CS</td></tr>
<tr><td>1/12/2021</td><td>2</td><td>300</td><td>1637 – 1733</td><td></td><td></td></tr>
<tr><td>2/12/2021</td><td>4</td><td>300</td><td>0920 - 1052</td><td></td><td></td></tr>
<tr><td>2/12/2021</td><td>6</td><td>300</td><td>1206 - 1352</td><td>Large Striped Skink</td><td>Ctenotus robustus</td></tr>
<tr><td>2/12/2021</td><td>5</td><td>300</td><td>1557 - 1702</td><td>Three-toed Skink</td><td>Hemiergis decresiensis</td></tr>
<tr><td>3/12/2021</td><td>7</td><td>280</td><td>0825 - 0956</td><td></td><td></td></tr>
</table>

Curtis Doughty (CD); Clint Schipper (CS).
*Number of rocks rolled

Figure 16: Pink-tailed Worm-lizard Survey Areas

Project: Navarre Wind Farm
Client: Aurecon Australasia Pty Ltd
Date: 27/03/2023



Wind farm boundary

Potential Pink-tailed Worm-lizard habitat

N

Metres
0 1,000

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The Pink-tailed Worm-lizard was not reported to occur within the wind farm study area, despite concentrated efforts undertaken during spring (turning over 600 rocks) and summer (1800 rocks). This result is in line with lack of records in the Victorian Biodiversity Atlas (VBA).

Habitats selected for the surveys seemed suitable and matched the characteristics of habitats where the Pink-tailed Worm-lizards was found near Bendigo or around the ACT (Figure 15). A small number of other common reptiles were recorded during the two surveys (Table 27).

11.5. Conclusions

The Pink-tailed Worm-lizard was not confirmed as occurring within the Navarre Wind Farm study area during the targeted survey, conducted in spring and summer of 2021. Based on this, this species is considered unlikely to occur at the proposed wind farm site.

12. Implications under Legislation and Policy

The sections below discuss the potential implications under the current, relevant legislation and policy as they apply to the entire study area.

12.1. Proposed development

The proposed Navarre Wind Farm will be located on a site of 18,404 hectares. The total area of all wind farm infrastructure will be around 440 hectares, approximately 2.4% of the total site.

The Navarre Wind Farm is planned as follows:

- 102 wind turbines;
- Two permanent substations, each up to 10ha

The following infrastructure will support the Navarre Wind farm:

- Internal access tracks, with site access points expected along Barkly-Navarre Road, Ararat-St Arnaud Road, Winjallock Road, Callawadda-Navarre Road and three locations along Bolangum Inn Road.
- Road upgrades to local roads
- Meteorological monitoring masts
- Internal power collection stations
- Internal underground cabling
- Two temporary concrete batching plants
- Temporary on-site quarry for wind farm construction rock
- Temporary and permanent site offices
- Amenities

The wind farm layout has been adjusted, where practicable, to avoid and minimise impacts on important native vegetation and fauna habitats on the site. Predominant land use within the site is for agricultural operations. This land use will continue during and after wind farm construction.

To determine impacts to native vegetation, the proposed construction layout was overlaid with the native vegetation mapped as part of this investigation. Native vegetation occurring in the following locations was considered to be removed based on the proposed development plan:

- Direct removal:
  - Native vegetation within all proposed wind turbine construction hardstands
  - Native vegetation within all proposed access tracks
  - Native vegetation within all proposed laydown and storage areas
  - Native vegetation within all proposed operations and management areas
  - Native vegetation within the proposed substation footprint
- Consequential removal:
  - Native vegetation within 10m of all wind turbine hardstands (to address potential 'cut and fill' requirements due to placement of turbines on slopes requiring earthworks)

Impacts to native vegetation associated with the proposed transmission line running from the wind farm site to Bulgana Terminal Station are considered separately in Section 13.

The following elements of the proposed design were not considered as part of this assessment:

- Impacts related to the temporary on-site quarry for wind farm construction rock
- Upgrades of road intersections to accommodate over-dimensional (OD) vehicles needed to transport turbine components
- Impacts from the transmission line between the eastern and the western section of the proposed wind farm as the route has not been finalised

Impacts to trees

In accordance with the *Assessor's Handbook* (DELWP 2018a), a tree is deemed lost when earthworks encroach on more than 10% of its Tree Protection Zone (TPZ). A TPZ is defined as an area around the trunk of the tree which has a radius of 12 × the DBH (to a maximum of 15 metres but no less than 2 metres). Dead trees are treated in the same manner.

12.2. Impacts of proposed development

In addition to the impacts outlined below, further impacts are likely to be identified in the additional assessment areas outlined in Section 5.3.

Various design measures have been undertaken for this proposal to avoid and minimise impacts to native vegetation. These are detailed in Section 12.5.1.

12.2.1. Native vegetation

The current footprint will result in the loss of a total extent of 127.515 hectares of native vegetation including 121.677 hectares of native vegetation in patches, 325 large trees in patches and 104 scattered trees as represented in Figure 2 and documented in the *Native Vegetation Removal* (NVR) report provided by DEECA (Appendix 11 & Appendix 12). Note that this does not include native vegetation removal associated with the transmission line. See Section 13 for an outline of the preliminary desktop assessment of the transmission line.

This comprised:

Western Section:

- 52.129 hectares of native vegetation in patches (including 111 large trees in patches)
- 52 scattered trees (namely 38 large scattered trees and 14 small scattered trees).

Eastern Section

- 69.548 hectares of native vegetation in patches (including 214 large trees in patches)
- 52 scattered trees (namely 36 large scattered trees and 16 small scattered trees).

3.484 hectares of the native vegetation to be removed is in an area mapped as an endangered Ecological Vegetation Class. This is in addition to 6.436 hectares of removal of mapped as an endangered Ecological Vegetation Class for the transmission line (see Section 13.3.2), totalling 9.92 hectares for the entire project.

It is understood that no native vegetation has been approved for removal on any property within the last five years; however, removal associated with the proposed transmission line will consider the wind farm as past removal (see Section 13.6.1)

12.2.2. Modelled species important habitat

The current proposal footprint will not have a significant impact on any habitat for any rare or threatened species as determined in Appendix 11 & Appendix 12.

12.2.3. Listed flora species

The analysis of the likelihood of occurrence of listed flora species presented in Section 0 in combination with targeted surveys identified that the following species could be impacted by any development in the study area:

- *Thelymitra* sp. (Sun-orchid, potentially EPBC Act and FFG Act listed)– 340 individuals recorded, some species are threatened
- *Diuris behrii* (Golden Cowslips, FFG Act: Endangered)– two individuals recorded
- *Allocasuarina luehmannii* (Buloke, FFG Act: Vulnerable)– five individuals recorded

It should be noted that all Sun-orchids are unidentified as they had not yet flowered during the September surveys and had finished flowering during the November surveys. As such, we have taken a precautionary approach in assuming that threatened Sun-orchids could be present.

The following species were detected during targeted surveys, but impacts have been avoided by altering layout design:

- Hairy Tails (*Ptilotus erubescens*).

12.2.4. Threatened ecological communities

The proposed development footprint will result in the following losses:

- 23.371 hectares *of Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* (EPBC Act: Endangered);
- 5.627 hectares of *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (EPBC Act: Critically Endangered); and
- 3.105 hectares of Grey Box – Buloke Grassy Woodland (FFG Act: Threatened).

12.4. Summary of planning implications

No overlays relevant to this investigation cover the study area.

A planning permit under Clause 52.17 of the Northern Grampians Planning Scheme is required for the removal of native vegetation.

12.5. Implications under the Guidelines

12.5.1. Avoid and minimise statement

In accordance with the Guidelines, all applications to remove native vegetation must provide an avoid and minimise statement which details any efforts undertaken to avoid the removal of and minimise the impacts on biodiversity and other values of native vegetation, and how these efforts focussed on areas of native vegetation that have the most value. Efforts to avoid and minimise impacts to native vegetation in the current application are presented as follows:

Nature Advisory have engaged with Aurecon and Neoen in an extensive, iterative design process to include the findings of native vegetation and targeted species surveys. This process has focussed on avoiding and minimising impacts to listed communities and threatened species as the highest priority, followed by avoiding large trees and high-quality patches, and then avoiding scattered trees and remaining patches based on score.

Specific examples of layout changes are documented below and illustrated in Appendix 15.

- Four turbines, S1.01, S1b.01, S1.03 and S1b.16, have been removed to avoid impacts to sensitive areas of native vegetation. This has resulted in a reduction of impacts to at least 3.126 hectares of native vegetation.
- Turbines W.1, W.7, W.10, W.9, W.22, W.26, W.43, W.52, E.8, E.9, E.14, E.34, E.39, E.41 and E.44 have been relocated to minimise impacts to native vegetation. This has resulted in an overall reduction of impacts to 4.347 hectares of native vegetation, and a reduction of impacts to 6.053 hectares of the EPBC Act listed Grey Box Grassy Woodland listed ecological community.
- The planned access track from Ararat-St Arnaud Road utilising Bennett Road has been removed and relocated to Bolangum Inn Road to minimise impacts to sensitive roadside native vegetation.
- The planned access track from Hannet Road has been removed and relocated to Ararat – St Arnaud Road to minimise impacts to roadside native vegetation.
- Where feasible, access tracks have been micro-sited to avoid and minimise impacts to native vegetation. Specific examples of this are illustrated in Appendix 15.
- Within the 100-metre radius area surveyed for each turbine site, the hard-stand and foundation areas have been located to minimise removal of native vegetation. Specific examples of this are illustrated in Appendix 15.
- The following turbine free habitat buffers have been implemented for threatened fauna species habitat as shown in Figure 14:
- Powerful Owl habitat – 300m buffer
- Swift Parrot habitat – 1 km buffer
- Wedge-tailed Eagle nests – 300m buffer

In the absence of legislative guidelines, these buffer distances have been chosen based on the species behaviour and, where available, flight data.

-

12.5.2. Assessment pathway

The assessment pathway is determined by the location category and the extent of native vegetation as detailed for the study area as follows:

- **Location Category:** Location 1, 2 and 3 all occur. The highest location category applies.
- **Extent of native vegetation:** A total of 127.515 hectares of native vegetation (including 399 large trees).

Based on these details, the Guidelines stipulate that the proposal is to be assessed under the **Detailed** assessment pathway.

This proposal triggers a referral to DEECA.

This does not include vegetation removal associated with the transmission line. A preliminary desktop assessment suggests an additional 7.256 ha may be impacted by the transmission line footprint.

12.5.3. Offset requirements

The total offsets required to compensate for the proposed removal of native vegetation from the study area equals 70.221 general habitat units. This has been determined based on 3 separate Native Vegetation Removal Reports (NVRRs) for the 3 sections of the project (Western Section of the wind farm, Eastern Section of the wind farm and Transmission Line). Offset requirements have considered all sections in the NVRRs. Details of the offset requirements for each section is as follows:

- Western Section of wind farm: 28.720 general habitat units with following requirements:
  - Minimum strategic biodiversity value (SBV) of 0.405
  - Occur within the North Central or Wimmera CMA boundary, or the Northern Grampians Shire Council municipal district.
  - Include protection of at least 149 large trees.
- Eastern Section of wind farm: 37.188 general habitat units with following requirements:
  - Minimum strategic biodiversity value (SBV) of 0.401
  - Occur within the North Central or Wimmera CMA boundary, or the Northern Grampians or Pyrenees Shire Council municipal district.
  - Include protection of at least 250 large trees.
- Southern Transmission Line: 4.314 general habitat units with following requirements:
  - Minimum strategic biodiversity value (SBV) of 0.372
  - Occur within the Wimmera CMA boundary, or the Northern Grampians Shire Council municipal district.
  - Include protection of at least 13 large trees.

Under the Guidelines all offsets must be secured prior to the removal of native vegetation.

12.5.4. Offset statement

The offset target for the current proposal will be achieved via a third-party offset.

An online search of the Native Vegetation Credit Register (NVCR) has shown that the required offset is currently available for purchase from two native vegetation credit owners (DEECA 2023e).

Evidence that the required offset is available is provided in Appendix 14.

It should be noted that the amount of general habitat units required as offsets is very large and will be quite costly (offset costs within the Wimmera CMA range average around $130K per GHU as per the 2023 trade prices published by DEECA).

12.6. Victorian Wind Farm Planning Guidelines

The Victorian Wind Farm Planning Guidelines (DELWP 2019) state that proponents of a wind energy facility must be aware of the following: EPBC Act listed values; FFG Act listed values; wetlands and wetland wildlife habitat designated under the Ramsar Convention; migratory species listed under the Japan-Australia Migratory Birds Agreement (JAMBA), the China-Australia Migratory Birds Agreement (CAMBA) or the Republic of Korea-Australia Migratory Birds Agreement (ROKAMBA) and Clause 52.17 Native vegetation of the Northern Grampians Shire Council and the Pyrenees Shire Council planning schemes. Listed species are considered in the previous sub-section above.

12.7. EPBC Act

The EPBC Act protects a number of threatened species and ecological communities that are considered to be of national conservation significance. Any significant impacts on these species require the approval of the Australian Minister for the Environment.

Based on the relevant guidelines, the proposed development is likely to result in a significant impact on EPBC Act-listed values presented below.

Ecological Communities

- 23.371 hectares of *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* (EPBC Act: Endangered)
- 5.627 hectares of White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (EPBC Act: Critically Endangered)

Flora

The following species was not directly recorded within the study area, but areas of suitable habitat and associated species were found:

- Brilliant Sun-orchid (EPBC Act: Vulnerable; FFG Act: Critically Endangered)

Due to the cryptic nature of the species and the abundance of unopened Sun-orchid flowers in the south east of the study area in the vicinity of turbines E.48 and E.49, this species is assumed to be susceptible to impacts from the development of these two turbines.

Impacts could not be assessed based on information obtained during the current assessment for the following listed values due to the timing of field surveys being unsuitable to determine their presence:

- Yellow-lip Spider-orchid (FFG Act: Endangered; EPBC Act: Endangered).

Pre-construction targeted surveys are therefore recommended to determine the status of these values in the study area and to assist micro-siting of turbines and infrastructure to avoid impacts on these values.

Fauna

The following EPBC Act listed species have the potential to occur in the study area occasionally or within areas of suitable habitat. The susceptibility of these species to possible impacts from any development is discussed below.

Birds

- Swift Parrot

Targeted surveys for this species found a pair of Swift Parrots within a nature reserve to the north of the wind farm site. This species is not expected to move across the site on a regular basis due to the lack of high-quality habitat on the wind farm site. Occasionally, individuals of Swift Parrot may visit the wind farm temporarily when food resources may attract them into the site. Such occasional visits by the species are considered unlikely to have a significant impact on their overall populations.

- Hooded Robin, Diamond Firetail, Brown Treecreeper, Painted Honeyeater

The first three species were recorded during the BUS, while Painted Honeyeater is considered to potentially occur. These four woodland bird species are unlikely to be impacted by turbines as they spend most of their time foraging on or near the ground or perching in trees of heights of no more than 20 metres, and rarely fly above tree top height.

Migratory species

- White-throated Needletail
- Fork-tailed Swift

These two migratory bird species are considered to potentially occur within the study region and could fly over the proposed wind farm site, but impacts are likely to be negligible. The White-throated Needletail, a known occasional casualty of turbines, is at the inland edge of its range at Navarre Wind Farm with only few records within the search region. The Fork-tailed Swift is a likely turbine casualty, but the number involved are such that there would be negligible population impacts on this widespread, mobile species, that may occur in the study area only on a few days per year. Impacts to both species are considered negligible from the proposed wind farm.

Invertebrates

- Golden Sun Moth

The Golden Sun Moth is considered to have the potential to occur in the study area. Golden Sun Moth have previously been recorded in the wider search area. Suitable habitat is present within the study area in form of native grassland and treed areas with a grassy understorey. The presence of this species is assumed within these habitats. The current proposed wind farm layout would impact 73.983 hectares of potential Golden Sun Moth habitat.

A Referral under the EPBC Act will be required for the above-listed values.

12.8. FFG Act

The Victorian FFG Act lists threatened and protected species and ecological communities (DELWP 2018b, DELWP 2017b). Any removal of threatened flora species or communities (or protected flora) listed under the FFG Act from public land requires a Protected Flora Permit under the Act, obtained from DEECA.

The FFG Act only applies to private land in relation to the commercial collection of grasstrees, tree-ferns and sphagnum moss.

The following FFG Act values listed as threatened or protected are susceptible to impacts from the proposed development on public land:

- Grey Box – Buloke Grassy Woodland Community
- Golden Cowslips (FFG Act – Endangered)
- Buloke (FFG Act: Vulnerable)

Protected species:

- Black Wattle (FFG Act – Protected);
- Common Bottle-daisy (FFG Act – Protected);
- Common Cotula (FFG Act – Protected);
- Common Sneezeweed (FFG Act – Protected);
- Cotton Fireweed (FFG Act – Protected);
- Flame Heath (FFG Act – Protected);
- Fuzzy New-holland Daisy (FFG Act – Protected);
- Cranberry Heath (FFG Act – Protected);
- Gold-dust Wattle (FFG Act – Protected);
- Golden Wattle (FFG Act – Protected);
- Grey Everlasting (FFG Act – Protected);
- Peach Heath (FFG Act – Protected);
- Scaly Buttons (FFG Act – Protected);
- Shiny Everlasting (FFG Act – Protected);
- Small Grass-tree (FFG Act – Protected);
- Smooth Solenogyne (FFG Act – Protected);
- Tiny Cudweed (FFG Act – Protected); and
- Twining Fringe-lily (FFG Act – Protected).

Given the large number of protected flora taxa recorded along roadsides associated with access into the wind farm site, individuals of these taxa have not been mapped or counted. Rather it is advised that a general Protected Flora Permit for the wind farm project be sought from DEECA to remove the plant taxa comprising the abovementioned listed threatened community, listed threatened flora species or otherwise protected values from public land.

12.9. EE Act

The *Ministerial Guidelines for Assessment of Environmental Effects under the* Environment Effects Act 1978 (DSE 2006), identifies criteria which trigger a Referral to the State Minister for Planning.

Based on the relevant criteria, a Referral to the state Minister for Planning will be required under the EE Act due to the following:

- Proposed clearing of >10ha of native vegetation; and
- Proposed loss of 3.105 hectares of the FFG Act listed community Grey Box – Buloke Grassy Woodland.

12.10. CaLP Act

The *Catchment and Land Protection Act 1994* (CaLP Act) requires that landowners (or a third party to whom responsibilities have been legally transferred) must eradicate regionally prohibited weeds and prevent the growth and spread of regionally controlled weeds.

Property owners who do not eradicate Regionally prohibited weeds or prevent the growth and spread of Regionally controlled weeds for which they are responsible, may be issued with a Land Management Notice or Directions Notice that requires specific control work to be undertaken.

In accordance with the *Catchment and Land Protection Act 1994*, the noxious weed species listed below, which were recorded in the study area, must be controlled.

- Horehound;
- Paterson's Curse;
- Ragwort;
- Spear Thistle;
- Spiny Rush;
- St John's Wort;
- Sweet Briar; and
- Variegated Thistle.

Precision control methods that minimise off-target kills (e.g. spot spraying) should be used in environmentally sensitive areas (e.g. within or near native vegetation, waterways, etc.).

13. Transmission Line Assessment

13.1. Introduction

An 18-kilometre-long transmission line corridor connects the electricity sub-station at the south-east of the Navarre wind farm site with the Bulgana Terminal Station to the south-southeast.

A flora and fauna overview assessment of potential transmission line routes was commissioned and undertaken in 2021. The study area comprised a corridor approximately 50 metres wide and extending 18 kilometres from the southern edge of the wind farm site to Bulgana Terminal Station.

The results of the overview assessment have been used to undertake a preliminary estimate of the native vegetation removal and offset requirements associated with the preferred transmission line route. This section provides a description of the mapped vegetation and the relevant Ecological Vegetation Classes (EVCs) and assesses the potential presence of EPBC Act and FFG Act listed flora and fauna species, the vegetation communities and the fauna habitat on the proposed transmission line easement.

The activities undertaken to complete this task are described below.

- A desktop review of flora and fauna information along the proposed transmission line route was undertaken.
- An overview site assessment of remnant native vegetation along the corridor was undertaken in 2021. This assessment was undertaken to inform the assessment of potential impacts on flora and fauna of the proposed transmission line.
- Maps were prepared of any threatened species and communities and native vegetation, including identification of EVCs, recorded along the route.

Further surveys will be undertaken before construction begins and should be required as a condition of the planning permit for the proposed transmission line. These surveys will inform the final layout of the transmission line with the aim to avoid native vegetation and habitat for threatened flora and fauna species where possible. These works include:

- Detailed habitat hectares assessments of areas proposed to be impacted by powerpoles and associated infrastructure (e.g. access tracks); and
- Targeted surveys for threatened flora and fauna species in areas of suitable habitat proposed to be impacted.

The transmission line layout is therefore only indicative of the preferred route at this stage and Figure 17 does not necessarily reflect its exact location. The final layout of the transmission line including exact pole locations will be provided after further detailed ecological surveys have been undertaken. Details of the transmission line construction and operational specifications (e.g. footing dimensions and associated works area, span length, ancillary construction access tracks, vehicle passing/turning bays, operational electrical clearance zones) will be developed based on the results of these surveys in order to minimise impacts on native vegetation and provided for approval before construction.

13.2. Methods

This section describes the methods employed for the flora and fauna survey including sources of information relied upon.

13.2.1. Existing Information

Existing information used for this investigation is described below. Note that 'study area' in this section refers to the proposed transmission line route from Navarre Wind Farm to Bulgana Terminal Station plus a 20-metre buffer on either side of the transmission line, as presented in Figure 17.

Native vegetation

Pre-1750 (pre-European settlement) vegetation mapping administered by DEECA was reviewed to determine the type of native vegetation likely to occur in the study area and surrounds. Information on Ecological Vegetation Classes (EVCs) was obtained from published EVC benchmarks. These sources included:

- Relevant EVC benchmarks for the Goldfields and Wimmera bioregions (DSE 2004a); and
- *NatureKit* (DELWP 2022a).

Listed matters

Existing flora and fauna species records and information about the potential occurrence of listed matters was obtained from an area termed the 'search region', defined here as a buffer area of 10 kilometres from a line between the following coordinates:

- latitude 36° 53' 27" S, longitude 143° 01' 42" E
- latitude 37° 02' 13" S and longitude 142° 58' 57" E.

A list of the flora and fauna species recorded in the search region was obtained from the *Victorian Biodiversity Atlas* (VBA), a database administered by DEECA.

The online EPBC Act *Protected Matters Search Tool* (DAWE 2022a) was consulted to determine whether nationally listed species or communities potentially occurred in the search region based on habitat modelling.

13.2.1. Field Methodology

The field assessment was conducted over 10 days from the 12th to 16th October and 9th to 13th November 2020. The surveys were conducted by a team of five experienced field staff from Nature Advisory. Prior to the field assessment, aerial photography (Nearmap 2020) and NVIM modelled native vegetation extent mapping (DELWP 2020a) were reviewed in order to attempt to gain a general understanding of the extent and types of native vegetation that could be expected to occur within the study area.

During the field assessment, the study area was surveyed by combination of 4WD vehicle and on foot where access was granted, and sites found to support native vegetation and/or the potential to support listed matters were broadly mapped via aerial photograph interpretation and ground-truthing.

Areas which were difficult to access (due to factors such as patch size, steep terrain and absence of vehicle tracks) or were no access was granted were surveyed with binoculars from the closest suitable vantage point.

Please note that the 'habitat hectares' methodology was not used to determine the detailed extent and condition of native vegetation (in accordance with the Guidelines) in the study area. In addition, the occurrence of listed ecological communities or species modelled to occur in the study area was not confirmed, but rather highlighted as having the potential to occur or otherwise.

Native vegetation

Native vegetation is defined as in Section 5.2.2.

Patches of native vegetation within the assessment corridor were not individually mapped. Rather, properties were categorised based on the abundance of native vegetation occurring within them, and large contiguous areas of native vegetation were mapped in order to guide layout design to avoid properties supporting large quantities of native vegetation.

Flora species and habitats

The potential for habitats to support listed flora species was assessed based on the criteria outlined below:

- The presence of suitable habitat for flora species such as soil type, floristic diversity and intactness of ground layer vegetation; and
- The level of disturbance of suitable habitats due to anthropogenic disturbances, grazing pressure and invasions by pest plants and animals.

Wherever appropriate, a precautionary approach was adopted in determining the likelihood of occurrence or flora listed under the EPBC Act and/or FFG Act. That is, where insufficient evidence was available on the potential occurrence of a listed species, it is assumed that it could be in an area of suitable habitat.

Fauna species and habitats

The techniques below were used to detect fauna species utilising the study area.

- Incidental searches for mammal scats, tracks and signs (e.g. diggings, signs of feeding and nests/burrows)
- Turning over logs/rocks and other ground debris for reptiles, frogs and mammals
- Daytime bird observations.
- General searches for reptiles and frogs; including identification of frog calls in seasonally wet areas.

Fauna habitat was assessed based on the criteria detailed below. These are based on habitat preferences by threatened fauna. Three fauna constraint categories were used, as described below.

Swift Parrot habitat

The Swift Parrot is listed as critically endangered under the Commonwealth EPBC Act, listed as threatened under the state FFG Act and listed as endangered under the Victorian Advisory list (DSE 2013). In western Victoria, the key tree species that the Swift Parrot uses to forage includes the following.

- Grey Box *Eucalyptus macrocarpa*,
- Yellow Box *E. melliodora*,
- Yellow Gum *E. leucoxylon* and/or
- Red Ironbark *E. sideroxylon* (Saunders & Tzaros 2011).

Areas within the study area where the above listed trees were present were marked on a map as Swift Parrot habitat.

High fauna constraint

Other fauna species that have the potential to occur in the study area and are listed under the EPBC Act include the Painted Honeyeater and Pink-tailed Worm-Lizard. The Brolga has been mapped under the high constraints also as there are significant implications for wind farm developments for mitigating impacts on this species. Due to high collision rates of Wedge-tailed Eagles with turbines, all nesting sites observed in the study area have been plotted and a 300-metre buffer has been applied around nesting sites.

The Painted Honeyeater forages on mistletoe in the upper canopy of trees. It feeds almost exclusively on mistletoe fruits but will also feed on the nectar of mistletoe and insects (Higgins *et al*. 2001). Areas where mistletoe was abundant have been marked on a map.

The Pink-tailed Worm-Lizard is found in habitats that generally include rocky outcrops or scattered partly buried rocks. This species is diurnal and largely fossorial, sheltering under rocks and vegetation, and in the burrow passages of small ants and termites within grassland and woodland habitats of south-eastern Australia (Robertson & Coventry 2019). The population from Bendigo occurs in box-ironbark habitats with a high cover of rocks. There are similar habitats on site that have been identified and marked on a map.

Brolga breed in wetlands that can hold water for 3-4 months during the breeding season from July – November (Marchant & Higgins 1993). The study area is within a very dry area that does not receive a high amount of rainfall. Many of the wetlands are unlikely to hold water long enough to support a breeding pair of Brolga. Only one wetland on the western edge of the north-south transmission line may have the potential to hold water for 3-4 months during the breeding season and has been marked on the biodiversity constraints map.

Wedge-tailed eagle nest in trees about three quarters of the way up. Wedge-tailed Eagles will have several nesting sites in their territory. They tend to rotate which nest they will use from year to year. Several Wedge-tailed Eagle nesting sites were observed across the study area. All Wedge-tailed Eagle nesting sites observed were marked on a map and a 200-metre buffer was applied around them.

Low fauna constraint

Other fauna species that have potential to occur within the study area and have lower constraints include the Barking Owl, Squirrel Glider, Brush-tailed Phascogale and Common Dunnart.

The Barking Owl inhabits eucalyptus dominated forests and woodlands, commonly near water-bodies, such as streams and rivers, and requires hollow bearing trees for nesting and trees with dense foliage for roosting (Higgins 1999). Nesting trees more likely to be used in the study area are River Red-gum along the creeks or scattered paddock trees. More likely to use the denser Yellow Box or Grey Box for roosting trees.

The Squirrel Glider inhabits River Red-gum forest and box-ironbark forest and woodland in western Victoria. The species relies on hollow bearing trees for nesting and breeding. It forages on blossoms though will also forage on the sap of acacia trees including Silver Wattle, Black Wattle Golden Wattle and Lightwood (DSE 2003) when blossoms are not in flower. Important habitat for this species is remnant vegetation along roadsides and creek and river frontages (The Australian Museum Trust 1995).

The Brush-tailed Phascogale is usually arboreal spending the majority of its time foraging in large trees, especially on dead branches, spiralling up tree trunks and running along or underneath tree branches (The Australian Museum Trust 1995). It is typically associated with box-ironbark and stringybark dominated habitats. It relies on hollow bearing trees for nesting and shelter.

The Common Dunnart is a ground dwelling marsupial mammal that inhabits woodland, open forest and heathland (The Australian Museum Trust 1995). Potential habitat for this species occurs in areas that have been revegetated and have rocks and fallen branches and logs that can be used for cover.

Threatened ecological communities

The potential for EPBC Act-listed and FFG Act-listed threatened ecological communities to occur in the study area was determined by checking general field observations, particularly the presence of relevant canopy tree species and understorey diversity, against published descriptions of relevant listed ecological communities modelled to potentially occur in the study area.

13.2.2. Limitations of field assessment

The overview field assessment was carried out in mid-late spring when the majority of annual and/or seasonally-emergent plant species are actively growing or are in the flowering stage of their life-cycle. In addition, most of the fauna are breeding, and habitat characteristics are easily identified. The timing of the survey and condition of vegetation was therefore considered suitable to ascertain the broad extent of native vegetation and potential for listed flora matters and constraints, as well as the presence of threatened fauna.

Areas which were difficult to access (due to factors such as patch size and absence of vehicle tracks) were surveyed with binoculars from the closest suitable vantage point.

The large size of the study area combined with the limited extent of vehicular tracks meant that certain areas were either difficult or impractical to ground-truth. In these situations, areas were surveyed from the closest possible vantage point with binoculars to identify their potential to support listed matters – i.e. dominant canopy tree species, the presence of understorey vegetation.

There were vast areas of grassland that have the potential to support Golden Sun Moth. These areas were impractical to map as they covered very large areas and insufficient survey time was available to map them. Habitat assessments will be required to determine areas of suitable Golden Sun Moth habitat.

The review of existing information combined with the field survey was considered ample to achieve the main objective of this investigation, which was to broadly map the extent of native vegetation in the study area and identify key biodiversity constraints for the proposed wind farm.

Wherever appropriate, a precautionary approach was adopted in the discussion of implications. That is, where insufficient evidence was available on the occurrence or potential occurrence of a species, it was assumed that it could be in an area of suitable habitat. The implications under legislation and policy were considered accordingly.

13.3. Results

13.3.1. Site description

The study area for this investigation was approximately 90 hectares of predominantly private land in central Victoria, located south-west of Navarre and extending southwards to Joel Joel Nature Conservation Reserve, approximately 20 kilometres north-east of Stawell and 110 kilometres west of Bendigo (Figure 1).

The study area is dominated by gently undulating plains and flat basins associated with rivers and creeklines. The study area supports well-drained sodic soils with poorer drainage in low-lying areas. These soils comprised fluvial gravel, sand and silt with a sandy loam (silty) surface texture (Agriculture Victoria 2019).

The study area supports a number of waterbodies comprising artificial dams throughout the study area, naturally-occurring ponds and billabongs in association with creeks and waterways, and wetlands along the western edge of the assessment corridor. The Wimmera River runs south-east to north-west through the study area, branching off into Heifer Station Creek, Six Mile Creek, Morrl Morrl Creek and a number of unnamed drainage lines.

The majority of remnant treed vegetation has been cleared from the study area, with much of the remaining treed vegetation occurring within road reserves and along waterways. The study area and surrounds predominantly supports livestock grazing (mostly sheep) and dryland cropping.

Native vegetation in the study area was most commonly represented by Grassy Woodland and Plains Woodland on the plains, and Creekline Grassy Woodland along waterways. Other less common vegetation types observed in the study area included Riparian Woodland and Alluvial Terraces Herb-rich Woodland along major watercourses. Vegetation in the study area was dominated by exotic pasture grasses and crops, although scattered remnant native trees were common throughout. More information regarding native vegetation in the study area is provided in Section 13.3.2.

Fauna habitat within the study area comprised remnant treed habitats, native grasslands and linear creek-line habitats. Much of the area has been cleared of trees for agricultural purposes and these areas provide limited habitat for native fauna.

The study area borders the southwest extent of the Kara Kara Conservation Management Network (CMN). The network is of high ecological importance, as it contains the largest remnants of temperate woodland left in the region and is managed for many listed species. While the study area is not within this network, it is close to Morrl Morrl Conservation Reserve and Joel Joel Nature Conservation Reserve, and contains several important waterway habitat corridors. Creekline and roadside vegetation natural bio links for the movement of wildlife in the region.

The study area lies within the Goldfields and Wimmera bioregions and the Victorian Midlands IBRA Bioregion, and falls within the Wimmera CMA area, and the Northern Grampians local government area.

13.3.2. Native vegetation

Pre–European EVC mapping (DELWP 2022a) indicated that the study area and surrounds would have supported Box Ironbark Forest (EVC 61), Alluvial Terraces Herb-rich Woodland (EVC 67), Creekline Grassy Woodland (EVC 68), Plains Grassland (EVC 132) Low Rises Grassy Woodland (EVC 175_61), Creekline Sedgy Woodland (EVC 640), Riparian Woodland (EVC 641) and Plains Woodland (EVC 803) prior to European settlement based on modelling of factors including rainfall, aspect, soils and remaining vegetation.

Evidence on site, including floristic composition and soil characteristics, suggested that Alluvial Terraces Herb-rich Woodland (EVC 67), Creekline Grassy Woodland (EVC 68), Low Rises Grassy Woodland (EVC 175_61), Creekline Sedgy Woodland (EVC 640), Riparian Woodland (EVC 641) and Plains Woodland (EVC 803) were present, mostly within the roadside reserves along the proposed transmission line route and in association with the several waterways which the study area bisects.

Details of where indigenous vegetation is likely to occur in the study area are shown in Figure 17 and descriptions of these vegetation types are provided in Table 28.

Table 28: Native vegetation categories and descriptions recorded within the transmission line route

EVC	Description
Alluvial Terraces Herb-rich Woodland (EVC 67)	Occurs in study area as open woodland and derived grasses and herbs on alluvial soils adjacent to waterways and within smaller ephemeral drainage lines. Understory contains few shrubs, being dominated by a diverse assemblage of herbs and grasses on moist sandy clay/loams with a high level of bare ground.
Creekline Grassy Woodland (EVC 68)	Dominant vegetation class along waterways and drainage lines throughout the study area. Comprises a canopy of mainly River Red-gum with Yellow Gum, Yellow Box and occasional Grey Box over a variable understory of shrubs, graminoids and herbs which is absent in many heavily grazed or cropped farmland areas. These minor drainage lines can include a range of aquatic and semi-aquatic graminoid and herbaceous species tolerant of waterlogged soils, and are presumed to sometimes resembled a linear wetland or system of interconnected small ponds.
Low Rises Grassy Woodland (EVC 175_61)	Most common vegetation class in the study area, occurring across the gently undulating plains on slight rises and in road reserves. Occurs predominantly as derived grass-dominated vegetation, but an open canopy of Grey Box, Yellow Box, Yellow Gum and occasional Buloke persists in road reserves and scattered sparsely throughout farmland.
Creekline Sedgy Woodland (EVC 640)	Vegetation class occuring sporadically along waterways and drainage lines throughout the study area. Comprises a canopy of mainly River Red-gum with Yellow Gum, Yellow Box and occasional Grey Box, and is differentiated from Creekline Grassy Woodland (EVC 68) by having an understory dominated by a diversity of aquatic and semi-aquatic sedges and herbs.
Riparian Woodland (EVC 641)	Occurs beside large waterways in the study area, particularly the Wimmera River. Tall woodland dominated by River Red-gum with a diverse understory of graminoids, semi-aquatic herbs and shrubs variously impacted by grazing.
Plains Woodland (EVC 803)	Second most common vegetation class in the study area, occurring on the plains in lower-lying areas than Low Rises Grassy Woodland (EVC 175_61), and often near to waterways. Occurs predominantly as an open woodland dominated by Yellow Box, Grey Box and Yellow Gum including occasional River Red-gum and Buloke, although in some areas only derived understory vegetation remains. Understory is dominated by grasses, but includes shrubs and herbs.

Scattered trees

Scattered trees were not recorded during the field assessment, but their relative abundance throughout properties in the study area was noted. Scattered trees were largely found throughout paddocks as remnants of woodland which had been cleared for agriculture, and consisted predominantly of Yellow Box, Grey Box, Yellow Gum and River Red-gum as well as Buloke.

Scattered trees in the study area would largely have once comprised the canopy components of Low Rises Grassy Woodland (EVC 175_61) and Plains Woodland (803).

The majority of the large trees contained hollows.

13.3.3. *Listed flora species*

VBA records (DELWP 2020d) and the EPBC Protected Matters Search Tool (DAWE 2020a) indicated that within the search region there were records of, or there occurred potential suitable habitat for, 24 species listed under the Commonwealth EPBC Act and 39 listed under the state FFG Act, including 21 listed under both Acts. No flora species listed under the EPBC Act were recorded during the field survey.

The likelihood of occurrence in the study area of species listed under the EPBC Act and FFG Act is addressed in Table 29. Species considered 'likely to occur' are those that have a very high chance of being in the study area based on numerous records in the search region and suitable habitat in the study area. Species considered to have the 'potential to occur' are those for which suitable habitat exists, but recent records are scarce.

This analysis indicates that the following 10 listed flora species are likely to occur or have the potential to occur:

- Buloke (FFG Act: Vulnerable);
- Common Beard-heath (FFG Act: Endangered);
- Fringed Sun-orchid (FFG Act: Vulnerable);
- Golden Cowslips (FFG Act: Endangered);
- Green-striped Greenhood (EPBC Act: Vulnerable; FFG Act: Endangered);
- Hairy Tails (FFG Act: Critically Endangered);
- Pale-flower Crane's-bill (FFG Act: Endangered);
- River Swamp Wallaby Grass (EPBC Act: Vulnerable);
- Tawny Spider-orchid (EPBC Act: Endangered; FFG Act: Endangered); and
- Tiny Bog-sedge (FFG Act: Endangered).

Table 29: Listed flora species and the likelihood of their occurrence in the transmission line study area

Common Name	Scientific name	EPBC	FFG	FFG-P	Habitat	Number of records	Date of last record	Likelihood of occurrence
Buloke	*Allocasuarina luehmannii*		VU	P	Woodlands on non-calcareous soils. Commonly grows with Grey Box (Entwisle 1996).	17	5/12/2014	Numerous trees recorded in the study area during the field assessment. **Does occur**
River Swamp Wallaby-grass	*Amphibromus fluitans*	VU			River Swamp Wallaby-grass grows mostly in permanent swamps and also lagoons, billabongs, dams and roadside ditches. The species requires moderately fertile soils with some bare ground; conditions that are caused by seasonally-fluctuating water levels (DAWE 2020).	None	N/A	Study area crosses multiple streams and areas potentially prone to inundation, and species is known to opportunistically establish. No nearby records, but species distribution poorly defined. **Potential to occur.**
Goldfield Boronia	*Boronia anemonifolia subsp. aurifodina*		EN	p	Apparently endemic in mallee communities between Bolangum (north of Stawell) and Rushworth.	2	12/09/2011	No Mallee vegetation present in study area. Nearby records are restricted to Morrl Morrl conservation reserve in Box Ironbark Forest, which does not occur along the transmission line corridor. **Unlikely to occur.**
McIvor Spider-orchid	*Caladenia audasii*	EN	CR	p	Dry box ironbark forest in central Victoria, from Bendigo to Stawell on auriferous soils containing buckshot. Known to occur in three populations; Bendigo, Kingower and Deep Lead (Todd 2000).	None	N/A	Box Ironbark vegetation does not occur in transmission line corridor. No nearby records. **Unlikely to occur.**
Red-cross Spider-orchid	*Caladenia cruciformis*		EN	p	Endemic to Victoria where known only from heathy open forests between Stuart Mill and Dalyenong in the western goldfields on sandy loams.	2	1/09/2010	Nearby records, but geographical range known to be highly restricted, and study area does not contain habitat. **Unlikely to occur.**

Common Name	Scientific name	EPBC	FFG	FFG-P	Habitat	Number of records	Date of last record	Likelihood of occurrence
Tawny Spider-orchid	*Caladenia fulva*	EN	EN	p	Drier forest with a sparse understorey. Grows on slopes and ridges in well-drained soil (Jones 2006).	3	14/09/2010	Overview survey indicates majority of habitat sub-optimal and degraded, but nearby records and potential for small pockets of higher quality habitat occur. **Potential to occur.**
Ornate Pink-fingers	*Caladenia ornata*	VU	EN	p	Heathy forest and among shrubs on seasonally moist sandy loams (Jones 2006).	None	N/A	Overview survey indicates majority of habitat sub-optimal and degraded. No nearby records. **Unlikely to occur.**
Veined Spider-orchid	*Caladenia reticulata s.s.*		EN	p	Confined to a small area of western Victoria in the vicinity of Stawell, where it grows in Box-ironbark forest (Jeanes & Backhouse 2006).	1	26/09/1992	Nearby records, but geographical range known to be highly restricted, and study area does not contain habitat. **Unlikely to occur.**
Rigid Spider-orchid	*Caladenia tensa*	EN		p	Known to occur in Eucalyptus and Callitris woodland in well-drained sandy loams, among shrubs. Widespread within and near Little Desert. (Jones 2006).	None	N/A	No nearby records, and no Callitris woodland recorded in study area. **Unlikely to occur.**
Candy Spider-orchid	*Caladenia versicolor*	VU	EN	p	Restricted to the western part of the Midlands region in the vicinity of Stawell, in woodland on winter-wet sandy loam.	None	N/A	Range known to be restricted to the west of the study area. No nearby records. **Unlikely to occur.**
Matted Flax-lily	*Dianella amoena*	EN	CR	P	Lowland grassland and grassy woodlands on well-drained to seasonally waterlogged fertile sandy loams to heavy cracking soils derived from sedimentary or volcanic Geology. It is widely distributed from eastern to south-western Victoria (DAWE 2020).	None	N/A	Study area occurs to the north of known distribution. Overview survey indicates majority of habitat sub-optimal and degraded. No nearby records. **Unlikely to occur.**

Common Name	Scientific name	EPBC	FFG	FFG-P	Habitat	Number of records	Date of last record	Likelihood of occurrence
Golden Cowslips	*Diuris behrii*		EN	p	Flat Grassy areas on heavy soils (Entwisle 1994).	2	10/11/2013	Majority of soils throughout study area are known to be skeletal and well-draining, but nearby records and potential for small pockets of suitable habitat occur. **Potential to occur.**
Broad-lip Diuris	*Diuris X palachila*		EN	p	Flat Grassy areas on heavy soils (Jeanes & Backhouse 2006).	1	18/10/1980	Majority of soils throughout study area are known to be skeletal and well-draining. No nearby recent records. **Unlikely to occur.**
Trailing Hop-bush	*Dodonaea procumbens*	VU			Grows in low lying, often winter wet areas in woodland, low open-forest heathland and grasslands on sands and clays. Largely confined to SW of Victoria (DAWE 2020).	None	N/A	Overview survey indicates majority of habitat sub-optimal and degraded. No nearby records. **Unlikely to occur.**
Pale-flower Crane's-bill	*Geranium sp. 3*		EN		Open, grassy areas of dry woodlands and forests (Smith 1999).	1	15/10/2005	Overview survey indicates majority of habitat sub-optimal and degraded, however treed roadside vegetation and some derived grassland still provide habitat. **Potential to occur.**
Clover Glycine	*Glycine latrobeana*	VU	VU	P	Found across south-eastern Australia in native grasslands, dry sclerophyll forests, woodlands and low open woodlands with a grassy ground layer. In Victoria, populations occur in lowland grasslands, grassy woodlands and sometimes in grassy heath (DAWE 2020).	None	N/A	Overview survey indicates majority of habitat sub-optimal and degraded. No nearby records. **Unlikely to occur.**

Common Name	Scientific name	EPBC	FFG	FFG-P	Habitat	Number of records	Date of last record	Likelihood of occurrence
Grampians Goodenia	*Goodenia lineata*		VU		Endemic to Victoria. Known only from the Grampians, Mt Clay and the lower Glenelg River area, usually in heathland on sandy soils.	1	5/11/1996	Study area outside of known range. Overview survey indicates majority of habitat sub-optimal and degraded. No nearby recent records. **Unlikely to occur.**
Square Raspwort	*Haloragis exalata var. exalata*	VU			Apparently confined to the south-west coast between the Glenelg River and Curdies River where it grows in damp riparian habitats (Jeanes 1996).	1	18/09/2008	Study area outside of known range. Overview survey indicates majority of habitat sub-optimal and degraded. **Unlikely to occur.**
Adamson's Blown-grass	*Lachnagrostis adamsonii*	EN	EN	P	Confined to slow moving creeks, swamps, flats, depressions or drainage lines that are seasonally inundated or waterlogged and usually moderately to highly saline. Appear to favour sites that have some shelter from the wind (DAWE 2020).	None	N/A	Study area outside of known range. Overview survey indicates majority of habitat sub-optimal and degraded. **Unlikely to occur.**
Spiny Peppercress	*Lepidium aschersonii*	VU	EN	P	The Spiny Peppercress occurs in periodically wet sites such as gilgai depressions and the margins of freshwater and saline marshes and shallow lakes, usually on heavy clay soil. Almost all sites receive some degree of soil waterlogging or seasonal flooding.	None	N/A	Study area outside of known range. Heavy clay soils not known to occur in study area. Overview survey indicates majority of habitat sub-optimal and degraded. **Unlikely to occur.**

Common Name	Scientific name	EPBC	FFG	FFG-P	Habitat	Number of records	Date of last record	Likelihood of occurrence
Winged Peppercress	*Lepidium monoplocoides*	EN	EN	P	Occurs predominantly in mallee scrub in semi-arid areas. Sites are seasonally moist to water-logged with heavy, fertile soils and a mean annual rainfall of around 300 to 500 mm. The predominant vegetation is usually an open-woodland dominated by *Allocasuarina leuhmannii* and/or eucalypts, particularly *Eucalyptus largiflorens* (Black Box) or *Eucalyptus populnea* (Poplar Box). The field layer of the surrounding woodland is dominated by tussock grasses (notably *Danthonia spp.* and *Stipa spp.*), but the seasonally waterlogged sites preferred by Winged Pepper-cress also support a number of moisture dependent herbs, such as Marsilea spp. Also known from riparian woodland (e.g. Gunbower Is.) (DAWE 2020).	None	N/A	No Mallee vegetation present in study area. Lack of associated species. No nearby records. **Unlikely to occur.**
White Sunray	*Leucochrysum albicans subsp. tricolor*	EN	EN	p	Occurs in a wide variety of grassland, woodland and forest habitats, generally on relatively heavy soils. Plants can be found in natural or semi-natural vegetation and grazed or ungrazed habitat. Bare ground is required for germination. The unpalatability of this species is likely to protect it in heavily grazed areas where patches of bare ground are likely to develop, favouring recruitment (DAWE 2020).	None	N/A	Study area outside of known range. Heavy soils limited within study area. Overview survey indicates majority of habitat sub-optimal and degraded. No nearby records. **Unlikely to occur.**

Common Name	Scientific name	EPBC	FFG	FFG-P	Habitat	Number of records	Date of last record	Likelihood of occurrence
Common Beard-heath	*Leucopogon virgatus var. brevifolius*		EN	p	Rather uncommon on heathland and heathy woodland on deep sands from the Douglas-Edenhope area in the south west to northern fringe of Little desert (Powell et al. 1996).	3	16/10/2005	No deep sands known to occur in study area, but nearby records occur and some pockets of suitable habitat may be identified in detailed site assessment. **Potential to occur.**
Spiny Rice-flower	*Pimelea spinescens subsp. spinescens*	CR	CR	p	Occurs in grassland or open shrubland on basalt derived soils, usually comprising black or grey clays. Plants from more northerly populations occur on red clay complexes, while plants from southern populations occur on heavy grey-black clay loams. Topography is generally flat but populations may occur on slight rises or in slightly wettish depressions.	None	N/A	Study area outside of known range. Heavy soils limited within study area. Overview survey indicates majority of habitat sub-optimal and degraded. No nearby records. **Unlikely to occur.**
Pomonal Leek-orchid	*Prasophyllum subbisectum*	EN	CR	p	Well-drained gravelly loam in heathy woodland (Jones 2006).	None	N/A	Study area outside of known range. Overview survey indicates majority of habitat sub-optimal and degraded. No nearby records. **Unlikely to occur.**
Green-striped Greenhood	*Pterostylis chlorogramma*	VU	EN	p	Occurs in mixed Box-Stringybark forest with a shrubby understorey, often with Pteridium esculentum as a major component on sandy or clay loam soils (Duncan et al. 2009).	None	N/A	No nearby records, but range poorly understood and records occur both east and west of study area. Some suitable Box-Stringybark forest occurs. **Potential to occur.**
Hairy Tails	*Ptilotus erubescens*		CR	P	Fertile soils with grassland and woodland communities (Walsh 1996).	1	4/12/1995	Recorded within Navarre wind farm site during detailed survey. Woodland and derived grassland communities known to occur. **Potential to occur.**

Common Name	Scientific name	EPBC	FFG	FFG-P	Habitat	Number of records	Date of last record	Likelihood of occurrence
Button Wrinklewort	*Rutidosis leptorhynchoides*	EN	EN	p	In Victoria restricted to open stands of plains grassland and grassy woodlands, on fertile clays to clay loams, usually in areas where the grass cover is more open, either as a result of recurrent fires or grazing by native macropods or stock. It also occurs on low rises with shallow, stony soils at less than 100 m above sea level.	None	N/A	Study area outside of known range. Heavy soils limited within study area. Overview survey indicates majority of habitat sub-optimal and degraded. No nearby records. **Unlikely to occur.**
Tiny Bog-sedge	*Schoenus nanus*		EN		Seasonally wet areas	3	16/10/2005	Study area crosses multiple streams and areas potentially prone to inundation, and species is known to opportunistically establish. Nearby records. **Potential to occur.**
Large-headed Fireweed	*Senecio macrocarpus*	VU	CR	p	In Victoria, Large-fruit Fireweed occurs most commonly in grasslands on red-brown earth soils. It may also occur in grassy woodlands and open woodlands predominantly in the Western (Basalt) Plains grassland on red brown earth soils found on recent Quaternary (basalt) deposits (DAWE 2020).	None	N/A	Study area outside of known range. Soils within study area are largely skeletal. Overview survey indicates majority of habitat sub-optimal and degraded. No nearby records. **Unlikely to occur.**
Fringed Sun-orchid	*Thelymitra luteocilium*		VU	p	Scattered and rare in Victoria, often in moist depressions. Grows among low shrubs in open forest, mallee scrub or in open rocky sites in well-drained and moisture-retentive soils (Weber & Entwisle 1994).	2	9/10/1981	At least some suitable soils occur throughout study area, and distribution is not well understood. Nearby records and potential for small pockets of suitable habitat occur. **Potential to occur.**

Common Name	Scientific name	EPBC	FFG	FFG-P	Habitat	Number of records	Date of last record	Likelihood of occurrence
Brilliant Sun-orchid	*Thelymitra mackibbinii*	VU	CR	p	*Eucalyptus leucoxylon* woodland within box ironbark forest in central and western Victoria (Jeanes & Backhouse 2006).	1	23/09/2013	Study area south-east of known range, and no box ironbark forest occurs within study area. Overview survey indicates majority of habitat sub-optimal and degraded. **Unlikely to occur.**
Spiral Sun-orchid	*Thelymitra matthewsii*	VU	EN	p	Slightly elevated sites to 300m in well-drained soils (sandy loams to gravelly limestone soils) in light to dense forest; sometimes in coastal sandy flats (Weber & Entwisle 1994).	None	N/A	Study area east of known range, and overview survey indicates majority of habitat sub-optimal and degraded. No nearby records. **Unlikely to occur.**

Notes: EPBC = threatened species status under EPBC Act (EX = presumed extinct in the wild; CR = critically endangered; EN = endangered; VU = vulnerable); FFG = threatened species status under the FFG Act.

13.3.4. Listed fauna species

Listed fauna species have not specifically been investigated for the transmission line yet but are assumed to be similar to investigations for the wind farm site. Once a detailed layout of the transmission line is finalised, impacts to listed fauna species will be assessed in more detail.

13.3.5. Listed ecological communities

The EPBC Protected Matters Search Tool (DAWE 2020a) indicated that six ecological communities listed under the EPBC Act had the potential to occur in the search region (Table 30). Their occurrence in the study area was determined based on an assessment of general field observations against published descriptions and condition thresholds for these communities.

Table 30: EPBC Act listed ecological communities and likelihood of occurrence in the study area

Ecological Community	EPBC Status	Occurrence in the study area
Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions	EN	This community occurs within the Murray Darling Depression and IBRA Riverina Bioregions (Cheal *et al* 2011), while the study area falls within the Victorian Midlands IBRA Bioregion (DELWP 2022a). **Does not occur.**
Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia	EN	Several habitat zones in the broader wind farm area meet the criteria for listing as this community. Multiple areas within the transmission corridor are dominated by Grey Box and grassland vegetation likely derived from Grey Box woodland, particularly on slight rises on undulating plains. **Likely to occur.**
Mallee Bird Community of the Murray Darling Depression Bioregion	EN	This community occurs within the Murray Darling Depression, while the study area falls within the Victorian Midlands IBRA Bioregion (DELWP 2022a). No Mallee vegetation was recorded within the study area, however several species which occur within mallee communities such as Red Stringybark, Buloke, Common Fringe-myrtle and Wirilda occur throughout the study area. **Does not occur.**
Natural Grasslands of the Murray Valley Plains	CR	This community occurs predominately across the southern parts of the Riverina IBRA Bioregion and extends into parts of the Murray Darling Depression and NSW South-Western Slopes IBRA Bioregions (TSSC 2012), while the study area falls within the Victorian Midlands IBRA Bioregion (DELWP 2022a). In addition, this community only includes grasslands which are not derived from previously treed vegetation. Treeless grassland is only modelled to occur within the study area on the western edge of the assessment corridor, and the abundance of large remnant scattered trees observed throughout the study area further indicates that natural grassland is not present. **Unlikely to occur.**
Plains mallee box woodlands of the Murray Darling Depression, Riverina and Naracoorte Coastal Plain Bioregions	CR	This community occurs within the Murray Darling Depression and IBRA Riverina Bioregions (Cheal *et al* 2011), while the study area falls within the Victorian Midlands IBRA Bioregion (DELWP 2022a). Its southern extent occurs in the Little Desert and extends eastwards towards Charlton, Boort and Kerang. The study area lies roughly 50km south of the extent of this community. Mallee vegetation was not recorded anywhere within the study area. **Does not occur.**

Ecological Community	EPBC Status	Occurrence in the study area
White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland	CR	Several habitat zones in the broader wind farm area meet the criteria for listing as this community. Many areas within the study area comprise woodland dominated by Yellow Box, and derived grasslands where Yellow Box is likely to have once been the dominant canopy species prior to clearing, particularly on open plains near to waterways and drainage lines. **Likely to occur.**

Notes: EPBC = status under the EPBC Act (CR = Critically Endangered; EN = Endangered; VU = Vulnerable).

In addition, the following ecological community listed as threatened under the FFG Act is considered likely to occur given its presence in the wider wind farm area and the abundance of Buloke and Grey Box throughout the study area:

- Grey Box – Buloke Grassy Woodland Community.

Figure 17-1: Study area and native vegetation removal - Transmission Line

Project: Navarre Wind Farm
Client: Neoen
Date: 9/06/2023

Wind farm boundary
Construction corridor (40m)
Turbines

Native vegetation

Large tree in patch
Tree to be removed
Box Ironbark Forest (EVC 61)
Plains Woodland (EVC 803)
Native vegetation to be removed

Potential listed flora

Listed Grey Box community

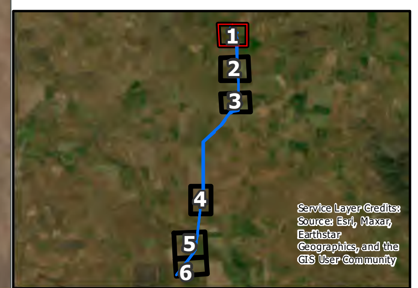

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Figure 17-2: Study area and native vegetation removal - Transmision Line

Project: Navarre Wind Farm
Client: Neoen
Date: 9/06/2023

Wind farm boundary
Construction corridor (40m)

Threatened species

Allocasuarina - Buloke
Plains Woodland (EVC 803)
Native vegetation to be removed

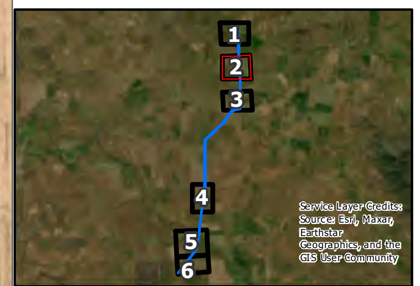

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Figure 17-3: Study area and native vegetation removal - Transmision Line

Project: Navarre Wind Farm
Client: Neoen
Date: 9/06/2023

- Wind farm boundary
- Construction corridor (40m)
- DELWP wetland
- Creekline Grassy Woodland (EVC 68)
- Riparian Woodland (EVC 641)
- Plains Woodland (EVC 803)
- Native vegetation to be removed

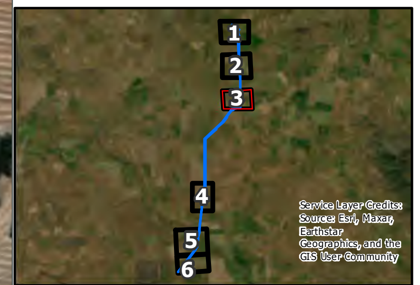

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Figure 17-4: Study area and native vegetation removal - Transmission Line

Project: Navarre Wind Farm
Client: Neoen
Date: 9/06/2023

Wind farm boundary
Construction corridor (40m)
Tree Protection Zone (TPZ)

Native vegetation

Large scattered tree
Tree to be removed
Low Rises Grassy Woodland (EVC 175_61)
Native vegetation to be removed

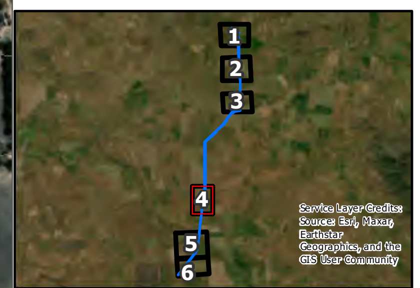

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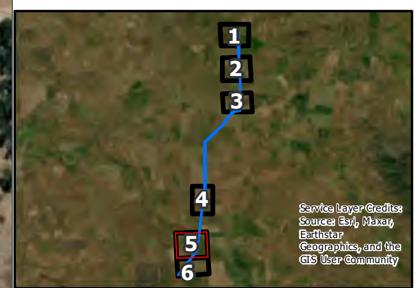
Figure 17-5: Study area and native vegetation removal - Transmision Line

Project: Navarre Wind Farm
Client: Neoen
Date: 9/06/2023

Wind farm boundary
Construction corridor (40m)
DELWP wetland
Tree Protection Zone (TPZ)

Native vegetation

Large scattered tree
Tree to be removed
Creekline Grassy Woodland (EVC 68)
Riparian Woodland (EVC 641)
Plains Woodland (EVC 803)
Native vegetation to be removed



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Metres
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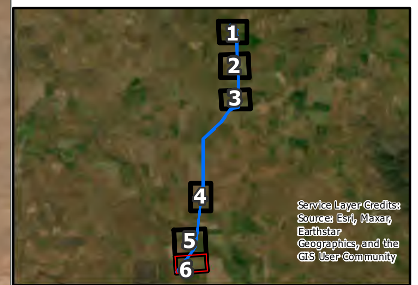
Figure 17-6: Study area and native vegetation removal - Transmision Line

Project: Navarre Wind Farm
Client: Neoen
Date: 9/06/2023

Wind farm boundary
Construction corridor (40m)
Tree Protection Zone (TPZ)

Native vegetation

Large scattered tree
Tree to be removed
Creekline Grassy Woodland (EVC 68)
Native vegetation to be removed



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13.4. Transmission line impacts

A preliminary assessment of the potential impacts arising from the preferred transmission line route has been undertaken by assuming the following:

- A 10-metre-wide disturbance footprint along the entire length of the transmission line; and
- A 40-metre-wide disturbance footprint where the transmission line will cross woody vegetation along road reserves or watercourses, to allow for clearance associated with electrical safety guidelines.

This footprint has been overlaid with the native vegetation mapped during the overview assessment. DEECA modelled scores have been used in the calculation of offset requirements. Native vegetation removal associated with the wind farm have been included as 'past removal' to account for cumulative impacts. This preliminary assessment is considered a 'worst-case' scenario, as detailed design of the transmission line will strive to avoid and minimise impacts to native vegetation where possible. Recommendations to be implemented during detailed design are included in Section 13.5 below.

13.5. Design Recommendations

Recommendations for the transmission line route design are provided below to assist in meeting the avoid and minimise principles of the Guidelines.

- Avoid and minimise removal of indigenous remnant patch vegetation. Detailed information gathered from fine scale mapping and a habitat hectare assessment will provide further guidance for avoidance and minimisation.
- Site the transmission line and access tracks to avoid and minimise removal of scattered trees where possible.
- In areas where removal of indigenous vegetation cannot be avoided, minimise the area to be removed. For example, vehicle access, pole placement and clearance to account for line-sway should be the sole vegetation removal causes. Lay-down areas, parking and site amenities should be located outside areas of native vegetation.
- Where practicable, transmission line works should be sited at least thirty metres away from wetlands and waterbodies, and towers should be located more than 50 metres from the edge of waterways edge to prevent erosion and potential incident during construction.
- Transmission tower structure should be chosen to optimise span length and/or height across waterway areas to minimise impacts.
- Where this is not practicable and ephemeral wetlands may be unavoidably impacted, undertake works when the wetlands are dry and the risk of altering the ground surface is lowest (i.e. when the ground is hard and dry).

13.6. Impacts of proposed development

13.6.1. Native vegetation

The assessment has indicated that the preferred transmission line route could result in the loss of a total extent of 7.256 hectares of native vegetation as represented in Figure 17 and documented in the *Native Vegetation Removal* (NVR) report provided by DEECA (Appendix 13).

This comprised the following:

- 6.632 hectares of native vegetation in patches (including four large trees in patches); and
- Nine scattered trees (all assumed to be large), equating to an area loss of 0.620 hectares.

The native vegetation to be removed includes 6.436 hectares mapped as an endangered Ecological Vegetation Class. This is in addition to 3.484 hectares of removal of mapped as an endangered Ecological Vegetation Class for the wind farm, totalling 9.92 hectares for the entire project.

Once the transmission line design is finalised and detailed native vegetation mapping undertaken, the 127.515 hectares of proposed removal associated with the wind farm development will be included as past removal in the NVR report, to account for cumulative impacts. This has not been possible at this time due to the large files sizes and processing time associated with the wind farm removal.

13.6.2. Modelled species important habitat

The current proposal footprint would not have a significant impact on any habitat for any rare or threatened species as determined in Appendix 13.

13.6.3. Listed flora species

The analysis of the likelihood of occurrence of listed flora species presented in Section 13.3.3 identified that the following species could be impacted by any development in the study area:

- Buloke (FFG Act: Vulnerable);
- Common Beard-heath (FFG Act: Endangered);
- Fringed Sun-orchid (FFG Act: Vulnerable);
- Golden Cowslips (FFG Act: Endangered);
- Green-striped Greenhood (EPBC Act: Vulnerable; FFG Act: Endangered);
- Hairy Tails (FFG Act: Critically Endangered);
- Pale-flower Crane's-bill (FFG Act: Endangered);
- River Swamp Wallaby Grass (EPBC Act: Vulnerable);
- Tawny Spider-orchid (EPBC Act: Endangered; FFG Act: Endangered); and
- Tiny Bog-sedge (FFG Act: Endangered).

The presence or otherwise of the above-listed species will need to be determined following detailed native vegetation mapping and detailed design of the transmission line.

13.6.4. Threatened ecological communities

The analysis of the likelihood of occurrence of listed ecological communities in Section 13.3.5 identified that the following communities could be impacted by any development in the study area:

- *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* (EPBC Act: Endangered);
- *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (EPBC Act: Critically Endangered); and
- *Grey Box – Buloke Grassy Woodland* (FFG Act: Threatened).

The presence or otherwise of the above-listed communities will need to be determined following detailed native vegetation mapping and detailed design of the transmission line.

13.7. Implications under the Guidelines

13.7.1. Assessment pathway

The assessment pathway is determined by the location category and extent of native vegetation as detailed for the study area as follows:

- Location Category: Location 1 and 2
- **Extent of native vegetation:** A total of 7.256 hectares of native vegetation (including 13 large trees), in addition to 127.515 hectares of proposed removal associated with the wind farm development.

Based on the extent of native vegetation removal being ≥ 0.5 hectares, the Guidelines stipulate that the proposal is to be assessed under the **Detailed** assessment pathway, as determined by the following matrix:

Table 31: Assessment pathway matrix

Extent of native vegetation	Location Category		
	Location 1	Location 2	Location 3
< 0.5 hectares and not including any large trees	Basic	Intermediate	Detailed
< 0.5 hectares and including one or more large trees	Intermediate	Intermediate	Detailed
≥ 0.5 hectares	Detailed	**Detailed**	Detailed

This proposal **would** trigger a referral to DELWP based on the above criteria.

13.7.2. Offset requirements

Offsets required to compensate for the proposed removal of native vegetation from the study area as previously documented in Section 12.5.3, are as follows:

- 4.314 general habitat units and must include the following offset attribute requirements:
    - Minimum strategic biodiversity value (SBV) of 0.372.
    - Occur within the Wimmera CMA boundary or the Northern Grampians municipal district.
    - Include protection of at least 13 large trees.

Under the Guidelines all offsets must be secured prior to the removal of native vegetation.

13.8. EPBC Act

The EPBC Act protects a number of threatened species and ecological communities that are considered to be of national conservation significance. Any significant impacts on these species require the approval of the Australian Minister for the Environment.

Impacts could not be assessed based on information obtained during the current assessment for the following listed values given that detailed design and detailed ecological survey have not yet been undertaken:

- *Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia* (EPBC Act: Endangered);

- *White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland* (EPBC Act: Critically Endangered)
- Green-striped Greenhood (EPBC Act: Vulnerable);
- River Swamp Wallaby Grass (EPBC Act: Vulnerable);
- Tawny Spider-orchid (EPBC Act: Endangered)

Targeted surveys are therefore recommended to determine the status of these values in the study area and to assess any potential impacts to these values.

13.9. FFG Act

The Victorian FFG Act lists threatened and protected species and ecological communities (DELWP 2018b, DELWP 2017b). Any removal of threatened flora species or communities (or protected flora) listed under the FFG Act from public land requires a Protected Flora Permit under the Act, obtained from DELWP.

Impacts could not be assessed based on information obtained during the current assessment for the following listed values given that detailed design and detailed ecological survey have not yet been undertaken:

- Grey Box – Buloke Grassy Woodland (FFG Act: Threatened)
- Buloke (FFG Act: Vulnerable);
- Common Beard-heath (FFG Act: Endangered);
- Fringed Sun-orchid (FFG Act: Vulnerable);
- Golden Cowslips (FFG Act: Endangered);
- Green-striped Greenhood (FFG Act: Endangered);
- Hairy Tails (FFG Act: Critically Endangered);
- Pale-flower Crane's-bill (FFG Act: Endangered);
- Tawny Spider-orchid (FFG Act: Endangered); and
- Tiny Bog-sedge (FFG Act: Endangered).

Targeted surveys are therefore recommended to determine the status of these species and community in the study area and to assess any impacts to these values.

14. References

Agriculture Victoria 2020, *Victorian Soils Map,* Agriculture Victoria, Victoria, https://vro.agriculture.vic.gov.au/dpi/vro/vrosite.nsf/pages/victorian_soils_map_2014.

Allen, GR, Midgley, SH & Allen, M 2002, Field Guide to the Freshwater Fishes of Australia, Western Australian Museum, Perth.

Atlas of Living Australia (ALA) 2022, Atlas of Living Australia, CSIRO, viewed October 2022, https://www.ala.org.au/.

Australasian Bat Society – BatMap http://ausbats.org/batmap.

Australian Wind Energy Association (AusWEA) 2005, Wind Farms and Birds: Interim Standards for Risk Assessment, prepared by Brett Lane & Associates, Carlton North.

Birdline New South Wales, Recent sightings, www.eremea.com, viewed 11 June 2021.

Birdline Victoria, Recent sightings, www.eremea.com, viewed 11 June 2021.

Cadwallader, PL & Backhouse, GN 1983, A Guide to the Freshwater Fish of Victoria, Fisheries and Wildlife, Melbourne.

Carter O & Walsh N 2006, Spiny Rice-flower *Pimelea spinescens* subspecies *spinescens* - National Recovery Plan, Commonwealth of Australia

Carter, N, Cooke R, White, JG, Whisson, DA, Isaac, B & Bradsworth, N 2019, 'Joining the dots: How does an apex predator move through an urbanizing landscape?', Global Ecology and Conservation, vol. 16, pp. 1-12.

Carter, O & Walsh, N 2006, National Recovery Plan for the Spiny Rice-flower (Pimelea spinescens subspecies spinescens), Available from: http://www.environment.gov.au/biodiversity/threatened/publications/p-spinescens.html.

Cheal D, Lucas A & Macaulay L 2011, National Recovery Plan for Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions, Commonwealth of Australia.

Churchill, S 2008, Australian Bats (2nd Ed.), Allen & Enwin, Crow's Nest, NSW.

Clean Energy Council (CEC) 2018, 'Best Practice Guidelines – for Implementation of Wind Energy Projects in Australia', accessed from cleanenergycouncil.com.au, 20th November 2020.

Clemann N & Gillespie GR 2004, 'Recovery Plan for Litoria raniformis 2004 – 2008', Department of Environment and Heritage, now Department of the Environment, Canberra.

Clemann N and Loyn R 2003, Flora and Fauna Guarantee Act, Action Statement No. 116: Barking Owl *Ninox connivens*, Department of Sustainability and Environment, East Melbourne, Victoria.

Cogger H 2014. Reptiles and Amphibians of Australia. Seventh Edition. CSIRO Publishing, Collingwood. Jones SR 1992. Habitat relationships, diet and abundance of the endangered pygopodid, Aprasia parapulchella. B. App. Sc. (Honours) Thesis, University of Canberra.

Cogger, HG 2000, Reptiles and Amphibians of Australia, Reed New Holland, Sydney.

Commonwealth of Australia (CA) 2016, National Recovery Plan for the Plains-wanderer (*Pedionomus torquatus*), Commonwealth of Australia, Canberra;

Commonwealth of Australia 2019, National Recovery Plan for the Swift Parrot (*Lathamus discolor*), Department of Agriculture, Water and Environment, Canberra.

DAWE 2013, *Draft survey guidelines for Australia's threatened orchids*, Department of Agriculture, Water and the Environment, Canberra.

DAWE (Department of Agriculture, Water and Environment) 2019, EPBC Act Protected Matters Search Tool, viewed 4 November 2019, www.environment.gov.au.

DAWE 2022a, *EPBC Act Protected Matters Search Tool*, Department of the Environment and Energy, Canberra, viewed 2nd May 2022, https://www.environment.gov.au/epbc/pmst/index.html.

DAWE 2022b, *Species Profile and Threats Database*, Department of Agriculture, Water and the Environment, Canberra, https://www.environment.gov.au/cgi-bin/sprat/public/sprat.pl.

DECC (Department of Environment and Climate Change) 2005, *Threatened Species profile – Swift Parrot* (*Lathamus discolor*). DECC, EPRG South Branch, Queanbeyan.

DELWP 2017a, *Guidelines for the removal, destruction or lopping of native vegetation* (dated December 2017), Department of Environment, Land, Water and Planning, East Melbourne.

DELWP 2017c, The Victorian Policy and planning guidelines – Development of wind energy facilities in Victoria. Department of Environment, Land, Water and Planning, East Melbourne, Victoria.

DELWP 2018a, *Assessor's Handbook – Applications to remove, destroy or lop native vegetation* (Version 1.1, dated October 2018), Department of Environment, Land, Water and Planning, East Melbourne.

DELWP 2019, Victorian Biodiversity Atlas 3.2.5, Department of Environment, Land Water and Planning, East Melbourne, Victoria, viewed 22nd October 2019, <http://www.depi.vic.gov.au>.

DELWP 2019a, *Flora and Fauna Guarantee Act 1988 - Protected Flora List, November 2019*, Department of Environment, Land, Water and Planning, East Melbourne.

DELWP 2020a, Native Vegetation Information Management system, Department of Environment, Land, Water and Planning, East Melbourne, Victoria, viewed 10th October 2020, https://nvim.delwp.vic.gov.au/

DELWP 2020b, NatureKit, Department of Environment, Land, Water and Planning, East Melbourne, Victoria, viewed 10th October 2020, http://maps.biodiversity.vic.gov.au.

DELWP 2020c, MapShareVic, Department of Environment, Land, Water and Planning, East Melbourne, Victoria, viewed 10th October 2020, https://www2.delwp.vic.gov.au/maps/maps-and-services/interactive-maps

DELWP 2020d, Victorian Biodiversity Atlas 3.2.5, Department of Environment, Land, Water and Planning, East Melbourne, Victoria, viewed 10th October 2020, < https://vba.dse.vic.gov.au>.

DELWP 2021a, Victorian Biodiversity Atlas, https://vba.dse.vic.gov.au/vba/#/, viewed 9 June 2021.

DELWP 2021b, NatureKit 2.0, https://www.environment.vic.gov.au/biodiversity/biodiversity-interactive-map, viewed 20 May 2021.

DELWP 2022a, *NatureKit*, Department of Environment, Land, Water and Planning, East Melbourne, Victoria, viewed 2nd May 2022, https://www.environment.vic.gov.au/biodiversity/naturekit.

DELWP 2022b, *MapShareVic*, Department of Environment, Land, Water and Planning, East Melbourne, Victoria, viewed 2nd May 2022, https://www2.delwp.vic.gov.au/maps/maps-and-services/interactive-maps.

DELWP 2022c, *Native Vegetation Information Management system*, Department of Environment, Land, Water and Planning, East Melbourne, Victoria, viewed 2nd May 2022, https://nvim.delwp.vic.gov.au/.

DELWP 2022d, *Victorian Biodiversity Atlas 3.2.8*, Department of Environment, Land, Water and Planning, East Melbourne, Victoria, viewed 2nd May 2022, https://vba.dse.vic.gov.au.

DEECA 2023e, *Online Search of the Native Vegetation Credit Register,* Department of Energy, Environment and Climate Action, East Melbourne, viewed 2nd May 2022, https://nvcr.delwp.vic.gov.au.

DELWP 2022f, *Flora and Fauna Guarantee Act 1988 – Threatened List, September 2022*, Department of Environment, Land, Water and Planning, East Melbourne.

DEWHA 2009, Background Paper to EPBC Act Policy Statement 3.12 – Significant Impact Guidelines for the Critically Endangered Golden Sun Moth (*Synemon plana*).

DEWHA 2010, Survey guidelines for Australia's threatened birds, Guidelines for detecting birds listed as threatened under the Environment Protection and Biodiversity Conservation Act, Canberra 2010.

DEWHA 2013; Richter A, Osborne W, Hnatuik S & Rowell A, 'Moths in fragments: insights into the biology and ecology of the Australian endangered golden sun moth Synemon plana (Lepidoptera: Castniidae) in natural temperate and exotic grassland remnants', Journal of Insect Conservation, vol. 17, No. 4.

DNRE 1997, *Victoria's Biodiversity – Directions in Management*, Department of Natural Resources and the Environment , East Melbourne.

DSE 1999, Action Statement No. 96, Small Milkwort *Comesperma polygaloides*, Department of Sustainability & Environment, East Melbourne.

DSE 2003, Action Statement No. 166 – Squirrel Glider *Petaurus norfolcensis*, DSE, East Melbourne.

DSE 2003, *Action Statement No. 169 – Swift Parrot*. Department of Sustainability and Environment, East Melbourne, Victoria.

DSE 2004a, *Ecological Vegetation Class (EVC) Benchmarks by Bioregion*, Department of Energy, Environment and Climate Action, East Melbourne.

DSE 2004b, *Native Vegetation: sustaining a living landscape, Vegetation Quality Assessment Manual – guidelines for applying the Habitat Hectare scoring method (Version 1.3)*, Department of Sustainability and Environment, East Melbourne.

DSE 2006, *Ministerial Guidelines for Assessment of Environmental Effects under the* Environmental Effects Act 1978, Department of Sustainability and Environment, East Melbourne.

DSE 2010, *Biodiversity Precinct Structure Planning Kit*, Department of Sustainability and Environment, East Melbourne, Victoria.

Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) 2011, Survey Guidelines for Australia's threatened reptiles, Commonwealth of Australia.

Duncan M 2010, National Recovery Plan for the Sturdy Leek Orchid *Prasophyllum validum*, Department of Sustainability and Environment, Melbourne.

Duncan M, Pritchard A & Coates F 2009, National Recovery Plan for Fifteen Threatened Orchids in South-eastern Australia, Department of Sustainability and Environment, now Department of Energy, Environment and Climate Action, Victoria.

Duncan M, Pritchard A & Coates F 2009, National Recovery Plan for Fifteen Threatened Orchids in South-eastern Australia, Department of Energy, Environment and Climate Action, Victoria.

Duretto, M.F. (1999). Rutaceae. In: Walsh, N.G.; Entwisle, T.J. (eds), Flora of Victoria Vol. 4, Cornaceae to Asteraceae. Inkata Press, Melbourne (as Boronia anemonifolia subsp. 2).

Dwyer, P D and Hamilton-Smith, E 1965, Breeding caves and maternity colonies of the Bent-winged Bat in South-eastern Australia, Helicite, October 1965.

Dwyer, PD 1965, Flight patterns of some eastern Australian bats, *Victorian Naturalists*, 82: 36-41.

eBird Species Maps, www.ebird.org, viewed 9 June 2021, Cornell Lab of Ornithology, Cornell University, New York State, USA.

Emison, WB, Beardsell, CM, Norman, FI Loyn, RH, & Bennett, SC 1987, *Atlas of Victorian Birds*. Department of Conservation, Forests and Lands & Royal Australasian Ornithologists Union, Melbourne.

Entwisle TJ 1994, 'Orchidaceae', in NG Walsh & TJ Entwisle (eds), Flora of Victoria, Volume 2: Ferns and Allied Plants, Conifers and Monocotyledons, Inkata Press, Melbourne, pp. 740-901.

Entwisle TJ 1994, 'Orchidaceae', in Walsh, NG & Entwisle, TJ (eds), Flora of Victoria, Volume 2: Ferns and Allied Plants, Conifers and Monocotyledons, Inkata Press, Melbourne, pp. 740-901.

Entwisle TJ 1996, 'Casuarinaceae', in NG Walsh & TJ Entwisle (eds), Flora of Victoria, Volume 3: Dicotyledons Winteraceae to Myrtaceae, Inkata Press, Melbourne, pp. 90-101.

Garnett ST and Crowley GM 2000, *The Action Plan for Australian Birds*, Environment Australia, Canberra.

Garnett ST, Szabo JK & Dutson G 2011, *The Action Plan for Australian Birds 2010*, CSIRO Publishing, Collingwood, Victoria.

Heathcote A 2020, 'Less than 300 Swift Parrots remain in the wild', Australian Geographic, 2 December 2020, www.australiangeographic.com.au, viewed 13 June 2021.

Higgins PJ 1999, Handbook of Australian, New Zealand and Antarctic Birds, Volume 4: Parrots to Dollarbird, Oxford University Press, Melbourne.

Higgins, PJ & Davies, SJJF 1996, Handbook of Australian, New Zealand and Antarctic Birds, Volume 3: Snipe to Pigeons, Oxford University Press, Melbourne.

Higgins, PJ & Peter, JM 2002, Handbook of Australian, New Zealand and Antarctic Birds, Volume 6: Pardalotes to Shrike-thrushes, Oxford University Press, Melbourne;

Higgins, PJ, Peter, JM & Cowling, SJ 2006, Handbook of Australian, New Zealand and Antarctic Birds, Volume 7: Boatbills to Starlings, Oxford University Press, Melbourne.

Higgins, PJ, Peter, JM & Steele, WK 2001, Handbook of Australian, New Zealand and Antarctic Birds, Volume 5: Tyrant-flycatchers to Chats, Oxford University Press, Melbourne.

Hollands, D 1991, *Birds of the Night.* Reed Books, New South Wales.

Hoye, G and Spence, J 2004, The Large Bent-wing Bat *Miniopterus schreibersii* in Urban environments: a survivor? in *Urban Wildlife: more than meets the eye*, edited by Lunney, D and Burgin, S, Royal Zoological Society of New South Wales, Mosman, NSW.

Jeanes J & Backhouse G 2006, Wild Orchids of Victoria, Australia, Aquatic Photographics, Seaford.

Jeanes J & Backhouse G 2006, Wild Orchids of Victoria,Australia, Aquatic Photographics, Seaford, Australia.

Jeanes JA 1996, 'Haloragaceae', in NG Walsh & TJ Entwisle (eds), Flora of Victoria, Volume 3: Dicotyledons Winteraceae to Myrtaceae, Inkata Press, Melbourne, pp. 887-908.

Jones DL 1994, 'Pterostylis', in NG Walsh & TJ Entwisle (eds), Flora of Victoria, Volume 2: Ferns and Allied Plants, Conifers and Monocotyledons, Inkata Press, Melbourne, pp. 798-831.

Jones DL 2006, A Complete Guide to Native Orchids of Australia Including the Island Territories, Reed New Holland, Sydney.

Jones DL 2006, A Complete Guide to Native Orchids of Australia Including the Island Territories, Reed New Holland, Sydney.

Jones SR 1999. Conservation biology of the pink-tailed worm lizard (*Aprasia parapulchella*). Unpublished PhD thesis, Applied Ecology Research Group, University of Canberra

Jones, D.L. (1994). Pterostylis. In: Walsh, N.G.; Entwisle, T.J. (eds), Flora of Victoria Vol. 2, Ferns and Allied Plants, Conifers and Monocotyledons. Inkata Press, Melbourne.

Kara Kara Conservation Management Network 2013, 'Kara Kara Conservation Management Network Strategic Plan 2013-2018' https://www.karakaracmn.org.au/.

Kavanagh, RP 2002, Conservation and management of large forest owls in south-eastern Australia, In '*Ecology and Conservation of Owls*'. (Eds. I Newton, R Kavanagh, J Olsen and IR Taylor). CSRIO: Collingwood, Australia. pp. 201-219.

Kavanagh, RP, Debus SJS, Rose AB & Turner, RJ 1995, Diet and Habitat of the Barking Owl in New South Wales, *Australian Bird Watcher*, 16, 137-144.

Kennedy SJ & Tzaros CL 2005, 'Foraging Ecology of the Swift Parrot *Lathamus discolor* in the box-ironbark forests and woodlands of Victoria', *Pacific Conservation Biology* 11: 158—173.

Lumsden LF, Moloney P and Smales I 2019. Developing a science-based approach to defining key species of birds and bats of concern for wind farm developments in Victoria. Arthur Rylah Institute for Environmental Research Technical Report Series No. 301. Department of Energy, Environment and Climate Action, Heidelberg, Victoria.

Marchant S & Higgins PJ 1990, Handbook of Australian, New Zealand and Antarctic birds, Volume 1: Ratites to Ducks, Oxford University Press, Melbourne.

Marchant S & Higgins PJ 1993, Handbook of Australian, New Zealand and Antarctic birds, Volume 2: Raptors to Lapwings, Oxford University Press, Melbourne.

Mavromihalis J 2010, National Recovery Plan for the Turnip Copperburr (*Sclerolaena napiformis*) Department of Sustainability and Environment, Melbourne.

Menkhorst, P 1995, Mammals of Victoria, Oxford University Press, Melbourne.

Morgan, GJ 1986, 'Freshwater crayfish of the genus Euastacus Clark (Decapoda: Parastacidae) from Victoria' Memoirs of the Museum of Victoria, 47:1-57.

Naarding JA 1983, Latham's Snipe in Southern Australia, Wildlife Division Technical Report 83/1, Tasmania National Parks and Wildlife Service, Tasmania.

Nature Advisory Pty Ltd 2019, *Navarre Wind Farm: Overview Flora and Fauna Constraints Assessment, Report No. 19222 (1.0)*, prepared for Neoen, October 2019, Hawthorn East, Victoria.

Nature Advisory 2021, *Navarre Wind Farm: Overview biodiversity constraints assessment* - Report No. 19222 (3.0), Nature Advisory Pty Ltd, Hawthorn East, consultant report prepared for Neoen Energy Pty Ltd.

NSW Office of Environment and Heritage (NSW OEH) 2012, National Recovery Plan for Button Wrinklewort (*Rutidosis leptorrhynchoides*), NSW Office of Environment and Heritage, Hurstville.

Osborne, W.S., Lintermans, M., & Williams, K.D. 1991. Distribution and conservation status of the endangered Pink-tailed legless lizard *Aprasia parapulchella* (Kluge). ACT Parks and Conservation Service. Research Report 5. 36 pp.

Parkes D, Newell G, & Cheal D 2003, 'Assessing the Quality of Native Vegetation: The 'habitat hectares' approach', Ecological Management and Restoration 4:29–38.

Read, JL 1994, 'The diet of three species of Firetail Finches in temperate South Australia', Emu - Austral Ornithology, vol. 94, pp. 1-8; Tzaros, C 2005, Wildlife of the Box-Ironbark Country, CSIRO Publishing, Collingwood.

Rex Andrews Engineered Transportation Pty Ltd 2023, Route Study – Navarre Wind Farm (draft).

Robertson, P & Coventry JA 2019, Reptiles of Victoria, CSIRO Publishing, Melbourne.

Robinson D & Johnson G 1997 Bush Stonecurlew *Burhinus grallarius*. Flora and Fauna Guarantee Action Statement No 78. Department of Natural Resources and Environment, Melbourne.

Robinson, D 1994, Research plan for threatened woodland birds of south-eastern Australia*, Arthur Rylah Institute for Environmental Research Technical Report Series No. 133*.

Roderick, M. 2021. Quoting 'Swift Parrot Recovery Team' as source, in communication to Emma Siossan, Australian Broadcasting Corporation, Mid-north Coast, 4 June 2021.

Royal Botanic Gardens Victoria (RBGV) 2019, VicFlora: Flora of Victoria, Royal Botanic Gardens Victoria, https://vicflora.rbg.vic.gov.au.

Saddlier S, Jackson J & Hammer, M 2010, 'National recovery plan for the Dwarf Galaxias (*Galaxiella pusilla*)', Department of Energy, Environment and Climate Change Action (DEECA), East Melbourne.

Saunders D & Heinsohn R 2008, 'Winter habitat use by the endangered, migratory Swift Parrot (*Lathamus discolor*) in New South Wales', *Emu* 108: 81—89.

Saunders, DL & Tzaros CL 2011, National Recovery Plan for the Swift Parrot *Lathamus discolor*, Birds Australia, Melbourne.

Schedvin, N 2007, *Distribution ecology of the barking owl Ninox connivens connivens in Victoria, Australia*. PhD thesis prepared for Charles Sturt University, Albury, Australia.

Scientific Advisory Committee (SAC) 2015, Flora and Fauna Guarantee Act 1988 – Threatened List: Characteristics of Threatened Communities, Department of Energy, Environment and Climate Action, East Melbourne, Victoria.

Soderquist T & Gibbons P 2007, Home range of the Powerful Owl in dry sclerophyll forest, *Emu* 108: 81—89.

State of Victoria 2021, *Flora and Fauna Guarantee Act. Listed Threatened Species of Flora and Fauna*. Government Gazette, 11 May 2021.

Stojanovic D, Webb M, Alderman R, Porfirio L & Heinsohn R 2014, Discovery of a novel predator reveals extreme but highly variable mortality for an endangered bird, *Diversity and Distributions*, 20, 1200-1207.

Swift Parrot Recovery Team, 2001. *Swift Parrot Recovery Plan*. Department of Primary Industries, Water and Environment, Hobart.

Taylor I, Kirsten & Peake P, 2002a, 'Habitat, breeding and conservation of the Barking Owl *Ninox connivens* in northeastern Victoria, Australia', In Newton et al. 2002, *Ecology and Conservation of Owls*, CSIRO Publishing, Victoria.

Taylor I, Kirsten & Peake P, 2002b, 'Distribution and Habitat of Barking Owls (*Ninox connivens*) in central Victoria, Australia', In Newton et al. 2002, *Ecology and Conservation of Owls*, CSIRO Publishing, Victoria.

The Australian Museum Trust 1995, The Mammals of Australia. Reed New Holland Book, Carlton, VIC.

Threatened Species Scientific Committee (TSSC) 2006, Commonwealth Listing Advice on White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland, Commonwealth of Australia.

Threatened Species Scientific Committee (TSSC) 2008a, Commonwealth Listing Advice on Grassy Eucalypt Woodland of the Victorian Volcanic Plain, Department of the Environment, Water, Heritage and the Arts, Canberra.

Threatened Species Scientific Committee (TSSC) 2008b, Commonwealth Listing Advice on Natural Temperate Grassland of the Victorian Volcanic Plain, Commonwealth of Australia.

Threatened Species Scientific Committee (TSSC) 2010, Commonwealth Listing Advice on Grey Box (Eucalyptus microcarpa) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia, Commonwealth of Australia.

Threatened Species Scientific Committee (TSSC) 2012, Commonwealth Listing Advice on Natural Grasslands of the Murray Valley Plains, Commonwealth of Australia.

Todd JA 2000, Recovery Plan for twelve threatened Spider-orchid Caladenia taxa (Orchidaceae: Caladeniinae) of Victoria and South Australia 2000 - 2004, Department of Natural Resources and Environment, Melbourne.

Todd, J 2000, Recovery Plan for twelve threatened Spider-orchid Caladenia taxa (Orchidaceae: Caladeniinae) of Victoria and South Australia 2000 - 2004, Department of Natural Resources and Environment, Melbourne.

Tzaros, C 2005, Wildlife of the Box-Ironbark Country, CSIRO Publishing, Collingwood.

Walsh NG 1996, 'Amaranthaceae,', in NG Walsh & TJ Entwisle (eds), Flora of Victoria, Volume 3: Dicotyledons Winteraceae to Myrtaceae, Inkata Press, Melbourne, pp. 199-215.

Walsh NG 1999, 'Polygalaceae', in NG Walsh & TJ Entwisle (eds), Flora of Victoria, Volume 4: Dicotyledons Cornaceae to Asteraceae, Inkata Press, Melbourne, pp. 130-137.

Walsh, N.G. (1996). Chenopodiaceae. In: Walsh, N.G.; Entwisle, T.J. (eds), Flora of Victoria Vol. 3, Dicotyledons Winteraceae to Myrtaceae. Inkata Press, Melbourne.

Walsh, N.G. (1999). Minuria. In: Walsh, N.G.; Entwisle, T.J. (eds), Flora of Victoria Vol. 4, Cornaceae to Asteraceae. Inkata Press, Melbourne.

Weber, JZ & Entwisle, TJ 1994, 'Thelymitra', in Walsh, NG & Entwisle, TJ (eds), Flora of Victoria. Vol. 2, Ferns and Allied Plants, Conifers and Monocotyledons, Inkata Press, Melbourne, pp. 840-854.

Webster, A, Humphries, R & Lowe, K 1999, *Powerful Owl. Action Statement No. 92*, Department of Natural Resources and Environment (Vic.), East Melbourne, Victoria.

Wilson, S & Swan, G 2003, A Complete Guide to the Reptiles of Australia, Reed New Holland, Sydney. Cheal D, Lucas A & Macaulay L 2011, *National Recovery Plan for Buloke Woodlands of the Riverina and Murray-Darling Depression Bioregions*, Commonwealth of Australia.