AN ASSESSMENT OF THE BAT FAUNA AT THE PROPOSED GLEN INNES WIND FARM, NSW

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for Connell Wagner Pty Ltd
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EXECUTIVE SUMMARY

Greg Richards and Associates Pty Ltd was commissioned by Connell Wagner Pty Ltd to conduct an assessment of the bat fauna at the site of the proposed Glen Innes Wind Farm, NSW. The survey was designed to compile a species inventory for the site, to target threatened species expected to be present, and to gain an insight into activity patterns in relation to the potential for turbine collision to significantly impact upon local populations.

Automated bat detectors were installed at seven sampling sites that were selected to sample the two major habitats present on the site (woodland remnants and open pasture).

The survey covered the period from 10 – 13 December 2007, from which more than 6000 detector files were recorded, producing a total of 3734 identifiable calls.

Twelve bat species were recorded during the survey, including three that are listed as Vulnerable in the NSW *Threatened Species Conservation Act 1995*: the Large-eared Pied Bat, the Eastern Falsistrelle and the Yellow-bellied Sheathtail Bat. The Large-eared Pied bat is also listed as Vulnerable in the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*. These listed species were extremely rare, each was only recorded from a single site, and by a very low number of calls (2, 3 and 2 calls respectively). A desktop study carried out prior to the field survey concluded that, based upon database records, sixteen species could be present in the project area.

It was concluded from a threatened species assessment that there would be little likelihood that the proposed wind farm would impact upon bat populations, especially threatened species. Information gleaned from recent studies of bat behaviour around turbines was provided to support this conclusion. A formal Seven Part Test of Significance arrived at the same conclusions.

INTRODUCTION

Greg Richards and Associates Pty Ltd was commissioned by Connell Wagner Pty Ltd to conduct an assessment of the bat fauna at the site of the proposed Glen Innes Wind Farm, NSW. The survey was designed to compile a species inventory for the site, to target threatened species expected to be present, and to gain an insight into activity patterns in relation to the potential for turbine collision to significantly impact upon local populations. This study follows from a "desktop" assessment report (Richards 2007).

The desktop assessment recommended that a field survey of the bat fauna be conducted to verify whether any threatened species were present and, if so, to estimate their relative abundance across the habitats that exist on the site. The major habitat in the area is open pastureland, but a number of open woodland remnants are also present.

METHODOLOGY

Bat Fauna Sampling

The species list produced in the desktop assessment was reviewed and indicated that the preferable survey method would be the use of bat detectors that record the species-specific echolocation calls of free-flying bats. Automated Anabat[2] detectors were installed at sampling sites and were programmed to commence operation approximately 30 minutes before dusk, and cease approximately 30 minutes after dawn.

Each bat call was recorded as a file on a compact flash card, with a unique filename being produced from an internal computer clock that showed the date and time that the bat passed the microphone. Files were displayed on a computer using dedicated software, with the species being identified by comparison with reference calls and also based on experience. An example of a computer display is shown in Figure 1.

During daytime traverses at the site, eucalypt trees were assessed for their flowering status with the view to conducted spotlight transects for feeding flying foxes if any mass flowering was noted.

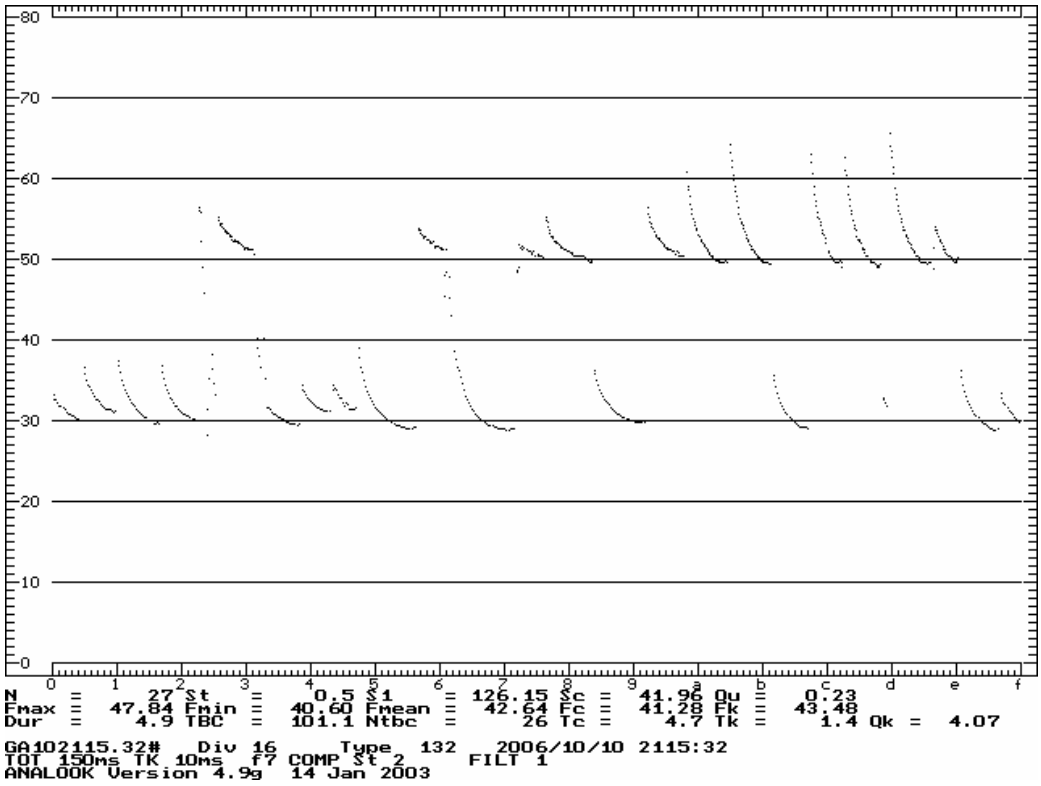
Sampling Sites

Richards (2002) showed that bat community structure in eastern Australia is determined by a number of habitat characteristics, primarily canopy tree number and basal area, subcanopy structure, understorey density and canopy tree foliage nutrients. Each species in a community appears to occupy a primary niche which is a unique combination of these variables. Additionally, if an important habitat component is removed, such as the understorey in a

[2] Titley Electronics, Ballina, NSW

woodland remnant or the tree canopy when pastureland is created, then certain species will become absent (Richards unpublished).

Figure 1: An example of a computer display of a bat call file showing two species recorded at the same time during the survey. The upper sequence is a Little Forest Bat (*Vespadelus vulturnus*), the lower is a Gould's Wattled Bat (*Chalinolobus gouldii*). The y-axis shows frequency (kHz) and the x-axis shows time (ms). Information in the first three lines beneath the plot provide information relevant to species identification, the lower three lines contain other relevant data such as filename, date and time.

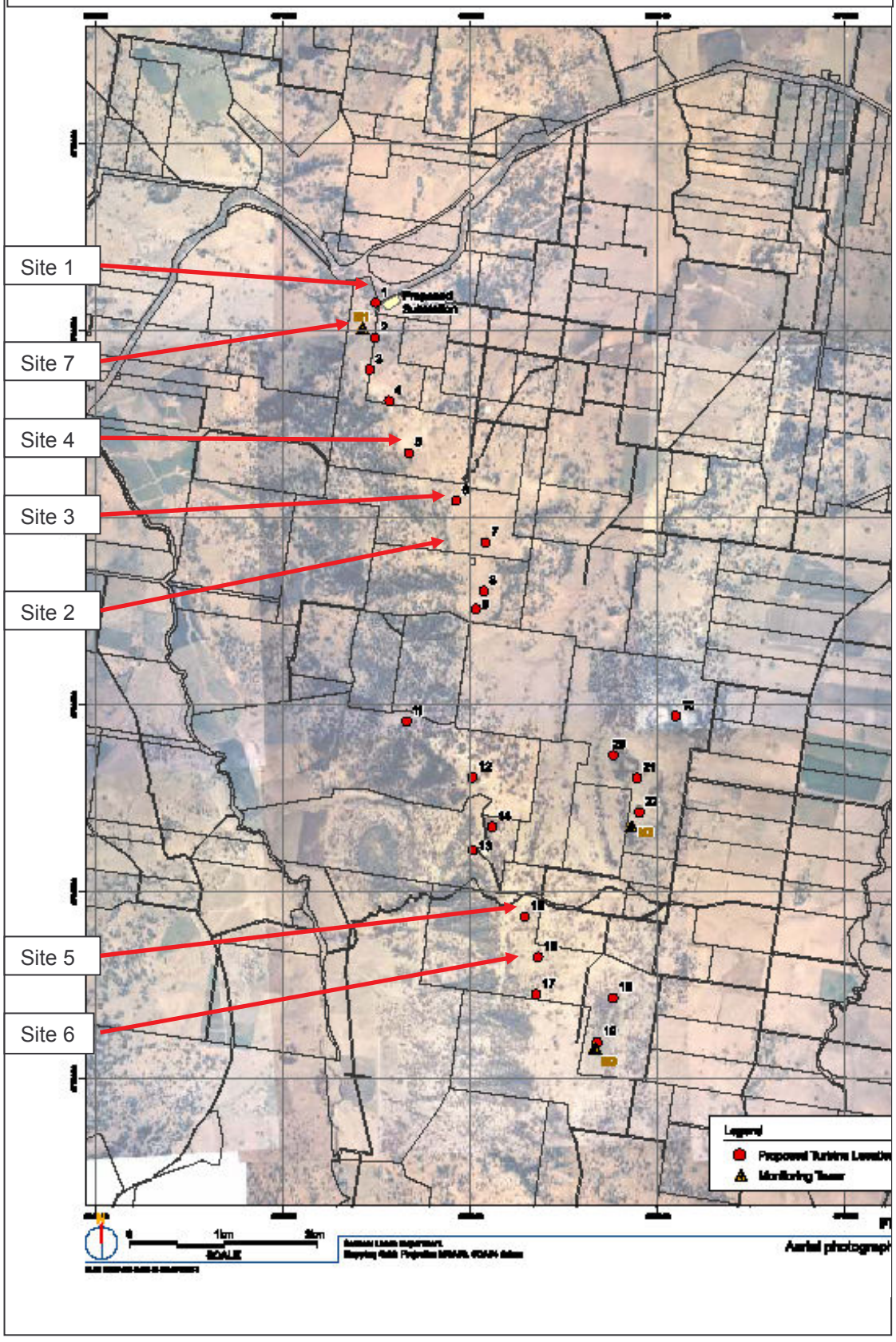


Seven sites were selected to sample the major habitats (woodland remnants and open pastureland) present on the site, located strategically along the north-south axis of the project area (Figure 2). The GPS coordinates of sites and their habitat description are shown in Table 1.

Table 1: Location of sites at the proposed Glen Innes Wind Farm and their habitat description

Site	Latitude	Longitude	Description
Woodland remnant sites			
1	29º43.740	151º36.251	Open woodland remnant near northern meteorological tower, grassy understorey
2	29º45.267	151º36.743	Dense woodland remnant just west of repeater station, shrubby understorey
5	29º47.108	151º37.435	Open woodland remnant, grassy understorey
6	29º47.122	151º37.298	Open woodland remnant, grassy understorey
Open pasture sites			
3	29º45.220	151º36.941	Open pasture
4	29º44.966	151º36.924	Open pasture
7	29º43.881	151º36.211	Open pasture in vicinity of meteorological tower

Figure 2: Approximate location of bat fauna sampling sites at the proposed Glen Innes Wind Farm, NSW.



RESULTS and DISCUSSION

The survey period covered three nights from 10 – 13 December 2007 inclusive, and more than 6000 Anabat files were recorded, from which 3734 were identifiable as bat calls.

Weather Conditions During Survey

Weather conditions during the survey period were optimal for monitoring bat activity. Heavy rain occurred prior to the commencement of the study, and there were occasional rain showers during each survey day. Night temperatures were mild, and the daily rainfall resulted in high humidity levels at night (Table 2), which would have contributed to high insect prey activity.

Table 2: Ranges of weather variables at night (8 pm - 6 am) measured during the survey period at Glen Innes.

		9-10 Dec	10-11 Dec	11-12 Dec	12-13 Dec
Temperature (°C)	Maximum	16.9	19.1	16.4	14.9
	Minimum	14.4	13.8	14.3	9.9
Relative humidity (%)	Maximum	98	98	98	96
	Minimum	97	90	93	88
Wind speed (kph)	Maximum	13	20	26	30
	Minimum	7	0	13	13
Barometric pressure (hPa)	Maximum	1018	1018	1019	1020
	Minimum	1015	1015	1017	1018

Species recorded

Twelve bat species were recorded during the survey (Table 3), all of which utilised woodland remnant sites, but only seven of these were found at open pasture sites (Table 4).

Relative abundance

Over 50% of the total calls recorded came from two highly abundant species, the Southern Forest Bat (31.7%) and the Eastern Freetail Bat (21.7%), and over 90% of the calls recorded came from these and four other common species: the Little Forest Bat (16.7%), the Chocolate Wattled Bat (10.5%), Gould's Wattled Bat (6.6%) and the Large Forest Bat (5.7%). These six species fit the "habitat generalist" classification of Richards (2002). The three threatened species (the Large-eared Pied Bat, the Eastern Falsistrelle and the

Yellow-bellied Sheathtail Bat) were recorded from only 2-3 calls, or 0.1% of the total.

Table 3: Species recorded during the bat fauna assessment at the proposed Glen Innes Wind Farm. Longeared bats are not identifiable to species level from bat call analysis. Species listed as Vulnerable in the NSW *Threatened Species Conservation Act* (TSC Act) are shown in bold. The Large-eared Pied Bat is also listed as Vulnerable in the Commonwealth *Environment Protection and Biodiversity Conservation Act* (EPBC Act).

Common name	Scientific name
Large-eared Pied Bat	*Chalinolobus dwyeri*
Gould's Wattled Bat	*Chalinolobus gouldii*
Chocolate Wattled Bat	*Chalinolobus morio*
Eastern Falsistrelle	*Falsistrellus tasmaniensis*
Eastern Freetail Bat	*Mormopterus* sp 2
Longeared Bats	*Nyctophilus* spp.
Yellow-bellied Sheathtail Bat	*Saccolaimus flaviventris*
Eastern Broadnosed Bat	*Scotorepens orion*
White-striped Freetail Bat	*Tadarida australis*
Large Forest Bat	*Vespadelus darlingtoni*
Southern Forest Bat	*Vespadelus regulus*
Little Forest Bat	*Vespadelus vulturnus*

Habitat utilisation

There was an almost ten-fold higher amount of activity (as reflected by the number of calls) by bats in woodland remnants as compared with open pasture habitat (2549 versus 271 calls) (Table 5). All of the twelve species present were recorded in woodland remnants, compared with only seven in the open pasture.

Because the number of bat calls reflect the level of activity rather than individuals, it is often prudent to ordinate the data to site records; that is, by examining the number of sites where a species was present, irrespective of its activity there. This analysis is shown in Table 6, where it can be seen that the common generalist species appeared to be distributed throughout the site, with three species utilizing all seven sites. Other species occupied four or five sites, and it is notable that the three threatened species were found only at one site each, and all of these were woodland remnants, in particular Site 2 which was one of the few remnants on site that had a shrubby (as opposed to grassy) understorey.

These results concur with survey work conducted elsewhere (Richards 2002 and unpublished) where more the complex habitats in an area will have the majority of bat species and the highest levels of bat activity.

Table 4: Bat call data obtained during the bat fauna assessment at the proposed Glen Innes Wind Farm. Species listed in the NSW *Threatened Species Conservation Act* are shown in bold.

Woodland remnant sites								
	Site 1	Site 2	Site 5	Site 6	Total calls	Mean calls per site	Mean calls per night	Mean calls per site per night
C. dwyeri	-	2	-	-	2	0.5	0.7	0.2
C. gouldi	54	42	81	49	226	56.5	75.3	18.8
C. morio	105	88	125	67	385	96.3	128.3	32.1
F. tasmaniensis	-	3	-	-	3	0.8	1.0	0.3
Mormopterus sp. 2	249	160	148	119	676	169.0	225.3	56.3
Nyctophilus spp.	44	63	56	14	177	44.3	59.0	14.8
S. flaviventris	-	-	2	-	2	0.5	0.7	0.2
S. orion	22	4	7	11	44	11.0	14.7	3.7
T. australis	14	21	32	11	78	19.5	26.0	6.5
V. darlingtoni	58	48	42	49	197	49.3	65.7	16.4
V. regulus	82	357	437	207	1083	270.8	361.0	90.3
V. vulturnus	63	126	254	147	590	147.5	196.7	49.2
Totals	691	914	1183	674	3462			
Overall means						865.5	1154	288.5
Open pasture sites								
		Site 3	Site 4	Site 7	Total calls	Mean calls per site	Mean calls per night	Mean calls per site per night
C. gouldi		8	11	3	22	7.3	7.3	2.4
C. morio		-	8	-	8	2.7	2.7	0.9
Mormopterus sp. 2		34	53	46	133	44.3	44.3	14.8
T. australis		4	9	7	20	6.7	6.7	2.2
V. darlingtoni		-	15	-	15	5.0	5.0	1.7
V. regulus		41	-	-	41	13.7	13.7	4.6
V. vulturnus		-	-	32	32	10.7	10.7	3.6
Totals		87	96	88	271			
Overall means						90.3	90.3	30.1

Table 5: Activity patterns in each habitat as indicated by the number of calls recorded. Species are ranked by the overall number of sites that they site utilised in each habitat and threatened species are shown in bold.

	Woodland remnant sites					Open pasture sites				Total calls overall
	Site 2	Site 1	Site 5	Site 6	Total calls in open woodland	Site 3	Site 4	Site 7	Total calls in open pasture	
	shrubby	grassy								
C. dwyeri	2	-	-	-	-	-	-	-	-	2
S. flaviventris	-	-	2	-	2	-	-	-	-	2
F. tasmaniensis	3	-	-	-	-	-	-	-	-	3
S. orion	4	22	7	11	40	-	-	-	-	44
T. australis	21	14	32	11	57	4	9	7	20	98
Nyctophilus spp.	63	44	56	14	114	-	-	-	-	177
V. darlingtoni	48	58	42	49	149	-	15	-	15	212
C. gouldi	42	54	81	49	184	8	11	3	22	248
C. morio	88	105	125	67	297	-	8	-	8	393
V. vulturnus	126	63	254	147	464	-	-	32	32	622
Mormopterus sp. 2	160	249	148	119	516	34	53	46	133	809
V. regulus	357	82	437	207	726	41	-	-	41	1124
Totals	914	691	1183	674	2549	87	96	88	271	3734

Table 6: Utilisation of each site and habitat, as indicated by a site record (●). Species are ranked by the number of sites that they site utilised in each habitat and threatened species are shown in bold.

	Woodland remnant sites					Open pasture sites				
	Site 2	Site 1	Site 5	Site 6	Total site records in woodland	Site 3	Site 4	Site 7	Total site records in open pasture	Total site records overall
C. dwyeri	●				1					1
F. tasmaniensis	●				1					1
S. flaviventris			●		1					1
Nyctophilus spp.	●	●	●	●	4					4
S. orion	●	●	●	●	4					4
C. morio	●	●	●	●	4		●		1	5
V. darlingtoni	●	●	●	●	4		●		1	5
V. regulus	●	●	●	●	4	●			1	5
V. vulturnus	●	●	●	●	4			●	1	5
C. gouldi	●	●	●	●	4	●	●	●	3	7
Mormopterus sp. 2	●	●	●	●	4	●	●	●	3	7
T. australis	●	●	●	●	4	●	●	●	3	7
Total species	11	9	10	9		4	5	4		

Threatened Species Assessment

Based on the author's past experience, it would appear that the project area is similar to other grazing properties elsewhere in New South Wales and Victoria and in general terms does not offer highly suitable habitat for threatened bat species (Richards, unpublished consultancy reports). This conclusion is supported by the apparent rarity of the three threatened species that were recorded during the survey: the Large-eared Pied Bat, the Eastern Falsistrelle and the Yellow-bellied Sheathtail Bat. Each was recorded from just one site and by only two or three calls. The former two species were recorded from Site 2, a large tract of woodland with a shrubby understorey. Further, each species was recorded on only one night.

Although the number of bat calls recorded during a survey does not equate to numbers of individual bats, when calls are in such low numbers an estimate can be made. This cannot be done with a large number of calls. For example, 100 calls may equate to one bat passing a detector 100 times, or ten bats ten times, or 100 bats once. However, in the case of the low number of calls from threatened species recorded during the survey, it can be assumed that the maximum number of individuals would be only two or three. This low number of individuals would not constitute a viable population, but may nevertheless indicate that larger population may be present in the broader area.

The aerial photograph in Figure 2 shows that the steep western slopes of the Waterloo Range are densely vegetated in parts, and this may provide habitat for threatened species. Particularly Site 2 and to some extent Site 5, where threatened species were recorded, are in the vicinity of wooded habitat, so the sites (and in the future several turbines) may be at the edge of threatened species habitat. However, other sites (3, 4 and 6) near the western edge of the range were not utilised by threatened species, which indicates that they are probably patchily distributed in the general area.

The data also shows that areas with open habitat were not utilised by the threatened species present in the area, so it would be expected that turbine sites would not be greatly utilised by threatened species. Figure 2 shows that there is very little wooded habitat to the east of the main line of turbines, and hence nothing to attract threatened species to commute from one side to the other.

Large-eared Pied Bat

The Large-eared Pied Bat roosts primarily in caves, disused mine adits, and crevices in cliffs, particularly sandstone. Foraging habitat is typically dry open forest and woodland. The listing advice under the EPBC Act provides two reasons for allocating Vulnerable status: "*It has undergone, is suspected to have undergone or is likely to undergo in the immediate future a substantial reduction in numbers"* and *"The estimated total of mature individuals is limited and evidence suggests that the number will continue to decline at a*

substantial rate". The profile for this species on the NSW DECC[3] website states that threats to this species include clearing and isolation of forest and woodland near cliffs, damage to roosting sites, and the use of pesticides. None of these threats are likely to occur as a result of the wind farm project.

Loss of individuals through turbine blade collision is likely to be minor because there would be very little activity of this species in the open pasture areas where they will be located, as indicated by the very low number of calls recorded during the survey

Eastern Falsistrelle

The Eastern Falsistrelle is a hollow-roosting species that favours relatively dense wet sclerophyl forests with several vegetative strata including shrubby understorey (Richards 2002). The profile of this species on the DECC website states that threats include loss of foraging and roosting habitat, and the use of pesticides.

In an assessment of the Taralga Wind Farm site, NSW, where the Eastern Falsistrelle was recorded, data was obtained that supported conclusions in the literature that it was a species that foraged around forest canopy edges, and in gaps and valleys in the upper forest canopy. The Taralga site was similar to the Glen Innes Wind Farm site, where no records of this species were obtained in open woodland or pastureland, indicating that it is faithful to dense habitats.

It is therefore not expected that this species will intercept turbines due to their placement in open pasture areas. As outlined above for the Large-eared Pied Bat, it is not expected to commute across turbine areas from the western side of the range to the poorer habitats on the eastern side.

Yellow-bellied Sheathtail Bat

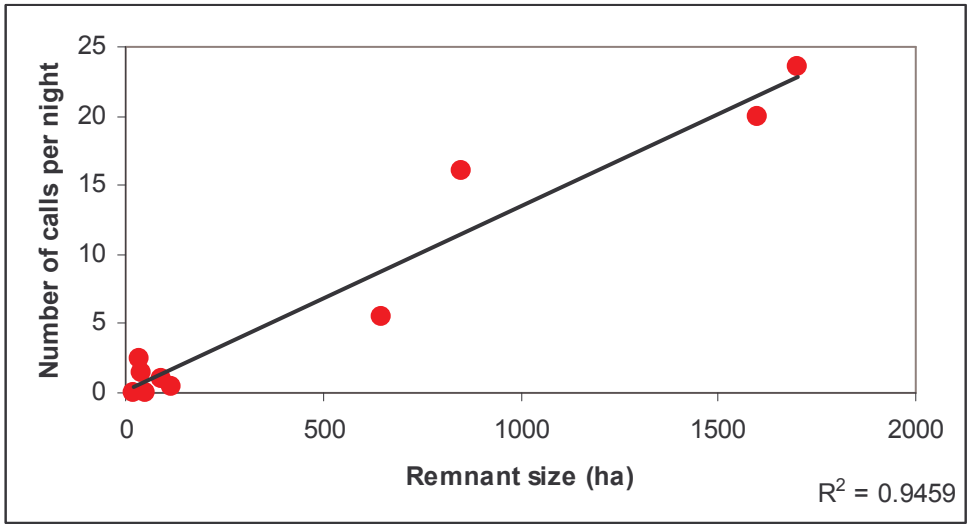
The Yellow-bellied Sheathtail Bat is a species that flies high and fast above the canopy of dense forest and woodlands. Threats are similar to those outlined above for the Eastern Falsistrelle.

An extensive study of habitat utilization by the Yellow-bellied Sheathtail Bat in the Cadia Valley (Orange district) NSW was conducted by the author in November 2004. In this study, ten woodland/open forest remnants ranging in size from 20 -1700 ha were monitored for this species (Richards unpublished). Regression analysis of the number of calls recorded (which bears some relationship to species relative abundance) was highly correlated (R^2 = 0.9459) with the approximate size of the remnants studied (Figure 3). There appeared to be a threshold of at least 500 ha before high levels of activity and relative abundance were observed.

[3] Department of Environment and Climate Change

It would appear that there is no tract of habitat in the project area that is as extensive as 500 ha, and hence it is concluded that the low number of Yellow-bellied Sheathtail Bat calls that were recorded indicates a very low population. It is concluded that the local population of this species in the vicinity of the project area would be too low to be viable, and if any individuals intercepted and collided with turbines then the extent of impact upon it would be minor.

Figure 3: Relationship between the size of remnants surveyed in the Cadia Valley region in 2004 and the number of Yellow-bellied Sheathtail Bat calls recorded.



Bat Behaviour at Wind Turbines

In their 10 night study with thermal imaging of bat flight behaviour around turbines, Horn and Arnett (2005) produced some interesting and relevant results. Of the 998 observations of bats, the majority were of no cause for concern, presumably the animals knew that there was an obstacle present. They attributed 47 (5%) of the observations to avoidance behaviour, with the bat significantly changing its flight path when near a blade. Eight of the observations (0.8%) were of actual collision, typified by the flight path changing abruptly and at an angle relative to the direction of the sweeping blade.

In a study conducted at an operational wind farm in Victoria, the author was involved in the monitoring of bat activity at several wind turbines at the same time that bat and bird carcasses were being monitored by a professional searcher. The study was conducted over an eight night period during October 2007. No bat carcasses were found during the study, yet a total of 110 calls from nine species were recorded at two turbines, indicating that bats were

aware of these obstacles and were also able to avoid the blades. Furthermore, 349 calls were recorded at the same time from the airspace at three locations 200 – 300 m away from turbines. This averaged 117 calls per sample point, compared with an average of 55 calls at the turbines, which suggests that activity was reduced at the latter.

This and the Horn and Arnett (2005) study, shed new light on the potential for bat collision with turbine blades at wind farms. It would be expected that the same extremely low collision rate would apply to the proposed Glen Innes Wind Farm. Nevertheless, a Section 5A assessment of threatened species is provided in Appendix 1.

CONCLUSIONS

1. It was concluded from a threatened species assessment that there would be little likelihood that the proposed wind farm would impact upon bat populations, especially threatened species.

2. Information gleaned from recent studies of bat behaviour around turbines was provided to support this conclusion.

3. A formal Seven Part Test of Significance arrived at the same conclusions.

4. These conclusions are based on the understanding that no areas of habitat will be cleared for the development. In the event that individual trees need to be lopped or removed to allow construction vehicle access, then candidates should be checked by a recognized expert to ensure that no bat colonies are present.

REFERENCES

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APPENDIX 1:

SECTION 5A ASSESSEMENT - SEVEN PART TEST OF SIGNIFICANCE

LARGE-EARED PIED BAT (*Chalinolobus dwyeri*)

1. In the case of a *threatened species*, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of this species is likely to be placed at risk of extinction.

In order to assess the impacts of the Glen Innes Wind Farm proposal on the life cycle of the Large-eared Pied Bat within a local population, it is necessary to address the primary components of the ecology of this species such as breeding, foraging, roosting and migration/movement.

Breeding

Very little is known about the biology of this species. Females have the typical pattern of breeding in summer, with a single young being born around late November – early December and weaned during the following January – February (Dwyer 1966; Hoye and Dwyer 1995). The general ecology of this species has been reviewed in general texts (Hall and Richards 1979; Hoye and Dwyer 1995; Menkhorst 1995; Churchill 1998).

Foraging

This species forages primarily around and below the tree canopy upon insects that are hunted by aerial pursuit. The DECC species profile for the Large-eared Pied Bat states that it prefers dry habitats, and that it prefers “well-timbered areas containing gullies”.

Roosting

The Large-eared Pied Bat roosts in caves, disused mine adits, cracks and crevices in cliffs, and occasionally in the bottle-shaped mud nests made by Fairy Martins. Sandstone caves with roof domes are used as annual maternity sites.

Summary and Assessment of Part (a)

There is strong evidence that this species prefers open woodland sclerophyll habitat, which appears to be present on the western side of Waterloo Range. The low number of calls recorded during the survey leads to the conclusion that very few individuals utilise the wind farm site itself. Therefore, the proposal is unlikely “*to have an adverse effect*

on the life cycle of the species such that a viable local population of this species is likely to be placed at risk of extinction".

2. In the case of an *endangered population*, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of this species of this species is likely to be placed at risk of extinction.

There is no population of the Large-eared Pied Bat that is listed as an endangered population; therefore this section is not applicable.

3. In the case of an *endangered ecological community or critically endangered ecological community, whether the action proposed :*

(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

4. In relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

No vegetation is expected to be cleared during construction of the proposed wind farm, nor will any habitat become isolated, modified or fragmented.

5. Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There is no habitat within the project area that has been identified as critical to the Large-eared Pied Bat.

6. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

It is understood that there is no recovery plan or threat abatement plan that has been prepared for this species. Recovery strategies and priority actions as outlined in the species profile for the Large-eared Pied Bat on the DECC website have been met by environmental studies, including the protection of woodland habitat around cliffs. Roost sites will not be affected by the proposal.

7. Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

No key threatening process such as *Clearing of Native Vegetation* will be carried out.

Requirement for a Species Impact Statement

It is concluded that a Species Impact Statement for the Large-eared Pied Bat would not be required for this project. This conclusion is based upon:

1. The indication from the low number of echolocation calls that a small number of individuals utilise woodland remnants in the study area.

2. A small number of individuals would not constitute, as a sole entity, a "*viable*" local population, under the terms of the NSW Threatened Species Conservation Act.

3. No habitat for this species will be cleared.

EASTERN FALSISTRELLE (*Falsistrellus tasmaniensis*)

1. In the case of a *threatened species*, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a <u>viable local population</u> of this species is likely to be placed at risk of extinction.

In order to assess the impacts of the Glen Innes Wind Farm proposal on the life cycle of the Eastern Falsistrelle within a local population, it is necessary to address the primary components of the ecology of this species such as breeding, foraging, roosting and migration/movement.

Breeding

Very little is known about the biology of this species. Females have the typical pattern of breeding in summer, with a single young being weaned during the following autumn (Phillips 1995). The general

ecology of this species has been reviewed in general texts (Hall and Richards 1979; Phillips 1995; Menkhorst 1995; Churchill 1998).

Foraging

This species forages primarily above and around the tree canopy upon insects that are hunted by aerial pursuit. Studies of bat communities in coastal NSW forests (Richards 2002) show that this species has the following habitat preferences within this ecosystem:

- a high density of canopy trees and a high tree species richness
- a high basal area of subcanopy plants (saplings etc)
- a shrubby understorey
- high levels of foliage potassium in canopy trees

The DECC species profile for the Eastern Falsistrelle states that it prefers moist habitats, with trees taller than 20 m

Roosting

The Eastern Falsistrelle roosts in tree hollows, either within trunks or in dead branch 'spouts'. Although occasional large colonies are known, it appears from most of the evidence that most roost would contain less than 10 individuals (Menkhorst 1995; Churchill 1998). Males appear to separate from females when they are raising young (Phillips 1995).

Summary and Assessment of Part (a)

There is strong evidence that this species prefers large tracts of complex tall sclerophyll habitat and such are not present on the wind farm site itself, though it may be present on the western side of Waterloo Range. The low number of calls recorded during the survey leads to the conclusion that very few individuals utilise the wind farm site itself.
Therefore, the proposal is unlikely "*to have an adverse effect on the life cycle of the species such that a viable local population of this species is likely to be placed at risk of extinction*".

2. In the case of an *endangered population*, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of this species of this species is likely to be placed at risk of extinction.

There is no population of the Eastern Falsistrelle that is listed as an endangered population; therefore this section is not applicable.

3. In the case of an *endangered ecological community or critically endangered ecological community, whether the action proposed :*

(iii) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(iv) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

4. In relation to the habitat of a threatened species, population or ecological community:

(iv) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(v) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(vi) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

No vegetation is expected to be cleared during construction of the proposed wind farm, nor will any habitat become isolated, modified or fragmented.

5. Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There is no habitat within the project area that has been identified as critical to the Eastern Falsistrelle.

6. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

It is understood that there is no recovery plan or threat abatement plan that has been prepared for this species. Recovery strategies and priority actions as outlined in the species profile for the Eastern Falsistrelle on the DECC website have been met by environmental studies, including the retention of vegetation that is floristically and structurally diverse, and roost sites will not be affected by the proposal.

7. Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

No key threatening process such as *Clearing of Native Vegetation* will be carried out.

Requirement for a Species Impact Statement

It is concluded that a Species Impact Statement for the Eastern Falsistrelle would not be required for this project. This conclusion is based upon:

1. The indication from the low number of echolocation calls that a small number of individuals utilise woodland remnants in the study area.

2. A small number of individuals would not constitute, as a sole entity, a "*viable*" local population, under the terms of the NSW Threatened Species Conservation Act.

3. No habitat for this species will be cleared.

YELLOW-BELLIED SHEATHTAIL BAT (*Saccolaimus flaviventris*)

1. In the case of a *threatened species*, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a <u>viable local population</u> of this species is likely to be placed at risk of extinction.

In order to assess the impacts of the Glen Innes Wind Farm proposal on the life cycle of the Yellow-bellied Sheathtail Bat within a local population, it is necessary to address the primary components of the ecology of this species such as breeding, foraging, roosting and migration/movement.

Breeding

Very little is known about the biology of this species, though breeding biology has been analysed from museum specimens (Chimimba and Kitchener 1987). Females of this species have the typical pattern of breeding in summer, with a single young being weaned during the following autumn (Chimimba and Kitchener *op. cit.*). The general ecology of this species has been reviewed in general texts (Hall and Richards 1979; Richards 1983, 1995; Menkhorst 1995; Rhodes and Hall 1997; Churchill 1998).

Foraging

This species forages primarily above the tree canopy upon insects that are hunted by aerial intercept. It has been shown that large and presumably viable populations only occur when habitat exceeds 500 ha (Richards unpublished).

Studies of bat communities in coastal NSW forests (Richards 2002) show that this species has the following habitat preferences within this ecosystem:

- a high density of canopy trees and a high tree species richness
- a high basal area of subcanopy plants (saplings etc)
- a shrubby understorey
- high levels of foliage potassium in canopy trees

Roosting

The Yellow-bellied Sheathtail Bat roosts in tree hollows, either within trunks or in dead branch 'spouts'. It is suspected that in habitats where tree canopy is dense, roosts must have an exit suitable for allowing flight to commence without obstruction, where a clear drop of 2-3 m is available (Richards and Hall 1994). Although occasional large colonies are known, it appears from most of the evidence that most roost would contain less than 10 individuals (Menkhorst 1995; Churchill 1998).

Migration/Movement

There is no information available in relation to movement or migration in this species. Richards (1983, 1995) concluded that because some individuals had been captured by hand in situations where they appeared to be exhausted and in open view of the public, that they may have been undertaking pre-winter migrations. Menkhorst (1995) noted that the few specimen records "are strongly biased towards the autumn; 88% of records fall between March and May and all fall between February and June inclusive.

However, based on data from the last few years, the alternative hypothesis is that these records may constitute individuals that have been afflicted with Lyssavirus and they may not have been exhausted but instead weak and unable to fly.

If the Yellow-bellied Sheathtail Bat was a long-distance migrant, then one would expect it to have crossed the 230 km (approx) Bass Strait barrier and occupy Tasmania, from where it is still absent.

Summary and Assessment of Part (a)

There is strong evidence that this species prefers large tracts of complex habitat and such are not present on the wind farm site. The low number of calls recorded during the survey (2) leads to the conclusion that very few individuals utilise the wind farm site. Therefore, the proposal is unlikely "*to have an adverse effect on the life cycle of the species such that a viable local population of this species is likely to be placed at risk of extinction*".

2. In the case of an *endangered population*, whether the action proposed is likely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of this species of this species is likely to be placed at risk of extinction.

There is no population of the Yellow-bellied Sheathtail Bat that is listed as an endangered population; therefore this section is not applicable.

3. In the case of an *endangered ecological community or critically endangered ecological community, whether the action proposed :*

(v) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

(vi) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

Not applicable.

4. In relation to the habitat of a threatened species, population or ecological community:

(vii) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and
(viii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
(ix) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

No vegetation is expected to be cleared during construction of the proposed wind farm, nor will any habitat become isolated, modified or fragmented .

5. Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly)

There is no habitat within the project area that has been identified as critical to the Yellow-bellied Sheathtail Bat.

6. Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan

It is understood that there is no recovery plan or threat abatement plan that has been prepared for this species. Recovery strategies and priority

actions as outlined in the species profile for the Yellow-bellied Sheathtail Bat on the DECC website have been met by environmental studies, including searches for this species in the proposed development area and the retention of vegetation.

7. Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

No key threatening process such as *Clearing of Native Vegetation* will be carried out.

Requirement for a Species Impact Statement

It is concluded that a Species Impact Statement for the Yellow-bellied Sheathtail Bat would not be required for this project. This conclusion is based upon:

1. The indication from the low number of echolocation calls that a small number of individuals utilise remnants in the study area.

2. A small number of individuals would not constitute, as a sole entity, a "*viable*" local population, under the terms of the NSW Threatened Species Conservation Act.

3. No habitat for this species will be cleared.

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