AVIFAUNA ASSESSMENT

Proposed Waddi Wind Farm Development, Dandaragan Shire

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SUMMARY

RPS was commissioned by Wind Prospect WA to undertake avifauna surveys for a proposed wind farm development in the Shire of Dandaragan, Western Australia. As part of the ecological investigations for the site, surveys were undertaken to gain information regarding the movements and habits of locally occurring birds. The surveys recorded all locally occurring birds, with particular consideration of those species that may be listed as Specially Protected or Threatened under the Western Australian *Wildlife Conservation Act 1950* (WC Act) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

The methodology for the avifauna surveys (Section 2.0) involved both preliminary desktop studies and a range of field survey methodologies, as guided by discussions with DEC, before survey works were undertaken and reference to relevant guidelines, notably EPA (2004) and Auswind (2005, 2006).

The majority of avifauna observed within the site (Section 3.0) were common bird species. The greatest diversity of birds occurred within structurally diverse native vegetation, including woodland with intact understorey vegetation, which does not characterise the elevated open country locations selected for wind turbine sitings.

Although there are a number of regional wetlands in the wider locality, most wetland habitats within the vicinity of the site were limited to small farm dams. The occasional small creeks in surrounding valleys offer very limited waterbird habitat. Local waterbird movements noted during the study were generally among closely associated wetlands to the west.

Limited numbers of nocturnal birds were observed during the survey period and those were associated with woodland vegetation, which largely occurs within lowland valley topographic contexts.

A number of open country bird species were noted to frequent typical wind turbine locations, although few species were observed to fly at elevations consistent with the Rotor Swept Area (RSA). Those species noted as occurring at RSA elevations on more than a rare occasion included Nankeen Kestrel, Wedge-tailed Eagle, Brown Falcon, White-backed Swallow, Black-shouldered Kite and Fairy Martin.

A general trend in bird movements in ridge-top contexts was relatively low flight elevations, possibly in response to the moderate to strong winds that characterise the Koodiwoodie Range on a daily basis. The Nankeen Kestrel was observed flying at RSA elevations on more than a rare occasion, but as with the majority of bird species observed flying within the RSA height, the greatest proportion of these observations were birds flying over valley areas and not the ridge-top contexts where turbines will be located.

One exception to this general low elevation flight pattern was the Wedge-tailed Eagle, which was most regularly observed soaring above RSA elevation. This is likely due to their dependence upon strong winds to stay aloft. The relatively high number of Wedge-tailed Eagle sightings was due, at least in part, to the obvious flight profile this species offers even at a great distance rather than the importance of the site.

A low number of records for the Brown Falcon, White-backed Swallow, Black-shouldered Kite and Fairy Martin during the survey period suggest that these species are unlikely to be at significant risk of impact due to very low densities within the locality.

Two species listed as Threatened under the WC Act, Carnaby's Black-Cockatoo (Schedule 1) and the Peregrine Falcon (Schedule 4), were observed during the surveys. The Peregrine Falcon was observed once, outside of the proposed wind farm site, near the Brand Highway, and Carnaby's Black-Cockatoo was observed to be associated with woodland and tall heathland, with its movements generally following vegetated valley corridors (i.e. outside the potential turbine locations).

Local flyway orientations were considered unlikely to traverse the proposed wind farm location, due to the general north–south alignment of drainage basins and coastal wetlands.

Based on the results of the avifauna investigations, it was concluded that no bird species potentially occurring within the site is at risk of a significant adverse impact by the proposed Waddi wind farm, either in isolation or in conjunction with other wind farm developments existing or proposed in the region. The other four existing or proposed regional wind farm developments do not align latitudinally, in an east to west sense, with the proposed Waddi wind farm and therefore have limited potential to represent a cumulative impact risk.

Recommendations provided to minimise the potential impact of the proposed wind farm include:

- power lines between turbines should be constructed underground and along road infrastructure where possible to minimise the number of easements through the area and potential for avian collisions (including the creation of perching locations in the vicinity of turbines)

- a post-construction bird monitoring program, such as that described Auswind (2006), should be established to determine the impacts of the project on bird populations

- construction and operational phases of the development should be undertaken in accordance with the Best Practice Guidelines for Wind Energy Projects (Auswind 2006), including the implementation of an Environmental Management Plan (EMP) and a Construction Management Plan (CMP).

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1.0 INTRODUCTION

1.1 Background

Wind Prospect WA Pty Ltd (Wind Prospect WA) is undertaking baseline surveys and impact assessments in support of the proposed Waddi Wind Farm development in the Shire of Dandaragan in Western Australia. A separate wind farm development (Yandin Wind Farm) is also proposed by Wind Prospect WA to the south of Waddi Wind Farm that may share some of the connection infrastructure to the electricity grid. These two wind farms will undergo separate approvals processes and are therefore being reported on separately.

RPS was commissioned by Wind Prospect WA to undertake avifauna surveys for the Waddi and Yandin Wind Farms and provide an assessment of the likely level of impacts to bird species from the proposed development. Only results for the Waddi Wind Farm are presented in this report.

As part of the ecological investigations for the site, targeted surveys were undertaken to gain information regarding the movements and habits of locally occurring birds. The surveys recorded all locally occurring birds, with particular consideration of those species that may be listed as Specially Protected or Threatened under the Western Australian *Wildlife Conservation Act 1950* (WC Act) and/or the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).

This report outlines the survey methods and findings of the avifauna surveys undertaken over the proposed wind farm development area, including surveys of wider regional bird populations and habitats, to assess potential risks to local bird populations.

1.2 Scope of the Study

In September 2008, RPS conducted a desktop study of the habitats and species that had been previously recorded on or within 15 km of the proposed development site (RPS, 2008).

The desktop study was used to determine what surveys would be required to establish an ecological baseline to support environmental approval processes. Consultation was undertaken with the Western Australian Department of Environment and Conservation (DEC) with regard to the scope of surveys required, these were:

- habitat surveys
- point count surveys
- roaming surveys
- night-time spotlighting surveys
- wetland bird surveys
- targeted survey for Carnaby's Black-Cockatoo.

The objectives of the avifauna surveys were to:

- identify avifauna species occurring within the proposed wind farm site
- identify the habitat usage of locally occurring avifauna species
- gather flight behaviour data for locally occurring bird species and their populations
- identify potential flight movements / corridors of regional and migratory bird populations.

In addition to the formal avian survey work undertaken on the proposed wind farm site, consideration was also afforded to surrounding areas and more distant areas containing wetlands with potential significance to birds. This allows for an appreciation of the environmental context of the site in regard to local species as well as transient and migratory species.

Information provided by the surveys was augmented with desktop review of relevant literature to allow an assessment of likely impact risks to birds from the proposed development.

This report details:

- the methods that were utilised to obtain avian fauna data
- the results of the avifauna surveys
- the 'priority' bird species that occur within the potential development area, which includes species protected under state and Commonwealth legislation and other species requiring particular consideration in relation to wind farm development (Auswind 2006)
- assessment of the likely level of risk to avifauna from a wind farm development at the site
- recommendations to minimise the potential impacts to birds.

2.0 METHODOLOGY

A variety of techniques were employed in this study to record avifauna that may occur across the proposed development site.

Targeted avifauna field surveys were undertaken within the study area by experienced bird ecologists in three separate survey periods, from 29 October – 7 November 2008, 18–26 November 2008 and 15–16 January 2009 inclusive. The avian surveys for this site were conducted in association with the adjoining Yandin Wind Farm proposed by Wind Prospect WA. These surveys were co-ordinated at the same time, used consistent quantitative and qualitative methodology and were on contiguous lands and similar habitats / topography. The surveys and associated research included a significant focus on the regional occurrence of avian species both on and off site, and these species' movements. This regional focus was considered to be important as it allowed the assessment to consider the likely impacts of the proposals in a regional sense, in relation to species occurrence, movements, topography, water-bodies and existing wind farm locations.

To broaden the scope of the assessment, and increase reliability of the information upon which the impact assessment was based, it was also considered advantageous to include the results of surveys from both wind farm sites in this assessment report. The increased reliability comes from increased overall survey effort and identification of numerous additional species for consideration that, if excluded, may underestimate the full range of species actually requiring consideration for either site. The current approach ensures the full complement (as far as possible) of birds, local movements and associated impacts of the wind farm, have been considered for both sites.

In addition, off-site surveys for both proposed wind farms included those areas such as wetlands and lakes in the surrounding region on which locally, regionally and internationally migratory birds might be expected to move between or around.

Guidance Statement 56 – Guidance Statement for Terrestrial Fauna Surveys for Environmental Impact in Western Australia (EPA 2004) was considered in the development of the survey methodology. However, avifauna assessments for wind energy projects, particularly within rural landscapes, require a modified approach to typical survey methods described under this Guidance Statement. Accordingly, while those key principles of avian survey such as habitat assessment, seasonal opportunity/variations and local movements, as required by *Guidance Statement 56* have been appropriately accounted for within survey methodologies and reporting, the survey methodology also incorporated the guidelines provided in the *Best Practice Guidelines for Implementation of Wind Energy Projects in Australia* (Auswind 2006) and the *Wind Farms and Birds: Interim Standards for Risk Assessment* (Auswind 2005), by ensuring that more detailed data relating to flight behaviour, flight height and species densities relating to each locality were also captured and assessed.

Furthermore, where appropriate, greater levels of assessment detail has been afforded to significant species at the state, national and international levels.

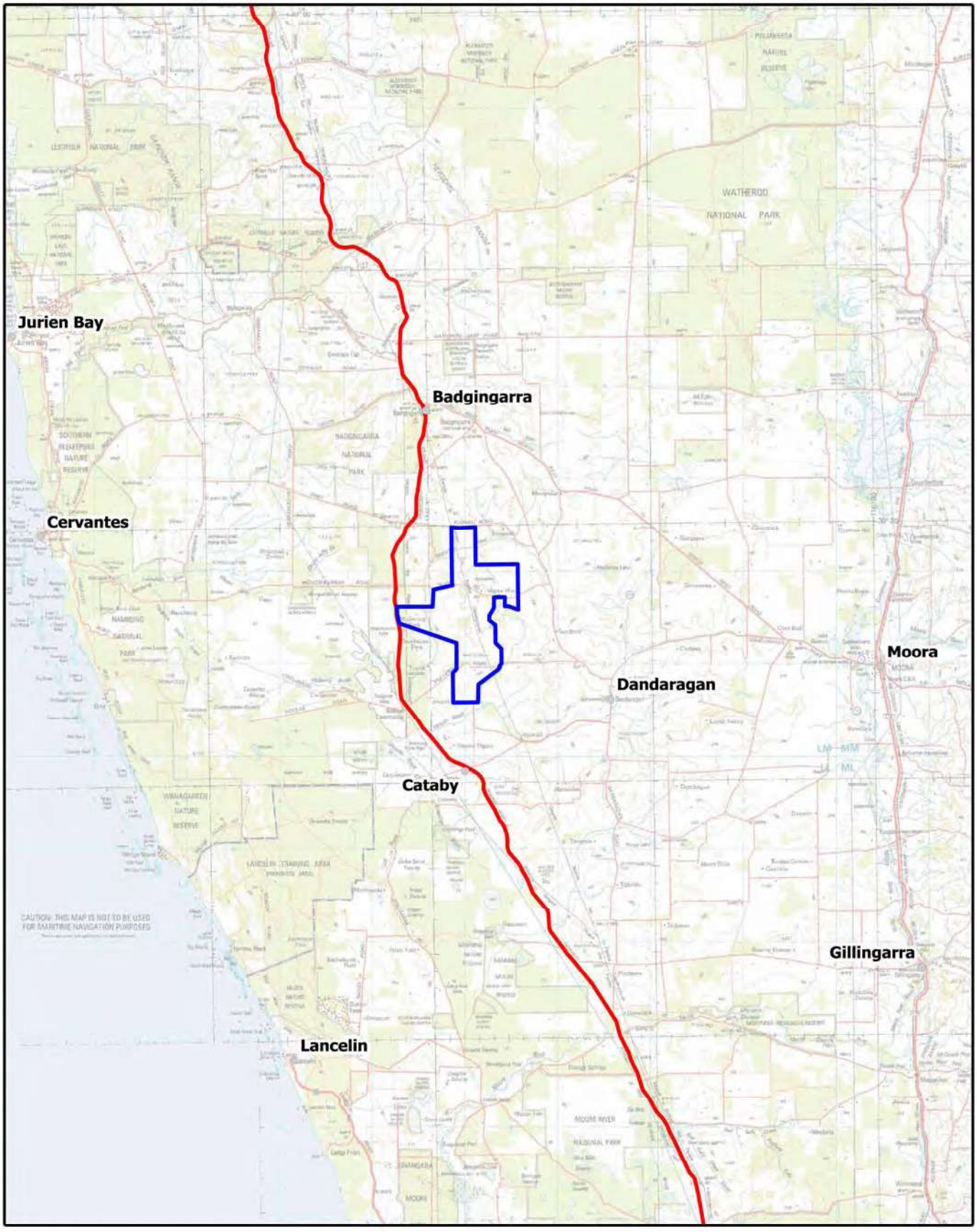
RPS has undertaken a number of avian surveys and impact assessments for wind farms and is familiar with the specific ecological issues associated with wind farm developments. Wind turbines need to be located away from tall remnant vegetation that may create wind turbulence which can be detrimental to the wind turbines and their performance. Therefore, the emphasis is on the identification of species at risk of collision with turbines or alienation from important habitat through an understanding of movement patterns of birds, and key habitat areas and corridors in the vicinity of the turbines.

Surveys focused on bird species present and associated habitat assessment (eg. identification of key habitats, potential movement corridors). Such an approach is consistent with the relevant requirements of DEH (2005), Auswind (2005), DEH (2006) and Auswind (2006).

The avifauna survey methods, as detailed herein, provide sufficient baseline information to detail the known and potential use of the site by locally occurring avifauna and to support an assessment of the potential use of the site by species listed as significant at both state and Commonwealth levels. They also provide baseline data for ongoing monitoring of avifauna during operation of the wind farm, if required.

2.1 Study Area

The study focused on the proposed Waddi wind farm development site (Figure 2-1). However, avifauna survey investigations were conducted across a a wider area of interest, including the Yandin Wind Farm site to the south, and seven representative sites outside the proposed wind farm footprint to gain broader baseline avian movement and distribution data (Figure 2-1). Further to the above surveys a wider regional appreciation of key features, which may influence local avifauna movements was also undertaken, including habitat assessment of lakes and wetlands occurring on the coastal plain and in near coastal areas to the west and drainage line lakes and wetlands associated with the Moore River drainage basin to the east.



LEGEND

- Town
- Wind Farm Boundary
- Brand Highway

kilometres

0 5 10 15 20

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Revision: A
Drafted by: HT
Source: Wind Prospect WA Pty Ltd, 01.09.10.

Figure 2-1

Waddi Windfarm Regional Location

2.2 Data Collation and Literature Review

A review of the biodiversity / Threatened Species data relevant to the site and the wider region was undertaken. Information relating to the potential environmental impacts on birds of wind turbines was also obtained and reviewed. Key information sources included:

- *Best Practice Guidelines for Implementation of Wind Energy Projects in Australia* (Auswind 2006).
- *Collision fatality of raptors in wind farms does not depend on raptor abundance, Journal of Applied Ecology* (de Lucas et al. 2008).
- *Draft NSW Wind Energy Environmental Impact Assessment Guidelines* (Planning NSW 2002).
- *Ecological Assessment for Waverley Wind Farm, Waverley, New Zealand.* Report prepared for Allco Wind Energy NZ Ltd (RPS HSO 2007).
- EPBC Act Policy Statements, *Supplementary Significant Impact Guidelines 2.1.1 Wind Farm Industry Sector* (DEH 2005).
- EPBC Act 'Protected Matters' Search Tool (Online, DEWHA 2009).
- *Fact Sheet 8: Wind Farms & Bird & Bat Impacts* (AusWEA 2004).
- *Flora and Fauna Assessment box Hill Wind Farm, Ben Lomond Guyra.* Report prepared for Box Hill Wind Farm Pty Ltd (HOS 2004).
- *Flora and Fauna Assessment Highfields Wind Farm, October 2005*, Energreen Wind Pty Ltd (HSO 2005_a).
- *Flora and Fauna Assessment Ben Lomond Wind Farm, August 2005*, Energreen Wind Pty Ltd (HSO 2005_b).
- *Flora and Fauna Assessment Ben Lomond North Wind Farm, August 2005*, Energreen Wind Pty Ltd (HSO 2005_c).
- *Flora and Fauna Assessment for Black Springs Wind Farm*. Report prepared for Wind Corporation Australia Ltd, (ref 23219) (HSO 2006).
- *Guidance Statement 56 – Guidance Statement for Terrestrial Fauna Surveys for Environmental Impact in Western Australia* (EPA 2004).

- *Liverpool Range Wind Farm Nowlands Gap Murrurundi*. Report prepared for Macquarie Generation Pty Ltd, (ref 22555) (HSO 2005_e).

- *Preliminary Ecological Results for the Ben Lomond Wind Farm* (PB 2004).

- *Species lists for the 1-degree block encompassing the Dandaragan Postcode locality*. (online, Birdata, October 2008).

- *Wind Farms and Birds: Interim Standards For Risk Assessment* (Auswind 2005).
-
- *Wind farm collision risk for birds – Cumulative risks for threatened and migratory species* (DEH 2006).

A one degree search from within the Birdata (2008) database was used to generate a list of avifauna that have been recorded in the vicinity of the Dandaragan postcode. Coupled with recorded distributions of endemic, migratory and vagrant species occurring in the region, the list formed the basis of an expected bird list for the area.

Local ecologists and DEC were consulted during the scoping process to identify key avian issues, which may apply to the site and the general locality.

In addition, a desk study conducted for this project (RPS 2008) acquired records from local data holdings for an area including the site and 15 kilometres from its boundary. Bird records from this search were also included in the bird list.

2.3 Avifauna Survey Methodology

Avifauna species present on the site were recorded through observation, bird calls and by sighting indirect evidence of species presence such as nests, white-wash and feathers.

2.3.1 Bird Flight Activity and Behaviour

During the bird surveys, bird flight activity and behaviour was observed at sixteen different census sites placed in close proximity to proposed wind turbine locations as shown in Figure 2-2. A further twenty bird census sites were located in close proximity to turbine locations within the Yandin Wind Farm site which adds to the relevant data for the area as a whole. A further seven census sites, representing 20% of the turbine location census sites, were placed in representative habitat areas outside the immediate footprint of both wind farm sites in the wider locality. These seven representative sites were included in the census to act as control sites for ongoing monitoring programs for both the proposed Yandin and Waddi wind farms, if required.

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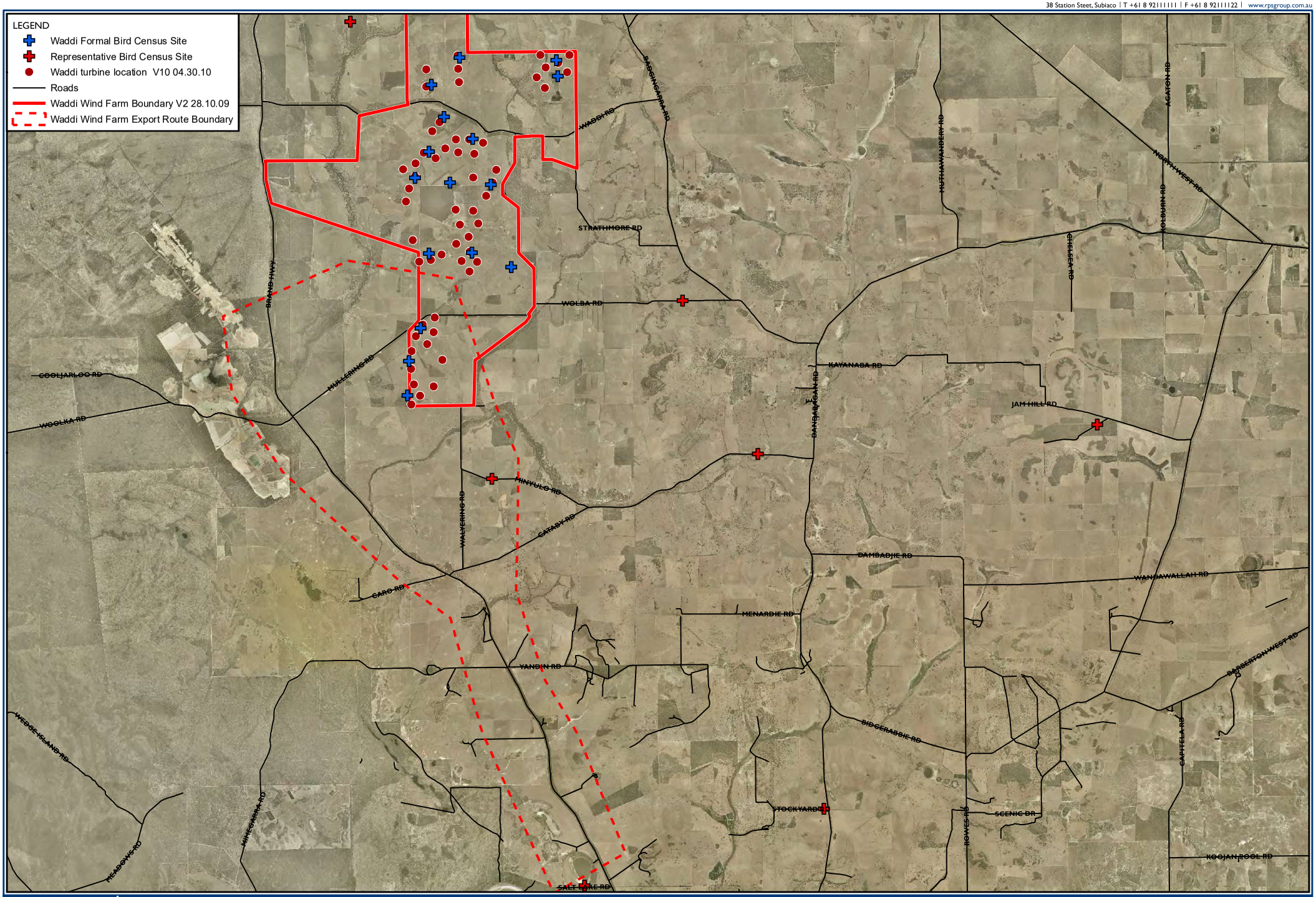

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Source: Air photograph (2004). Bird Census Data - RPS Newcastle (2010).

0 625 1,250 2,500 3,750 5,000 metres

Figure 2-2

Bird Sampling Locations and Reference Sites - Waddi Windfarm

RPS' bird census methodology followed the 'sample plot counts' method, where a twenty minute search within each 1.0 ha plot was conducted. All species heard or observed were recorded. Survey locations were selected in elevated areas proximate to proposed wind turbine locations and predominantly encompassed four key habitat types, including:

- open pasture/cultivation dominated areas
- remnant heathland vegetation
- woodland remnants / elements
- areas where various combinations of the above habitats exist.

Apart from these terrestrial habitats the occurrence of wetland habitats within the vicinity of the proposed wind farms were limited to small to moderately sized farm dams. Several small brooks were located within several kilometres of the site's turbine locations.

In addition to those species recorded within the 1.0 ha census plots, all species observed outside census plots were also recorded to ensure (conservatively) that all species that potentially occur within the survey area were identified. Traditional census plot survey procedures usually ignore results outside of discrete plots, due to associated bias toward conspicuous species as distances from the surveyor increase. As a consequence biased results would ensue, particularly if data are to be a measure of species density per area and/or time. However, the premise of this survey was to record all of those species that may potentially be at risk in the wind farm landscape. Limiting survey coverage to 1.0 ha plots would very likely have eliminated records of species that maintain home range territories encompassing many kilometres, such as raptors (birds of prey) and to a lesser extent the corvids (ravens and crows) and similar species such as magpies.

Surveys were also conducted around wetland habitats in the wider locality to determine the status and movements of local waterbird populations and to assess habitat potential for migratory wading bird species. The identification of different wetland habitats in relation to the known habits and habitat requirements of different waterbird and wading bird guilds was undertaken to determine potential movements of these species within the region encompassing the proposed wind farm. Wetland bird surveys were conducted in the late afternoon and evenings to observe any waterbird and wading bird movements that might be taking place on a daily basis. All surveys were conducted in the spring and early summer to coincide with the likely period of migration for most bird species, in particular Carnaby's Black-Cockatoo.

The flight characteristics of individual species throughout all bird surveys were recorded, with flight height ranges split into three zones:

- Zone 1 – 0–40 m (below tip of turbine blade).
- Zone 2 – 40–135 m (rotor swept area - potential collision zone).
- Zone 3 – >135 m (above tip of turbine blade).

After the surveys had been finalised, the wind turbine specifications were changed and altered the height of the RSA. The RSA was increased by the new turbine specification to range from 40 to 152 m above ground level. The assessment in this document has therefore been adjusted by the ornithologists based on their knowledge and professional opinion of those birds recorded flying at the upper limit of Zone 2 and lower limit of Zone 3.

Data were generally collected in accordance with Auswind (2005). The surveys were undertaken in various weather conditions and each 1.0 ha survey plot was surveyed four times. Each site was visited twice in the morning prior to 10.00 am to ensure adequate survey for passerine species, and twice after 10.00 am to ensure adequate survey for soaring species such as waterbirds and birds of prey. Survey teams were rotated between sites to ensure that any potential for observer bias was eliminated from data collected at individual sites.

A targeted survey constituting a component of Level 2 assessment was also undertaken to assess the use of the site and surrounding area by Carnaby's Black-Cockatoo during its migration from the wheat belt region in the east to the coastal plains in the west. This was undertaken during two days in early January 2009. The survey was conducted through the cooler parts of the day from dawn to noon and from later afternoon until dusk, and concentrated on areas between large stands of vegetation and turbine locations. These areas were selected with the expectation that if Carnaby's Black-Cockatoos were flying across the site and at risk of turbine strike they would be flying through such locations.

2.3.2 Call Playback

Nocturnal birds were surveyed using call playback, whereby recordings of the vocalisations of birds are broadcast to elicit a response, either vocal or behavioural. Species calls used included Southern Boobook, and Barn Owl. Calls were broadcast using a portable MP3 player and amplified through a megaphone at woodland sites.

2.3.3 Spotlighting

Spotlighting surveys were undertaken, from a vehicle, along Waddi, Mullering and Yandi Roads, travelling at a speed of 10 km/h using a handheld 100 W spotlight

2.3.4 Survey Dates and Prevailing Conditions

Table 2-1 depicts the dates and prevailing weather during the ecological investigations conducted by RPS ecologists during the October and November 2008 and January 2009 survey periods. The data were derived from a weather station located at Dandaragan to the east of the proposed wind farm site.

Table 2-1: Survey Dates and Prevailing Weather

Date	Weather					
	Temp	Rain (24 hrs to 9.00 am)	Sun		Moon	
			Rise	Set	Rise	Set
28.10.2008	12–18 °C	0 mm	06:25	19:37	04:35	18:08
29.10.2008	12–21 °C	10 mm	06:24	19:38	05:07	19:06
30.10.2008	9–18 °C	1 mm	06:23	19:38	05:42	20:04
31.10.2008	6–21 °C	0 mm	06:22	19:39	06:22	21:01
02.11.2008	9–27 °C	0 mm	06:20	19:41	07:55	22:45
03.11.2008	9–18 °C	0 mm	06:20	19:42	08:48	23:30
04.11.2008	9–18 °C	0 mm	06:19	19:42	09:44	N/A
05.11.2008	9–18 °C	0 mm	06:18	19:43	10:42	00:10
06.11.2008	6–18 °C	5 mm	06:17	19:44	11:39	00:45
07.11.2008	6–18 °C	1 mm	06:17	19:45	12:38	01:18
18.11.2008	12–27 °C	0 mm	06:10	19:54	N/A	9:57
19.11.2008	12–30 °C	0 mm	06:10	19:55	00:03	11:04
20.11.2008	15–24 °C	0 mm	06:09	19:56	00:39	12:08
21.11.2008	9–24 °C	0 mm	06:09	19:57	01:11	13:09
23.11.2008	12–21 °C	5 mm	06:08	19:59	02:08	15:04
24.11.2008	12–21 °C	1 mm	06:08	20:00	02:37	16:02
25.11.2008	12–21 °C	1 mm	06:08	20:00	3:08	16:59
26.11.2008	12–21 °C	1 mm	06:07	20:01	03:42	17:57
15.01.2009	19–41 °C	0 mm	06:32	20:26	00:42	12:49
16.01.2009	24–42 °C	0 mm	06:33	20:26	22:43	10:50

Source:
Australian Government – Geoscience Australia [http://www.ga.gov.au/geodesy/]

2.4 Avifauna Habitat Assessment

The habitat assessment reviewed the potential value of the site (and surrounds) for all avifauna guilds. Particular emphasis was placed on the identification of specific habitat types and resources on the site favoured by known Specially Protected and Threatened Species recorded from the region.

Habitat assessment was based on the specific habitat requirements of each species in regards to home range, feeding, roosting, breeding, movement patterns, corridor requirements and relative value of the habitat(s) present on the proposed development site. Consideration was given to contributing factors including topography, vegetation types and potential foraging, roosting and breeding resources for Specially Protected, Threatened and local avifauna.

The survey concentrated on census points and wetland habitats. More regional and local observations of bird habitat usage trends were also noted where possible, to gain a broader picture of avian ecology for the locality.

2.5 Limitations

Two survey events were undertaken in October and November 2008, and a targeted Carnaby's Black-Cockatoo survey was conducted in January 2009. Survey times were selected because conditions were favourable for studying a wide range of avifauna including sedentary species and summer migrants. The climatic conditions during the surveys were considered to be representative of average conditions for the region such that typical avian communities were recorded during the survey. However, there may be differences in avian species and/or activity in the area in the cooler, wetter months.

Permanent water-bodies were holding sufficient water to support a diversity of waterfowl and waders, providing a relatively high level of confidence in the accuracy of the assessment of recorded and potentially occurring species. However, some more ephemeral regional wetlands had dried beyond the capacity to support moderate or high numbers of waterbird species during the survey period, with higher water levels apparently being restricted to winter months.

The proposed wind farm will occur on undulating hill tops, therefore the majority of formal census points were located on the top or near to the tops of hills. Larger species (e.g. raptors, corvids or cockatoos) observed in these locations tended to keep relatively low over hill top areas compared with their elevation relative to the ground when over valleys. Observations of birds occurring outside of the formal plots were generally of these large species and at significant distances (up to 2 km) from census points. The resulting observed flight elevations of these records were often inflated by their position over the valleys. As a consequence, some of the overall elevation percentages of species recorded during the study may overestimate the actual potential of birds occurring within the RSA.

Of the forty-four species recorded within the sixteen Waddi Wind Farm avian survey plots, thirty-seven species returned less than thirty individual observations, increasing the potential for observed behavioural trends to be skewed by outliers in the low sample numbers. However the number of Waddi species returning less than thirty individual observations is reduced to only seventeen species when taking into account the additional twenty-seven avian survey plots across Yandin and representative sites. To further overcome potential skews in behavioural data, the results were compared with known ecological characteristics of the species observed and, where appropriate, comment is offered on results that appear aberrant in regard known behaviours.

Most bird species avoid people wherever possible, with the proximity at which avoidance occurs varying for different species and generally increasing as bird size increases. Ravens, raptors and in some cases Australian Magpies, may avoid close proximity to people by increasing flight elevation. The presence of the surveyors or other people in the area may have induced this behaviour in some of the individual birds recorded.

Whilst every effort was made to coincide avifauna surveys with migrating bird groups such as waders and black cockatoos, migration periods vary between years and peak events can be missed. However, information on the habitats and landscape was also used to augment and/or validate the data acquired in determining likely distributions across the site.

The conspicuous nature of some bird species at long distances (such as Wedge-tailed Eagles and Ravens) and the relatively close proximity of survey plots are likely to result in some double counting of these species. Therefore, counts of large and high flying species outside of the survey plots is likely to be an unreliable indicator of abundance, probably overestimating true abundance.

2.6 Impact Assessment

Risk assessment for those avian species which were recorded during the survey period from the wider study area, including representative sites, was undertaken by evaluating:

1. The likelihood of impact.
2. The likely severity (consequence) of the impact.

Likelihood was determined through consideration of four aspects of the ecology of each species being:

- Habitat Description (as frequented by the species locally)
- Chance of Occurrence in RSA
- Abundance within the Site Vicinity
- Chance of Occurrence on Site.

This process allows key information about bird ecology within the local context to inform the likelihood each species might be subjected to potential impact given turbine locations and elevation profiles.

A qualitative measure of the likelihood for each species to be impacted was assigned as follows.

- Very Rare – Refers to those species that are considered as having almost no chance of impact, due to either a lack of habitat within the site or its vicinity or flight behaviour that does not approach the RSA.

- Rare – Refers to those species that are considered as having a low chance of impact, due to occasional flight behaviour within the RSA and habitat within the site, or regular RSA flight behaviour but low numbers within the site and its vicinity.

- Possible – Refers to those species that are considered as having a low - moderate chance of impact, with suitable habitat within the site and more regular flight behaviour within the RSA.

- Probable – Refers to those species that are considered as having a moderate - high chance of collision, with suitable habitat within the site, regular flight behaviour within the RSA and potentially high numbers of birds at the site.

A qualitative assessment of the consequences of potential impacts, incorporating the conservation status and local ecological considerations for each species, was undertaken by applying the consequence definitions below.

- Insignificant – Affected species are considered common in regard to distribution and / or abundance. Behavioural and or collision impacts would be highly localised or involve relatively low numbers with no affect at local population levels.

- Minor – Affected species are considered common in regard to distribution but lower in local abundances, including at the site (some raptor species may fall in this category). Behavioural and or collision impacts may impact local populations but no affect at regional levels.

- Moderate – Affected species with restricted distributions or abundance and local numbers likely to be reduced by impacts, possibly affecting regional populations. This category includes species that might only be impacted in low numbers, but due to their legislative status loss of low numbers is considered to be of moderate consequence.

- Significant – Affected species with highly restricted distributions or abundance and impacts could involve a substantial proportion of local numbers with effects to regional or broader populations.

Overall risk level was then analysed in accordance with the risk analysis matrix approach, as described in Auswind (2006).

3.0 RESULTS

3.1 Avifauna Overview

An observed and expected avifauna species list for the site is detailed in **Appendix 1**.

Across all formal avian census plots, including those in the proposed Waddi Wind Farm area, the proposed Yandin Wind Farm area and the seven representative plots, a total count of eighty-eight bird species were recorded. Within this total, forty-four bird species were recorded within formal bird census plots across the proposed Waddi wind farm, including three species that were not recorded in formal plots outside of the Waddi area. A further twenty-five species not observed within the Waddi wind farm area were observed within the proposed Yandin Wind Farm area and another nineteen additional species were recorded at representative plots alone, the majority of which are wetland species associated with the lake to the north-east of Guraga Lake. A further six species were observed in the vicinity of the site during nocturnal movements around the study area. A small number of other species that were noted within the wider locality may have potential to move through the site, on an intermittent basis, due to their nomadic, dispersive or migratory habits, including the Peregrine Falcon, which is listed under Schedule 4 of the *WC Act 1950*. Only two introduced bird species were recorded during the survey period.

Notable results from the October–November 2008 survey period included:

- two bird species listed as Specially Protected under the WC Act, namely, Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) and Peregrine Falcon (*Falco peregrinus*) were recorded. *Calyptorhynchus latirostris* is also listed under the EPBC Act as Endangered

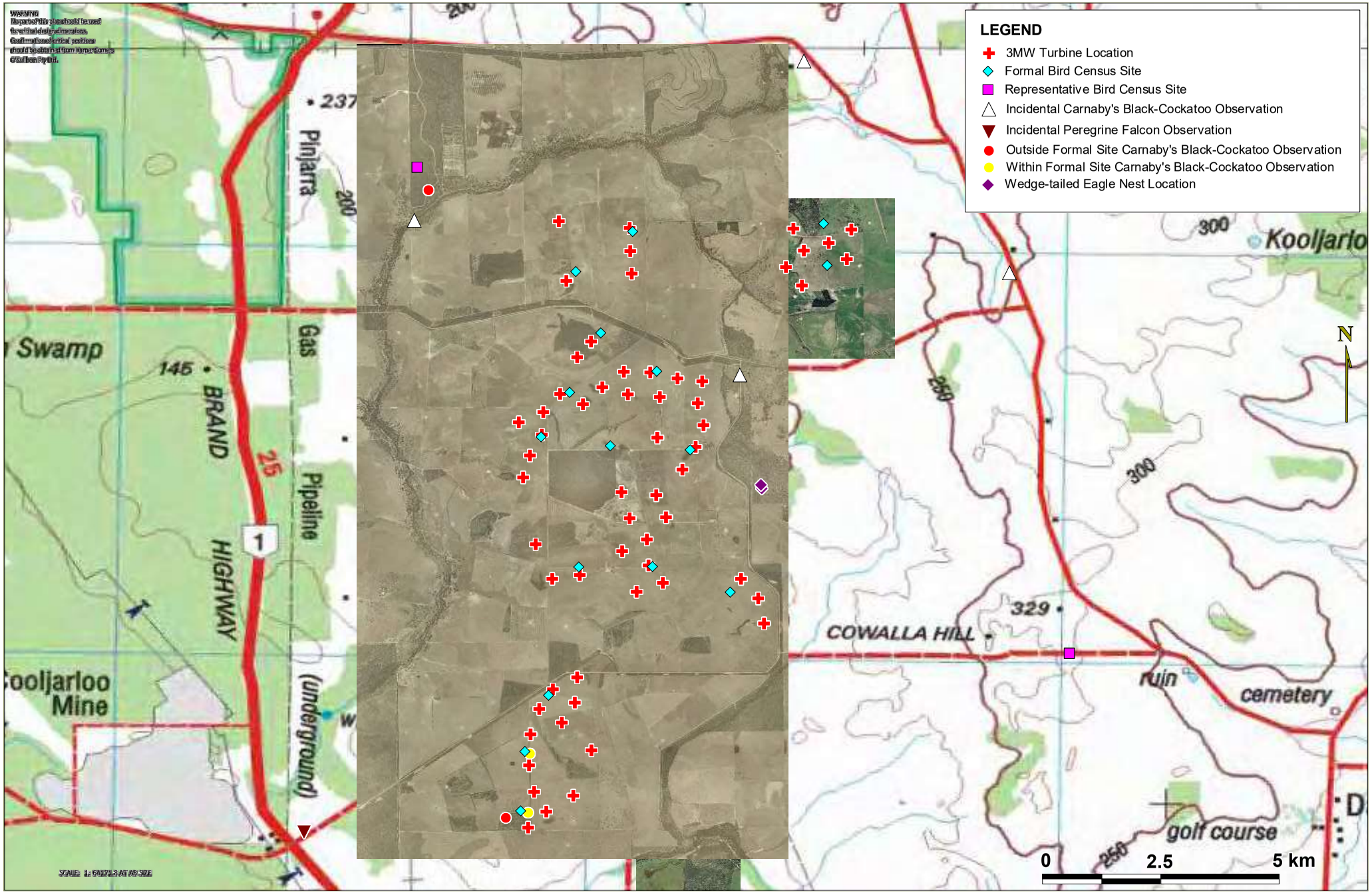
- the Rainbow Bee-eater (*Merops ornatus*) and a number of members of the families Accipitridae (Osprey, hawks, eagles and harriers), Anatidae (ducks, swans and geese), Charadriidae (plovers, dotterels and lapwings) and Scolopacidae (snipe, godwits, curlews, sandpipers, stints and phalaropes) were observed within the site all of which are listed as Migratory under the EPBC Act

- birds of prey such as Collared Sparrowhawk (*Accipiter cirrhocephalus*), Brown Falcon (*Falco berigora*), Wedge-tailed Eagle (*Aquila audax*), Australian Hobby (*Falco longipennis*), Black-shouldered Kite (*Elanus axillaris*) and Nankeen Kestrel (*Falco cenchroides*) were observed within the site

- nocturnal bird species such as Southern Boobook (*Ninox boobook*), Barn Owl (*Tyto alba*), Tawny Frogmouth (*Podargus strigoides*) and Australian Owlet-nightjar (*Aegotheles cristatus*) were observed within the vicinity of the site.

The two introduced bird species, Rock Dove (*Columba livia*) and Laughing Turtle-dove (*Streptopelia chinensis*), that were recorded within the vicinity of the site are commensal with humans and were only recorded from urban areas. All avian species recorded within the site were native bird species.

Locations of threatened and other significant (priority) species observations are shown in Figure 3-1.



TITLE:	WADDI WIND FARM AVIAN REPORT	LOCATION:	FIG 3-1 THREATENED SPECIES MAP	DATUM: PROJECTION:	DATUM LONGITUDE / LATITUDE (NAD 83)
DATE:	02/02/2010	PURPOSE:	PURPOSE	LAYOUT REF:	J:\JOBS\25K\25342 - DANDARAGAN, WA\DRAFTING\MAPINFO\FAUNA MAPPING 25342 FIGURE 3-1THREATENED SPECIES MAP A-A4 220509
VERSION (PLAN BY):	A. RICHARDSON				

CLIENT: WIND PROSPECT
JOB REF: 25342

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3.2 Avifauna Survey Results

Specific information was collated on avian diversity, activity and behaviour. Key results from the 43 bird census points surveyed, including 16 Waddi, 20 Yandin and seven Representative sites are presented in Table 3-1and Table 3-2 (including height ranges frequented).

The survey was conducted using flight height zones that were changed after the survey had been completed. Therefore, data reported in this document has been adjusted using the revised RSA zone heights and is reflected in the Tables. Only those species that were recorded flying in Zones 2 and 3 or just in Zone 3 have been affected by this change.

The data collected in the field did not differentiate birds flying between 135 m (upper limit of the old RSA) and 152 m (upper limit of the new RSA), and therefore actual flight time percentages could not be accurately estimated. Data for birds recorded flying only in Zone 1 or in Zones 1 and 2 would not be affected by the changes, because 40 and 135 m respectively was the upper limits of their flight. Therefore, the percentages of time spent in these two zones would not change.

The flight time percentages of those species flying in Zones 3 and 2 may be under-estimated as a result of the changes in RSA height, and the level of risk will be adjusted using the precautionary principle. The differences between flight times in the original zones and new zones are however, likely to be negligible given that the change is only 17 m.

Those species recorded flying in Zone 3 and not Zone 2, may also be affected by the change in RSA height, and will be dealt with using the professional judgement of the project ornithologists.

Table 3-1 shows elevation height data collected during the census period. Elevation percentages are derived from all records collected from both formal and representative census plots and include those records made inside and outside of all plots.

Table 3-2 shows the spatial distribution of data collected in reference to numbers of each species observed as reported in Table 3-1. Field results are divided into those occurring within and outside of formal census plots.

Raw data upon which results in Table 3-1 and Table 3-2 were derived are presented in full in Appendices 2 and 3.

Notable outcomes of the formal surveys and opportunistic sightings, undertaken during varying weather conditions and diurnal periods, were:

- There was a relatively low diversity of bird species recorded from open pasture areas characterising proposed wind turbine positions.
- There were relatively low numbers of individual birds recorded from open pasture areas characterising proposed wind turbine positions.
- The greatest diversity of bird species recorded in the vicinity of proposed turbine locations were limited to stands of intact native vegetation comprised mostly of heath.
- The majority of movement observations were limited to localised movements.
- Few species were routinely recorded flying within the RSA (40–152 m (as adjusted post-survey)), particularly in ridge top contexts where proposed wind turbines will be located.
- Only five species were recorded flying in the original Zones 2 and/or 3 and therefore in need of consideration for the revised RSA heights. All five of these were common birds and none listed on any lists of conservation concern.
- There were relatively few Threatened bird species recorded within formal survey plots and the majority of those records were outside of the RSA.
- The presence of isolated trees within cleared areas often attracted birds albeit in small numbers and at low diversities.
- No specific areas within the proposed wind farm areas were observed as being significant avian corridors.
- The most prevalent species recorded included Western Corella (Northern), Australian Raven, Galah, Straw-necked Ibis, Australian Ringneck, Yellow-rumped Thornbill, Brown Songlark, and Australian Magpie.
- Threatened avian species recorded regularly in the locality, namely Carnaby's Black-Cockatoo, were found to primarily frequent low-land areas and movements of these species tended to follow valleys with woodland vegetation.
- Raptors including Nankeen Kestrel and Wedge-tailed Eagle, in order of abundance, were observed throughout the study area.
- Other locally abundant species such as waterfowl and waders were observed within specific habitat types not associated with the locations of proposed turbine positions.

Table 3-1: Formal Bird Census Results showing Habitat over which the Bird Species were Recorded, Indication of their Movement Patterns and Speed Category in which they were Recorded Flying

Species	Total Records Across all Sites	Total Waddi Records	Height Ranges Frequented			Habitat	Movements	Flight Speed
			Zone 1 (below RSA)	Zone 2 (within RSA)	Zone 3 (above RSA)			
Australian Shelduck	4509	0				Wetlands	Sedentary/Dispersive	Med
Black Swan	1633	0				Wetlands	Sedentary/Dispersive	Slow–Medium
Western Corella	901	7				Woodland/Grassland	Locally nomadic	Medium Flocks
Galah	458	254				Woodland/Grassland	Locally nomadic	Medium Flocks
Australian Raven	427	119				Forest/Woodland/Heath/ Grassland	Locally nomadic	Medium
Australian Ringneck	374	46				Forest/Woodland	Sedentary	Swift
Straw-necked Ibis	366	65				Wetlands/Grassland	Locally nomadic	Slow
Brown Songlark	236	206				Grassland	Aerial Breeding displays	Medium
Tree Martin	213	16				Woodland/Aerial	Sedentary	Medium–Swift
Australian Magpie	198	62				Forest/Woodland/Grassland	Sedentary	Medium–Swift
Yellow-rumped Thornbill	194	60				Woodland/Shrubland/Grassland	Sedentary	Slow
Red-capped Plover	179	0				Salt and Freshwater Wetlands	Nomadic/Dispersive	Medium–Swift
Australasian Shoveler	154	0				Wetlands	Nomadic/Dispersive	Swift
Grey Teal	119	0				Wetlands	Nomadic	Swift
Australian Magpie-lark	114	33				Forest/Woodland/Grassland	Sedentary	Slow–Medium
Australian Pipit	105	58				Grassland	Aerial Breeding displays	Medium
Red-necked Stint	104	0				Intertidal Zone and Saline Wetlands	Migratory/Nomadic	Medium–Swift

Species	Total Records Across all Sites	Total Waddi Records	Height Ranges Frequented			Habitat	Movements	Flight Speed
			Zone 1 (below RSA)	Zone 2 (within RSA)	Zone 3 (above RSA)			
Carnaby's Black- Cockatoo	100	36				Forest/Woodland/Heath	Seasonally Nomadic	Slow Flocks
Welcome Swallow	99	20				Aerial space above most habitat	Sedentary/Nomadic	Medium–Swift
Black-winged Stilt	98	0				Intertidal Zone and Wetlands	Nomadic/Dispersive	Medium
Black-faced Woodswallow	96	55				Forest/Woodland/Grassland/Aerial	Sedentary Migratory	Slow–Swift
Brown Honeyeater	85	5				Forest/Woodland/Shrubland/Heath	Sedentary	Slow–Medium
Stubble Quail	84	69				Grassland	Nomadic/Irruptive	Swift (but short)
Wedge-tailed Eagle	82	20				Forest/Woodland/Grassland	Sedentary (large territory)	Slow–Swift
White-cheeked Honeyeater	77	31				Woodland/Heath	Sedentary	Slow–Medium
Nankeen Kestrel	70	21				Grassland/ Woodland edges	Sedentary/ Dispersive	Slow–Swift
White-winged Fairy-wren	59	20				Shrublands/Heath	Sedentary	Slow
Willie Wagtail	53	21				Woodland/Grassland	Sedentary	Slow
Silver Gull	50	0				Coastal Fringe and Saline Wetlands	Sedentary/Locally nomadic/Dispersive	Slow–Medium
White-fronted Chat	50	34				Shrubland/Grassland/Heath/Flats	Nomadic	Medium
Silvereye	49	13				Forest	Seasonal nomad	Medium Flocks
Splendid Fairy-wren	44	19				Woodland/Shrublands/Heath	Sedentary	Slow
Rufous Whistler	43	7				Woodland/Shrubland	Sedentary/Breeding Migrant	Slow
Black-faced Cuckoo-shrike	41	6				Forest/Woodland/Shrubland	Locally nomadic	Medium
Rainbow Bee-eater	38	20				Forest/Woodland/Shrubland	Sedentary/Migratory	Swift
Grey Butcherbird	32	9				Forest/Woodland/Shrubland	Sedentary	Slow–Medium

Species	Total Records Across all Sites	Total Waddi Records	Height Ranges Frequented			Habitat	Movements	Flight Speed
			Zone 1 (below RSA)	Zone 2 (within RSA)	Zone 3 (above RSA)			
Singing Honeyeater	29	9				Forest/Woodland/Shrubland	Sedentary	Medium
Crested Pigeon	28	3				Grassland/ Woodland edges	Sedentary	Slow–Swift
Western Gerygone	24	0				Forest/Woodland/Shrubland	Sedentary	Slow
Rufous Fieldwren	22	19				Heath/Sparse shrubland	Sedentary	Slow
White-winged Triller	16	4				Woodland/Shrubland/Heath	Breeding Migrant	Slow–Medium
Musk Duck	16	0				Deep Water Wetlands	Dispersive	Medium–Swift
Tawny-crowned Honeyeater	15	7				Heath	Sedentary	Slow–Medium
Variegated Fairy-wren	14	0				Woodland/Shrublands/Heath	Sedentary	Slow
Australian Wood Duck	13	0				Wetlands	Locally nomadic	Med
Inland Thornbill	12	0				Forest/Woodland/Shrubland	Sedentary	Slow
Zebra Finch	11	0				Grassland and Open Shrublands	Nomadic/Dispersive	Slow
Yellow-throated Miner	10	0				Forest/Woodland/Shrubland	Sedentary	Slow
Black Honeyeater	9	4				Shrubland/Heath	Sedentary/Nomadic	Medium–Swift
Laughing Kookaburra	8	0				Forest/Woodland	Sedentary	Slow
Rufous Songlark	7	4				Grassland	Aerial Breeding displays	Medium
Grey Shrike-thrush	7	0				Forest/Woodland/Shrubland	Sedentary	Medium
Horsfield's Bronze-cuckoo	6	1				Forest/Woodland	Sedentary/Migratory	Medium–Swift
Australian Pelican	6	0				Coastal Fringe and Large Inland Water Bodies	Locally nomadic/ Dispersive	Medium–Swift
Banded Lapwing	5	5				Grasslands	Dispersive	Slow–Swift
Common Bronzewing	5	2				Woodlands/Heaths	Sedentary	Swift
Crimson Chat	5	3				Woodland/Shrubland/Heath	Nomadic	Medium

Species	Total Records Across all Sites	Total Waddi Records	Height Ranges Frequented			Habitat	Movements	Flight Speed
			Zone 1 (below RSA)	Zone 2 (within RSA)	Zone 3 (above RSA)			
Sacred Kingfisher	4	0				Forest/Woodland	Sedentary/Migratory	Swift
White-faced Heron	4	0				Grasslands/Wetlands Coastal Fringe	Nomadic	Medium
Western Thornbill	4	0				Forest/Woodland/Shrubland	Sedentary	Slow
Varied Sittella	4	0				Forest/Woodland/Heath	Sedentary	Slow–Medium
White-backed Swallow	4	0				Watercourses	Sedentary	Slow–Medium
Brown Falcon	4	3				Grassland/ Woodland edges	Sedentary/ Dispersive	Slow–Swift
Red-capped Parrot	3	0				Marri Woodlands	Sedentary	Swift
Shining Bronze-cuckoo	3	0				Forest/Woodland	Migratory/Sedentary	Medium–Swift
Red Wattlebird	3	0				Woodland/Heath	Sedentary/Nomadic	Slow
Whistling Kite	2	0				Woodlands, Coastal Fringe and Wetlands	Sedentary/Locally Nomadic	Sow–Medium
Collared Sparrowhawk	2	1				Forest/Woodland	Sedentary (large territory)	Slow–Swift
Brown Goshawk	2	0				Forest/Woodland	Sedentary (large territory)	Slow–Swift
Australian Hobby	2	1				Grassland/ Woodland edges	Sedentary/ Dispersive	Slow–Swift
Red-necked Avocet	2	0				Estuaries and Saline Wetlands	Nomadic/Dispersive	Medium
Striated Pardalote	2	0				Forest/Woodland	Sedentary	Swift
White-browed Scrubwren	2	2				Forest/Woodland	Sedentary	Slow
Weebill	2	0				Forest/Woodland	Sedentary	Slow
Red-capped Robin	2	0				Woodland/Shrubland	Sedentary	Slow

Species	Total Records Across all Sites	Total Waddi Records	Height Ranges Frequented			Habitat	Movements	Flight Speed
			Zone 1 (below RSA)	Zone 2 (within RSA)	Zone 3 (above RSA)			
Hooded Robin	2	0				Woodland/Shrubland	Sedentary	Slow
Black-shouldered Kite	2	1				Grassland/Woodland	Locally nomadic/ dispersive	Medium
Pacific Black Duck	1	0				Wetlands	Dispersive	Swift
Little Egret	1	0				Estuaries and Saline Wetlands	Locally Nomadic/ Dispersive	Slow
Australian White Ibis	1	0				Estuaries, Wetlands and Grasslands	Locally Nomadic/ Dispersive	Slow–Medium
White-bellied Sea-eagle	1	0				Estuaries, Rivers and Large Inland Water bodies	Locally Nomadic/ Dispersive	Slow–Swift
Gull-billed Tern	1	0				Estuaries and Saline Wetlands	Sedentary/Locally Nomadic/Dispersive	Medium–Swift
Brown-headed Honeyeater	1	0				Forest/Woodland/Heath	Sedentary	Slow–Medium
Grey Fantail	1	0				Forest/Woodland/Shrubland	Sedentary/Seasonal Migrant	Slow
Pied Butcherbird	1	0				Woodland	Sedentary	Slow–Medium
Mistletoebird	1	0				Forest/Woodland	Sedentary/Nomadic	Medium–Swift
Little Grassbird	1	0				Dense Wetland Vegetation	Sedentary	Slow
Fairy Martin	1	1				Aerial proximate to nesting sites	Sedentary	Medium–Swift

= Species commonly recorded at this height range during study (25% and >25%)

= Species occasionally recorded at this height range during study (>5% and < 25%)

= Species rarely recorded at this height range during study (> 0% and up to 5%)

= Species not recorded at this height range during study (0%)

Table 3-2: Bird Species Observation Frequency. NOTE: Data for Waddi, Yandin and Reference Sites have been included to indicate the Bulk of Data Collected in the Combined Survey Approach, which reflects an acute understanding of the Bird Species and Movement Patterns across both Sites

Bird Species (Common Name)	Formal Plots Waddi and Yandin		Representative Plots		Total
	Inside Census	Outside Census	Inside Census	Outside Census	
Australian Shelduck	0	0	5	4504	4509
Black Swan	0	0	0	1633	1633
Western Corella (Northern)	25	154	102	620	901
Australian Raven	19	260	10	138	427
Galah	140	251	21	46	458
Australian Ringneck	197	104	39	34	374
Straw-necked Ibis	26	64	1	275	366
Tree Martin	23	11	1	178	213
Australian Magpie	39	98	4	57	198
Red-Capped Plover	0	0	8	171	179
Australasian Shoveler	0	0	0	154	154
Yellow-rumped Thornbill	107	18	64	5	194
Grey Teal	1	0	0	118	119
Brown Songlark	176	51	3	6	236
Red-Necked Stint	0	0	20	84	104
Australian Magpie-lark	28	50	10	26	114
Black-Winged Stilt	0	0	84	14	98
Brown Honeyeater	47	15	11	12	85
Welcome Swallow	29	11	36	23	99
Wedge-tailed Eagle	4	63	0	15	82
Australian Pipit	61	33	2	9	105
Carnaby's Black-Cockatoo	15	67	2	16	100
White-cheeked Honeyeater	27	19	19	12	77
Nankeen Kestrel	22	42	0	6	70
Stubble Quail	33	45	3	3	84
Black-faced Woodswallow	51	21	13	11	96
White-winged Fairy Wren	28	22	3	6	59
Willie Wagtail	25	9	13	6	53
Silver Gull	0	0	35	15	50
White-fronted Chat	21	18	6	5	50
Silvereye	13	8	19	9	49
Rufous Whistler	14	16	6	7	43
Splendid Fairy-wren	29	13	2	0	44

Bird Species (Common Name)	Formal Plots Waddi and Yandin		Representative Plots		Total
	Inside Census	Outside Census	Inside Census	Outside Census	
Rainbow Bee-eater	23	13	2	0	38
Black-faced Cuckoo-Shrike	25	7	3	6	41
Grey Butcherbird	7	18	1	6	32
Singing Honeyeater	13	10	3	3	29
Crested Pigeon	16	9	0	3	28
Western Gerygone	9	7	7	1	24
Rufous Fieldwren	10	12	0	0	22
Variegated Fairy-Wren	7	7	0	0	14
White-Winged Triller	11	2	1	2	16
Musk Duck	0	0	0	16	16
Tawny-crowned Honeyeater	2	5	4	4	15
Australian Wood Duck	6	0	0	7	13
Inland Thornbill	12	0	0	0	12
Zebra Finch	0	0	4	7	11
Yellow-Throated Miner	5	4	1	0	10
Black Honeyeater	4	0	3	2	9
Horsefields Bronze-Cuckoo	4	0	1	1	6
Laughing Kookabura	1	2	2	3	8
Rufous Songlark	0	7	0	0	7
Australian fPelican	0	0	0	6	6
Grey Shrike-Thrush	2	1	3	1	7
Banded Lapwing	0	5	0	0	5
Common Bronzewing	4	0	0	1	5
Sacred Kingfisher	1	2	0	1	4
Crimson Chat	3	0	0	2	5
White-faced Heron	3	0	0	1	4
Western Thornbill	4	0	0	0	4
Varied Sittella	4	0	0	0	4
White-backed Swallow	0	2	2	0	4
Brown Falcon	0	4	0	0	4
Red-Capped Parrot	1	2	0	0	3
Shining Bronze-Cuckoo	2	1	0	0	3
Red Wattlebird	0	3	0	0	3
Whistling Kite	0	0	0	2	2
Collared Sparrowhawk	0	1	0	1	2
Brown Goshawk	0	2	0	0	2
Australian Hobby	1	0	0	1	2

Bird Species (Common Name)	Formal Plots Waddi and Yandin		Representative Plots		Total
	Inside Census	Outside Census	Inside Census	Outside Census	
Red-Necked Avocet	0	0	0	2	2
Striated Pardalote	1	1	0	0	2
White-Browed Scrubwren	2	0	0	0	2
Weebill	2	0	0	0	2
Red-Capped Robin	1	0	1	0	2
Hooded Robin	2	0	0	0	2
Black-Shouldered Kite	0	2	0	0	2
Pacific Black Duck	0	0	0	1	1
Little Egret	0	0	0	1	1
Australian White Ibis	0	0	0	1	1
White-Bellied Sea-Eagle	0	0	0	1	1
Gull-Billed Tern	0	0	1	0	1
Brown-Headed Honeyeater	1	0	0	0	1
Grey Fantail	1	0	0	0	1
Pied Butcherbird	1	0	0	0	1
Mistletoebird	0	0	1	0	1
Little Grassbird	0	0	0	1	1
Fairy Martin	1	0	0	0	1

3.3 Avifauna Habitat Assessment

3.3.1 Habitats of the Site

The Waddi wind farm site is characterised by a range of different habitats dominated largely by cleared or modified lands with remnant patches/elements of native vegetation. The locality is characterised by undulating hills with ephemeral to semi-permanent drainage lines occurring in the gullies and valleys. This diversity in local topography exhibits general trends in vegetation community assemblages, which in turn provide opportunities for different assemblages and guilds of native bird species.

Four key habitat types occur within the vicinity of the proposed Waddi Wind Farm site, namely:

- Open pasture/cultivation areas.
- Remnant heathland vegetation.
- Woodland remnants/elements.
- Areas where various combinations of heathland and/or woodland are associated with areas dominated by open pasture/cultivation habitats.

Open pasture and cultivated lands occur on hill tops and slopes and largely characterise those lands upon which wind turbine sites are proposed. Heathland habitat varies in height, and plant species assemblage varies in relation to elevation on undulating hills. A shorter heathland community characterises the tops and higher slopes of hills while on the lower slopes and flats, heathland communities have both a shrubby lower stratum and an upper stratum of large shrubs/small trees. Gullies and valleys have woodland habitats largely associated with drainage lines and these communities merge with heathland on the lower slopes. The different habitats provide a mosaic of different habitat opportunities for bird species occurring in the locality.

3.3.2 Habitat Usage

3.3.2.1 Open Pasture/Cultivation Habitats

Where pasture and cultivated habitats are isolated from native plant communities, there are limited habitat opportunities, diversity of native bird species. Species commonly encountered in this habitat type during the study were limited to typical open country species such as Stubble Quail, Brown Songlark, Australian Pipit and Nankeen Kestrel. Straw-necked Ibis were observed foraging in this habitat type intermittently, although usually in lowland locations. Australian Ravens were often observed foraging in this habitat where there were no associated trees.

Fence line windbreaks composed of native or exotic tree species increase shelter and foraging niches when associated with open habitats. Where these linear features occur a number of bird species use the proximity of shelter and open pastures for foraging and nesting opportunities. Such species include Australian Magpie-larks, Australian Magpie, Grey and Pied Butcherbirds, Black-faced Cuckoo-shrike, Australian Ringneck, Black-faced Woodswallow, White-winged Triller, Brown Falcon, Splendid Fairy-wren, Yellow-rumped Thornbill, Western Gerygone, White-fronted Chat, Willie Wagtail and Crested Pigeon. The same species were also found to use open pasture habitat where scattered trees provide the same increased shelter opportunities as windbreak vegetation.

Stands of scattered shrubs and vegetation (shrubs and canola) along fence lines provide sufficient shelter for White-winged Fairy-wrens.

Tagasaste (Tree Lucerne) is planted in some areas to provide fodder for cattle. This man-made shrubland provides shelter and foraging, in particular for the smaller species, such as Splendid, Variegated and White-winged Fairy-wrens, Silvereyes, Red-capped Robin, White-browed Scrubwren, Singing Honeyeater, White-fronted Chat and Willie Wagtail.

Although there is an increase in bird diversity associated with windbreaks, scattered trees and fence line shrubs, this influence is generally limited to the immediate area around these shelter opportunities and does not extend very far into the open pasture. The species using open pasture most widely in this enhanced open habitat context was Australian Magpie.

3.3.2.2 Heathland Habitats

Short heathland habitats on hill tops were characterised by a distinctive assemblage of species, including: Rufous Fieldwren, Tawny-crowned Honeyeater, White-winged Fairy-wren, White-fronted Chat and Black Honeyeater. Taller heathland habitats were frequented by other species, such as: Brown Honeyeater, Brown-headed Honeyeater, White-cheeked Honeyeater, Singing Honeyeater, Red Wattlebird, White-winged Triller, Black-faced Woodswallow, Rainbow Bee-eater, Variegated Fairy-wren, Splendid Fairy-wren, Common Bronzewing, White-browed Scrubwren, Silvereye and Crested Pigeon.

Where heathland vegetation occurs in close proximity to open pasture habitat, and to a lesser extent cultivation, a number of small bird species use the shelter or higher vantage point that the heathland vegetation offers to access open habitat for foraging purposes. These birds include: Yellow-rumped Thornbills, White-fronted Chats, Crimson Chats and Black-faced Woodswallows.

3.3.2.3 Woodland Habitats

Woodland habitats within the study area were found for the most part to occur in lowland areas and on the lower slopes of hillsides. The woodland stands were most often associated with semi-permanent or ephemeral drainage lines where there is some topographical shelter from prevailing winds.

Woodland habitats locally provide the greatest opportunities for bird species due to the diversity of strata and vegetation complexity. Trees provide nesting sites for larger species such as Australian Raven, birds of prey, Australian Magpie, Grey Butcherbird, Australian Ringneck and Red-capped Parrot. The associated foliage provides foraging and nesting opportunities for mid to upper canopy species, such as Rufous Whistler, Western Gerygone, Black-faced Cuckoo-shrike, Spotted and Striated Pardalotes, Sacred Kingfisher and Singing Honeyeater. The understorey is often represented by heathland shrubs and provides shelter and foraging for a range of smaller bird species, including Splendid, Variegated and White-winged Fairy-wrens, White-browed Scrubwrens and Inland Thornbill. Locally, woodland habitats also provide foraging, nesting and roosting opportunities for two cockatoo species, the Western Corella and Carnaby's Black-Cockatoo. Local movements of these species within the study area were noted as being primarily associated with lowland woodland habitats.

3.3.2.4 Wetland Habitats

Apart from those occurring in the wider locality (Section 3.6), wetland habitats in the vicinity of the proposed Waddi wind farm site are few, with water often provided for stock via drinking troughs. The only other sources of water within the Waddi site are the two brooks that run through the bottom of the valleys. These provide very limited waterbird habitat opportunities.

3.3.2.5 Aerial Habitats

In addition to the terrestrial habitats noted above, the sky above these habitats offers foraging opportunities for a number of bird species. Wedge-tailed Eagles were recorded throughout the study area and two nests, one containing a partly fledged eaglet, were found in woodland habitat to the east of Mullering Road. Welcome Swallows and Nankeen Kestrels were recorded over all habitat types, Tree Martins were observed intermittently around suitable nesting trees and Black–faced Woodswallows were noted on heathland shrubs, power lines, remnant trees or associated fence lines where vegetation or other structures afford vantage points for hawking out for insects. The Australian Hobby was observed within the site, although infrequently. The Peregrine Falcon was also observed opportunistically within the locality.

3.3.2.6 Nocturnal Bird Species

Spotlighting surveys were undertaken to identify nocturnal bird species in the area that might occur within the proposed Waddi Wind Farm site.

Southern Boobook was heard calling from riparian woodland habitat on a number of nights at the Waddi Bush resort and one individual was observed in riparian woodland vegetation at the western end of Waddi Road. An Australian Owlet-nightjar was heard in woodland habitat at the Waddi Bush Resort.

A Barn Owl was recorded near the junction of Yandin and Menardie Roads and a Tawny Frogmouth was observed in woodland near Yandin Reserve at the eastern end of Yandin Road during a survey for a wind farm some 15 km south of the Waddi site.

3.4 Bird Movements/Aerial Habits

3.4.1 Species with 0% Records within the RSA

Of the eighty-eight species detected within all survey plots censused in the locality, sixty-nine species were sighted in the formal census sites. Of these sixty-nine species, forty-four were observed within the proposed Waddi Wind Farm site. Fourteen of these species were recorded in the Waddi site in thirty or more individual observations, which provides sufficient data upon which to assume that trends recorded might approximate with some accuracy the behaviours of these species (see Table 3-1). However if results from representative and Yandin sites are included, 28 of those species recorded within the Waddi Wind Farm site returned more than 30 individual records across all surveys. Where results of observed species fall below a number indicating statistical robustness (<30 obs.) the results have been assessed against the known flight behaviours of these species to validate that flight values observed are consistent with the flight habits of the respective species.

Of those twenty-eight Waddi Wind Farm species with more than thirty overall records, 15 species returned 0% of observations within the Rotor Swept Area (RSA). However, only thirteen of those species returned 0% of records in the RSA over total sites surveyed in the locality. Those species with more than thirty records returning percentages above 5% within the RSA on the Waddi site were Galah, Australian Raven, Australian Ringneck, Straw-necked Ibis, Brown Songlark, Australian Magpie, Australian Magpie-lark, Australian Pipit, Carnaby's Black-Cockatoo Wedge-tailed Eagle and Nankeen Kestrel. These results are further discussed below in Section 3.4.3 however, in most cases these records were either from distant observations outside of formal 1ha plot areas or influences by the relatively low numbers of records or both. A large number of which were inflated by the bird's position above valleys and not the ridge-top locations that wind turbines will be located. No changes were required to the list of birds here following review of the RSA height after the survey had been completed.

One species, being the Black-shouldered Kite recorded 100% of records within the RSA, although the number of records for this species within the site was only a single record and is therefore too low to draw any meaningful statistical conclusions from. The single record for the kite was one of only two records made during the course of field investigations in the locality.

Investigation of potential results anomalies noted that two species within the group returning 0% of records in the RSA on the Yandin site, being the Rainbow Bee-eater and White-fronted Chat may under some circumstances fly at elevations within the RSA, largely within long range movements. The Rainbow Bee-eater is an aerial hunter and it may forage at relatively high elevations at times when sufficient prey is available. Another species the Australian Shelduck, which was recorded in high numbers to the west at Guraga Lake North and Namming Lake, also has the potential to fly within the RSA, but all movements noted over the top of undulating hills in the vicinity of the proposed wind farm were at low elevations.

Of the forty-five species encountered within the vicinity of the proposed Waddi Wind Farm, seventeen species returned less than thirty records over all sites surveyed and thirty-one species returned less than thirty records within Waddi surveys alone. Of these seventeen species, fourteen species returned 0% of observations within the RSA. These results are considered to be accurately representative for the majority of these species, due to the low height of native vegetation within the locality and the general premise that the ecology and lifecycle of most of these species is closely tied to the immediate vicinity of native vegetation. However, there are at least three species guilds in this group that are known to sometimes fly at considerable heights, those being birds of prey (Collared Sparrowhawk, and Australian Hobby), Honeyeaters (Singing Honeyeater, Tawny-crowned Honeyeater, and Black Honeyeater) and waterfowl (ducks, geese and waders).

The Collared Sparrowhawk (*n* = 2) is a predominantly bird hunting species which targets passerine birds, particularly in woodland habitats. Foraging activity is usually associated with the habitat of their woodland prey, but this species is known to soar at considerable heights, usually over foraging areas. This species also performs elevated courtship displays. However, these flights are usually made over the breeding territory and usually associated with foraging areas. This species is likely to be primarily associated with lowland woodland areas that are not closely associated with the ridge top locations where the proposed wind turbines would be located.

The Australian Hobby largely forages and performs aerial courtship displays at low elevations. However, there are times when it soars or flies at higher elevations. Other Australian Hobbys (3) observed elsewhere in the region during the same period of the survey were noted as flying at elevations below RSA and one bird was observed targeting young Welcome Swallows, which were flying at low elevations and perching on heathland vegetation near the sea.

Although most heathland honeyeater species are confined to the low vegetation during the majority of their lifecycle, many perform nuptial flights above their breeding territories during the breeding season. There are variations upon the theme, but the general nuptial flight pattern is a slow ascent while calling, sometimes with undulations at the top, and a relatively steep or undulating descent to a prominent perch in the breeding territory. With heathland species these displays take place over heathland territories and do not reach RSA elevations.

Generally, most potentially higher flying bird species observed during the survey period were recorded as flying low over the highest sections of associated undulating hills (i.e. prospective turbine locations).

3.4.2 Species with > 95% but <100% of Records below RSA

Of the forty-five bird species noted within the vicinity of the proposed Waddi Wind Farm, two species recorded 95% or greater but < 100% of records below the RSA. These species were the Black-faced Woodswallow (96%, *n* = 55) and Welcome Swallow (95%, *n* = 20).

The Black-faced Woodswallow, in contrast to some other Woodswallow species, is rather less aerial in its habits and individuals noted during the survey spent most of their time hawking at low elevations from low perches. Welcome swallows are likely to fly at a range of elevations depending upon altitude of prey items, although most birds were seen to hunt insects associated with vegetation, which is of low elevation surrounding the potential wind turbine sites.

3.4.3 Species with > 5% of Records within RSA

Of fourteen species recorded within formal census sites in the wider locality returning > 5% of observations recorded from within the RSA only ten returned >5% of records from within the RSA on the Waddi Wind Farm site. However, two species returning <5% overall, the Australian Ringneck and Australian Magpie-lark, returned >5% of records within the RSA on the Waddi site. Table 3-3 below lists these species, the number of records made, the zone in which they were recorded and the calculated percentages represented in each zone.

Table 3-3: Bird Species with > 5% of Observations within the RSA. NOTE: these values have not been adjusted to account for the revised RSA height.

Species Observed		*n*	Total % in Zone 1	Total % in Zone 2	Total % in Zone 3
Scientific Name	**Common Name**				
Cacatua roseicapilla	Galah	458	78	22	0
Cacatua roseicapilla	Galah	254	59	41	0
Corvus coronoides	Australian Raven	427	85	12	3
Corvus coronoides	Australian Raven	119	58	38	4
Threskiornis spinicollis	Straw-necked Ibis	366	84	8	8
Threskiornis spinicollis	Straw-necked Ibis	65	40	40	20
Cincloramphus cruralis	Brown Songlark	236	81	19	0
Cincloramphus cruralis	Brown Songlark	206	78	22	0
Gymnorhina tibicen	Australian Magpie	198	88	10	2
Gymnorhina tibicen	Australian Magpie	62	61	32	7
Anthus novaeseelandiae	Australian Pipit	105	94	6	0
Anthus novaeseelandiae	Australian Pipit	58	91	9	0
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	100	88	12	0
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	36	67	33	0
Aquila audax	Wedge-tailed Eagle	82	22	27	51
Aquila audax	Wedge-tailed Eagle	20	25	40	35
Falco cenchroides	Nankeen Kestrel	70	79	20	1
Falco cenchroides	Nankeen Kestrel	21	76	24	0
Coracina novaehollandiae	Black-faced Cuckoo-Shrike	41	93	7	0
Coracina novaehollandiae	Black-faced Cuckoo-Shrike	6	100	0	0
Cheramoeca leucosternus	White-backed Swallow	4	50	50	0
Cheramoeca leucosternus	White-backed Swallow	0	0	0	0
Falco berigora	Brown Falcon	4	25	75	0
Falco berigora	Brown Falcon	3	33	67	0
Elanus axillaris	Black-Shouldered Kite	2	0	100	0
Elanus axillaris	Black-Shouldered Kite	1	0	100	0
Banardius zonarius	Australian Ringneck	374	99	1	0

Species Observed		*n*	Total % in Zone 1	Total % in Zone 2	Total % in Zone 3
Scientific Name	**Common Name**				
Banardius zonarius	Australian Ringneck	46	89	11	0
Grallina cyanoleuca	Australian Magpie-lark	114	98	2	0
Grallina cyanoleuca	Australian Magpie-lark	33	94	6	0

Unshaded rows represent total records for locality
Shaded rows represent records from Waddi Wind Farm
n = the number of individual birds observed of each species
Zone 1 – Represents elevations below the RSA (Rotor Swept Area)
Zone 2 – Represents elevations within the RSA
Zone 3 – Represents elevations above the RSA

In respect to some of the figures quoted within Table 3-3 above, there is some inflation of individual Zone 2 (RSA) percentage figures for a number of species due to the inclusion of records outside the formal census plots where a significant number of observations were over lowland areas. Galah, Australian Raven, Straw-necked Ibis Australian Magpie, Carnaby's Black-Cockatoo, Wedge-tailed Eagle, Nankeen Kestrel and Black-shouldered Kite results were inflated in this way as the majority of those records within the RSA for these species were recorded outside of the formal Census plots during surveys. In the majority of cases these species were noted as flying below the RSA when flying across the highest areas of the undulating hills where wind turbines will be located. Observations made of birds such as Ravens in transit over high topography suggested that such species flew low over the tops of hills to avoid stronger winds at higher elevations, particularly in the context of the study area, which is prone to moderate – high wind velocities for much of each day.

Movements of Carnaby's Black-Cockatoo during the survey period were noted as occurring along woodland corridors within valleys. Those observations made within the RSA were largely in down-slope areas outside formal survey plots and there were no records of this species occurring within the RSA in ridge top contexts (see Appendix 2).

Nankeen Kestrel and Black-shouldered Kite hover at a range of altitudes, including elevations occasionally occurring within the RSA, however the Kestrel's RSA percentage during the study is significantly inflated by down-slope observations and the Kite's figures are not indicative of the species' normal habitats due to the very small data set skewing the figures away from normal trends.

Brown Songlark and Australian Pipit are essentially open country species foraging and nesting on the ground, but the males of both these species perform aerial flight displays during territorial and courtship behaviour. As a consequence, the RSA percentages recorded for these species are considered accurate.

Black-faced Cuckoo-shrike figures are considered relatively accurate as this species is known to fly at higher elevations at times, although no RSA records were made within the Waddi site despite the numbers elsewhere in the locality.

White-backed Swallow and Fairy Martin are aerial hunting species that forage at a range of elevations including those occurring within the RSA, but the percentages returned during the study are highly skewed away from what would be expected as normal, due to the low incidence of records during the study.

The Brown Falcon results are also influenced by the low number of records. Observations of this species during the study were made close to the observer, which may have pushed the bird higher to avoid closer proximity to the observer. This species was observed hunting over hilltop heath habitats, which provides abundant niches for its favoured reptile prey. The same individual was observed on a number of occasions perching in tall roadside heath habitat or associated windbreak pines.

A number of species recorded relatively higher percentages in the RSA within the Waddi Wind Farm survey site alone. These species include Galah 41% (*n* = 254), Australian Raven 38% (*n* = 119), Straw-necked Ibis 40% (*n* = 65), Brown Songlark 22% (*n* = 206), Australian Magpie 32% (*n* = 62), Carnaby's Cockatoo 33% (*n* = 36), Wedge-tailed Eagle 40% (*n* = 20), Nankeen Kestrel 24% (*n* = 21) and Brown Falcon 67% (*n* = 3). The majority of these records are exaggerated when compared to overall results from the locality (see table 3-3 above), although it is noted that the greatest majority of higher elevation records came from birds observed outside of the formal census plots, which were in most cases flying over valley areas not closely associated with potential ridge top turbine locations. In the case of Wedge-tailed Eagles, considering the size of these birds, it is possible they may, in contrast to most other species recorded within the study, seek out areas characterised by high wind to stay aloft. The Wedge-tailed Eagle nests to the east of Mullering Road are in valley woodland habitat at a height of no more than 7 m. The nest positions are on a slope that allows the birds to fly down-slope to the east away from the proposed Waddi Wind Farm site to become airborne. Furthermore, access to the nest is from the east so that the birds fly uphill into the prevailing wind to alight on the nest. The nests occur approximately 1.6 km from the nearest turbines to the west of Mullering Road.

3.5 Regional Wetland Habitats and Associated Movements

3.5.1 Habitats

The proposed Waddi wind farm site occurs in undulating hills approximately 50 km from the coast. There are few wetlands apart from farm dams in the vicinity of the site, although a small lake occurs some 10 km to the east of the wind farm at Aggies Cottage on Badgingarra Road (see Section 3.3.2.4). However, there are a number of relatively large water bodies to the south-west (~18 km) of the wind farm site, small to moderate sized water bodies to the east near Dandaragan (~10 km), a considerable number of water bodies in the upper Moore River catchment near Moora (~37 km) and a number of large water bodies further west near Wongan Hills including Lake Hinds (~120 km) and Lake Ninan (~130 km). The location of regional wetlands is shown on Figure 3-2.

3.5.1.1 Lake Guraga and Nearby Lakes

Lake Guraga occurs to the west of the Brand Highway some 18 km to the south-west of the Yandin section of the wind farm. Two other relatively large water bodies occur nearby including the heritage listed Lake Namming to the south of Lake Guraga and a relatively large water body near to the Brand Highway just north-east of Lake Guraga. Aerial photography reveals that there are a number of other water bodies at a similar distance from the coast to the Lake Guraga group.

During November, when wetland surveys were conducted, Lake Guraga was only holding a couple of very shallow crescent shaped ponds and there were approximately 30 Red-capped Plovers foraging on the lake substrate, the majority of which were away from the small ponds. No other bird species were observed at Lake Guraga. Due to the very shallow substrate profile, it is likely that Lake Guraga would support a range of water bird species when filled, including waterfowl and both migratory and resident wading bird species.

Namming Lake to the south of Guraga Lake was full during the November waterbird survey. The lake had no shoreline habitat for waders to forage and no migratory or resident wader species were observed. The lake does appear to be an important permanent water body for waterfowl, with Musk Ducks (approximately 60), Blue-billed Ducks (approximately 80), Australian Shelduck (approximately 500), Australasian Shoveler (approximately 150), Hoary-headed Grebe (40) and a single Black Swan. Little Black (7) and Little Pied Cormorants (1) and a single Yellow-billed Spoonbill were also present. The lake is surrounded by *Melaleuca* sp. trees, which provided roosting and foraging sites for water birds and may represent breeding sites for those species observed on the lake.

The lake to the north-east of Guraga Lake was holding a significant amount of water and due to the shallow substrate profile was found to have significant shoreline habitats at the southern end. Large numbers of water fowl were recorded on this lake, including, Australian Shelduck (> 1200) and Black Swan (> 400). Other smaller waterfowl were also present but observation distances made confident identification difficult. However, numbers of Australasian Shoveler (> 100), Grey Teal (60+) and Pacific Black Duck (2) were observed. Shoreline habitats in the south were supporting both resident and migratory waders including Red-capped Plover (88), Black-winged Stilt (35), Red-necked Avocet (2), Common Greenshank (1) and Red-necked Stint (35). Other species closely associated with the lake included Silver Gull (22), Gull-billed Tern (1), Little Egret (1), Nankeen Night Heron (1), Straw-necked Ibis (70 – roosting), White-bellied Sea-eagle (1) and Whistling Kite (1).

Another lake/dam occurring to the south-east of Namming Lake opposite Nammegarra Road's intersection with the Brand Highway was surveyed on several occasions and found to contain fluctuating numbers of Australian Shelduck, Black-winged Stilt, Black-fronted Dotterel, Australasian Shoveler, Pacific Black Duck and Whistling Kite were also observed.

3.5.1.2 Thetis Lake

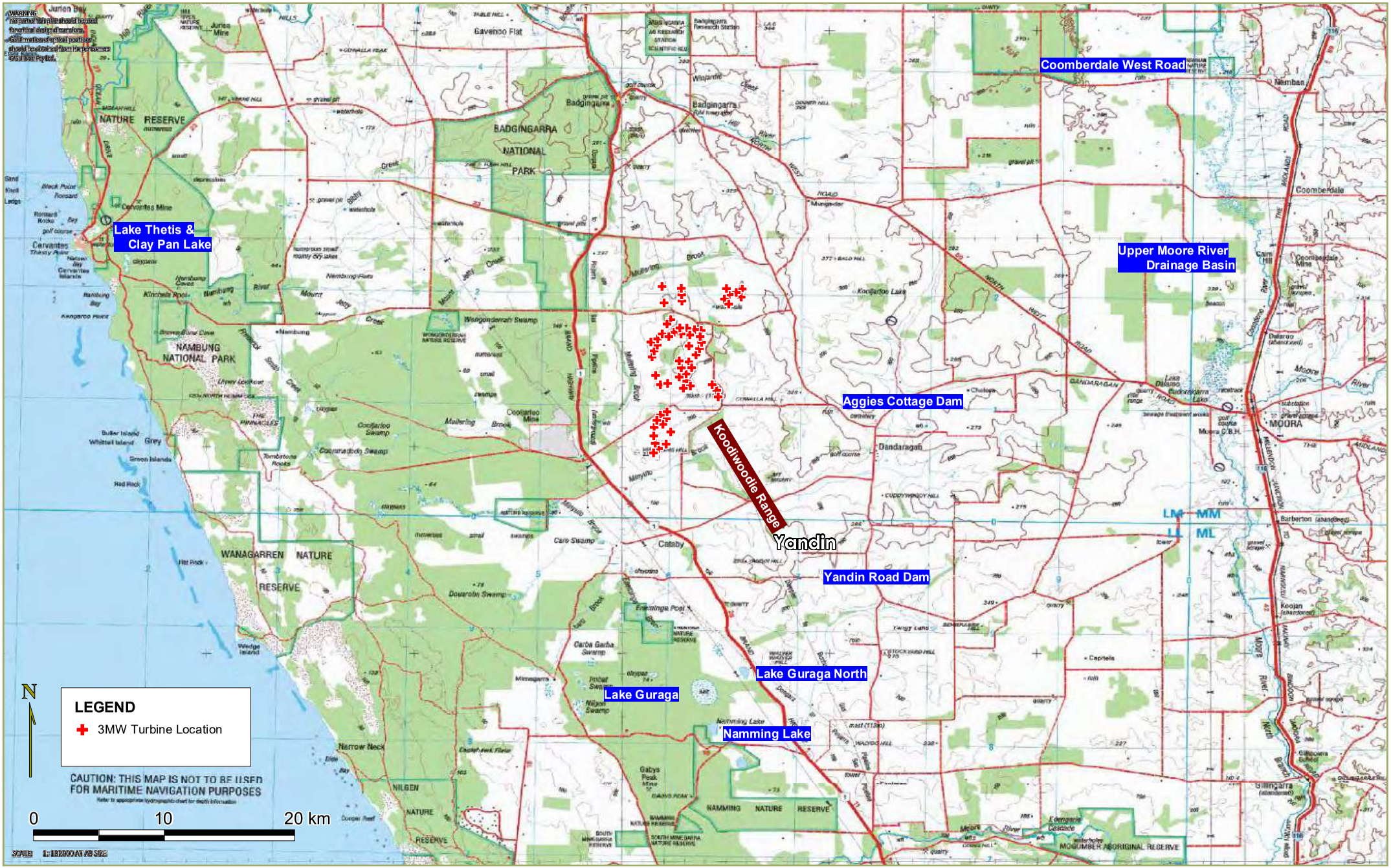
Thetis Lake is a saline lake occurring in near coastal dunes to the south-east of Cervantes approximately 25 km west of the proposed wind farm site. Waterfowl and waders were observed using the lake, including Black Swan (6), Australian Shelduck (> 20), Pacific Black Duck (4), Hoary-headed Grebe (3), Common Greenshank (23), Common Sandpiper (1), Pacific Golden Plover (4) and Red-capped Plover (1). The lake was surveyed as representative of a number of saline lakes occurring in near coastal areas along the coast, particularly to the north of Jurien Bay.

3.5.1.3 Upper Moore River Catchment near Moora

The upper Moore River catchment near Moora, approximately 23 km east of the proposed wind farm site, is represented by broad lowlands traversed by a number of channels and a string of small to large lakes, some saline in water quality. A number of these lakes, particularly those to the west of Moora and north of Dandaragan Road were holding little water during the survey period and hence were limited in the diversity of waterbirds they were attracting. Relatively large numbers (> 100) of Red-capped Plovers were observed foraging over wet substrate within a largely waterless lake just to the north of the Moora Golf Course. Some lakes further to the north on Coomberdale West Road were holding water; one in particular appeared reasonably permanent with short vegetation around the edges. A number of resident and migratory waders were using this lake, including Black-winged Stilt (96), Banded Stilt (1), Sharp-tailed Sandpiper (23) and Pectoral Sandpiper (1). A larger lake to the south of Coomberdale West Road was only holding about a third of its capacity and there were Black-winged Stilt (43), Red-necked Avocet (11) and Banded Stilts (2) present.

3.5.1.4 Aggie's Cottage and Farm Dams

There is a moderately sized dam/lake at Aggie's Cottage to the south-east of the intersection between Wolba Road and Badgingarra Road, which lies approximately 9 km east of the proposed Waddi Wind Farm site. The lake is freshwater and used by a number of waterfowl, including Australian Shelduck (4), Pacific Black Duck (2), Grey Teal (11), Musk Duck (2), Australasian Shoveler (10), Hardhead (6), Black Swan (1) and Hoary-headed Grebe (102). Little Pied (1) and Little Black Cormorant (1) and Black-winged Stilt (11) were also observed. A small farm dam to the west (1.2 km) of Aggies Cottage regularly had a pair of Australian Shelducks and often up to six Grey Teal in attendance during the November survey period.



TITLE:	WADDI WIND FARM AVIAN REPORT	LOCATION:	FIG 3-2 REGIONAL WETLAND MAP	DATUM: PROJECTION:	DATUM LONGITUDE / LATITUDE (NAD 83)
DATE: PURPOSE:	02/02/2010 PURPOSE	LAYOUT REF: VERSION (PLAN BY):	J:\JOBS\25K\25342 - DANDARAGAN, WA\DRAFTING\MAPINFO\FAUNA MAPPING 25342 FIGURE 3-2 WADDI REGIONAL WETLAND MAP A-A3 300709 A. RICHARDSON		

CLIENT: WIND PROSPECT
JOB REF: 25342

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3.5.2 Waterbird Movement Surveys

A number of the above wetlands were visited in the late afternoon and evenings to determine whether there were any water bird movements to and from these water bodies during this time of day. Movements of birds to and from these water bodies were also noted whenever water bird surveys were conducted at the above wetland areas,

Evening movement surveys were conducted at the lake to the north-east of Guraga Lake, due to the significant number of birds using this site, the lake on Yandin Road due to its proximity to the wind farm and Thetis Lake near Cervantes to note any potential movements of migratory wading birds to or from near coastal habitats.

The surveys revealed a number of limited avian movements from these water bodies during the course of the survey, involving a low diversity of species.

3.5.2.1 Lake North-east of Guraga Lake

The majority of movements observed were to and from the lake to the north-east of Guraga Lake. Small groups (< 10) of Australian Shelducks were noted flying in from the south in the early evening and another couple of small (sounding) groups were heard flying in from the same direction after dark. During morning surveys two small groups (< 10) were observed flying from the lake to the south-east and one group of about 10 individuals were observed flying east over hills to the east of the Brand Highway. Due to the directions of flights, the large number of Australian Shelducks at Namming Lake and the fluctuating numbers of Australian Shelducks at the small lake near the Nammegarra Road turnoff, it is highly likely that these movements were to or from these water bodies.

After dark a Nankeen Night Heron and a Common Greenshank were heard to fly in from the south. It is likely that the Night Heron roosts by day at Namming Lake and nocturnally forages on the shore of north-east lake, due to the roosting opportunities within the surrounding melaleuca trees at Namming Lake, but it is not known where the Greenshank may have flown in from. However, Common Greenshank numbers observed at Thetis Lake suggests that movements to this more inland band of lakes may be from near coastal saline wetlands.

Red-necked Stints, Black-winged Stilts and Red-capped Plovers were observed foraging during the night (spotlighting) at north-east lake and movements observed were limited to accessing different foraging areas of the shoreline.

3.5.2.2 Yandin Road Dam

No movements were observed during late afternoon and evening surveys at Yandin Road Dam. During the November survey period the dam at Yandin Road was used primarily by waterbirds as breeding habitat (see Section 3.3.2.4).

3.5.2.3 Thetis Lake

Most movements observed around Thetis Lake were between different shoreline areas for roosting or foraging purposes. A group of five Common Greenshank and a single Pacific Golden Plover were observed flying off to the south-south-east at sunset on 2 November 2008. There is another shallow saline lake in the south-south-east on the eastern side of Pinnacles Drive in Nambung National Park, which is the most likely destination of this movement. The fluctuating numbers of species and abundances at Thetis Lake suggested that birds moved at least on a local basis between similar habitats, although the presence of a Common Greenshank at the lake to Guraga Lake's north-east indicates that this species moves further inland on occasion.

Movements of observed migratory species to these habitats from the northern hemisphere are likely made along near coastal habitats, although the distributions of Common Sandpiper and Common Greenshank extend inland considerable distances and so there may be some movements between the inland and coast when conditions are favourable.

3.5.2.4 Upper Moore River Catchment

No movements of resident or migratory wading birds were noted at the wetlands along Coomberdale West Road to the north of Moora, or those west of Moora adjacent to Dandaragan Road. However, Red-necked Avocets and Banded Stilts are highly nomadic in response to the fluctuations of ephemeral inland lakes and other water bodies and move between different wetlands to access foraging opportunities when they are at their peak. Sharp-tailed Sandpiper and the Pectoral Sandpiper were flushed when another car stopped close by, but moved elsewhere in the lake. These sandpipers migrate from the northern hemisphere and likely follow similar habitat down the Moore River catchment from the north.

Lakes further west near Wongan Hills reported as containing large flocks of Banded Stilts on 24 October 2008 were dry with no birds on 23 November 2008, evidencing the ephemerality of these species in response to water availability.

There is likely to be some intermittent movement toward Guraga Lake water bodies from these eastern inland water bodies by resident waders, as indicated by the pair of Red-necked Avocets at the lake to Guraga Lake's north-east.

3.6 Threatened Species

3.6.1 Environment Protection and Biodiversity Conservation Act 1999

3.6.1.1 Threatened Species

One bird species listed as Threatened under the EPBC Act was recorded on the proposed Waddi Wind Farm site namely, Carnaby's Black-Cockatoo. Carnaby's Black-Cockatoo is listed under the EPBC Act as Endangered.

Carnaby's Black-Cockatoo was noted as being strongly associated with the woodland habitat which occurs within valleys and gullies on the site, particularly for roosting purposes and likely breeding opportunities. The majority of observed movements by this species, both within formal census plots and incidental records, were in association with lowland corridors. The remaining movements of this species were recorded at low altitude over pasture in the valleys or on hill tops below the RSA, when they appeared to be moving intently between locations rather than milling or foraging.

The Carnaby's Black-Cockatoo uses the woodland and tall heathland vegetation for foraging purposes. A flock in excess of 200 birds was observed some 30 km to the north-west of the site, east of Cervantes, over pine plantations. The cones of *Pinus* sp. may represent a food resource for this species in the region during some season contexts, as reported within Higgins (1999).

3.6.1.2 Migratory Species

A number of species and families observed within the site, its vicinity and more widely within the region are listed under the EPBC Act as Migratory. The families Accipitridae (Osprey, hawks, eagles and harriers), Anatidae (ducks, swans and geese), Charadriidae (plovers, dotterels and lapwings) and Scolopacidae (snipe, godwits, curlews, sandpipers, stints and phalaropes) are listed as Migratory species under the EPBC Act. In the case of the families Accipitridae and Anatidae there are no Australian species which can be considered truly migratory between Australia and other countries, although some make dispersive, nomadic or migratory movements within Australia. Most of these species are common local species, with no particular conservation significance and therefore they are not included in the assessment of migratory species within this report. Such treatment of common species, which have been inadvertently included within Commonwealth Migratory species schedules under the EPBC Act as a component of adopting migratory species agreements with northern hemisphere countries, is standard practice within Ecological Assessments and has been verified with the Department of Sustainability, Environment, Water, Population and Communities (SEWPC, formally Department of Environment, Water, Heritage and the Arts (DEWHA)) personnel by RPS Ecologists in the past and adopted within all assessment documents.

Only some representatives of the plover (Charadriidae) and Sandpiper (Scolopacidae) families, which occur in Australia, are truly migratory and these species are specifically identified under the legislation. No habitat exists for migratory members of these families within the vicinity of the proposed wind farm, although a Greenshank and Red-necked Stints were observed in the wider locality at the lake to the north-east of Lake Guraga to the site's south-west. Greenshank were also observed at Thetis Lake near Cervantes and it is likely that greenshank and some other migratory waders may make intermittent movements between these lakes occurring in the coastal strip west of the Koodiwoodie Range , although movements further east to inland lakes may occur on rare occasions, when conditions are suitable.

The Rainbow Bee-eater is a listed Migratory species under the EPBC Act, but was sighted as a breeding resident within the proposed Waddi Wind Farm during the survey period. No migratory movements of this species were noted during the survey but this species may move through the region during their annual north-south movements.

No Fork-tailed Swift individuals were observed during the survey period from anywhere within the region, but this EPBC Act listed Migratory species may occur locally during dispersive movements particularly in the summer months.

Migratory bird species have been further discussed in Table 3-5 and Section 3.7.

3.6.2 Wildlife Conservation Act 1950

Two bird species listed as Specially Protected under the WC Act, namely, Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) and Peregrine Falcon (*Falco peregrinus*) were recorded within the locality of the proposed wind farm site.

The Carnaby's Black-Cockatoo has been further discussed in Section 3.6, Table 3-5 and Section 3.7.3.2.

Over a period of 18 survey days across the site and wider locality the Peregrine Falcon was observed once, which indicates that numbers of this species in the region are relatively low. The Peregrine Falcon has been discussed further in Section 3.6, Table 3-5 and Section 3.7.3.3.

3.7 Impact Assessment

3.7.1 Background Research

3.7.1.1 Overview

Research undertaken internationally (including New Zealand) and in Australia (NWCC 2004; Auswind 2005; Birdlife International 2003) has demonstrated three main types of potential impacts to birds from wind farms:

- Direct mortality from collisions.
- Indirect impacts from avoidance, habitat disruption and displacement.
- Loss of, or damage to, habitat resulting from wind turbines and associated infrastructure.

There are a number of important factors that influence avian mortality (Drewitt and Langston 2006). The location of wind farms is seen as a major factor, with those sited near wetlands, critical habitat areas, or along migratory flight paths having greatest impacts. The rates of collisions can be influenced by adverse weather conditions and poor visibility, flight characteristics of birds (e.g. fast flying, flocking, and nocturnal flyers may be more prone to collisions) and an individual species' ecology (e.g. migratory species may be less familiar with the area (Drewitt and Langston 2006)).

Turbulence created by the rotors (as a specific consideration) is also likely to affect species and result in a low level of mortality (Winkelman 1992). This aspect of wind turbine impacts has been subject to little available research. Such effects are particularly likely for smaller birds and bats, which are considered less able to divert course away from the blades/strong turbulence, once caught in the turbulence zone.

No specific calculations are available to accurately determine the turbulence zone size, although the turbulence zone has been assumed likely to be at least 100 m in either direction of the rotor blades. Turbulence causes a range of effects on flying birds depending on the proximity of the bird to each blade and speed of the blade (Winkelman 1992).

Occasional deaths may be attributable to birds and bats being caught in such a turbulence zone generated by the proposed wind turbines, particularly if it causes significant deviation of flight path or disorientation, however numbers of such potential events are unlikely to be significant. Furthermore, it is unlikely that the number of bird fatalities attributable to blade-strike in general would be significant given the lack of through-site bird movements. This is particularly due to the locations of the turbines being in existing cleared areas.

The probability of adverse bird interactions appears to be both site-specific and species specific. The most important step that can be taken to avoid adverse bird interactions is to locate facilities based on careful siting studies and away from critical habitat (Colson and Associates 1995).

Turbulence in a large part of this zone is likely only to cause small disruptions to flight patterns to a degree that would not affect the individual bird. In a smaller part of this zone the turbulence may be strong enough to entrap individual birds or cause significant changes to the flight patterns that may then put birds at risk of injury. Very close to the blades turbulence may put birds at risk of direct physical harm either by causing collision with the blade or sudden changes in pressure (compression and rarefaction) that could cause barotraumas (physical injury to tissue especially that surrounding air cavities such as lungs and sinuses) (Baerwald et al. 2008).

3.7.1.2 International Examples

Impacts to birds have been shown to vary among sites and are considered likely to depend on several factors including the amount of bird use, vegetation, and biological characteristics of the specific wind farm and surrounding area (NWCC 2004). Studies conducted at a number of other wind farm sites in the USA and Scotland have recorded few to no fatalities, including sites frequented by raptors (Rae 2005).

Based on a review of 12 comprehensive bird-monitoring studies in the USA, fatality rates have averaged 2.3 individuals per turbine per year (NWCC 2004). The impact of wind turbine collisions has been estimated to be less than 0.02 per cent of the 200–500 million collision related deaths in the USA from other structures, such as vehicles (60–80 million), buildings and windows (98–980 million), and communication towers (4–50 million) (AusWEA 2004).

Recent research in North America (Barclay et al. 2007), undertaken over 33 wind farm sites, indicates that the average annual mortality rate for birds was 0.61 per turbine. This included a range of tower heights and rotor swept areas. Heights ranged from 24 to 94 m, while diameter of rotor swept areas ranged from 15 to 80 m. The study also indicated that differences in rotor swept area were not a significant factor in relation to impacts, with no evidence that taller turbines are associated with increased bird fatalities. In fact, the per turbine mortality rate for birds was constant despite variations in tower height. Barclay et al. (2007) indicated that factors influencing fatality rates may include differences in the number of species present within the area, their population sizes, the use of migration corridors, variation from site to site at which birds fly, and variation in numbers of migrants from year to year.

3.7.1.3 New Zealand Examples

New Zealand-based research on bird mortality is limited. NZWEA indicates that as at 2005 there had been no domestic reports of mortalities of any rare, threatened or endangered bird species at domestic wind farms since they started operations and that,

in general existing data from New Zealand wind farms would seem to indicate a lower mortality rate than the global average. Indications are that recorded deaths in New Zealand are predominantly of common species such as Australian Magpies, various gulls and Blackbirds. Specific examples of New Zealand wind farm operations that have been monitored include Brooklyn (near Wellington), Hau Nui and Tararua. Bird mortality at these locations has been identified as being minor, or non-existent, with scientific monitoring at Tararua abandoned, in part due to the lack of data (i.e. bird mortality).

3.7.1.4 Australian Examples

In Australia, collision rates reported have been generally around one to two birds per turbine per year (AusWEA 2004). NZWEA (2005) also refers to rates in Australia being generally between 0.23–2.7 birds per year. The most susceptible Australian birds are likely to include:

- birds of prey and owls, particularly soaring species such as eagles and kites
- nocturnal migrating songbirds
- locally-breeding high-flying songbirds such as Australian Magpie-larks
- waterbirds such as Straw-necked Ibis and Black Swans
- ducks
- shorebirds, including migratory waders
- Neophema Parrots (AusWEA 2002).

Within Australia most wind farm development has been along coastal areas in Western Australia, South Australia and Victoria. In Tasmania, the first two stages of the Woolnorth wind farm have been the subject of a bird and bat strike-monitoring program. There has been some evidence for a slightly decreased usage of the site by birds post-construction (i.e. displacement) and several species have been reportedly hit by turbines including Wedge-tailed Eagles, seabirds such as petrels, Common Skylark, Grey Fantail, Black Currawong and Banded Lapwing (Rae 2005).

Studies conducted at Stanwell's Toora wind farm in South Gippsland found no evidence of significant levels of bird mortality, with impacts confined to localised indirect effects on common farmland birds. Species such as Wedge-tailed Eagles were regularly observed before and after operations began, but they avoided the turbines by flying around or between them (AusWEA 2004).

As the Australian wind farm industry develops, information increasingly suggests that the mortality rates at Australian wind farms are lower than in the northern hemisphere, apparently due primarily to the lack of large numbers of night-migrating songbirds in Australia (AusWEA 2004).

3.7.2 Risks to Avifauna Occurring within the Site

Potential impacts to avifauna from the wind farm primarily relate to turbine operation, ie collision risk and indirect effects from avoidance, habitat disruption and displacement.

The proposed turbine locations are in areas that have already been cleared for agriculture and clearing of native vegetation, if required, for cables and access roads is expected to be minimal (<150 m^2). While the locations of these roads and cables have yet to be finalised, the results of the investigations undertaken indicate that the clearing of this small an area of vegetation is unlikely to have a significant impact on any avifauna species as a result of habitat loss. Further, significant areas of vegetation have been mapped (refer Vegetation reports) to ensure avoidance during any micro-siting work.

Risks from turbine operations to all avifauna species which have been recorded within the site and its vicinity during onsite investigations are summarised in Table 3-4. This Table is structured to include the heads of consideration that informed the assessment process, as follows.

Species – Each species is identified by its recognised common name as adopted in Christidis and Boles (2008).

Habitat Description – A brief broad characterisation of habitat in which each species frequently occurs is given as a comparative reference against the largely open habitats represented by turbine positions.

Chance of Occurrence in RSA – Local movements of those avian species observed to occur within the site during the survey period are given a qualitative (Low, Moderate or High) measure of their likelihood to occur within the RSA in reference to movements observed within the site and its vicinity during onsite investigations. Due to the difficulty in observing the full range of bird flight activity and behaviour within time constraints determined by short (20 minute) census periods, the full range of known behaviours of recorded species was taken into account to establish flight elevation tendencies in the survey area.

Abundance within the Site Vicinity – A qualitative abundance (Low, Moderate or High) measure based on observed species densities within the site is given.

Chance of Occurrence on Site – Depending on habitat requirements the likelihood that different species might occur within the site varies. Based on observed occurrences and known habitat usage of local species a qualitative (Low, Moderate or High) measure of their likelihood to occur within the site is given.

Likelihood of Impact – Based upon the above heads of consideration a qualitative (very rare (VR), rare (R), possible (Po) or probable (Pr)) measure of the likelihood for each species to be considered at risk of impact is given.

Status – The conservation status of each species observed within the site's vicinity is stated as:

- C = Common with no particular conservation status (i.e. not listed)

- M = Listed as a Migratory species under the EPBC Act
- E = Listed as Endangered under the EPBC Act
- R = Listed under Schedule of the WC Act as a species that is rare or likely to become extinct.

Consequence – A qualitative (insignificant (In), minor (Mi), moderate (Mo) or significant (S)) measure of Risk for each avian species is given.

Likely Level of Risk – The resultant (Low, Moderate or High) measure of the likely level of risk for each avian species based on consideration of Consequence and Likelihood of impacts is provided.

Table 3-4: Risk Assessment Table for Avian Species occurring within the Site and its Vicinity

Species	Habitat Description	Chance of Occurrence in RSA	Abundance Within the Site Vicinity	Chance of Occurrence on Site	Likelihood of Impact	Status	Consequence	Likely Level of Risk
Stubble Quail	Grassland	Low	Moderate	High	**Low**	C	**In**	**Low**
Australian Wood Duck	Wetlands/Grassland	Low	Low–Moderate	High	**Low**	M	**In**	**Low**
Musk Duck	Deepwater Wetlands	Low	Low	Low	**Low**	M	**In**	**Low**
Black Swan	Wetlands	Low	Low	Low–Moderate	**Low**	M	**In**	**Low**
Australian Shelduck	Wetlands	Low	Low–Moderate	High	**Low–Moderate**	M	**In**	**Low**
Pacific Black Duck	Wetlands	Low	Low	Low–Moderate	**Low**	M	**In**	**Low**
Australasian Shoveler	Wetlands	Low	Low	Low–Moderate	**Low**	M	**In**	**Low**
Grey Teal	Wetlands	Low	Low	Low–Moderate	**Low**	M	**In**	**Low**
Australian Pelican	Wetlands	Low	Low	Low–Moderate	**Low**	M	**In**	**Low**
White-faced Heron	Wetlands/ Grasslands	Low	Low	Low–Moderate	**Low**	C	**In**	**Low**
Little Egret	Wetlands	Low	Low	Low	**Low**	C	**In**	**Low**
Straw-necked Ibis	Wetlands/Grassland	Low–Moderate	Moderate	High	**Low–Moderate**	C	**In**	**Low**
Australian White Ibis	Wetlands	Low	Low	Low	**Low**	C	**In**	**Low**
Black-Shouldered Kite	Grassland/ Woodland	Moderate	Low	High	**Low**	M	**Mi**	**Low**
Whistling Kite	Woodland/Grassland/ Heath/Wetlands	Low	Low	Low–Moderate	**Low**	M	**In**	**Low**
Collared Sparrowhawk	Forest/Woodland	Low–Moderate	Low	High	**Low**	M	**Mi**	**Low**
Brown Goshawk	Forest/Woodland	Low–Moderate	Low	High	**Low**	M	**Mi**	**Low**
White-Bellied Sea-Eagle	Wetlands/Large Watercourses	Low	Low	Low	**Low**	M	**Mi**	**Low**

Species	Habitat Description	Chance of Occurrence in RSA	Abundance Within the Site Vicinity	Chance of Occurrence on Site	Likelihood of Impact	Status	Consequence	Likely Level of Risk
Wedge-tailed Eagle	Forest/Woodland/ Grassland	Moderate–High	Low	High	**Moderate**	C	**Mi**	**Low–Moderate**
Brown Falcon	Grassland/Woodland edges	Moderate	Low	High	**Low**	C	**Mi**	**Low**
Nankeen Kestrel	Grassland/Woodland edges	Moderate	Low–Moderate	High	**Low–Moderate**	C	**Mi**	**Low**
Australian Hobby	Grassland/Woodland edges	Low	Low	High	**Low**	C	**Mi**	**Low**
Peregrine Falcon	Grassland/Woodland edges	Low	Low	Low–Moderate	**Low**	R	**In**	**Low**
Red-Necked Stint	Wetlands	Low	Low	Low	**Low**	M	**Mi**	**Low**
Black-Winged Stilt	Wetlands	Low	Low	Low	**Low**	C	**Mi**	**Low**
Red-Necked Avocet	Wetlands	Low	Low	Low	**Low**	C	**Mi**	**Low**
Red-Capped Plover	Wetlands	Low	Low	Low	**Low**	M	**Mi**	**Low**
Banded Lapwing	Grasslands	Low	Low	High	**Low**	M	**Mi**	**Low**
Silver Gull	Wetlands	Low	Low	Low	**Low**	C	**Mi**	**Low**
Gull-Billed Tern	Wetlands	Low	Low	Low	**Low**	C	**In**	**Low**
Common Bronzewing	Woodlands/Heaths	Low	Low–Moderate	High	**Low**	C	**Mi**	**Low**
Crested Pigeon	Grassland/Woodland edges	Low	Low–Moderate	High	**Low**	C	**In**	**Low**
Carnaby's Black-Cockatoo	Forest/Woodland/ Heath	Low	Low–Moderate	High	**Low**	R, E	**In**	**Low**
Galah	Woodland/Grassland	Low–Moderate	Moderate	High	**Low**	C	**Mi**	**Low**
Western Corella (Northern)	Woodland/Grassland	Low–Moderate	Moderate	High	**Low–Moderate**	C	**In**	**Low**
Red-Capped Parrot	Woodland	Low	Low	Low–Moderate	**Low–Moderate**	C	**In**	**Low**

Species	Habitat Description	Chance of Occurrence in RSA	Abundance Within the Site Vicinity	Chance of Occurrence on Site	Likelihood of Impact	Status	Consequence	Likely Level of Risk
Australain Ringneck	Woodland	Low	Moderate	High	**Low**	C	**In**	**Low**
Horsefields Bronze-Cuckoo	Forest/Woodland	Low	Low	High	**Low**	C	**In**	**Low**
Shining Bronze-Cuckoo	Forest/Woodland	Low	Low	High	**Low**	C	**In**	**Low**
Laughing Kookabura	Forest/Woodland	Low	Low	High	**Low**	C	**In**	**Low**
Sacred Kingfisher	Forest/Woodland	Low	Low	High	**Low**	C	**In**	**Low**
Rainbow Bee-eater	Forest/Woodland/ Shrubland	Low	Low	High	**Low**	M	**In**	**Low**
Splendid Fairy-wren	Woodland/ Shrublands/Heath	Low	Low	High	**Low**	C	**Mi**	**Low**
Variegated Fairy-Wren	Woodland/ Shrublands/Heath	Low	Low	High	**Low**	C	**In**	**Low**
White-winged Fairy Wren	Shrublands/Heath	Low	Low	High	**Low**	C	**In**	**Low**
Striated Pardalote	Forest/Woodland	Low	Low	High	**Low**	C	**In**	**Low**
White-Browed Scrubwren	Forest/Woodland	Low	Low	High	**Low**	C	**In**	**Low**
Rufous Fieldwren	Heath/Sparse shrubland	Low	Low	High	**Low**	C	**In**	**Low**
Western Gerygone	Forest/Woodland/ Shrubland	Low	Low	High	**Low**	C	**In**	**Low**
Inland Thornbill	Forest/Woodland/ Shrubland	Low	Low	High	**Low**	C	**In**	**Low**
Western Thornbill	Forest/Woodland/ Shrubland	Low	Low	Low–Moderate	**Low**	C	**In**	**Low**
Yellow-rumped Thornbill	Woodland/Shrubland/ Grassland	Low	Low–Moderate	High	**Low**	C	**In**	**Low**

Species	Habitat Description	Chance of Occurrence in RSA	Abundance Within the Site Vicinity	Chance of Occurrence on Site	Likelihood of Impact	Status	Consequence	Likely Level of Risk
Weebill	Forest/Woodland	Low	Low	High	**Low**	C	**In**	**Low**
Red Wattlebird	Woodland/Heath	Low	Low	High	**Low**	C	**In**	**Low**
Yellow-Throated Miner	Forest/Woodland/ Shrubland	Low	Low	High	**Low**	C	**In**	**Low**
Singing Honeyeater	Forest/Woodland/ Shrubland	Low	Low	High	**Low**	C	**In**	**Low**
Brown-Headed Honeyeater	Forest/Woodland/ Heath	Low	Low	High	**Low**	C	**In**	**Low**
White-cheeked Honeyeater	Woodland/Heath	Low	Low	High	**Low**	C	**In**	**Low**
Tawny-crowned Honeyeater	Heath	Low	Low	High	**Low**	C	**In**	**Low**
Black Honeyeater	Shrubland/Heath	Low	Low	High	**Low**	C	**In**	**Low**
Brown Honeyeater	Forest/Woodland/ Shrubland/Heath	Low	Low	High	**Low**	C	**In**	**Low**
Crimson Chat	Woodland/Shrubland/ Heath	Low	Low	High	**Low**	C	**In**	**Low**
White-fronted Chat	Shrubland/Grassland/ Heath/Flats	Low	Low	High	**Low**	C	**In**	**Low**
Red-Capped Robin	Woodland/Shrubland	Low	Low	High	**Low**	C	**In**	**Low**
Hooded Robin	Woodland/Shrubland	Low	Low	High	**Low**	C	**In**	**Low**
Rufous Whistler	Woodland/Shrubland	Low	Low	High	**Low**	C	**In**	**Low**
Grey Shrike-Thrush	Forest/Woodland/ Shrubland	Low	Low	High	**Low**	C	**In**	**Low**
Willie Wagtail	Woodland/Grassland	Low	Low	High	**Low**	C	**In**	**Low**
Grey Fantail	Forest/Woodland/ Shrubland	Low	Low	High	**Low**	C	**In**	**Low**

Species	Habitat Description	Chance of Occurrence in RSA	Abundance Within the Site Vicinity	Chance of Occurrence on Site	Likelihood of Impact	Status	Consequence	Likely Level of Risk
Black-faced Cuckoo-Shrike	Forest/Woodland/ Shrubland	Low–Moderate	Low	High	**Low**	C	**In**	**Low**
White-Winged Triller	Woodland/Shrubland/ Heath	Low	Low	High	**Low**	C	**In**	**Low**
Black-faced Woodswallow	Forest/Woodland/ Grassland/Aerial	Low	Low	High	**Low**	C	**In**	**Low**
Grey Butcherbird	Forest/Woodland/ Shrubland	Low	Low	High	**Low**	C	**In**	**Low**
Pied Butcherbird	Woodland	Low	Low	High	**Low**	C	**In**	**Low**
Australian Magpie-lark	Forest/Woodland/ Grassland	Low–Moderate	Moderate	High	**Low–Moderate**	C	**In**	**Low**
Australian Magpie	Forest/Woodland/ Grassland	Low–Moderate	Moderate	High	**Low–Moderate**	C	**In**	**Low**
Australian Raven	Forest/Woodland/ Heath/Grassland	Low–Moderate	Moderate	High	**Low–Moderate**	C	**In**	**Low**
Zebra Finch	Woodland/Tall heath	Low	Low	Low	**Low**	C	**In**	**Low**
Australian Pipit	Grassland	Low–Moderate	Moderate	High	**Low–Moderate**	C	**In**	**Low**
Mistletoebird	Forest/Woodland	Low	Low	High	**Low**	C	**In**	**Low**
Welcome Swallow	Aerial space above most habitat	Low–Moderate	Moderate	High	**Low–Moderate**	C	**In**	**Low**
White-backed Swallow	Woodland/Watercourses	Moderate	Low	High	**Low**	C	**In**	**Low**
Tree Martin	Woodland/Aerial	Low–Moderate	Low	High	**Low**	C	**In**	**Low**
Fairy Martin	Aerial proximate to nesting sites	Moderate	Low	High	**Low**	C	**In**	**Low**
Little Grassbird	Wetlands	Low	Low	High	**Low**	C	**In**	**Low**
Brown Songlark	Grassland	Low–Moderate	Moderate	High	**Low–Moderate**	C	**In**	**Low**

Species	Habitat Description	Chance of Occurrence in RSA	Abundance Within the Site Vicinity	Chance of Occurrence on Site	Likelihood of Impact	Status	Consequence	Likely Level of Risk
Rufous Songlark	Woodland/Grassland	Low	Low	High	**Low**	C	**In**	**Low**
Silvereye	Forest	Low	Low	High	**Low**	C	**In**	**Low**
Varied Sittella	Forest/Woodland/ Heath	Low	Low	Low–Moderate	**Low**	C	**In**	**Low**

C = Common with no conservation status other than as a protected species under Western Australia legislation.
M = Listed as a Migratory species under the EPBC Act.
R = Listed as a Rare species under the WC Act.
E = Listed as an Endangered species under the EPBC Act.

3.7.3 Assessment of Risks to Listed Avifauna Species

3.7.3.1 Summary

Further detail of key elements of the assessment undertaken for avifauna species listed under the WC Act and the EPBC Act that have been gazetted/recorded from within the site or its vicinity is provided in Table 3-5. Explanatory description is provided for each species in regards to consideration of its potential to occur within the study area and the likely impacts as a result of the proposed development. Table 3-5 is structured as follows.

Species – Lists each listed species known from the vicinity of the site. The status of each species under the WC Act and EPBC Act is also provided.

Habitat Description – Provides a brief account of preferred habitat attributes required for the existence/survival of each species.

Chance of Occurrence within Site – Assesses the likelihood of each species to occur within the site in terms of the aforementioned habitat description and taking into account local habitat preferences, results of recent field investigations, data gained from various sources and previously gained knowledge via fieldwork undertaken within other ecological assessments in the locality.

Potential Impacts within Development Site – Assesses the potential and likely impacts to each species that would result from the proposed Wind Farm development, taking into account both short and long-term effects. This assessment considers the probability of occurrence of each species in the area of potential impact, including the RSA, with due recognition to other parameters such as home range, habitat use, connectivity, etc.

For listed species that were observed on the site or its vicinity during the surveys, further textual discussion is provided in Sections 3.7.3.2. to 3.7.3.5.

Table 3-5: Listed Avian Species Assessment Detail

Species/ Community	Habitat Description	Chance of Occurrence On Site	Potential Impacts	Likely Level of Risk
Avifauna (Listed under the *Wildlife Conservation Act 1950*)				
Calyptorhynchus latirostris Carnaby's Black-Cockatoo (*1*)	Occurs in eucalypt forests and heath in SW Western Australia. The division of habitat-use largely follows woodland habitats for roosting and breeding purposes and heathland for foraging where it mainly takes the seeds of Banksias and other proteaceous heathland vegetation. This species is also known to forage in pine plantations under some seasonal contexts and it is also reported as coming to the ground to feed on *Erodium* sp. within pastures and roadside habitats, although it is not known to forage on cereal crops. It requires large Eucalypt tree hollows for nesting, although some tree species are more reliably utilised due to their higher occurrence of hollows.	**High** Carnaby's Black-Cockatoo was recorded within the site and the wider locality during field surveys. Habitat utilisation within the site and its locality followed what is generally known of the species, i.e. onsite occurrences were largely confined to intact Marri (*Corymbia calophylla*) woodland areas, which occur as riparian remnants along valley bottom watercourses and lower slopes, and tall heathland communities and their remnants on sand plains and lower slopes in the wider locality. Local movements were restricted to valley vegetation corridors and rare traversed of more elevated open country were at low elevations. During the survey period a large flock (200+) was noted over a pine plantation east of Cervantes, some 30 km north-west of the site.	Potential consequences of the wind farm upon this species would be limited to rotor blade collision and changed movement paths. However, targeted surveys for this species found that in the locality this species was associated with woodland habitats for roosting, and likely breeding purposes, and tall heathland habitats containing large *Banksia* and proteaceous species for foraging. These communities occur at lower elevations away from turbine locations on the higher ground. All movements within the site and its locality were noted as following lowland valleys. Few movements (12%) across the entire study area were observed to be within the RSA and those areas of high elevation were observed over valley areas. No RSA height movements were observed over elevated areas where the proposed wind turbines would be located. As such, it is considered unlikely that local populations of this species would be at significant risk of collision and/or changed movement patterns as a consequence of the proposed wind farm development. Further discussion on this species is included in Section 4.4, due to records in the vicinity of the site.	**Low**
Leipoa ocellata Malleefowl (*1*)	Occurs in temperate Australia largely limited to the semi-arid zone. Mostly limited to areas of inland semi-arid scrub, this species prefers a dry environment with low-growing eucalypt trees and shrubs, referred to as mallee country. Although their diet exhibits seasonal variation, they mostly feed on ants and the seeds of wattle and other legume plants.	**Low** This species was not recorded within the site during fieldwork. This species is highly unlikely to occur within the site due to the absence of suitable habitat within the site and the wider locality.	Unlikely to be any potential consequences associated with local occurrences of this species, due to the absence of suitable habitat in which this species is mostly found.	**Low**

Species/ Community	Habitat Description	Chance of Occurrence On Site	Potential Impacts	Likely Level of Risk
Falco peregrinus Peregrine Falcon (*4*)	Occurs over most terrestrial habitat types across Australia including coastal shorelines and desert areas where reporting rates are somewhat lower than those in higher rainfall areas. In most of its range territories are often associated with cliffs and rocky outcrops or rocky coastal islands but in the absence of rocky habitat eyrie opportunities Peregrines will nest in trees or tall man-made structures. It is essentially an aerial species and hunts above canopy vegetation where it's favoured prey is medium sized birds such as Galah and Rock Doves.	**Low— Moderate** This species was not detected during targeted field surveys within the site. However, a single bird was observed within the vicinity of the site utilising similar habitat to what was present within the site. Furthermore, due to the widespread utilisation of associated lands for cropping purposes there maybe seasonal periods where influxes of medium sized cockatoos, such as galahs and corellas, may attract predatory species including Peregrines, of which these parrots are a favoured prey. It is therefore considered that this species may occur within the site on at least an intermittent basis.	Potential consequences of the wind farm upon this species would be limited to rotor blade collision. Despite the general absence of this species across the site it is considered likely that it may occur within the site intermittently. This species is an aerial specialist and may at times fly at RSA elevation and above. Due to its considerable aerial ability it is considered unlikely that Peregrines would collide with turbine blades during normal flight, but it is possible that collision could occur during hunting manoeuvres while the bird might be focussed on its prey. However, the chance of this occurrence is considered remote, due to the low frequency of local observations.	**Low**
Avifauna (Listed under the *EPBC Act 1999*)				
Apus pacificus Fork-tailed Swift (*M*)	Essentially an aerial species that occurs widely over a range of habitats at a range of elevations from quite close to the ground to at least 300 m, although likely higher. Although it occurs across a wide range of habitats within Australia it is mostly observed over inland plains and is seen over coastal beaches and cliffs. A non-breeding visitor to Australian skies from the northern hemisphere it is more frequently observed in coastal eastern Australia than elsewhere, due no doubt to a higher density of observers. Flocks in the thousands have been observed during the wet season at Anna Plains in NW Western Australia (RPS ecologist pers. Obs).	**Low – Moderate** The Fork-tailed Swift was not recorded within the site during fieldwork. Although, this species was not recorded within the site or its wider locality during field surveys, due to its wide ranging movements across open areas within Australia, its occurrence within the site on at least an intermittent seasonal basis cannot be discounted.	Potential consequences of the wind farm upon this species would be limited to rotor blade collision. There is potential for this species to fly at RSA height if flocks were to move through the area under some seasonal conditions. However this species has considerable aerial ability and is likely to easily avoid collision. Moreover, local occurrences of this species are likely to be intermittent spasmodic seasonal occurrences.	**Low**

Species/ Community	Habitat Description	Chance of Occurrence On Site	Potential Impacts	Likely Level of Risk
Ardea modesta Eastern Great Egret (*M*)	A large egret common across a wide range of wetland habitats throughout Australia, including inland swamps, rivers and lakes and coastal swamps, watercourses and estuarine systems. Movements are generally of a localised nature although the species is dispersive in response to rainfall conditions and it often breeds in association with other egret/heron species, Ibis, spoonbills and cormorants.	**Low** This species was not detected during field surveys within the site. There are no habitat opportunities for this species within the site. The occurrence of suitable habitat both to the east and west of the site may indicate that east – west movements through the site are possible. However, taking into account the low densities of this species locally to the west and only intermittent habitat opportunities to the east, east-west movements through the site are only considered to occur on rare occasions.	Potential consequences of the wind farm upon this species would be limited to rotor blade collision and changed movement paths. There is potential for this species to fly at RSA height if birds were to disperse between regional wetlands, however birds are likely to fly at lower elevations over high areas to avoid wind as many other species appear to do. Moreover, local occurrences of this species are likely to be intermittent spasmodic occurrences linked to rainfall patterns.	**Low**
Ardea ibis Cattle Egret (*M*)	A small to medium sized egret occurring across most of Australia apart from the arid interior and central western coasts. Often occurring in flocks associated with grazing cattle. General habitat is pasture lands and a range of fresh and estuarine wetlands. A colonial breeder it often returns to the same breeding sites sometimes attended by other waterbird species. It may travel reasonable distances between roosting and communal foraging areas.	**Low** This species was not observed during surveys on site at the time of survey. There are limited habitat opportunities for this species within the site, due to the dominance of cropping lands. The occurrence of suitable habitat both to the east and west of the site may indicate that east – west movements through the site are possible. However, there are few records for this species locally and it was not observed during the survey period, which suggests that local movements through the site are considered unlikely.	Unlikely to be any potential consequences associated with local occurrences of this species, due to the absence of local records.	**Low**

Species/ Community	Habitat Description	Chance of Occurrence On Site	Potential Impacts	Likely Level of Risk
Calyptorhynchus latirostris Carnaby's Black-Cockatoo (*V*)	Occurs in eucalypt forests and heath in SW Western Australia. The division of habitat-use largely follows woodland habitats for roosting and breeding purposes and heathland for foraging where it mainly takes the seeds of Banksias and other proteaceous heathland vegetation. This species is also known to forage in pine plantations under some seasonal contexts and it is also reported as coming to the ground to feed on *Erodium* sp. within pastures and roadside habitats, although it is not known to forage on cereal crops. It requires large Eucalypt tree hollows for nesting, although some tree species are more reliably utilised due to their higher occurrence of hollows.	**High** Carnaby's Black-Cockatoo was recorded within the site and the wider locality during field surveys. Habitat utilisation within the site and its locality followed what is generally known of the species i.e. onsite occurrences were largely confined to intact Marri (*Corymbia calophylla*) woodland areas, which occur as riparian remnants along valley bottom watercourses and lower slopes, and tall heathland communities and their remnants on sand plains and lower slopes in the wider locality. Local movements were restricted to valley vegetation corridors and rare traversed of more elevated open country were at low elevations. During the survey period a large flock (200+) was noted over a pine plantation east of Cervantes, some 30 km north-west of the site.	Potential consequences of the wind farm upon this species would be limited to rotor blade collision and changed movement paths. However, targeted surveys for this species found that in the locality this species was associated with woodland habitats for roosting, and likely breeding purposes, and tall heathland habitats containing large *Banksia* and proteaceous species for foraging. These communities occur at lower elevations away from turbine locations, all of which are on higher ground. All movements within the site and its locality were noted as following lowland valleys. Few movements (12%) across the entire study area were observed to be within the RSA and those areas of high elevation were observed over valley areas. No RSA height movements were observed over elevated areas where the proposed wind turbines would be located. As such it is considered unlikely that local populations of this species would be at significant risk of collision and/or changed movement patterns as a consequence of the proposed wind farm development.	**Low**
Leipoa ocellata Malleefowl (*V*)	Occurs in temperate Australia largely limited to the semi-arid zone. Mostly limited to areas of inland semi-arid scrub, this species prefers a dry environment with low-growing eucalypt trees and shrubs, referred to as mallee country. Although their diet exhibits seasonal variation, they mostly feed on ants and the seeds of wattle and other legume plants.	**Low** This species was not recorded within the site during fieldwork. This species is highly unlikely to occur within the site due to the absence of suitable habitat within the site and the wider locality.	Unlikely to be any potential consequences associated with local occurrences of this species, due to the absence of suitable habitat in which this species is mostly found.	**Low**

Species/ Community	Habitat Description	Chance of Occurrence On Site	Potential Impacts	Likely Level of Risk
Haliaeetus leucogaster (White-bellied Sea-Eagle) (*M*)	Found commonly over a range of fresh and saltwater habitats, including lakes, bays, estuaries, river systems and dams. Largely found near coastal regions but can be found long distances inland along major river systems. Uses large dead/living trees or structures for nesting. Mostly territorially sedentary in habits but dispersive movements to inland water bodies occur by some adults and immature birds.	**Low** This species was not recorded within the site during fieldwork. Habitat for this species within the region occurs within the coastal fringe and lakes occurring to the south-west. Although this species is unlikely to occur within the site due to the absence of suitable habitat it is possible that it may traverse the site on rare occasions during dispersive movements inland.	Potential consequences of the wind farm upon this species would be limited to rotor blade collision. Due to the general absence of this species preferred habitat within the vicinity of the site, it is considered that it may occur within the site only rarely. Therefore it is unlikely that this species would be placed at significant collision risk as a consequence of the proposed wind farm.	**Low**
Merops ornatus (Rainbow Bee-eater) (*M*)	This species occurs widely across the Australian mainland apart from central western arid zone. Frequents open woodland, heathland and riparian habitats characterised by sandy soils and vertical nesting opportunities such as occur on the edges of riverbanks, sand-ridges, watercourses, cuttings and cliffs. It is also known to burrow into flat ground within suitable soil substrates.	**High** This species was recorded during field surveys. Its status within the site during the survey period was as a breeding resident. It is possible that seasonal north (Feb/Apr) – south (Sep/Oct) movements of more southerly individuals of this species may traverse the site on migration.	Potential consequences of the wind farm upon this species would be limited to rotor blade collision. There is potential for this species to fly at RSA height if flocks were to move through the area under some seasonal conditions. However this species has considerable aerial ability and is likely to easily avoid collision. Moreover, local occurrences of this species are likely to be intermittent seasonal occurrences.	**Low**

Key: **(1)** = Schedule 1 – Fauna that is rare or is likely to become extinct, listed under the Wildlife Conservation Act 1950(WC Act1950).
(4) = Schedule 4 – Other specially protected fauna, listed under the Wildlife Conservation Act 1950(WC Act 1950).
(M) = Migratory listed under Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act 1999).
(V) = 'Vulnerable' Species listed under EPBC Act 1999.
(E) = Endangered Species listed under EPBC Act 1999.

3.7.3.2 Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*)

This species is widespread in the south-west region of Western Australia. The species migrates domestically, occurring within the Wheatbelt region in Kwongon woodlands nesting in hollow bearing *Eucalyptus. wandoo* and *E. salmonophloia* during the breeding season and migrating to the coast, primarily roosting and foraging in remnant Banksia woodland and pine plantations on the Swan Coastal Plain following breeding.

The range of Carnaby's Black-Cockatoo has contracted with birds being recorded from a third of its original breeding range since the mid 1970s. These contractions are mostly as a result of fragmentation or the destruction of habitat from the effects of agriculture, forestry and mining. Carnaby's Black-Cockatoo is listed under Schedule 1 of the WC Act and listed as Endangered under the EPBC Act. The SEWPC is yet to release a formal policy for the management of species, however current advice indicates that a 10:1 offset will be required if clearing breeding or foraging habitat.

This species is gregarious and is usually seen in small parties, occasionally in large flocks of hundreds. The Carnaby's Black-Cockatoo and the Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*) are almost indistinguishable from a distance, with only slight variations in their calls and a longer upper beak on the Baudin's Black-Cockatoo, both species have a prominent white ear patch and white panels in the tail.

The foraging behaviour and habitat of the Carnaby's Black-Cockatoo is the easiest way to distinguish the two species. In general the Caranaby's Black-Cockatoo feeds on proteaceous shrubs in the Kwongon heathland during the breeding season, and Banksia, Dryandra, Hakea, Grevillea and Marri seeds and a variety of introduced species (pines, cape lilac, wild radish and wild geranium) when foraging on the coast in the non-breeding season. The Baudin's Black-Cockatoo tends to be found in the Jarrah forests although foraging ranges may overlap with Baudin's Black-Cockatoo during the non-breeding season.

Within the proposed wind farm site, Carnaby's Black-Cockatoo was observed to be strongly associated with woodland habitat, which occurs within valleys and gullies between the higher ridges of the Koodiwoodie Range, particularly for roosting purposes and potential breeding opportunities. A flock of some fifty birds were observed to regularly roost in woodland habitats associated with the Waddi Bush Resort to the north of the wind farm development. The majority of observed movements by this species, both from formal census plots and incidental local records were in association with lowland corridors.

In addition to woodland occurrences observed within the locality of the proposed wind farm site, Carnaby's Black-Cockatoo was also observed regularly in tall heathland containing tall *Banksia* sp. on the lower sandy flats to the west of the Koodiwoodie Range along the Brand Highway. A relatively small number of observations of foraging birds were made in remnant heathland components occurring in woodland patches or as

isolated plants within cleared areas, along roads surrounding the wind farm site (see Figure 3-1). A flock in excess of 200 birds was observed some 30 km to the north-west of the site, east of Cervantes, over pine plantations. The cones of *Pinus* sp. may represent a food resource for this species in the region during some season contexts, as reported by Higgins (1999). Although local observations of the species were largely consistent with habits reported within literature (Higgins 1999), no birds within the site were observed to come to the ground for foraging purposes as has been reported in some areas.

Although observed flight elevations of Carnaby's Cockatoos were occasionally at heights consistent with the RSA, as with many other species observed in the locality, RSA height observations tended to be over lowland areas and lower flight patterns were recorded over the higher ridges where wind turbines will be located. This is likely due to avoidance of moderate to high wind velocities that characterise the site on a daily basis and the somewhat laboured flight action of Black-Cockatoos. As a consequence it is considered unlikely that this species will be placed at a level of risk, which might threaten the viability and numbers of local populations, due to the proposed wind farm.

3.7.3.3 Peregrine Falcon (*Falco peregrinus*)

The Peregrine Falcon occurs across most of the world. In Australia they are widely distributed, but appear to avoid small areas in the arid interior. In Western Australia they are widespread but recorded sporadically. They are rare in the desert regions of WA, although more commonly occur in the western Kimberley region, south coast especially rocky islands, Stirling Ranges and inland ranges that extend into Northern Territory. Records also extend to the Nullarbor, Goldfields and Pilbara regions. The Peregrine Falcon is listed in Schedule 4 of the WC Act.

The Peregrine Falcon is a solitary aggressive falcon occurring across most habitats. It flies and soars strongly at great heights and can dive at high speeds in pursuit of prey. They hunt aerially at a range of elevations from high altitudes down to within 1 m off the ground. Large birds are sometimes taken, although medium sized birds are the primary prey and usually taken from an elevated assault. Despite a predominant focus upon avian prey, prey animals can vary according to the habitat, with other food sources including rabbits and large insects. Peregrines mainly hunt diurnally however they may hunt during the crepuscular period and occasionally nocturnally.

Preferred habitat is over wooded and forested lands, open country and wetlands of tropical and temperate areas. The range encompasses varied elevations from sea level to alpine areas and extends into arid areas, although it does not include treeless and waterless deserts. Peregrines avoid densely forested habitat as they prefer an unhindered line of sight from above, enabling a fast attack and greater manoeuvrability.

Breeding occurs across its range. Nest sites have been known to occur as high as 900 m in Tasmania (Olsen 1985, Mooney and Brothers 1987). The preferred nesting sites are ledges and cavities in sea cliffs of mainland and offshore islands and also rugged inland

ranges. Records have shown that nesting sites also include hollows in trees usually on plains and undulating country, river systems and wetlands. Occasionally stick nests of other birds are used and on rare occasions they nest in caves, sink holes, on the ground or in buildings.

This species is generally accepted to be sedentary, within much of breeding range, but some birds may disperse to inland areas during summer. Most established pairs remain within their nesting territory all year round.

In general, however, widespread clearing of forests has provided open areas for hunting, and has promoted the expansion of Galah (*Cacatua roseicapilla*) and introduced bird populations, which are the favoured prey of falcons, but as a consequence, forest clearing has generally reduced the number of native bird species available as prey. (Olsen and Olsen 1980, White et al. 1981).

Locally Peregrine Falcons were observed to be scarce during field investigations with only a single bird being recorded off site within the vicinity and wider locality of the site, including coastal habitats from Lancelin to Green Head and easterly flats to Moora. The bird was perched in tall heath habitat near the Brand Highway on Mullering Road to the south-west of the site (see Figure 3-1). A pair nesting in a remnant woodland patch at Pithara, some 120 km to the north-east, was recorded during wider excursions within the survey period. The very large stick nest contained a fledgling, located in a tall eucalypt within woodland dominated by mallee eucalypts. The location lies within country dominated by wheat production and the birds are likely to occur in that area in order to target granivorous birds attracted by the wheat.

There are potential Peregrine hunting opportunities within the site and its vicinity due to the occurrence of wheat and pasture lands attracting medium sized cockatoos. Nesting opportunities are generally scarce due to the lack of cliffs and the lack of suitable hollows in local woodland dominated by *Corymbia calophylla* (Marri). As a consequence it is possible that the locality of the site in general may only experience intermittent occurrences of this species. There is a general paucity of records for the locality as evidenced in Birds Australia data (Birdata 2005–2007), which has a single record for the area.

A bird possessing such acute vision, highly honed flying skills and largely diurnal habits, it is unlikely that Peregrines would have a high risk of collision with turbine rotors. As such it is unlikely that this species is likely to be placed at a significantly higher level of risk of local adverse impacts as a consequence of the proposed wind farm development.

3.7.3.4 Migratory Species as Listed under the EPBC Act

As aforementioned in Section 3.6.1.2, the vast majority of listed migratory species recorded within the site (Table 3-4) are not indeed migratory in their habits (being predominantly resident or nomadic/dispersive within Australia). Duck and raptor species in particular (Families Anatidae and Accipitridae respectively) fall into this category.

Only a limited number of the species listed as Migratory within the area of interest can be considered truly migratory, and only a limited number are likely to occur within the site at greater frequencies than occasional rare occurrences, including Fork-tailed Swift and Rainbow Bee-eater, Great Egret and Cattle Egret.

Of these species, only the Rainbow Bee-eater could be considered to utilise the habitats contained within the site on a regular basis as a consequence of their migration to south-western Australia. Such habitat opportunities are not confined to the site, but occur widely throughout the region. The sandy substrates associated with landscapes in the locality are favoured by this species for nesting opportunities. Although there is only a relatively sparse collection of records widely spread within the region, this is likely due to limitations on local survey effort as similar results are returned for locally common species such as the Australian Ringneck.

This species is occasionally observed hunting at moderately high elevations, which might be consistent with the RSA, however, their insectivorous hunting habits, in the locality, were observed to be strongly associated with stunted heathland vegetation, where an abundance of flowering plants is the dominant attractor of the Bee-eater's insect prey. Due to the dominance of low elevation hunting opportunities locally it is unlikely that this species would fly at RSA elevations more than rarely, during its general day to day activities. Therefore it is unlikely that this species would be placed at a significant risk of adverse impact as a consequence of the proposed wind farm.

3.7.3.5 Migratory Wading Bird Species

Certain members of the families Charadriidae (plovers, dotterels and lapwings) and Scolopacidae (snipe, godwits, curlews, sandpipers, stints and phalaropes) are also listed as Migratory species under the EPBC Act. Within these families a number of species are recognised as resident species and although they are somewhat nomadic or dispersive in their movements, they breed within Australia and so they are not considered to be truly migratory in habits. A range of other members of these families migrate annually from temperate and arctic regions in the northern hemisphere to Australia during the onset of the Austral summer period. These species are those that are considered to be true migrants.

The site does not contain habitat for migratory wading bird species, although there are habitats within the region that are frequented by these species.

A number of migratory wading bird species were recorded from wetland habitats around Lake Guraga to the south-west, the near coastal Lake Thetis near Cervantes and from the Upper Moore River area to the north-west and west of Moora. Movements to and from these wetland habitats by migratory wading birds are likely to follow north–south routes, which follow the general landscape arrangement of these habitats in relation to drainage basins in the east and coastal dune topography in the west. As such, it is unlikely that significant movements of migratory wading birds would take place in an east–west direction across the Koodiwoodie Range where the proposed wind farm is to be constructed. As a consequence it is unlikely that migratory wading bird species will be placed at significant risk of adverse impact due to the proposed wind farm.

3.7.4 Risks to Other Priority Species

Auswind (2006) guidelines for bird assessments describe a need to consider species which may not be included on legislative schedules but which are present in significant numbers on or near the site or prone to collisions or other effects from wind farms.

Of those species observed to occur within the site, only one species, the Wedge-tailed Eagle, was observed flying with regularity at RSA elevations and is considered to have a greater than low risk of impact in relation to the proposed wind farm development (Table 3-4).

The Wedge-tailed Eagle is a declared pest of agriculture under the provisions of the Agriculture and Related Resources Protection Act 1976, administered by the Western Australian Department of Agriculture and Food. This declaration allows for the approval and implementation of a management program in various areas of the state including agricultural areas such as those in the locality of the proposed Waddi Wind Farm (DEC 2007).

As a native species, the Wedge-tailed Eagle is protected under the provisions of the WC Act, administered by the DEC. The shooting of Wedge-tailed Eagles is not permitted, but damage licences may be issued by DEC to shoot or scare the eagles away from livestock (DEC 2007).

Wedge-tailed Eagles were widely recorded across the site and the surrounding area, with some 76 individual observations made during the course of the survey period. However, of those 76 records only four were recorded within formal survey plots. The relatively high number of records from the site is largely due to the sedentary nature of local birds and their high visibility from long distances, which has resulted in individuals being repeatedly observed from a number of formal survey plots. This species occupies territories representing large areas, and therefore numbers of individuals noted within the study areas were generally low.

It is likely that the northern portion of the study area is occupied by a single pair and perhaps a young bird or two from previous breeding seasons, although it is possible that the territories of other individuals occurring largely offsite to the east and west may include some areas of the Koodiwoodie Range. The numbers of Wedge-tailed Eagles are likely to fluctuate, with occasional influxes from birds occurring in areas adjacent to the Koodiwoodie Range. Two nests were observed in the wider locality to the north of the proposed wind farm, just east of Mullering Road, one containing a half fledged, half downy eaglet.

Fifty-one per cent of Wedge-tailed Eagle observations within the survey period were from elevations higher than the RSA, 29% were from elevations within the RSA and 20% were from elevations lower than the RSA (Appendix 2). It is likely that the eagles may have been flying for longer periods within the revised RSA height of between 40 and 152 m. However, given the difference is only 17 m, the flying time within RSA height is unlikely to change substantially and affect the overall conclusions.

Apart from those species with observation numbers that are too low to draw valid statistical results, such as Fairy Martin, White-backed Swallow and Black-shouldered Kite, this species was recorded as occurring within RSA elevations more than any other species. This can to some extent be accounted for by observations made of distant birds flying over valley areas outside of the formal census plots as is the case for the Nankeen Kestrel. Nevertheless, in contrast to most species observed over elevated areas, Wedge-tailed Eagles were observed to fly at generally higher altitudes with 51% of observations exceeding the RSA. This is likely due to the eagle's size and therefore dependence upon the prevailing winds to aid its soaring flight habits.

Despite its higher elevation flight patterns local Wedge-tailed Eagles are sedentary individuals, which are likely to have a detailed knowledge of local landscape features and it is considered likely that local birds would easily avoid turbine collisions. Being a diurnal species with no known nocturnal habitats it is unlikely that there would be periods where the turbines might be unsighted by individuals, apart from foggy mornings during which birds are not likely to be active, due to the lack of wind.

There is a possibility, given their generally more elevated flying patterns over the Koodiwoodie Range, that young of this species might collide with turbines on rare occasions. However, based on the generally low densities that occur in the area and probability that local individuals will tend to avoid turbines, combined with the common and secure status of this species in the locality, the level of risk to the species is considered to be greater than low, but not sufficient to be considered of moderate significance.

3.7.5 Potential Cumulative Impacts from other Wind Farm Proposals

In the wider regional context there are four other wind farm projects of relevance. The first is an existing wind farm at Emu Downs, some 12 km to the north-north-west of the

proposed Waddi wind farm development. The other three are proposed wind farm developments. These include the proposed Badgingarra wind farm to the north of the existing Emu Downs wind farm, the Yandin wind farm on the Koodiwoodie Range some 9.5 km to the south-east and another at Nilgen some 30 km to the south-west of the proposed Waddi wind farm.

Three of these other wind projects occur in a more westerly context to the current proposal and are situated upon rises in the coastal strip between the near coastal dune system and the Koodiwoodie Range. The fourth is situated on the Koodiwoodie Range in a similar topographical context to the proposed Waddi wind farm.

Potential impacts within each of these sites are likely to primarily involve local bird populations occurring in the vicinity of each development due to the limited likelihood of significant bird movements through the general area. The proposed Waddi wind farm is unlikely to act together with any of these proposed developments to represent a significant cumulative impact upon regional bird movements. This is due to the Waddi wind farm's eastern location inland of likely migratory wading bird exchanges between western lakes such as Guraga Lake and near coastal lake systems further west.

The respective north to south alignments of both coastal and easterly drainage basin wetland habitats is likely to provide natural movement corridors for truly migratory species due to the continuity of potential stopover opportunities that these north to south habitat linkages represent. As such, there are no known important migratory bird movements that might traverse the proposed Waddi wind farm and any other wind farm proposal in the region. There is the potential for intermittent east to west movements by resident waterbirds in response to inland inundation events, but these are considered to represent rare occurrences and would not require movement across multiple wind farm developments due to their staggered spread in a latitudinal sense.

4.0 CONCLUSIONS AND RECOMMENDATIONS

The avian surveys conducted within the proposed wind farm site and over a large area of the Koodiwoodie range and the surrounding locality in the Dandaragan Shire Council area, indicate that the avifauna of the site are predominantly common bird species. The open country (cleared) locations selected for wind turbine sitings are of relatively low habitat value for birds, with greatest species diversity associated with areas of structurally diverse native vegetation. Surveys observed limited numbers of avian species in habitats associated with ridge-top turbine locations.

Species observed which are listed under state and Commonwealth schedules, including migratory species, were found to primarily frequent or move through/between lowland areas where more suitable habitat for these species occurs. Local flyway orientations were considered unlikely to traverse the proposed wind farm location, due to the general north-south alignment of drainage basins and coastal wetlands, although the potential for some intermittent east to west bird movements may exist, due to the temporary nature of regional wetlands in response to periodic inundations, particularly those in the east.

During the period surveyed, most species appear to fly at lower elevations in relation to the ground over ridge-top areas to avoid the strong westerly winds that characterise the site on a daily basis. In contrast to this general trend in flight behaviour, one species, the Wedge-tailed Eagle, was often observed at elevations much higher than the RSA, which is likely attributable to their dependence upon high winds to stay aloft.

Assessment of all avian species potentially occurring within the site concluded that no bird species is considered to be at risk of a significant adverse impact by the proposed wind farm, either in isolation or through cumulative effects from the existing and currently proposed wind farms in the region. The wind turbines were unlikely to have a significant impact on avifauna in the area of interest, as the majority of species tended to be low flying, or concentrated in lower valleys and heathlands where turbines would not be located. All turbines will be located within cleared paddocks, and the extent of potential clearing of vegetation will be minimal, making it unlikely that loss of habitat will have a significant impact on any of the avifauna species on the site.

Specially Protected and Threatened Species were targeted during the surveys, and the Carnaby's Black-Cockatoo and the Peregrine Falcon were identified, however both of these species were located outside the formal census plots and are unlikely to be significantly impacted by the proposed wind farm development. The Carnaby's Black-Cockatoo is likely to forage and roost in woodlands and tall heathland near to their food sources such as Banksia and Marri seeds. The Peregrine Falcon is a high flying species and unlikely to occur within the RSA.

The following recommendations have been outlined to ensure that the ecological impact of the proposed wind farm is minimised as far as possible:

- Power lines between turbines should be constructed underground and along road infrastructure to minimise number of easements through the area and further incidents of potential avian collisions (including the creation of perching locations in the vicinity of turbines).

- A post-construction bird monitoring program, such as that described by Auswind (2005) should be established to determine the impacts of the project on bird populations. Such data may prove invaluable for assessing the impacts of future wind farms within the Region and elsewhere within Australia.

- Constructional and operational phases of the development should be in line with the Best Practice Guidelines for Wind Energy Projects (Auswind 2005), including the implementation of an Environmental Management Plan (EMP) and a Construction Management Plan (CMP).

- Vegetation and associated habitat loss is kept at a minimum through careful planning of cable and access road alignments.

5.0 REFERENCES

Australian Wind Energy Association (AusWEA). 2002. *Best Practice Guidelines for Implementation of Wind Energy Projects in Australia*. Australian Wind Energy Association. March 2002.

Australian Wind Energy Association (AusWEA). 2004. *Fact Sheet 8: Wind Farms & Bird & Bat Impacts*. Australian Wind Energy Association.

Australian Wind Energy Association (Auswind). 2005. *Wind Farms and Birds: Interim Standards For Risk Assessment. Australian Wind Energy Association*. July 2005. Prepared by Brett Lanes and Associates.

Australian Wind Energy Association (Auswind). 2006. *Best Practice Guidelines for Implementation of Wind Energy Projects in Australia.* Prepared by Hydro Tasmania Consulting.

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

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

Birdata. 2005–2007. *Atlas Distribution Maps*. Retrieved from http://www.birdata.com.au/maps.vm on 21 May 2009. Birds Australia.

Birdata. 2008. *Species lists for the 1-degree block encompassing the Dandaragan Postcode locality*. Available from http://www.birdata.com.au/homecontent.do. Accessed October 2008.

Birdlife International. 2003. *Wind farms and Birds: An analysis of the effects of wind farms on birds, and guidance on environmental assessment criteria and site selection issues*. Report written by Birdlife International, on behalf of the Bern Convention, RHW Langston and J D Pullan, RSPB/ Birdlife, UK.

Christidis, L. and Boles, W.E. 2008. *Systematics and Taxonomy of Australian Birds*. CSIRO Publishing, Collingwood.

Colson and Associates. 1995. *Avian interactions with wind energy facilities: a summary*. Prepared for the American Wind Energy Association, Washington DC, USA.

de Lucas, M. Janss, G.F.E., Whitfield, D.P. and Ferrer, M 2008, "Collision fatality of raptors in wind farms does not depend on raptor abundance", *Journal of Applied Ecology* Volume 45, Number 6, December 2008 , pp. 1695-1703(9). Blackwell Publishing.

Department for Environment and Heritage (DEH). 2005. *Supplementary Significant Impact Guidelines 2.1.1 Wind Farm Industry Sector*. EPBC Act Policy Statements. Government of Australia, Canberra.

Department for Environment and Heritage (DEH). 2006. *Wind farm collision risk for birds – Cumulative risks for threatened and migratory species*. Government of Australia, Canberra.

Department of Environment and Conservation (DEC). 2007. *DEC Fauna Note No. 17 – Wedge-tailed Eagle*. DEC, Perth.

Department of Environment, Water, Heritage and the Arts (DEWHA). 2009. EPBC Act Protected Matters Search Tool. Available from http://www.environment.gov.au/erin/ert/epbc/index.html.

Drewitt, A.L. and Langston, R.H.W. 2006. Assessing the impacts of wind farms on birds. *Ibis* **148**, 29-42.

Environmental Protection Authority (EPA). 2004. *Guidance Statement No. 56 Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia*, EPA, Perth.

Higgins, P.J. (Ed.). 1993. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings.* Oxford University Press, Melbourne.

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

HSO. 2004. *Flora and Fauna Assessment box Hill Wind Farm, Ben Lomond Guyra.* Report prepared for Box Hill Wind Farm Pty Ltd. HSO Pty Ltd, Newcastle.

HSO. 2005. *Flora and Fauna Assessment Highfields Wind Farm, October 2005*, Energreen Wind Pty Ltd. HSO Pty Ltd, Newcastle.

HSO. 2005$_b$. *Flora and Fauna Assessment Ben Lomond Wind Farm, August 2005*, Energreen Wind Pty Ltd. HSO Pty Ltd, Newcastle.

HSO. 2005$_c$. *Flora and Fauna Assessment Ben Lomond North Wind Farm, August 2005*, Energreen Wind Pty Ltd. HSO Pty Ltd, Newcastle.

HSO. 2005$_e$. *Liverpool Range Wind Farm Nowlands Gap Murrurundi*. Report prepared for Macquarie Generation Pty Ltd, (ref 22555). HSO Pty Ltd, Newcastle.

HSO. 2006. *Flora and Fauna Assessment for Black Springs Wind Farm*. Report prepared for Wind Corporation Australia Ltd, (ref 23219). HSO Pty Ltd, Newcastle.

Mooney and Brothers 1987 in Higgins, P.J. (Ed.). 1993. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings.* Oxford University Press, Melbourne.

National Wind Coordinating Collaborative (NWCC). 2004. *Wind Turbine Interactions with Birds and Bats: A Summary of Research Results and Remaining Questions*. National Wind Coordinating Committee. November 2004.

New Zealand Wind Energy Association (NZWEA). 2005a. *Fact Sheet 3 – Climate Change and the Environment.* New Zealand Wind Energy Association, August 2005.

New Zealand Wind Energy Association (NZWEA). 2005b. *Fact Sheet 5 – Siting. New Zealand Wind Energy Association*, August 2005.

New Zealand Wind Energy Association (NZWEA). 2005c. *Fact Sheet 8 – Birds and Bats*. New Zealand Wind Energy Association, August 2005.

Olsen 1985 in Higgins, P.J. (Ed.). 1993. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings.* Oxford University Press, Melbourne.

Olsen and Olsen 1980 in Higgins, P.J. (Ed.). 1993. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings.* Oxford University Press, Melbourne.

Parsons Brinckerhoff (PB) 2004. *Preliminary Ecological Results for the Ben Lomond Wind Farm*. PB Pty Ltd.

Planning New South Wales (NSW). 2002. *Draft NSW Wind Energy Environmental Impact Assessment Guidelines*. Planning NSW, Sydney.

RPS HSO. 2007. *Ecological Assessment for Waverley Wind Farm, Waverley, New Zealand.* Report prepared for Allco Wind Energy NZ Ltd, Newcastle.

White et al. 1981 in Higgins, P.J. (Ed.). 1993. *Handbook of Australian, New Zealand and Antarctic Birds. Volume 2: Raptors to Lapwings.* Oxford University Press, Melbourne.

Winkelman, J.E. 1992. *The Impact of the Sep Wind Park Near Oosterblerum (Fr.), the Netherlands, on Birds, 1: Collision Victims*. RIN report no. 92/2.

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APPENDIX I

Avifauna Species List

APPENDIX 1: Avian Species List

Below is a list of avifauna species that could be *reasonably* expected to be found within the study area at some occurrence. Such an approach has been taken given the low probability of recording *all* potentially occurring species within an area during formal fauna surveys (due to seasonality, climatic limitations, crypticism, etc).

Family sequencing and taxonomy follow for each fauna class:

Birds – Christidis and Boles (2009)

Appendix Key: ✓ = Species Detected
* = Introduced species
(E) = Species listed under *EPBC Act 1999* as Endangered.
(R) = Species listed under WA *WC Act 1950* as Rare.
(O) = Species listed under WA *WC Act 1950* as Other Specially Protected Fauna
(M*) = Species listed under the Commonwealth EPBC Act as Migratory
(C) = Species listed under CAMBA
(J) = Species listed under JAMBA

Data Source: **W** = Species recorded within Waddi formal census
Y = Species recorded within Yandin formal census
R = Species recorded within representative plots
✓ = observed

Known and Expected Bird List

Family Name	Scientific Name	Common Name	W	Y	R
Casuariidae (Emu)	*Dromaius novaehollandiae*	Emu			
Phasianidae (True Quails, Pheasants and Fowls)	*Coturnix pectoralis*	Stubble Quail	✓	✓	✓
	Coturnix ypsilophora	Brown Quail			
Anatidae (Swans, Geese and Ducks)	*Oxyura australis*	Blue-billed Duck (M*)			
	Biziura lobata	Musk Duck (M*)			✓
	Cygnus atratus	Black Swan (M*)			✓
	Tadorna tadornoides	Australian Shelduck (M*)			✓
	Chenonetta jubata	Australian Wood Duck (M*)		✓	✓
	Anas platyrhynchos	*Northern Mallard (M*)			
	Anas rhynchotis	Australasian Shoveler (M*)			✓
	Anas superciliosa	Pacific Black Duck (M*)			✓
	Anas gracilis	Grey Teal (M*)		✓	✓

Family Name	Scientific Name	Common Name	W	Y	R
	Anas castanea	Chestnut Teal (M*)			
	Malacorhynchus membranaceus	Pink-eared Duck (M*)			
	Aytha australis	Hardhead (M*)			
Podicipedidae (Grebes)	*Tachybaptus novaehollandiae*	Australasian Grebe			
	Poliocephalus poliocephalus	Hoary-headed Grebe			
	Podiceps cristatus	Great Crested Grebe			
Anhingidae (Darters)	Anhinga novaehollandiae	Australasian Darter			
Phalacrocoracidae (Cormorants)	Phalacrocorax carbo	Great Cormorant			
	Microcarbo melanoleucos	Little Pied Cormorant			
	Phalacrocorax sulcirostris	Little Black Cormorant			
	Phalacrocorax varius	Pied Cormorant			
Pelecanide (Pelicans)	*Pelecanus conspicillatus*	Australian Pelican			✓
Ardeidae (Herons, Bitterns and Egrets)	*Ardea pacifica*	White-necked Heron			
	Egretta novaehollandiae	White-faced Heron		✓	✓
	Egretta garzetta	Little Egret (J)			✓
	Ardea modesta	Great Egret (C,J, M*)			
	Nycticorax caledonicus	Nankeen Night Heron			
Threskiornithidae (Ibises and Spoonbills)	*Plegadis falcinellus*	Glossy Ibis (C, M*)			
	Threskiornis molucca	Australian White Ibis			✓
	Threskiornis spinicollis	Straw-necked Ibis	✓	✓	✓
	Platalea flavipes	Yellow-billed Spoonbill			
Accipitridae (Hawks, Kites and Eagles)	*Pandion cristatus*	Osprey			
	Elanus axillaris	Black-shouldered Kite (M*)	✓	✓	
	Lophoictinia isura	Square-tailed Kite (M*)			
	Haliastur sphenurus	Whistling Kite (M*)			✓
	Haliaeetus leucogaster	White-bellied Sea-Eagle (C, M*)			✓
	Circus assimilis	Spotted Harrier (M*)			
	Circus approximans	Swamp Harrier (M*)			
	Accipiter fasciatus	Brown Goshawk (M*)		✓	
	Accipiter cirrhocephalus	Collared Sparrowhawk (M*)	✓		✓
	Aquila audax	Wedge-tailed Eagle (M*)	✓	✓	✓
	Hieraaetus morphnoides	Little Eagle (M*)			

Family Name	Scientific Name	Common Name	W	Y	R
Falconidae (Falcons)	*Falco berigora*	Brown Falcon (M*)	✓	✓	
	Falco longipennis	Australian Hobby (M*)		✓	✓
	Falco peregrinus	Peregrine Falcon (M* O)			
	Falco cenchroides	Nankeen Kestrel (M*)	✓	✓	✓
Rallidae (Crakes, Rails and Gallinules)	*Fulica atra*	Eurasian Coot			
	Porzana tabuensis	Spotless Crake			
	Porphyrio porphyrio	Purple Swamphen			
	Tribonyx ventralis	Black-tailed Native-hen			
Otididae (Bustards)	*Ardeotis australis*	Australian Bustard			
Turnicidae (Button-Quails)	*Turnix velox*	Little Button-quail			
	Turnix varius	Painted Button-quail			
	Turnix pyrhothorax	Red-chested Button-quail			
Scolopacidae (Snipe, Godwits, Curlews, Sandpipers, Stints & Phalaropes)	*Limosa limosa*	Black-tailed Godwit (M*,C)			
	Limosa lapponica	Bar-tailed Godwit (M*,C)			
	Numenius minutes	Little Curlew (M*)			
	Tringa nebularia	Common Greenshank (M*,C)			
	Tringa glareola	Wood Sandpiper (M*,C)			
	Actitis hypoleucos	Common Sandpiper (M*,C)			
	Tringa brevipes	Grey-tailed Tattler (M*,C)			
	Arenaria interpres	Ruddy Turnstone (M*,C)			
	Calidris tenuirostris	Great Knot (M*,C)			
	Calidris canutus	Red Knot (M*,C)			
	Calidris alba	Sanderling (M*,C)			
	Calidris ruficollis	Red-necked Stint (M*,C)			✓
	Calidris subminuta	Long-toed Stint (M*,C)			
	Calidris acuminata	Sharp-tailed Sandpiper (M*,C)			
	Calidris ferruginea	Curlew Sandpiper (M*,C)			
Haematopodidae (Oystercatchers)	*Haematopus longirostris*	Australian Pied Oystercatcher			
Recurvirostridae (Stilts & Avocets)	*Himantopus himantopus*	Black-winged Stilt (M*)			✓
	Cladorhynchus leucocephalus	Banded Stilt			
	Recurvirostra novaehollandiae	Red-necked Avocet (M*)			✓

Family Name	Scientific Name	Common Name	W	Y	R
Charadriidae (Lapwings, Plovers and Dottrels)	*Pluvialis squatarola*	Grey Plover (M*,C)			
	Charadrius ruficapillus	Red-capped Plover (M*)			✓
	Charadrius mongolus	Lesser Sand Plover (M*,C)			
	Erythrogonys cinctus	Red-kneed Dotterel (M*)			
	Elseyornis melanops	Black-fronted Dotterel (M*)			
	Vanellus tricolor	Banded Lapwing (M*)	✓		
Laridae (Gulls and Terns)	*Chroicoephalus novaehollandiae*	Silver Gull			✓
	Larus pacificus	Pacific Gull			
	Chlidonias hybridus	Whiskered Tern			
	Hydroprogne caspia	Caspian Tern (M*,C)			
	Gelochelidon nilotica	Gull-billed Tern			✓
	Thalasseus bergii	Crested Tern			
		Roseate Tern			
		Fairy Tern			
		Little Tern			
		Bridled Tern			
	Sterna hirundo	Common Tern (M*,C)			
	Sternula albifrons	Little Tern (M*,C)			
Columbidae (Pigeons and Doves)	**Columba livia*	Rock Dove			
	Streptopelia senegalensis	Laughing Turtle Dove			
	Ocyphaps lophotes	Crested Pigeon	✓	✓	✓
	Phaps chalcoptera	Common Bronzewing	✓	✓	✓
	Phaps elegans	Brush Bronzewing			
Cacatuidae (Cockatoos)	*Calyptorhynchus banksii*	Red-tailed Black-Cockatoo			
	Calyptorhynchus latirostris	Carnaby's Black-Cockatoo (R, E)	✓	✓	✓
	Eolophus roseicapillus	Galah	✓	✓	✓
	Cacatua tenuirostris	Long-billed Corella			
	Cacatua pastinator derbyi	Western Corella (Northern)	✓	✓	✓
	Cacatua sanguinea	Little Corella			
Psittacidae (Parrots)	*Glossopsitta porphyrocephala*	Purple-crowned Lorikeet			
	Polytelis anthopeplus	Regent Parrot			
	Platycercus icterotis	Western Rosella			
	Barnardius zonarius	Australia Ringneck	✓	✓	✓
	Melopsittacus undulatus	Budgerigar			
	Neophema petrophila	Rock Parrot			

Family Name	Scientific Name	Common Name	W	Y	R
Cuculidae (Old World Cuckoos)	*Chrysococcyx osculans*	Black-eared Cuckoo			
	Cacomantis flabelliformis	Fan-tailed Cuckoo			
	Chalcites basalis	Horsfield's Bronze-Cuckoo	✓	✓	✓
	Chalcites lucidus	Shining Bronze-Cuckoo		✓	
	Cacomantis pallidus	Pallid Cuckoo			
Strigidae (Hawk Owls)	*Ninox boobook*	Southern Boobook			
Tytonidae (Barn Owls)	*Tyto javanica*	Barn Owl			
Podargidae (Frogmouths)	*Podargus strigoides*	Tawny Frogmouth			
Aegothelidae (Owlet-nightjars)	*Aegotheles cristatus*	Australian Owlet-nightjar			
Apodidae (Typical Swifts)	*Apus pacificus*	Fork-tailed Swift (M*,C)			
Halcyonidae (Kingfishers and Kookaburras)	*Dacelo novaeguineae*	Laughing Kookaburra		✓	✓
	Todiramphus sanctus	Sacred Kingfisher		✓	✓
Meropidae (Bee-eaters)	*Merops ornatus*	Rainbow Bee-eater (M*)	✓	✓	✓
Maluridae (Fairy-Wrens and Emu-Wrens)	*Malurus splendens*	Splendid Fairy-wren	✓	✓	✓
	Malurus lamberti	Variegated Fairy-wren		✓	
	Malurus pulcherrimus	Blue-breasted Fairy-wren			
	Malurus leucopterus	White-winged Fairy-wren	✓	✓	✓
	Stipiturus malachurus	Southern Emu-wren (M*)			
Pardalotidae (Pardalotes, Scrubwrens, Thornbills)	*Pardalotus punctatus*	Spotted Pardalote			
	Paradalotus striatus	Striated Pardalote		✓	
	Sericornis frontalis	White-browed Scrubwren	✓		
	Hylacola cauta	Shy Heathwren			
	Calamanthus campestris	Rufous Fieldwren	✓	✓	
	Pyrrholaemus brunneus	Redthroat			
	Smicrornis brevirostris	Weebill		✓	
	Gerygone fusca	Western Gerygone		✓	✓
	Acanthiza apicalis	Inland Thornbill		✓	
	Acanthiza uropygialis	Chestnut-rumped Thornbill			
	Acanthiza inornata	Western Thornbill		✓	
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill	✓	✓	✓

Family Name	Scientific Name	Common Name	W	Y	R
Meliphagidae (Honeyeaters)	*Anthochaera carunculata*	Red Wattlebird		✓	
	Anthochaera lunulata	Western Wattlebird			
	Acanthagenys rufogularis	Spiny-cheeked Honeyeater			
	Manorina flavigula	Yellow-throated Miner		✓	✓
	Lichenostomus virescens	Singing Honeyeater	✓	✓	✓
	Lichenostomus leucotis	White-eared honeyeater			
	Lichenostomus penicillatus	White-plumed Honeyeater			
	Lichenostomus ornatus	Yellow-plumed Honeyeater			
	Melithreptus brevirostris	Brown-headed Honeyeater		✓	
	Melithreptus lunatus	White-naped Honeyeater			
	Lichmera indistincta	Brown Honeyeater	✓	✓	✓
	Phylidonyris novaehollandiae	New Holland Honeyeater			
	Phylidonyris niger	White-cheeked Honeyeater	✓	✓	✓
	Glyciphila melanops	Tawny-Crowned Honeyeater	✓		✓
	Acanthorhynchus superciliosus	Western Spinebill			
	Certhionyx niger	Black Honeyeater	✓		✓
	Epthianura tricolor	Crimson Chat	✓		✓
	Epthianura aurifrons	Orange Chat			
	Epthianura albifrons	White-fronted Chat	✓	✓	✓
Eopsaltriidae (Robins)	*Petroica boodang*	Scarlet Robin			
	Petroica goodenovii	Red-capped Robin		✓	✓
	Melanodryas cucullata	Hooded Robin	✓		
	Eopsaltria griseogularis	Western Yellow Robin			
	Eopsaltria georgiana	White-breasted Robin			
Pomatostomidae (Australo-Papuan Babblers)	*Pomatostomus superciliosus*	White-browed Babbler			
Neosittidae (Sittellas)	*Daphoenositta chrysoptera*	Varied Sittella		✓	
	Oreoica gutturalis	Crested Bellbird			
Pachycephalidae (Whistlers, Shrike-tit, Shrike-thrushes)	*Pachycephala pectoralis*	Golden Whistler			
	Pachycephala rufiventris	Rufous Whistler	✓	✓	✓
	Colluricincla harmonica	Grey Shrike-thrush		✓	✓
Dicruridae (Monarchs, Fantails and Drongo)	*Myiagra inquieta*	Restless Flycatcher			
	Grallina cyanoleuca	Magpie-lark	✓	✓	✓

Family Name	Scientific Name	Common Name	W	Y	R
	Rhipidura albiscarpa	Grey Fantail		✓	
	Rhipidura leucophyrs	Willie Wagtail	✓	✓	✓
Campephagidae (Cuckoo-shrikes and Trillers)	*Coracina novaehollandiae*	Black-faced Cuckoo-shrike	✓	✓	✓
	Lalage sueurii	White-winged Triller	✓	✓	✓
Artamidae (Woodswallows, Butcherbirds, Currawongs)	*Artamus*	Masked Woodswallow			
	Artamus cinereus	Black-faced Woodswallow	✓	✓	✓
	Artamus cyanopterus	Dusky Woodswallow			
	Cracticus torquatus	Grey Butcherbird	✓	✓	✓
	Cracticus nigrogularis	Pied Butcherbird		✓	
	Cracticus tibicen	Australian Magpie	✓	✓	✓
	Strepera versicolor	Grey Currawong			
Corvidae (Crows and allies)	*Corvus coronoides*	Australian Raven	✓	✓	✓
	Corvus bennetti	Little Crow			
Motacillidae (Old World Wagtails,Pipits)	*Anthus novaeseelandiae*	Australasian (Richard's) Pipit	✓	✓	✓
Passeridae (Sparrows, Weaverbirds, Waxbills)	*Taeniopygia guttata*	Zebra Finch			✓
Dicaeidae (Flowerpeckers)	*Dicaeum hirundinaceum*	Mistletoebird			✓
Hirundinidae (Swallows and Martins)	*Cheramoeca leucosterna*	White-Backed Swallow		✓	✓
	Hirundo neoxena	Welcome Swallow	✓	✓	✓
	Petrochelidon nigricans	Tree Martin	✓	✓	✓
	Petrochelidon ariel	Fairy Martin	✓		
Sylviidae (Old World Warblers)	*Acrocephalus australis*	Clamorous Reed Warbler			
	Megalurus gramineus	Little Grassbird			✓
	Megalurus timorensis	Tawny Grassbird			
	Cincloramphus cruralis	Brown Songlark	✓	✓	✓
	Cincloramphus mathewsi	Rufous Songlark	✓	✓	
Zosteropidae (White-eyes)	*Zosterops lateralis*	Silvereye	✓	✓	✓

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APPENDIX 2

Waddi Species Elevation Records

APPENDIX 2: Waddi Species Elevation Records

Waddi Species Seen		1 ha Site Survey Plots												1 Ha Reference and Yandin Plots												Totals			
		n Within 1Ha Plots				*n* Outside 1ha Plots				% within Site Survey Plots				*n* Within 1Ha Reference Plots				*n* Outside 1ha Reference Plots				% within Reference Plots							
Scientific Name	**Common Name**	Elevation 1	Elevation 2	Elevation 3	Elevation 1	Elevation 2	Elevation 3	% inside Plot in 1	% inside Plot in 2	% inside Plot in 3	% Out of Plot in 1	% Out of Plot in 2	% Out of Plot in 3	Elevation 1	Elevation 2	Elevation 3	Elevation 1	Elevation 2	Elevation 3	% inside Plot in 1	% inside Plot in 2	% inside Plot in 3	% Out of Plot in 1	% Out of Plot in 2	% Out of Plot in 3	*N*	Total % in 1	Total % in 2	Total % in 3
Tadorna tadornoides	Australian Shelduck	0	0	0	0	0	0							5	0	0	4503	1	0	100	0	0	100	0	0				
Cygnus atratus	Black Swan	0	0	0	0	0	0							0	0	0	1633	0	0				100	0	0				
Cacatua pastinator	Western Corella	0	0	0	7	0	0				100	0	0	127	0	0	726	41	0	100	0	0	95	5	0	7	100	0	0
Cacatua roseicapilla	Galah	65	2	0	86	101	0	97	3	0	46	54	0	94	0	0	110	0	0	100	0	0	100	0	0	254	59	41	0
Corvus coronoides	Australian Raven	3	0	0	66	45	5	100	0	0	57	39	4	23	3	0	273	3	6	88	12	0	97	1	2	119	58	38	4
Banardius zonarius	Australian Ringneck	22	5	0	19	0	0	81	19	0	100	0	0	209	0	0	119	0	0	100	0	0	100	0	0	46	89	11	0
Threskiornis spinicollis	Straw-necked Ibis	13	13	0	13	13	13	50	50	0	33	33	33	1	0	0	281	4	15	100	0	0	94	1	5	65	40	40	20
Cincloramphus cruralis	Brown Songlark	124	38	0	37	7	0	77	23	0	84	16	0	17	0	0	13	0	0	100	0	0	100	0	0	206	78	22	0
Hirundo nigricans	Tree Martin	16	0	0	0	0	0	100	0	0				8	0	0	189	0	0	100	0	0	100	0	0	16	100	0	0
Gymnorhina tibicen	Australian Magpie	6	0	0	32	20	4	100	0	0	57	36	7	37	0	0	99	0	0	100	0	0	100	0	0	62	61	32	6
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	47	0	0	13	0	0	100	0	0	100	0	0	124	0	0	10	0	0	100	0	0	100	0	0	60	100	0	0
Charadrius ruficapillus	Red-Capped Plover	0	0	0	0	0	0							8	0	0	171	0	0	100	0	0	100	0	0				
Anas rhynchotis	Australasian Shoveler	0	0	0	0	0	0							0	0	0	154	0	0				100	0	0				
Anas gracilis	Grey Teal	0	0	0	0	0	0							1	0	0	118	0	0	100	0	0	100	0	0				
Grallina cyanoleuca	Australian Magpie-lark	13	0	0	18	2	0	100	0	0	90	10	0	25	0	0	56	0	0	100	0	0	100	0	0	33	94	6	0
Anthus novaeseelandiae	Australian Pipit	34	4	0	19	1	0	89	11	0	95	5	0	24	1	0	22	0	0	96	4	0	100	0	0	58	91	9	0
Calidris ruficollis	Red-Necked Stint	0	0	0	0	0	0							20	0	0	84	0	0	100	0	0	100	0	0				
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	2	3	0	22	9	0	40	60	0	71	29	0	12	0	0	52	0	0	100	0	0	100	0	0	36	67	33	0
Hirundo neoxena	Welcome Swallow	15	0	0	4	1	0	100	0	0	80	20	0	50	0	0	29	0	0	100	0	0	100	0	0	20	95	5	0
Himantopus himantopus	Black-Winged Stilt	0	0	0	0	0	0							84	0	0	14	0	0	100	0	0	100	0	0				
Artamus cinerius	Black-faced Woodswallow	42	0	0	11	2	0	100	0	0	85	15	0	22	0	0	19	0	0	100	0	0	100	0	0	55	96	4	0
Lichmera indistincta	Brown Honeyeater	0	0	0	5	0	0				100	0	0	58	0	0	22	0	0	100	0	0	100	0	0	5	100	0	0
Coturnix pectoralis	Stubble Quail	26	0	0	43	0	0	100	0	0	100	0	0	10	0	0	5	0	0	100	0	0	100	0	0	69	100	0	0
Aquila audax	Wedge-tailed Eagle	2	2	0	3	6	7	50	50	0	19	38	44	0	0	0	13	14	35				21	23	56	20	25	40	35
Phylidonyris nigra	White-cheeked Honeyeater	14	0	0	17	0	0	100	0	0	100	0	0	32	0	0	14	0	0	100	0	0	100	0	0	31	100	0	0
Falco cenchroides	Nankeen Kestrel	7	0	0	9	5	0	100	0	0	64	36	0	13	2	0	26	7	1	87	13	0	76	21	3	21	76	24	0
Malurus leucopterus	White-winged Fairy Wren	5	0	0	15	0	0	100	0	0	100	0	0	26	0	0	13	0	0	100	0	0	100	0	0	20	100	0	0
Rhipidua leucophrys	Willie Wagtail	13	0	0	8	0	0	100	0	0	100	0	0	25	0	0	7	0	0	100	0	0	100	0	0	21	100	0	0
Larus novaehollandiae	Silver Gull	0	0	0	0	0	0							35	0	0	15	0	0	100	0	0	100	0	0	0			
Epthianura albifrons	White-fronted Chat	17	0	0	17	0	0	100	0	0	100	0	0	10	0	0	6	0	0	100	0	0	100	0	0	34	100	0	0
Zosterops lateralis	Silvereye	9	0	0	4	0	0	100	0	0	100	0	0	23	0	0	13	0	0	100	0	0	100	0	0	13	100	0	0

Waddi Species Seen		1 ha Site Survey Plots												1 Ha Reference and Yandin Plots												Totals			
		n Within 1Ha Plots			*n* Outside 1ha Plots			% within Site Survey Plots						*n* Within 1Ha Reference Plots			*n* Outside 1ha Reference Plots			% within Reference Plots									
Scientific Name	**Common Name**	Elevation 1	Elevation 2	Elevation 3	Elevation 1	Elevation 2	Elevation 3	% inside Plot in 1	% inside Plot in 2	% inside Plot in 3	% Out of Plot in 1	% Out of Plot in 2	% Out of Plot in 3	Elevation 1	Elevation 2	Elevation 3	Elevation 1	Elevation 2	Elevation 3	% inside Plot in 1	% inside Plot in 2	% inside Plot in 3	% Out of Plot in 1	% Out of Plot in 2	% Out of Plot in 3	*N*	Total % in 1	Total % in 2	Total % in 3
Malurus leucopterus	Splendid Fairy-wren	13	0	0	6	0	0	100	0	0	100	0	0	18	0	0	7	0	0	100	0	0	100	0	0	19	100	0	0
Pachycephala rufiventris	Rufous Whistler	3	0	0	4	0	0	100	0	0	100	0	0	17	0	0	19	0	0	100	0	0	100	0	0	7	100	0	0
Coracina novaehollandiae	Black-faced Cuckoo-Shrike	4	0	0	2	0	0	100	0	0	100	0	0	21	3	0	11	0	0	88	13	0	100	0	0	6	100	0	0
Merops ornatus	Rainbow Bee-eater	11	0	0	9	0	0	100	0	0	100	0	0	14	0	0	4	0	0	100	0	0	100	0	0	20	100	0	0
Cracticus torquatus	Grey Butcherbird	1	0	0	8	0	0	100	0	0	100	0	0	7	0	0	16	0	0	100	0	0	100	0	0	9	100	0	0
Lichenostomus virescens	Singing Honeyeater	3	0	0	6	0	0	100	0	0	100	0	0	13	0	0	7	0	0	100	0	0	100	0	0	9	100	0	0
Ocyphaps lophotes	Crested Pigeon	2	0	0	1	0	0	100	0	0	100	0	0	14	0	0	11	0	0	100	0	0	100	0	0	3	100	0	0
Gerygone fusca	Western Gerygone	0	0	0	0	0	0							16	0	0	8	0	0	100	0	0	100	0	0	0			
Calamanthus campestris	Rufous Fieldwren	8	0	0	11	0	0	100	0	0	100	0	0	2	0	0	1	0	0	100	0	0	100	0	0	19	100	0	0
Lalage sueurii	White-Winged Triller	3	0	0	1	0	0	100	0	0	100	0	0	9	0	0	3	0	0	100	0	0	100	0	0	4	100	0	0
Biziura lobata	Musk Duck	0	0	0	0	0	0							0	0	0	16	0	0				100	0	0	0			
Phylidonyris melanops	Tawny-crowned Honeyeater	2	0	0	5	0	0	100	0	0	100	0	0	4	0	0	4	0	0	100	0	0	100	0	0	7	100	0	0
Malurus lamberti	Variegated Fairy-Wren	0	0	0	0	0	0							7	0	0	7	0	0	100	0	0	100	0	0	0			
Chenonetta jubata	Australian Wood Duck	0	0	0	0	0	0							6	0	0	7	0	0	100	0	0	100	0	0	0			
Acanthiza apicalis	Inland Thornbill	0	0	0	0	0	0							12	0	0	0	0	0	100	0	0				0			
Taeniopygia guttata	Zebra Finch	0	0	0	0	0	0							4	0	0	7	0	0	100	0	0	100	0	0	0			
Manorina flavigula	Yellow-Throated Miner	0	0	0	0	0	0							6	0	0	4	0	0	100	0	0	100	0	0	0			
Certhionyx niger	Black Honeyeater	4	0	0	0	0	0	100	0	0				3	0	0	2	0	0	100	0	0	100	0	0	4	100	0	0
Dacelo novaeguineae	Laughing Kookaburra	0	0	0	0	0	0							3	0	0	5	0	0	100	0	0	100	0	0	0			
Cincloramphus mathewsi	Rufous Songlark	0	0	0	4	0	0				100	0	0	0	0	0	3	0	0				100	0	0	4	100	0	0
Colluricincla harmonica	Grey Shrike-Thrush	0	0	0	0	0	0							5	0	0	2	0	0	100	0	0	100	0	0	0			
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo	1	0	0	0	0	0	100	0	0				4	0	0	1	0	0	100	0	0	100	0	0	1	100	0	0
Pelecanus conspicillatus	Australian Pelican	0	0	0	0	0	0							0	0	0	6	0	0				100	0	0	0			
Vanellus tricolor	Banded Lapwing	0	0	0	5	0	0				100	0	0	0	0	0	0	0	0							5	100	0	0
Phaps chalcoptera	Common Bronzewing	2	0	0	0	0	0	100	0	0				2	0	0	1	0	0	100	0	0	100	0	0	2	100	0	0
Epthianura tricolor	Crimson Chat	3	0	0	0	0	0	100	0	0				0	0	0	2	0	0				100	0	0	3	100	0	0
Todiramphus sanctus	Sacred Kingfisher	0	0	0	0	0	0							1	0	0	3	0	0	100	0	0	100	0	0	0			
Egretta novaehollandiae	White-faced Heron	0	0	0	0	0	0							3	0	0	1	0	0	100	0	0	100	0	0	0			
Acanthiza inornata	Western Thornbill	0	0	0	0	0	0							4	0	0	0	0	0	100	0	0				0			
Daphoenositta chrysoptera	Varied Sittella	0	0	0	0	0	0							4	0	0	0	0	0	100	0	0				0			
Cheramoeca leucosternus	White-backed Swallow	0	0	0	0	0	0							2	0	0	0	2	0	100	0	0	0	100	0	0			
Falco berigora	Brown Falcon	0	0	0	1	2	0				33	67	0	0	0	0	0	1	0				0	100	0	3	33	67	0
Purpureicephalus spurius	Red-Capped Parrot	0	0	0	0	0	0							1	0	0	2	0	0	100	0	0	100	0	0	0			

Waddi Species Seen		1 ha Site Survey Plots												1 Ha Reference and Yandin Plots												Totals			
		n Within 1Ha Plots			*n* Outside 1ha Plots			% within Site Survey Plots						*n* Within 1Ha Reference Plots			*n* Outside 1ha Reference Plots			% within Reference Plots									
Scientific Name	**Common Name**	**Elevation 1**	**Elevation 2**	**Elevation 3**	**Elevation 1**	**Elevation 2**	**Elevation 3**	**% inside Plot in 1**	**% inside Plot in 2**	**% inside Plot in 3**	**% Out of Plot in 1**	**% Out of Plot in 2**	**% Out of Plot in 3**	**Elevation 1**	**Elevation 2**	**Elevation 3**	**Elevation 1**	**Elevation 2**	**Elevation 3**	**% inside Plot in 1**	**% inside Plot in 2**	**% inside Plot in 3**	**% Out of Plot in 1**	**% Out of Plot in 2**	**% Out of Plot in 3**	***N***	**Total % in 1**	**Total % in 2**	**Total % in 3**
Chrysococcyx lucidus	Shining Bronze-Cuckoo	0	0	0	0	0	0							2	0	0	1	0	0	100	0	0	100	0	0	0			
Anthochaera carunculata	Red Wattlebird	0	0	0	0	0	0							0	0	0	3	0	0				100	0	0	0			
Haliastur sphenurus	Whistling Kite	0	0	0	0	0	0							0	0	0	2	0	0				100	0	0	0			
Accipiter cirrhocephalus	Collared Sparrowhawk	0	0	0	1	0	0				100	0	0	0	0	0	1	0	0				100	0	0	1	100	0	0
Accipiter fasciatus	Brown Goshawk	0	0	0	0	0	0							0	0	0	2	0	0				100	0	0	0			
Falco lonipennis	Australian Hobby	1	0	0	0	0	0	100	0	0				0	0	0	1	0	0				100	0	0	1	100	0	0
Recurvirostra novaehollandiae	Red-Necked Avocet	0	0	0	0	0	0							0	0	0	2	0	0				100	0	0	0			
Pardalotus striatus	Striated Pardalote	0	0	0	0	0	0							1	0	0	1	0	0	100	0	0	100	0	0	0			
Sericornis frontalis	White-Browed Scrubwren	2	0	0	0	0	0	100	0	0				0	0	0	0	0	0							2	100	0	0
Smicrornis brevirostris	Weebill	0	0	0	0	0	0							2	0	0	0	0	0	100	0	0				0			
Petroica goodenovii	Red-Capped Robin	0	0	0	0	0	0							2	0	0	0	0	0	100	0	0				0			
Melanodryas cucullata	Hooded Robin	0	0	0	0	0	0							2	0	0	0	0	0	100	0	0				0			
Elanus axillaris	Black-Shouldered Kite	0	0	0	0	1	0				0	100	0	0	0	0	0	1	0				0	100	0	1	0	100	0
Anas superciliosa	Pacific Black Duck	0	0	0	0	0	0							0	0	0	1	0	0				100	0	0	0			
Egretta garzetta	Little Egret	0	0	0	0	0	0							0	0	0	1	0	0				100	0	0	0			
Threskiornis molucca	Australian White Ibis	0	0	0	0	0	0							0	0	0	1	0	0				100	0	0	0			
Haliaeetus leucogaster	White-Bellied Sea-Eagle	0	0	0	0	0	0							0	0	0	1	0	0				100	0	0	0			
Sterna nilotica	Gull-Billed Tern	0	0	0	0	0	0							1	0	0	0	0	0	100	0	0				0			
Melithriptus brevirostris	Brown-Headed Honeyeater	0	0	0	0	0	0							1	0	0	0	0	0	100	0	0				0			
Rhipidura fuliginosa	Grey Fantail	0	0	0	0	0	0							1	0	0	0	0	0	100	0	0				0			
Cracticus nigrogularis	Pied Butcherbird	0	0	0	0	0	0							1	0	0	0	0	0	100	0	0				0			
Dicaeum hirundinaceum	Mistletoebird	0	0	0	0	0	0							1	0	0	0	0	0	100	0	0				0			
Megalurus gramineus	Little Grassbird	0	0	0	0	0	0							0	0	0	1	0	0				100	0	0	0			
Hirundo ariel	Fairy Martin	0	1	0	0	0	0	0	100	0				0	0	0	0	0	0							1	0	100	0

RPS

APPENDIX 3

Total Species Elevation Records

APPENDIX 3: Total Species Elevation Records

Total Species Seen Across All Formal Sites		1 ha Site Survey Plots												1 Ha Reference Plots												Totals			
		n Within 1Ha Plots				*n* Outside 1ha Plots				% within Site Survey Plots				*n* Within 1Ha Reference Plots				*n* Outside 1ha Reference Plots				% within Reference Plots							
Scientific Name	**Common Name**	Elevation 1	Elevation 2	Elevation 3	Elevation 1	Elevation 2	Elevation 3	% inside Plot in 1	% inside Plot in 2	% inside Plot in 3	% Out of Plot in 1	% Out of Plot in 2	% Out of Plot in 3	Elevation 1	Elevation 2	Elevation 3	Elevation 1	Elevation 2	Elevation 3	% inside Plot in 1	% inside Plot in 2	% inside Plot in 3	% Out of Plot in 1	% Out of Plot in 2	% Out of Plot in 3	N	Total % in 1	Total % in 2	Total % in 3
Tadorna tadornoides	Australian Shelduck	0	0	0	0	0	0							5	0	0	4503	1	0	100	0	0	100	0	0	4509	100	0	0
Cygnus atratus	Black Swan	0	0	0	0	0	0							0	0	0	1633	0	0							1633	100	0	0
Cacatua pastinator	Western Corella	25	0	0	113	41	0							102	0	0	620	0	0							901	95	5	0
Cacatua roseicapilla	Galah	138	2	0	150	101	0							21	0	0	46	0	0							458	78	22	0
Corvus coronoides	Australian Raven	16	3	0	201	48	11	84	16	0				10	0	0	138	0	0	100	0	0				427	85	12	3
Banardius zonarius	Australian Ringneck	192	5	0	104	0	0							39	0	0	34	0	0							374	99	1	0
Threskiornis spinicollis	Straw-necked Ibis	13	13	0	19	17	28							1	0	0	275	0	0							366	84	8	8
Cincloramphus cruralis	Brown Songlark	138	38	0	44	7	0	78	22	0				3	0	0	6	0	0							236	81	19	0
Hirundo nigricans	Tree Martin	23	0	0	11	0	0							1	0	0	178	0	0							213	100	0	0
Gymnorhina tibicen	Australian Magpie	39	0	0	74	20	4	100	0	0				4	0	0	57	0	0							198	88	10	2
Acanthiza chrysorrhoa	Yellow-rumped Thornbill	107	0	0	18	0	0							64	0	0	5	0	0							194	100	0	0
Charadrius ruficapillus	Red-Capped Plover	0	0	0	0	0	0							8	0	0	171	0	0	100	0	0	100	0	0	179	100	0	0
Anas rhynchotis	Australasian Shoveler	0	0	0	0	0	0							0	0	0	154	0	0							154	100	0	0
Anas gracilis	Grey Teal	1	0	0	0	0	0							0	0	0	118	0	0							119	100	0	0
Grallina cyanoleuca	Australian Magpie-lark	28	0	0	48	2	0							10	0	0	26	0	0							114	98	2	0
Anthus novaeseelandiae	Australian Pipit	56	5	0	32	1	0				97	3	0	2	0	0	9	0	0				100	0	0	105	94	6	0
Calidris ruficollis	Red-Necked Stint	0	0	0	0	0	0							20	0	0	84	0	0							104	100	0	0
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	12	3	0	58	9	0							2	0	0	16	0	0							100	88	12	0
Hirundo neoxena	Welcome Swallow	29	0	0	10	1	0	100	0	0	91	9	0	36	0	0	23	0	0				100	0	0	99	99	1	0
Himantopus himantopus	Black-Winged Stilt	0	0	0	0	0	0							84	0	0	14	0	0							98	100	0	0
Artamus cinerius	Black-faced Woodswallow	51	0	0	19	2	0	100	0	0	90	10	0	13	0	0	11	0	0				100	0	0	96	98	2	0
Lichmera indistincta	Brown Honeyeater	47	0	0	15	0	0	100	0	0				11	0	0	12	0	0							85	100	0	0
Coturnix pectoralis	Stubble Quail	33	0	0	45	0	0	100	0	0	100	0	0	3	0	0	3	0	0	100	0	0	100	0	0	84	100	0	0
Aquila audax	Wedge-tailed Eagle	2	2	0	10	15	38							0	0	0	6	5	4							82	22	27	51
Phylidonyris nigra	White-cheeked Honeyeater	27	0	0	19	0	0							19	0	0	12	0	0							77	100	0	0
Falco cenchroides	Nankeen Kestrel	20	2	0	30	11	1							0	0	0	5	1	0							70	79	20	1
Malurus leucopterus	White-winged Fairy Wren	28	0	0	22	0	0				100	0	0	3	0	0	6	0	0							59	100	0	0
Rhipidua leucophrys	Willie Wagtail	25	0	0	9	0	0							13	0	0	6	0	0							53	100	0	0

Total Species Seen Across All Formal Sites		1 ha Site Survey Plots												1 Ha Reference Plots												Totals			
		n Within 1Ha Plots				*n* Outside 1ha Plots				% within Site Survey Plots				*n* Within 1Ha Reference Plots				*n* Outside 1ha Reference Plots				% within Reference Plots							
Scientific Name	**Common Name**	**Elevation 1**	**Elevation 2**	**Elevation 3**	**Elevation 1**	**Elevation 2**	**Elevation 3**	**% inside Plot in 1**	**% inside Plot in 2**	**% inside Plot in 3**	**% Out of Plot in 1**	**% Out of Plot in 2**	**% Out of Plot in 3**	**Elevation 1**	**Elevation 2**	**Elevation 3**	**Elevation 1**	**Elevation 2**	**Elevation 3**	**% inside Plot in 1**	**% inside Plot in 2**	**% inside Plot in 3**	**% Out of Plot in 1**	**% Out of Plot in 2**	**% Out of Plot in 3**	*N*	**Total % in 1**	**Total % in 2**	**Total % in 3**
Larus novaehollandiae	Silver Gull	0	0	0	0	0	0							35	0	0	15	0	0							50	100	0	0
Epthianura albifrons	White-fronted Chat	21	0	0	18	0	0	100	0	0				6	0	0	5	0	0							50	100	0	0
Zosterops lateralis	Silvereye	13	0	0	8	0	0	100	0	0	100	0	0	19	0	0	9	0	0				100	0	0	49	100	0	0
Malurus leucopterus	Splendid Fairy-wren	29	0	0	13	0	0	100	0	0	100	0	0	2	0	0	0	0	0							44	100	0	0
Pachycephala rufiventris	Rufous Whistler	14	0	0	16	0	0	100	0	0	100	0	0	6	0	0	7	0	0	100	0	0	100	0	0	43	100	0	0
Coracina novaehollandiae	Black-faced Cuckoo-Shrike	22	3	0	7	0	0	88	12	0	100	0	0	3	0	0	6	0	0	100	0	0	100	0	0	41	93	7	0
Merops ornatus	Rainbow Bee-eater	23	0	0	13	0	0	100	0	0	100	0	0	2	0	0	0	0	0							38	100	0	0
Cracticus torquatus	Grey Butcherbird	7	0	0	18	0	0	100	0	0	100	0	0	1	0	0	6	0	0	100	0	0	100	0	0	32	100	0	0
Lichenostomus virescens	Singing Honeyeater	13	0	0	10	0	0	100	0	0				3	0	0	3	0	0	100	0	0				29	100	0	0
Ocyphaps lophotes	Crested Pigeon	16	0	0	9	0	0	100	0	0	100	0	0	0	0	0	3	0	0							28	100	0	0
Gerygone fusca	Western Gerygone	9	0	0	7	0	0				100	0	0	7	0	0	1	0	0				100	0	0	24	100	0	0
Calamanthus campestris	Rufous Fieldwren	10	0	0	12	0	0	100	0	0	100	0	0	0	0	0	0	0	0							22	100	0	0
Lalage sueurii	White-Winged Triller	11	0	0	2	0	0	100	0	0	100	0	0	1	0	0	2	0	0	100	0	0				16	100	0	0
Biziura lobata	Musk Duck	0	0	0	0	0	0							0	0	0	16	0	0							16	100	0	0
Phylidonyris melanops	Tawny-crowned Honeyeater	2	0	0	5	0	0	100	0	0	100	0	0	4	0	0	4	0	0							15	100	0	0
Malurus lamberti	Variegated Fairy-Wren	7	0	0	7	0	0	100	0	0	100	0	0	0	0	0	0	0	0							14	100	0	0
Chenonetta jubata	Australian Wood Duck	6	0	0	0	0	0	100	0	0				0	0	0	7	0	0							13	100	0	0
Acanthiza apicalis	Inland Thornbill	12	0	0	0	0	0	100	0	0				0	0	0	0	0	0							12	100	0	0
Taeniopygia guttata	Zebra Finch	0	0	0	0	0	0							4	0	0	7	0	0							11	100	0	0
Manorina flavigula	Yellow-Throated Miner	5	0	0	4	0	0	100	0	0	100	0	0	1	0	0	0	0	0	100	0	0				10	100	0	0
Certhionyx niger	Black Honeyeater	4	0	0	0	0	0	100	0	0				3	0	0	2	0	0							9	100	0	0
Dacelo novaeguineae	Laughing Kookaburra	1	0	0	2	0	0	100	0	0				2	0	0	3	0	0							8	100	0	0
Cincloramphus mathewsi	Rufous Songlark	0	0	0	7	0	0				100	0	0	0	0	0	0	0	0							7	100	0	0
Colluricincla harmonica	Grey Shrike-Thrush	2	0	0	1	0	0	100	0	0				3	0	0	1	0	0							7	100	0	0
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo	4	0	0	0	0	0							1	0	0	1	0	0							6	100	0	0
Pelecanus conspicillatus	Australian Pelican	0	0	0	0	0	0							0	0	0	6	0	0							6	100	0	0
Vanellus tricolor	Banded Lapwing	0	0	0	5	0	0				100	0	0	0	0	0	0	0	0							5	100	0	0
Phaps chalcoptera	Common Bronzewing	4	0	0	0	0	0							0	0	0	1	0	0							5	100	0	0
Epthianura tricolor	Crimson Chat	3	0	0	0	0	0	100	0	0				0	0	0	2	0	0				100	0	0	5	100	0	0
Todiramphus sanctus	Sacred Kingfisher	1	0	0	2	0	0				100	0	0	0	0	0	1	0	0				100	0	0	4	100	0	0

Total Species Seen Across All Formal Sites		1 ha Site Survey Plots												1 Ha Reference Plots												Totals			
		n Within 1Ha Plots				*n* Outside 1ha Plots				% within Site Survey Plots				*n* Within 1Ha Reference Plots				*n* Outside 1ha Reference Plots				% within Reference Plots							
Scientific Name	**Common Name**	Elevation 1	Elevation 2	Elevation 3	Elevation 1	Elevation 2	Elevation 3	% inside Plot in 1	% inside Plot in 2	% inside Plot in 3	% Out of Plot in 1	% Out of Plot in 2	% Out of Plot in 3	Elevation 1	Elevation 2	Elevation 3	Elevation 1	Elevation 2	Elevation 3	% inside Plot in 1	% inside Plot in 2	% inside Plot in 3	% Out of Plot in 1	% Out of Plot in 2	% Out of Plot in 3	*N*	Total % in 1	Total % in 2	Total % in 3
Egretta novaehollandiae	White-faced Heron	3	0	0	0	0	0	100	0	0				0	0	0	1	0	0							4	100	0	0
Acanthiza inornata	Western Thornbill	4	0	0	0	0	0	100	0	0				0	0	0	0	0	0							4	100	0	0
Daphoenositta chrysoptera	Varied Sittella	4	0	0	0	0	0	100	0	0				0	0	0	0	0	0							4	100	0	0
Cheramoeca leucosternus	White-backed Swallow	0	0	0	0	2	0				0	100	0	2	0	0	0	0	0	100	0	0				4	50	50	0
Falco berigora	Brown Falcon	0	0	0	1	3	0							0	0	0	0	0	0							4	25	75	0
Purpureicephalus spurius	Red-Capped Parrot	1	0	0	2	0	0	100	0	0				0	0	0	0	0	0							3	100	0	0
Chrysococcyx lucidus	Shining Bronze-Cuckoo	2	0	0	1	0	0	100	0	0	100	0	0	0	0	0	0	0	0							3	100	0	0
Anthochaera carunculata	Red Wattlebird	0	0	0	3	0	0							0	0	0	0	0	0							3	100	0	0
Haliastur sphenurus	Whistling Kite	0	0	0	0	0	0							0	0	0	2	0	0				100	0	0	2	100	0	0
Accipiter cirrhocephalus	Collared Sparrowhawk	0	0	0	1	0	0							0	0	0	1	0	0							2	100	0	0
Accipiter fasciatus	Brown Goshawk	0	0	0	2	0	0				100	0	0	0	0	0	0	0	0							2	100	0	0
Falco lonipennis	Australian Hobby	1	0	0	0	0	0	100	0	0				0	0	0	1	0	0				100	0	0	2	100	0	0
Recurvirostra novaehollandiae	Red-Necked Avocet	0	0	0	0	0	0							0	0	0	2	0	0				100	0	0	2	100	0	0
Pardalotus striatus	Striated Pardalote	1	0	0	1	0	0	100	0	0	100	0	0	0	0	0	0	0	0							2	100	0	0
Sericornis frontalis	White-Browed Scrubwren	2	0	0	0	0	0							0	0	0	0	0	0							2	100	0	0
Smicrornis brevirostris	Weebill	2	0	0	0	0	0	100	0	0				0	0	0	0	0	0							2	100	0	0
Petroica goodenovii	Red-Capped Robin	1	0	0	0	0	0	100	0	0				1	0	0	0	0	0	100	0	0				2	100	0	0
Melanodryas cucullata	Hooded Robin	2	0	0	0	0	0	100	0	0				0	0	0	0	0	0							2	100	0	0
Elanus axillaris	Black-Shouldered Kite	0	0	0	0	2	0							0	0	0	0	0	0							2	0	100	0
Anas superciliosa	Pacific Black Duck	0	0	0	0	0	0							0	0	0	1	0	0				100	0	0	1	100	0	0
Egretta garzetta	Little Egret	0	0	0	0	0	0							0	0	0	1	0	0							1	100	0	0
Threskiornis molucca	Australian White Ibis	0	0	0	0	0	0							0	0	0	1	0	0				100	0	0	1	100	0	0
Haliaeetus leucogaster	White-Bellied Sea-Eagle	0	0	0	0	0	0							0	0	0	1	0	0							1	100	0	0
Sterna nilotica	Gull-Billed Tern	0	0	0	0	0	0							1	0	0	0	0	0	100	0	0				1	100	0	0
Melithriptus brevirostris	Brown-Headed Honeyeater	1	0	0	0	0	0	100	0	0				0	0	0	0	0	0							1	100	0	0
Rhipidura fuliginosa	Grey Fantail	1	0	0	0	0	0							0	0	0	0	0	0							1	100	0	0
Cracticus nigrogularis	Pied Butcherbird	1	0	0	0	0	0	100	0	0				0	0	0	0	0	0							1	100	0	0
Dicaeum hirundinaceum	Mistletoebird	0	0	0	0	0	0							1	0	0	0	0	0							1	100	0	0
Megalurus gramineus	Little Grassbird	0	0	0	0	0	0							0	0	0	1	0	0				100	0	0	1	100	0	0
Hirundo ariel	Fairy Martin	0	1	0	0	0	0	0	100	0				0	0	0	0	0	0							1	0	100	0

RPS

APPENDIX 4

Species Plot Results

APPENDIX 4: Species Plot Results

Waddi Wind Farm Results 1																																									
Species Seen		W1					W2					W3					W4					W5					W6					W7					W8				
Scientific Name	Common Name	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp
Coturnix pectoralis	Stubble Quail			H	H		H				H				H	H					H				H			O			H					H					H
Chenonetta jubata	Australian Wood Duck																																								
Biziura lobata	Musk Duck																																								
Cygnus atratus	Black Swan																																								
Tadorna tadornoides	Australian Shelduck																																								
Anas superciliosa	Pacific Black Duck																																								
Anas rhynchotis	Australasian Shoveler																																								
Anas gracilis	Grey Teal																																								
Pelecanus conspicillatus	Australian Pelican																																								
Egretta novaehollandiae	White-faced Heron																																								
Egretta garzetta	Little Egret																																								
Threskiornis spinicollis	Straw-necked Ibis																																								
Threskiornis molucca	Australian White Ibis																																								
Elanus axillaris	Black-Shouldered Kite																																								
Haliastur sphenurus	Whistling Kite																																								
Accipiter cirrhocephalus	Collared Sparrowhawk																																								
Accipiter fasciatus	Brown Goshawk																																								
Haliaeetus leucogaster	White-Bellied Sea-Eagle																																								
Aquila audax	Wedge-tailed Eagle	O	O								O										O															O					
Falco berigora	Brown Falcon																				o		0			O															
Falco cenchroides	Nankeen Kestrel					O										O					O					O					O										
Falco lonipennis	Australian Hobby													O						H																					
Calidris ruficollis	Red-Necked Stint																																								
Himantopus himantopus	Black-Winged Stilt																																								
Recurvirostra novaehollandiae	Red-Necked Avocet																																								
Charadrius ruficapillus	Red-Capped Plover																																								
Vanellus tricolor	Banded Lapwing					O																																			
Larus novaehollandiae	Silver Gull																																								
Sterna nilotica	Gull-Billed Tern																																								
Phaps chalcoptera	Common Bronzewing																																								
Ocyphaps lophotes	Crested Pigeon																																								
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo																																								

Waddi Wind Farm Results 1

Species Seen		W1					W2					W3					W4					W5					W6					W7					W8				
Scientific Name	**Common Name**	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp
Cacatua roseicapilla	Galah					O			O					O	O	O		O			O					O					O			O	O	O					
Cacatua pastinator derbyi	Western Corella															O																									
Purpureicephalus spurius	Red-Capped Parrot																																								
Banardius zonarius	Australian Ringneck															H			H	H	O					H								O	O						
Chrysococcyx basalis	Horsfield's Bronze-Cuckoo																																								
Chrysococcyx lucidus	Shining Bronze-Cuckoo																																								
Dacelo novaeguineae	Laughing Kookaburra																																								
Todiramphus sanctus	Sacred Kingfisher																																								
Merops ornatus	Rainbow Bee-eater	O																																							
Malurus leucopterus	Splendid Fairy-wren																										O									O					
Malurus lamberti	Variegated Fairy-Wren																																								
Malurus leucopterus	White-winged Fairy Wren					O/H											H	O								O															
Pardalotus striatus	Striated Pardalote																																								
Sericornis frontalis	White-Browed Scrubwren																																								
Calamanthus campestris	Rufous Fieldwren				H	H																				O											H				
Gerygone fusca	Western Gerygone																																								
Acanthiza apicalis	Inland Thornbill																																								
Acanthiza inornata	Western Thornbill																																								
Acanthiza chrysorrhoa	Yellow-rumped Thornbill										O		H						O								O						O		O						
Smicrornis brevirostris	Weebill																																								
Anthochaera carunculata	Red Wattlebird																																								
Manorina flavigula	Yellow-Throated Miner																																								
Lichenostomus virescens	Singing Honeyeater															H			H																						H
Melithriptus brevirostris	Brown-Headed Honeyeater																																								
Phylidonyris nigra	White-cheeked Honeyeater	H			O	O																H			O	O/H														O	
Phylidonyris melanops	Tawny-crowned Honeyeater																									H															
Certhionyx niger	Black Honeyeater																																								
Lichmera indistincta	Brown Honeyeater					O																H				H															
Epthianura tricolor	Crimson Chat																																								
Epthianura albifrons	White-fronted Chat																																				O				H
Petroica goodenovii	Red-Capped Robin																																								
Melanodryas cucullata	Hooded Robin																																								
Pachycephala rufiventris	Rufous Whistler																							O		H															H
Colluricincla harmonica	Grey Shrike-Thrush																																								

Waddi Wind Farm Results 1

Species Seen		W1					W2					W3					W4					W5					W6					W7					W8				
Scientific Name	**Common Name**	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp	29/10/2008	30/10/2008	31/10/2008	2/11/2008	Opp
Rhipidura leucophrys	Willie Wagtail	O										O	O		O				O																	H					
Rhipidura fuliginosa	Grey Fantail																																								
Coracina novaehollandiae	Black-faced Cuckoo-Shrike		O									O	O						O																						
Lalage sueurii	White-Winged Triller																																								
Artamus cinerius	Black-faced Woodswallow	O										O	O		O				O							H		O								O					
Cracticus torquatus	Grey Butcherbird										H					O				O	H					H															H
Cracticus nigrogularis	Pied Butcherbird																																								
Grallina cyanoleuca	Australian Magpie-lark													O	H	O		O	O	H	H					H					H										H
Gymnorhina tibicen	Australian Magpie				O						H					O	O			O	H					O				O						H					H
Corvus coronoides	Australian Raven	O				O					O/H		O			O					O					O					H					H					H
Taeniopygia guttata	Zebra Finch																																								
Anthus novaeseelandiae	Australian Pipit		O			H	O		O/H	H	O/H		O		O	O					O		O			O/H		O		O								H			
Dicaeum hirundinaceum	Mistletoebird																																								
Hirundo neoxena	Welcome Swallow					O	O	O	O	O							O																							O	
Cheramoeca leucosternus	White-backed Swallow																																								
Hirundo nigricans	Tree Martin									O	O																														
Hirundo ariel	Fairy Martin																																								
Megalurus gramineus	Little Grassbird																																								
Cincloramphus cruralis	Brown Songlark					H				H	H		O		O	H		O	O	O	H				H				O	O	O	O			H	H	O		O	H	H
Cincloramphus mathewsi	Rufous Songlark															H					H																				
Zosterops lateralis	Silvereye			O																																					
Daphoenositta chrysoptera	Varied Sittella																																								