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Contents

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1. Introduction

The purpose of the present report is to assess the potential impacts of the construction and operation of wind turbines (the development), which are proposed to be located on the northern slope of Transit Hill, Lord Howe Island on local bird populations.

The present report:

- describes the location and the options for the construction and operation of wind turbines on Lord Howe Island;
- reviews ornithological literature and databases relevant to the development;
- describes the methodology and results of surveys of bird populations and their flight paths;
- addresses potential impacts on bird populations that may result from the development;
- assesses the likelihood of significant impacts on threatened bird species, populations, ecological communities, according to Section 5A of the NSW *Environmental Planning and Assessment Act, 1979* (EP&A Act), NSW *Threatened Species Conservation Act, 1995* (TSC Act) and Commonwealth *Environmental Protection and Biodiversity Conservation Act, 1999* (EPBC Act). This was done to determine the need for a Species Impact Statement (SIS) under the TSC Act or a referral under the EPBC Act; and
- proposes appropriate impact mitigation measures to minimise or avoid the impacts of the wind turbines on local bird populations.

O'Neill and Carlile (2016) conducted surveys and a comprehensive assessment of the potential impacts of the proposed wind turbines on the status of the Flesh-footed Shearwater (*Ardenna carneipes*). This report is attached as Appendix A. Therefore, the remainder of the present report focuses on potential impacts of the development on other bird species of conservation significance that occur on Lord Howe Island.

2. Proposed Development

2.1 Subject Site

The proposed turbine site (the subject site) is located on the mid-slope of a ridgeline on the northern side of Transit Hill (135 m), with a generally north-westerly aspect and an elevation of around 60 m. Detailed descriptions of the site and adjoining habitats, including the structure and composition of flora communities, and the environmental context of the landscape are provided in NGH Environmental (2016).

The subject site has a moderate gradient and no water features. The turbines would be sited in a cleared paddock around 1.5 hectares in size. The site carries exotic pasture (mostly Kikuyu *Pennisetum clandestinum*, Parramatta Grass *Sporobolus africanus* and Paspalum *Paspalum dilatatum*) (Figure 1) and is primarily used for dairy cattle grazing, although the soils are relatively poor and the site is not prime agricultural land (LHIB 2015). The site is on basalt geology, with shallow clay soil and areas of outcropping rock. The paddock is surrounded by native closed forest

Figure 1 **View of cleared paddock from near the western end of the subject site with monitoring mast in the background.**

vegetation. A 45-m high monitoring mast was erected at the top (eastern end) of the cleared paddock in 2014 to collect wind and solar resource and environmental data.

The distribution of vegetation communities on and adjacent to the subject site is shown in Figure 2. The vegetation community along the access track at the western end of the subject site is Greybark-Blackbutt (*Drypetes deplanchei–Cryptocarya triplinervis*) Closed Forest, which is described in the Lord Howe Island Biodiversity Management Plan (DECC 2007). The community is also dominant around most of the perimeter of the cleared paddock, particularly on the southern and south-western side of the subject site.

Lowland Mixed Forest borders the cleared paddock in the south-western corner of the subject site, to the south-west of the proposed access track. Flora species typical of this community include Scalybark (*Syzigium fullagarii*), Melicope (*Melicope polybotrya*), Island Cedar (*Guioa coriacea*), Big Mountain Palm (*Hedyscepe canterburyana*), Maulwood (*Olea paniculata*), Hotbark (*Zygogynum howeanum*), Black Grape (*Psychotria carronis*), Bush Cane (*Flagellaria indica*), Burny Vine (*Trophis scandens*), Greater Brown Sedge (*Carex brunnea*), Rough Maidenhair Fern (*Adiantum hispidulum*), *Pteris microptera* and Fishbone Fern (*Nephrolepis cordifolia*).

Canopy height in the forest surrounding the subject site is generally 8 to 12 m, with emergents up to 18 m on the north-eastern side of the cleared paddock. Views of the forest remnants along the boundaries of the cleared paddock are shown in Figures 3 to 6.

Figure 2 Distribution of vegetation communities on and adjacent to the subject site.

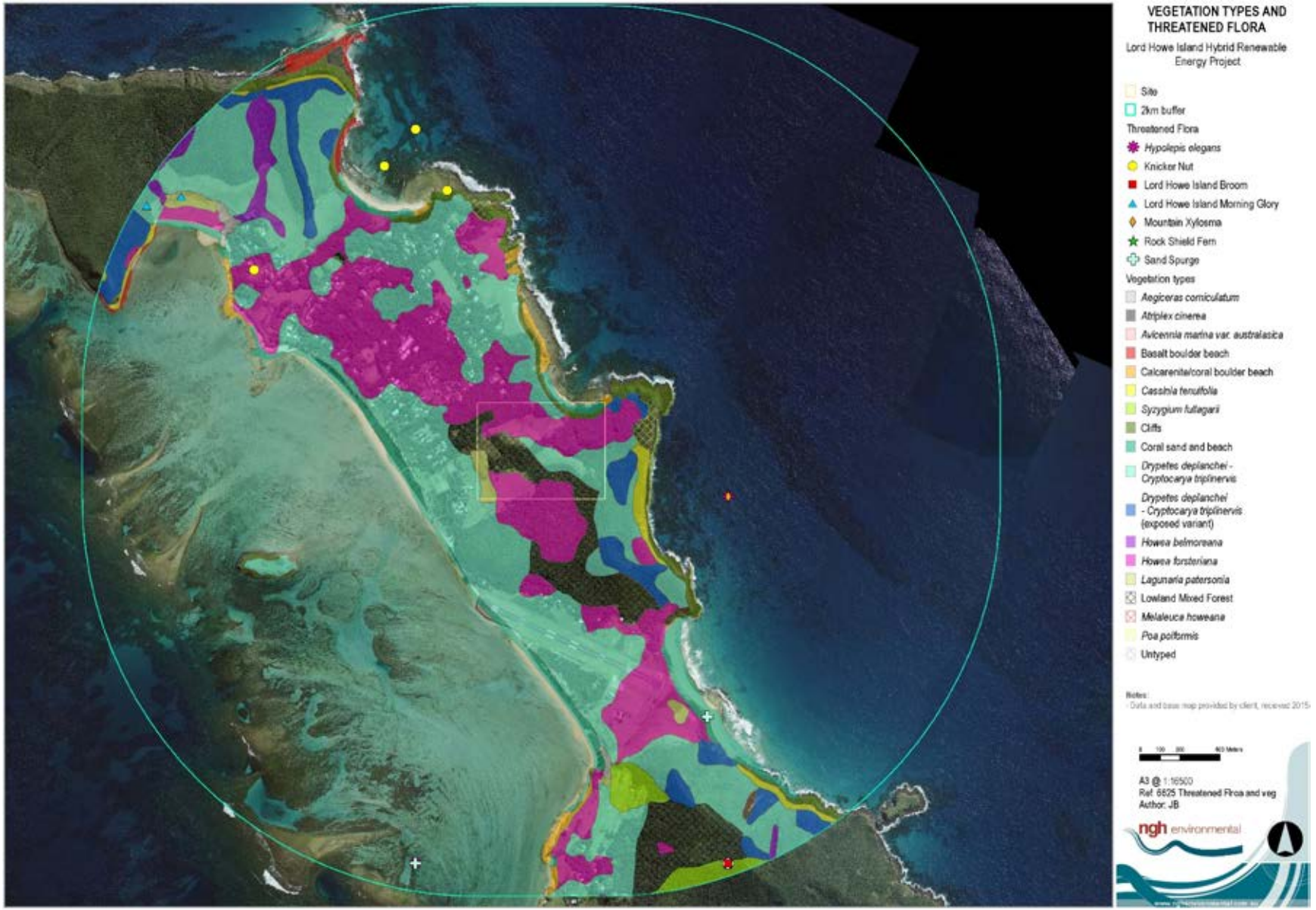


Figure 3 **Forested area along the northern boundary of the cleared paddock.**

Figure 4 **Forested area along the southern boundary of the cleared paddock.**

Figure 5 **Forested area along the eastern boundary of the cleared paddock with the base of the monitoring mast in the foreground.**

Figure 6 **Forested area along the western boundary of the cleared paddock.**

2.2 Proposed Turbine Development

The proposed locations for the installation of wind turbines (WT1 and WT2) are shown in Figure 7, and would be located approximately 60 to 70 m above sea level. The geographical co-ordinates of these locations are:

- WT1: Easting 507064 m, Northing 6511667 m; and
- WT2**:** Easting 507157 m, Northing 6511661 m.

The wind turbine design option preferred by the proponent is the installation of two 200 kW Vergnet wind turbines, one located at WT1 and the other at WT2 (Option 1).

Alternative options under consideration are the installation of:

- one 200 kW Vergnet wind turbine, either at WT1 or WT2. (Option 2); and
- two 100 kW XANT wind turbines at WT1 and WT2 (Option 3).

The design features of Vergnet and XANT turbines are shown in Figure 8. The standard hub height of the Vergnet turbine is fixed at 55 m. However, standard hub heights for the XANT turbine vary, and the heights considered in the present report are 23 m, 31.8 m and 38 m.

3. Bird Survey and Assessment Methods

3.1 Overview

The importance of the subject site and adjacent areas as habitat for bird species (particularly for threatened, locally endemic and migratory species), and the identification of potential ecological constraints for the construction and operation of wind turbines, was investigated by reviewing relevant literature and databases and conducting site surveys. The methods by which this information was collected and analysed are presented below.

3.2 Existing Records

The following literature was consulted in the current assessment:

Ornithological and Ecological Literature

- Barrett, G., Silcocks, A., Barry, S., Cunningham, R. and Poulter, R. (2003). The New Atlas of Australian Birds (Royal Australasian Ornithologists Union, Hawthorn East, Victoria).
- Blakers, M., Davies, S.J.J.F. and Reilly, P.N. (1984). *The Atlas of Australian Birds* (Melbourne University Press, Carlton).
- Cooper, R.M., McAllan, I.A.W. and Curtis, B.R. (2014). *An Atlas of the Birds of NSW and the ACT. Volume I: Emu to Plains Wanderer* (NSW Bird Atlassers Inc., Coffs Harbour).
- DECC (2007). Lord Howe Island Biodiversity Management Plan (Department of Environment and Climate Change, Coffs Harbour).
- Frith, C.B. (2013). *The Woodhen: A Flightless Island Bird Defying Extinction* (CSIRO Publishing, Collingwood).

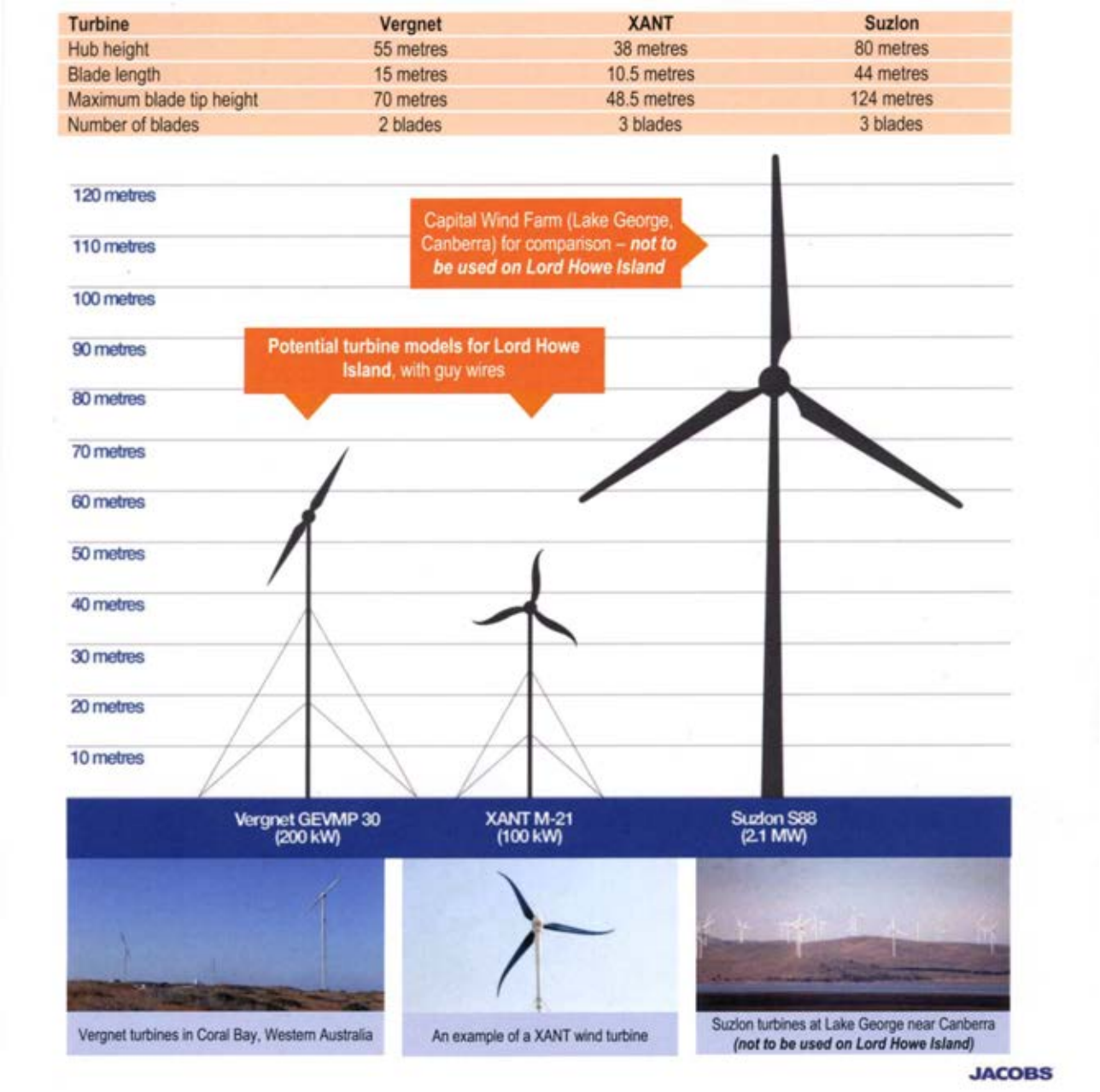
- Garnett, S.T., Szabo, J.K. and Dutson, G. (2011). *The Action Plan for Australian Birds 2010* (CSIRO Publishing, Collingwood).
- Hutton, I. (1991). *Birds of Lord Howe Island Past and Present* (I. Hutton, Coffs Harbour, NSW).
- Hutton, I. (1998). *The Australian Geographic Book of Lord Howe Island* (Australian Geographic, Terrey Hills, NSW).
- Hutton, I. (2014). *A Field Guide to the Birds of Lord Howe Island.* 4th ed. (I. Hutton, Lord Howe Island).
- Hutton, I. (2014). *A Guide to World Heritage Lord Howe Island* (I. Hutton, Lord Howe Island).
- McAllan, I.A.W., Curtis, B.R., Hutton, I. & Cooper, R.M. (2004). The Birds of the Lord Howe Island Group: a review of records. Australian Field Ornithology 21 (Supplement): 1-82.
- Recher, H.F. and Clark, S.S. (1974). Environmental Survey of Lord Howe Island: Report to the Lord Howe Island Board (NSW Government Printer, Sydney).
- Reid, T.A., Hindell, M.A., Eades. D.W. and Newman, O.M.G. (2004). *Seabird Atlas of South-eastern Australian Waters* (Royal Australasian Ornithologists Union, Melbourne).

Project Technical Reports

- Lord Howe Island Board (LHIB) (2015) Tender Documents. Lord Howe Island Hybrid Renewable Energy Project – Environmental Assessment for Proposed Wind Turbines. Contract no. 2015/22, November 2015.
- Jacobs (2015). Lord Howe Island Renewable Energy Project: Wind Turbine Generator Noise Impact Assessment. Report prepared for Lord Howe Island Board by Jacobs Group (Australia) Pty Ltd (dated 23 April 2015).
- Jacobs (2015). Lord Howe Island Solar Photovoltaic Project: Environment Report (including the Statement of Environmental Effects. Report prepared for Lord Howe Island Board by Jacobs Group (Australia) Pty Ltd (dated 23 July 2015).
- GEV MP C 275 kW Vergnet Wind turbine brochure (Vergnet Wind Turbines, Ormes, France) www.vergnet.com
- NGH Environmental (2016). Biodiversity Assessment: Lord Howe Island Renewable Energy Project. Stage 2: Wind Turbines. Draft report prepared for Lord Howe Island Board by NGH Environmental Pty Ltd.

Figure 7 **Proposed locations of wind turbines (WT1 and WT2) and locations of vantage points during bird surveys (A to H).**

Figure 8 **Vergnet and XANT turbine options for Lord Howe Island in comparison with the Suzlon S88 wind turbine design at the Capital Wind Farm (Lake George, ACT).**



The following databases were also consulted as part of the present study:

- Atlas of Living Australia Database;
- Department of Environment Database for Nationally-threatened and Migratory Species;
- OEH Wildlife Atlas Database;
- BirdLife Australia Atlas Database (1977-81) and (1998 onwards);
- NSW Bird Atlas Database (1977 onwards); and
- Australian Museum specimen collection database.

These databases only contain indicative records of bird species in the locality and are not the result of a systematic bird survey. Database records for individual species will vary in quality, reliability and accuracy of the geographic co-ordinates. Therefore, some species records are highly accurate in space and time such as the Birds Australia Atlas Database and the Australian Museum Specimen

Collection Database. However, others are more tentative or only contain estimates of geographical locations. For instance, records from the OEH Wildlife Atlas Database have a limited accuracy based on a 1 km^2 recording grid.

Consultation with Andrew Logan (Manager of Infrastructure and Engineering Services, Lord Howe Island Board), Hank Bower (Environment Manager, Lord Howe Island Board) and Ian Hutton (Ornithologist, Lord Howe Island Museum) during field trips to Lord Howe Island supplemented the ornithological and project information provided in the literature and databases.

3.3 Field Surveys

Bird surveys at the subject site were conducted during three survey periods: 21-25 February 2016 (inclusive), 15-17 March 2016 (inclusive) and 3-7 July 2016 (inclusive). The first two survey periods coincided with the nesting and roosting periods of some seabird species on Lord Howe Island (e.g. Flesh-footed Shearwater, Wedge-tailed Shearwater *Ardenna pacifica*, Black-winged Petrel *Pterodroma nigripennis*, Brown Noddy *Anous stolidus*, Black Noddy *Anous minutus*, Red-tailed Tropicbird *Phaethon rubricauda* and White Tern *Gygis alba*), and the presence of migratory species (e.g. migratory shorebirds and White-throated Needletails *Hirundapus caudicutus*). The March surveys coincided with the period when migratory species were testing the local winds in preparation for their northward migrations, and after the arrival of the Providence Petrel (*Pterodroma solandri*) on Lord Howe Island. The July survey period coincided with typical winter conditions on the island, when low pressure systems produce heavy, low cloud cover, strong winds and rain squalls. During winter, the Providence Petrel (*Pterodroma solandri*) is nesting and roosting on Mts Lidgbird and Gower, but most other seabird species have migrated elsewhere or spend their time on the open ocean.

During the 21-25 February 2016 survey period, there were three survey sessions conducted per day: 0500–0900 hr, 1130-1400 hr and 1600-2000 hr. Each of these surveys was repeated over the equivalent of three days, equating to a total of 9 survey periods.

During the March 2016 survey period, surveys were conducted between brief rain showers from:

- 0545–0915 hr, 1100–1300 hr and 1500-1900 hr on 15 March 2016;
- 0545–1215 hr and 1445-1600 hr on 16 March 2016; and
- 1030-1730 hr on 17 March 2016.

During the July 2016 survey period, surveys were conducted from:

- 1245-1630 hr on 3 July 2016;
- 0645-1030 hr and 1200-1630 hr on 4, 5 and 6 July 2016; and
- 0645-1130 hr on 7 July 2016.

In each survey period, observations of bird flights over the cleared paddock were made from 8 stationary vantage points (VPs), each spaced about 30 m apart along an east-west transect through the paddock (Figure 7). Bird movements (flights) through or over the open areas of the paddock were recorded within 15 m east and west of each VP and extending to the northern and southern edges of the open paddock. A single set of observations at each VP lasted 10 minutes, the observer facing east and west for 5 minutes at a time.

In the first survey period (21-25 February 2016), each VP was surveyed twice in each of the early morning (0500–0900 hr) and late afternoon/early evening (1600-2000 hr) survey session and once

in the survey period conducted in the middle of the day (1130-1400 hr). The order in which the VPs were selected in each survey session was randomised. The total survey effort was 20 hrs [(6 survey sessions x 8 VPs x 10 mins/VP x 2 replications) + (3 survey periods x 8 VPs x 10 mins/VP)].

In the second survey period (14-17 March 2016), each VP was surveyed 1, 2, 4 or 5 times in a survey session, depending on the duration of the session. All VPs were surveyed 16 times across the survey period. The order in which the VPs were selected in each survey session was randomised. The total survey effort was 20 hrs (8 VPs x 10 mins/VP x 15 replications).

In the third survey period (3-7 July 2016), each VP was surveyed twice on 3 July 2016 (1245-1630 hr) (afternoon survey) and on 7 July (0645-1030 hr) (morning survey), and four times in morning surveys (0645-1130 hr) and afternoon surveys (1200-1630 hr) on 4, 5 and 6 July 2016. The total survey effort was 37.3 hrs [(6 survey sessions x 8 VPs x 10 mins/VP x 4 replications) + (2 survey sessions x 8 VPs x 10 mins/VP x 2 replications)].

The number of bird flights, altitude, direction, ground distance flown over open paddock and identity of species were recorded during observation periods at each vantage point. Incidental observations of other bird movements over the paddock were also recorded. Flight heights of birds were estimated using known heights of the weather stations on the weather monitoring mast and the forest canopy on either side of the paddock for comparison. These data were used to determine the extent of the risk of recorded bird species colliding with the blades or guy wires associated with each wind turbine option.

4. Results

4.1 Overview

Typical of remote oceanic islands, the terrestrial vertebrate fauna of the Lord Howe Island Group (LHIG) is dominated by birds. A total of 182 species of birds are recorded from the LHIG, of which 20 are resident landbirds, 14 are breeding seabirds, 17 are regular visitors and 120 are vagrants (McAllan *et al*. 2004). At the time of European settlement the native avifauna consisted of 26 species of land bird (including 13 migratory waders) and 13 species of sea bird. Thirteen (50%) of the land birds were endemic species or subspecies. Eleven of the sea bird species continue to have important breeding populations in the LHIG, with Lord Howe Island reputed to have more sea bird species breeding in higher numbers than anywhere else in Australia (P. Fullagar, in Hutton 1998).

Two species of seabirds are classified as locally extinct as they are only known from subfossil remains (McAllan *et al*. 2004). In contrast to the sea birds, nine of the land bird species have become extinct in the period since human settlement (all endemic species or subspecies). The most recent extinction was the Lord Howe subspecies of Southern Boobook (*Ninox novaeseelandiae albaria*), which was last recorded in the 1950s (DECC 2007).

4.2 Field Studies

4.2.1 Weather Conditions

Bird surveys in February and March 2016 were conducted during warm and humid conditions, with light cloud cover and relatively weak winds, and when atmospheric conditions were under the influence of high pressure systems. The July 2016 bird surveys were conducted during typical winter conditions, with mild temperatures, gale-force winds, and associated rain squalls. A summary of data from the weather monitoring mast collected during each bird survey session is shown in Table 1.

During the first survey period (February 2016), the ambient temperature on Lord Howe Island ranged from a minimum of 21.3 ºC (23 February 2016) to a maximum of 26.5 ºC (25 February 2016). Relative humidity ranged from 60 to 81%. No rain fell during this period.

During the second survey period (March 2016), the ambient temperature on Lord Howe Island ranged from a minimum of 19.2 ºC (17 March 2016) to a maximum of 27.1 ºC (15 & 16 March 2016). Relative humidity ranged from 70 to 91%. 0.2 mm of rain fell on 15 March (late afternoon) and 0.6 mm on 17 March 2016 (overnight/early morning).

During the third survey period (July 2016), the ambient temperature on Lord Howe Island ranged from a minimum of 15.2 ºC (7 July 2016) to a maximum of 20.0 ºC (4 July 2016). Relative humidity ranged from 51 to 87%. About 42.8 mm of rainfall was recorded over the survey period, of which 40.2 mm fell overnight on 5-6 July 2016.

4.2.2 Directions of Observed Bird Flights

Bird species, their directions of flight over the subject site, and their overall altitudinal ranges across the three survey periods are shown in Table 2. The breakdown of data into each survey period is shown in the Tables in Appendix B.

Twenty-five (25) bird species were observed flying across the cleared paddock and one flightless species, the Lord Howe Woodhen (*Gallirallus sylvestris*), was observed at the forest edge near the south-eastern corner of the paddock. The majority of the observed flights were by the Welcome Swallow *Hirundo neoxena* (49.0%), Lord Howe Silvereye *Zosterops lateralis tephropleurus* (26.2% of total flights), Magpie-lark *Grallina cyanoleuca* (4.5%), White-throated Needletail *Hirundapus caudacutus* (4.0%), Sacred Kingfisher Todiramphus sanctus (1.9%), Whimbrel *Numenius phaeopus* (1.8%), Lord Howe Pied Currawong *Strepera graculina crissalis* (1.8%) and Australian Kestrel *Falco cenchroides* (1.7%) and Pacific Golden Plover *Pluvialis fulva* (1.7%).

A total of 1,948 observed bird flights (75.1%) were orientated approximately along a north/south axis across the paddock, compared with 310 flights (11.9%) along an approximate east/west axis, 130 flights (5.0%) along a north-west/south-east axis, and 206 flights (7.9%) along a north-east/south-west axis. Birds observed flying along approximate north/south, north-west/south-east and north-east/south-west axes were mostly flying between forest remnants that occur along the borders of the cleared paddock. Welcome Swallows were also foraging for small aerial insects (midges) while in flight, usually less than two metres above ground level, in July 2016. Individuals that were observed flying along an approximate east/west axis were mostly seabirds (e.g. Black-winged Petrel, Red-tailed Tropicbird, Sooty Tern and White Tern) that gained aerial height by soaring on westerly winds and thermals as they flew over the top of Transit Hill.

4.2.3 Spatial Distribution of Observed Bird Flights

Bird species and the total numbers of flights observed over each bird survey area (VP1 to VP8) across the three survey periods are shown in Table 3. The breakdown of data into each survey period is shown in the Tables in Appendix C.

Birds were observed flying across the cleared paddock along its entire length (east-west axis). However, 58.0% of observed flight events were in survey areas surrounding VPs 3 to 5, whereas the fewest observed flights were in survey areas near the eastern and western ends of the paddock. This reflects forest birds flying the shortest distances over open space between forest remnants on either side of the cleared paddock (VP3 to VP5), and preferring to move through forest around the eastern and western ends of the paddock (and thus mostly hidden from the observer), rather than through the paddock itself.

4.2.5 Altitudinal Distribution of Observed Bird Flights

Bird species and the altitudinal distribution of their flights over the subject site, observed across the three survey periods are shown in Table 4. The breakdown of data into each survey period is shown in the Tables in Appendix D.

About 86.5% of all observed flight events across the paddock were 12 m above ground level (agl) or less, 11.5% were between 12 and 24 m agl, and only 2.0% great than 24 m agl. These data reflect most birds flying across the paddock between forest remnants at heights below the maximum height of the forest canopy. Birds flying at heights greater than 20 m agl, where mostly seabirds flying over the subject site between coastlines or ocean areas, or flying from the southern mountains, or terrestrial birds which were soaring on thermals (e.g. Australian Kestrels) or flying relatively long distances over forested areas of the island (e.g. Lord Howe Pied Currawong).

4.3 Threatened Bird Taxa

Threatened bird taxa that have been recorded in the Lord Howe Island Catchment Management Authority (CMA) Sub-region, and which are listed under the schedules of the TSC and/or EPBC Acts, their habitat requirements, and an assessment of their likelihood of occurring on or above the subject site are shown in Table 5.

Nine threatened bird taxa were observed flying across the cleared paddock during the bird survey periods. These were the:

- Lord Howe Silvereye (*Zosterops lateralis tephropleurus*);
- Lord Howe Pied Currawong (*Strepera graculina crissalis*);
- Red-tailed Tropicbird (*Phaethon rubricauda*);
- Lord Howe Golden Whistler (*Pachycephala pectoralis contempta*);
- Sooty Tern (*Onychoprian fuscata*);
- Eastern Curlew (*Numenius madagascariensis*);
- Black-winged Petrel (*Pterodroma nigripennis*);
- White Tern (*Gygis alba*); and
- Little Shearwater (*Puffinus assimilis*).

Collectively, they were responsible for 31.6% of the bird flights observed over the cleared paddock during the bird survey sessions. The Flesh-footed Shearwater was also recorded flying repeatedly across the subject site by O'Neill & Carlile (2016) and in the present study, although the latter study did not quantify movements of this species. The Lord Howe Woodhen was observed at the forest

edge near the south-eastern corner of the paddock during the February 2016 surveys. Therefore, a total of 11 threatened bird species were recorded on or flying over the subject site across the three survey periods.

An additional four threatened bird taxa have the potential to fly low over the subject site, but were not observed flying over the subject site during the bird survey periods. These are the:

- Providence Petrel (*Pterodroma solandri*);
- Kermadec Petrel (west Pacific subspecies) (*Pterodroma neglecta neglecta*);
- Masked Booby (*Sula dactyla*); and
- Curlew Sandpiper (*Calidris ferruginea*).

The other 16 threatened taxa listed in Table 5 are unlikely to occur on or above the subject site because they are birds of the open ocean and are seldom found near land when in the Lord Howe CMA Sub-region, there is no suitable habitat on or adjacent to the subject site, and/or they are occasional vagrants to the sub-region.

Potential impacts of the proposed development on threatened species are discussed in Section 5 and in Appendices I and J of the present report.

4.4 Migratory Bird Taxa

Threatened bird taxa that have been recorded in the Lord Howe Island Catchment Management Authority (CMA) Sub-region, and which are listed under the schedules of EPBC Act, their habitat requirements, and an assessment of their likelihood of occurring on or above the subject site are also shown in Table 5.

Seven listed migratory bird taxa were observed in or flying across the cleared paddock during the bird survey periods. These were the:

- White-throated Needletail (*Hirundapus caudacutus*);
- Flesh-footed Shearwater (*Ardenna carneipes*);
- Red-tailed Tropicbird (*Phaethon rubricauda*);
- Pacific Golden Plover (*Pluvialis fulva*);
- Eastern Curlew (*Numenius madgascariensis*);
- Whimbrel (*Numenius phaeopus*); and
- Common (Brown) Noddy (*Anous stolidus*).

Collectively, they were responsible for 8.6% of the bird flights observed over the cleared paddock during the bird survey sessions (excluding movements of the Flesh-footed Shearwater).

An additional 14 migratory bird taxa have the potential to occur on or above the subject site, but were not observed across the three survey periods. These are the:

- Fork-tailed Swift (*Apus pacificus*);
- Wedge-tailed Shearwater (*Ardenna pacificus*);
- Providence Petrel (*Pterodroma solandri*);
- Masked Booby (*Sula dactyla*);
- Cattle Egret (*Ardea ibis*);
- Ruddy Turnstone (*Arenaria interpres*);
- Sharp-tailed Sandpiper (*Calidris acuminata*);

- Red Knot (*Calidris canutus*);
- Curlew Sandpiper (*Calidris ferruginea*);
- Red-necked Stint (*Calidris ruficollis*);
- Latham's Snipe (*Gallinago hardwickii*);
- Bar-tailed Godwit (*Limosa lapponica*);
- Grey-tailed Tattler (*Tringa brevipes*); and
- Wandering Tattler (*Tringa incana*).

The other 30 migratory bird taxa listed in Table 5 are unlikely to occur on or above the subject site because they are birds of the open ocean and are seldom found near land when in the Lord Howe CMA Sub-region, there is no suitable habitat on or adjacent to the subject site, and/or they are occasional vagrants to the sub-region.

Potential impacts of the proposed development on threatened species are discussed in Section 5 and in Appendix K of the present report.

4.5 Island Endemics

All of Lord Howe Island's terrestrial bird endemics were observed on or flying low over the subject site. These taxa are the Lord Howe Woodhen, Lord Howe Golden Whistler, Lord Howe Pied Currawong and Lord Howe Silvereye. All these taxa are also listed as threatened. The latter three taxa are responsible for 29.3% of the bird flights observed over the cleared paddock during the bird survey sessions. Potential impacts of the proposed development on island endemics are discussed in Section 5 and in Appendices I and J of the present report.

Table 1 Data from the weather monitoring mast at the time of the February, March and July 2016 bird surveys.

* Heights of wind speed measurements expressed as metres above ground level (agl). Other weather variables measured at 2 m above ground level.
Maximum recorded wind speed during February survey period = 14.4 m.sec^{-1} (moderate breeze) at 38 m agl.
Maximum recorded wind speed during March survey period = 9.5 m.sec^{-1} (gentle breeze) at 38 and 48 m agl.
Maximum recorded wind speed during July survey period = 25.0 m.sec^{-1} (stormy winds) at 29 m agl

Date	Survey Period (hrs)	Ambient Temp (ºC)		Relative Humidity (%)		Wind speed * (m.sec^{-1})		Wind Direction	Barometric Pressure (mb)	
		Min	Max	Min	Max	Min	Max		Min	Max
21 Feb 2016	1600 – 2000 hrs	22.1	24.1	70.7	77.5	11 m: 0.0 29 m: 1.5 38 m: 0.0 48 m: 0.0	11 m: 5.0 29 m: 7.6 38 m: 2.1 48 m: 13.9	E	1014	1016
22 Feb 2016	0500 – 0900 hrs	21.9	24.4	71.1	79.3	11 m: 0.0 29 m: 0.0 38 m: 0.0 48 m: 0.0	11 m: 8.3 29 m: 8.9 38 m: 12.6 48 m: 6.4	E	1014	1016
22 Feb 2016	1130 – 1400 hrs	24.8	26.6	61.7	70.2	11 m: 0.0 29 m: 0.0 38 m: 0.0 48 m: 0.0	11 m: 6.4 29 m: 10.1 38 m: 11.4 48 m: 3.3	E	1014	1015
22 Feb 2016	1600 – 2000 hrs	22.3	25.4	69.8	80.5	11 m: 0.0 29 m: 0.0 38 m: 0.0 48 m: 0.0	11 m: 6.4 29 m: 8.3 38 m: 10.1 48 m: 3.9	E	1013	1014
23 Feb 2016	0500 – 0900 hrs	21.4	24.9	65.8	72.6	11 m: 0.0 29 m: 0.0 38 m: 0.0 48 m: 0.0	11 m: 10.8 29 m: 9.5 38 m: 14.4 48 m: 13.9	E	1012	1012
23 Feb 2016	1130 – 1400 hrs	25.1	26.3	59.9	64.4	11 m: 0.0 29 m: 0.0 38 m: 0.0	11 m: 6.4 29 m: 13.2 38 m: 10.8	E	1011	1012

Date	Survey Period (hrs)	Ambient Temp (ºC)		Relative Humidity (%)		Wind speed * ($m.sec^{-1}$)		Wind Direction	Barometric Pressure (mb)	
		Min	Max	Min	Max	Min	Max		Min	Max
						48 m: 0.0	48 m: 7.6			
24 Feb 2016	1130 – 1400 hrs	25.5	26.8	63.6	69.6	11 m: 0.0 29 m: 0.0 38 m: 0.0 48 m: 0.8	11 m: 3.4 29 m: 11.4 38 m: 8.3 48 m: 9.5	E	1009	1010
24 Feb 2016	1600 – 2000 hrs	22.8	25.8	70.2	81.4	11 m: 0.0 29 m: 0.0 38 m: 0.0 48 m: 0.0	11 m: 5.2 29 m: 8.9 38 m: 9.5 48 m: 10.8	E	1009	1011
25 Feb 2016	0500 – 0900 hrs	22.9	25.0	73.0	79.7	11 m: 0.8 29 m: 1.4 38 m: 1.4 48 m: 3.3	11 m: 8.3 29 m: 9.5 38 m: 10.1 48 m: 9.5	ENE	1010	1010
15 March 2016	0545–0915 hrs	22.6	25.6	78.9	87.8	11 m: 0.0 29 m: 0.0 38 m: 0.0 48 m: 0.0	11 m: 5.2 29 m: 8.3 38 m: 9.5 48 m: 8.9	E	1007	1008
15 March 2016	1100–1300 hrs	25.8	26.3	74.5	76.5	11 m: 0.0 29 m: 0.8 38 m: 2.1 48 m: 1.5	11 m: 7.7 29 m: 5.8 38 m: 9.5 48 m: 9.5	E	1008	1008
15 March 2016	1500-1900 hrs	24.9	26.3	73.0	85.5	11 m: 0.0 29 m: 0.0 38 m: 0.0 48 m: 0.0	11 m: 5.2 29 m: 6.4 38 m: 7.7 48 m: 7.7	NE	1007	1007
16 March 2016	0545–1215 hrs	22.8	26.3	69.7	82.1	11 m: 0.0 29 m: 0.8	11 m: 5.8 29 m: 7.6	ENE	1007	1008

Date	Survey Period (hrs)	Ambient Temp (ºC)		Relative Humidity (%)		Wind speed * ($m.sec^{-1}$)		Wind Direction	Barometric Pressure (mb)	
		Min	Max	Min	Max	Min	Max		Min	Max
						38 m: 1.4 48 m: 0.8	38 m: 5.8 48 m: 6.4			
16 March 2016	1445-1600 hrs	21.5	25.2	74.4	91.0	11 m: 0.0 29 m: 0.0 38 m: 0.8 48 m: 0.8	11 m: 5.2 29 m: 7.6 38 m: 8.3 48 m: 8.3	NE	1006	1006
17 March 2016	1030-1730 hrs	25.4	26.3	67.1	77.4	11 m: 0.0 29 m: 0.0 38 m: 0.0 48 m: 0.0	11 m: 5.8 29 m: 6.4 38 m: 7.0 48 m: 7.0	SSW - SW	1002	1005
3 July 2016	1245-1615 hrs	17.8	19.7	62.0	68.9	11 m: 0.8 29 m: 2.7 38 m: 2.7 48 m: 3.3	11 m: 9.5 29 m: 11.4 38 m: 10.8 48 m: 11.4	SW	1014	1014
4 July 2016	0645-1130	15.8	20.0	66.8	74.9	11 m: 0.8 29 m: 0.0 38 m: 0.0 48 m: 0.0	11 m: 5.2 29 m: 5.8 38 m: 7.0 48 m: 6.4	SSW	1015	1016
4 July 2016	1200-1630	17.0	19.7	62.7	77.1	11 m: 0.0 29 m: 0.0 38 m: 0.0 48 m: 0.8	11 m: 6.4 29 m: 6.4 38 m: 7.0 48 m: 7.0	ENE	1013	1015
5 July 2016	0645-1130	17.7	19.6	65.1	75.0	11 m: 0.0 29 m: 2.7 38 m: 3.3 48 m: 3.9	11 m: 13.2 29 m: 14.5 38 m: 13.2 48 m: 14.5	NE	1011	1012
5 July 2016	1200-1630	17.5	19.3	69.5	86.7	11 m: 0.8 29 m: 3.9	11 m: 15.1 29 m: 16.4	NE	1006	1009

Date	Survey Period (hrs)	Ambient Temp (ºC)		Relative Humidity (%)		Wind speed * (m.sec^{-1})		Wind Direction	Barometric Pressure (mb)	
		Min	Max	Min	Max	Min	Max		Min	Max
						38 m: 0.0 48 m: 5.2	38 m: 16.3 48 m: 17.0			
6 July 2016	0645-1130	17.2	18.7	55.9	80.1	11 m: 2.1 29 m: 2.7 38 m: 3.9 48 m: 3.9	11 m: 13.2 29 m: 14.5 38 m: 15.1 48 m: 15.1	W	1000	1001
6 July 2016	1200-1630	17.0	18.7	50.6	58.0	11 m: 1.4 29 m: 2.7 38 m: 3.3 48 m: 3.3	11 m: 12.6 29 m: 13.8 38 m: 13.9 48 m: 13.9	WNW	998	1000
7 July 2016	0645-1030	15.2	17.0	63.8	88.7	11 m: 2.7 29 m: 5.2 38 m: 5.2 48 m: 6.4	11 m: 21.3 29 m: 25.0 38 m: 21.3 48 m: 24.4	WNW	993	994

Table 2 **Directions and altitudinal ranges of bird flights over the open paddock observed during the February, March and July 2016 survey periods.**

Species	No. Observed Flights	Altitudinal Range (m)	Direction of Movement			
			N-S, S-N	E-W, W-E	NW–SE, SE-NE	NE-SW, SW-NE
Welcome Swallow	1273	0-40	856	249	50	118
Lord Howe Silvereye	680	1-20	630		25	25
Magpie-lark	117	0-30	82	12	12	11
White-throated Needletail	105	1-30	100			5
Sacred Kingfisher	50	0-10	47			3
Lord Howe Pied Currawong	48	0-50	31	6	9	2
Whimbrel	46	0-30	22	8	10	6
Australian Kestrel	44	4-70	27	6	5	6
Pacific Golden Plover	44	0-12	24	10	3	7
Lord Howe Golden Whistler	33	0.5-10	29	3		1
White-faced Heron	27	0-20	15	5	4	3
Red-tailed Tropicbird	16	15-60	12	1		3
Eurasian Blackbird	15	1-10	11		4	
Sooty Tern	15	10-30	8	2	1	4
Emerald Dove	13	0-12	11		1	1
Little Egret	12	0-30	11	1		
Black Noddy	9	20-30	3	4		2
Eastern Curlew	9	0-20	3		2	4
Black-winged Petrel	9	12-60	7			2
Masked Lapwing	8	0-20	4		4	
Pacific Black Duck	8	30-50	8			
White Tern	8	12-30	2	3		3
Buff-banded Rail	3	0-1	3			
Common Noddy	2	20	2			
Little Shearwater	1	12-16		1		
Lord Howe Woodhen	0	0				
Total bird flights	**2595**		**1948**	**310**	**130**	**206**
% grand total of observed flights.			**75.1**	**11.9**	**5.0**	**7.9**

Table 3 **Total number of observed bird flights over each survey area in the open paddock at Transit Hill during the February, March and July 2016 survey periods.**

NB: Some individual bird flights were recorded in more than one survey area.

Species	Survey Area								Total
	VP1 (East)	VP2	VP3	VP4	VP5	VP6	VP7	VP8 (West)	
Welcome Swallow	32	116	350	357	329	188	101	118	1591
Lord Howe Silvereye	45	110	186	178	80	41	15	34	689
Magpie-lark	4	5	14	29	5	40	38	31	166
White-throated Needletail	6		8	32		45	7	8	106
Australian Kestrel	6	14	11	6	2	10	5	2	56
Sacred Kingfisher	13	11	15	3	5	1	1	1	50
Lord Howe Pied Currawong	1	10	3	9	12	3	5	4	47
Pacific Golden Plover	2		4	8	15	13	5		47
Whimbrel			3	9	7	11	14	2	46
Lord Howe Golden Whistler	1	6	8	8	2	2		9	35
Black Noddy	4	4	4	4	6	4	4	4	34
White Tern	3	3	3	3	3	6	9	3	33
Red-tailed Tropicbird	5	1	2	2	1	3	3	9	26
White-faced Heron	1	2	4	5	6	2	3	2	25
Little Egret	2	1	2	3	1	2	8	1	20
Sooty Tern	6	2	2	1	1	1	2	4	19
Eurasian Blackbird		2		5	3	2	1	1	14
Emerald Dove	1	3	2	1	2		1		10
Eastern Curlew		2	2			2	2	1	9
Pacific Black Duck								8	8
Black-winged Petrel			1	2			4		7
Masked Lapwing					2	4			6
Buff-banded Rail	1	1					1	1	4
Common Noddy							2		2
Lord Howe Woodhen	1								1
Total bird flights	**134**	**293**	**624**	**665**	**482**	**380**	**231**	**243**	**3052**
% grand total of observed flights.	**4.4**	**9.6**	**20.4**	**21.8**	**15.8**	**12.4**	**7.6**	**8.0**	

Table 4 **Total number of observed bird flights across a range of altitudes over the open paddock at Transit Hill during February, March and July 2016 survey periods.**

NB: Some individual bird flights were recorded in more than one altitude category.

Species	Altitude of bird flights (m)							Total
	0.0-4.0	4.1-8.0	8.1-12.0	12.1-16.0	16.1-20.0	20.1-24.0	> 24.0	
Welcome Swallow	1149	169	78	24	18	14	2	1454
Lord Howe Silvereye	145	364	394	69	13			985
White-throated Needletail	17	40	58	64	29		2	210
Magpie-lark	89	62	17	34			2	204
Whimbrel	32	30	31	8	4	4	1	110
Lord Howe Pied Currawong	11	11	21	15	7		1	66
Australian Kestrel		2	8	12	9	8	24	63
Sacred Kingfisher	33	20	8					61
White-faced Heron	16	9	15	9	3			52
Pacific Golden Plover	35	9	11					55
Lord Howe Golden Whistler	26	11	4					41
Sooty Tern			1	10	6	3	3	23
Little Egret	4	3	6	6	1		1	21
Masked Lapwing	6	4	4	5	2			21
Red-tailed Tropicbird				2	1	1	14	18
Emerald Dove	11	3	2	1				17
Eurasian Blackbird	6	5	2					13
Eastern Curlew	3	3	3	1	2			12
White Tern				1	2	4	4	11
Pacific Black Duck							8	8
Black Noddy					2		4	6
Black-winged Petrel				2			4	6
Buff-banded Rail	4	1	1					6
Common Noddy					2			2
Little Shearwater			1					1
Lord Howe Woodhen	1							1
Total bird flights	**1588**	**746**	**665**	**263**	**101**	**34**	**70**	**3467**
% grand total of observed flights.	**45.8**	**21.5**	**19.2**	**7.6**	**2.9**	**1.0**	**2.0**	

Table 5 Threatened and nationally-listed migratory bird taxa that have been recorded within the Lord Howe Island Catchment Management Sub-region within the last 25 years.

Threatened Status Categories:

* = *Listed under the Commonwealth Environmental Protection and Biodiversity Conservation Act 1999 (EPBC Act).*
CE = *Endangered under Schedule 1 of the NSW Threatened Species Conservation Act 1995 (TSC Act).*
*CE** = *Endangered under Schedule 1 of the TSC Act and EPBC Act.*
E = *Endangered under Schedule 1 of the NSW Threatened Species Conservation Act 1995 (TSC Act).*
*E** = *Endangered under Schedule 1 of the TSC Act and EPBC Act.*
V = *Vulnerable under Schedule 2 of the TSC Act.*
*V** = *Vulnerable under Schedule 2 of the TSC Act and EPBC Act.*

Migratory Status Categories:

C = *Listed under the schedules of the China-Australia Migratory Bird Agreement, 1988 (CAMBA).*
J = *Listed under the schedules of the Japan-Australia Migratory Bird Agreement, 1981 (JAMBA).*
K = *Listed under the schedules of the Republic of Korea-Australia Migratory Bird Agreement, 2007 (ROKAMBA).*

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
Family Apodidae						
Apus pacificus	Fork-tailed Swift	C, J, K		Aerial flyer over most habitats across Australia. Usually flies high in sky in association with cold- or storm-fronts. 8 database records. Potential to fly low over the subject site.	**Yes**	No
Hirundapus caudacutus	White-throated Needletail	C, J, K		Aerial flyer over most habitats across Australia. Usually flies high in sky in association with cold- or storm-fronts. 6 database records. Potential to fly low over the subject site. Recorded flying through the subject site during the February & March 2016 survey periods.	**Yes**	No
Family Diomedeidae						
Diomedia exulans	Wandering Albatross	E*, J	E	Breeds on South Georgia (Georgias del Sur) (c. 25% of the global breeding population), Prince Edward Islands (South Africa) (c. 40% of the global population), Crozet Islands and Kerguelen Islands (French Southern Territories) (approximately 10% of the global population) and	No	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				Macquarie Island (Australia) (approximately four pairs breeding per year). Typically forages in oceanic waters, however considerable time is spent over shelf areas during certain stages of the breeding season. 3 database records. Regular visitor to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.		
Thalassarche melanophris	Black-browed Albatross	V*	V	Breeds on subantarctic and peri-antarctic islands in colonies located on terraces of coastal cliffs, slopes of nearby hills, summits of rocky islets or on flat or gently-sloping ground. Inhabits Antarctic, subantarctic and temperate waters and occasionally enters the tropics. It can tolerate a broad range of sea-surface temperatures from 0–24º C. Forages around the breaks of continental and island shelves and across nearby underwater, but also frequents other marine habitats, such as oceanic waters and the iceberg belt at the limit of the Antarctic pack ice. In the non-breeding season it follows cold water currents north to the continental shelves of Australia, South America and Africa where it can occur in coastal and inshore waters and sometimes enter fjords and channels. 2 database records. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No
Family Procellariidae						
Pufinus assimilis	Little Shearwater		V	A widespread species in the subtropical Atlantic, Pacific and Indian Oceans. Lord Howe Island has one of the larger breeding colonies in the Australian region. Breeding sites at Lord Howe Island include Roach Island, Muttonbird Island, Blackburn Island and on the main Island at Muttonbird Point and Transit Hill. 183 database records. At least one breeding record from forested area adjacent to cleared paddock. One individual observed flying over subject site during March 2016 survey period.	No	**Yes**
Ardenna carneipes	Flesh-footed Shearwater	J, K	V	A migratory seabird that ranges widely across the Pacific and Indian Oceans. The principal breeding populations are in Australia and New Zealand. The only breeding site in eastern Australia is on Lord Howe Island. Forages in waters over continental shelves and slopes and occasionally inshore waters. Individuals also pass through the tropics and over deeper waters when on migration.	**Yes**	**Yes**

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				13,129 database records. Major breeding and roosting colony in forested area along the northern boundary (down-slope) of subject site. Individuals fly low over the cleared paddock upon their return to the colony around dusk.		
Ardenna grisea	Sooty Shearwater	C, J		Forages in pelagic (open ocean) sub-tropical, sub-Antarctic and Antarctic waters. The species migrates and forages in the North Pacific and Atlantic Oceans during the non-breeding season. Sooty Shearwaters may forage inshore occasionally, especially during rough weather. breeds mainly on subtropical and sub-Antarctic islands, as well as on the mainland of New Zealand. Birds nest in burrows or rock crevices on coastal slopes, ridges and cliff tops, in herbfields, tussock grassland or forest. Areas with waterlogged or shallow soils and/or dense vegetation are avoided. 2 database records. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly low over or land on subject site.	No	No
Ardenna pacificus	Wedge-tailed Shearwater	J		Feeds at sea during the day, returns to onshore colonies from mid-afternoon. Breeds mainly on islands offshore from Lord Howe Island, but has been breeding along the lagoon shores and at Signal Point in recent years. 696 database records. Potential to fly low over the subject site.	**Yes**	No
Ardenna tenuirostris	Short-tailed Shearwater	J, K		Australia's most numerous seabird. During breeding season, millions converge on many small islands from NSW to Western Australia, with their stronghold in Bass Strait. After their chicks are large enough to fend for themselves, the adults leave the breeding islands and migrate north-east, flying on a broad front through the central Pacific Ocean. They spend the southern winter at sea in the northern Pacific, off Japan, Siberia and Alaska. In summer months, the Short-tailed Shearwater is the most common shearwater along the south and south-east coasts of Australia. Enormous flocks of birds head south to breeding grounds off these coasts as they return from wintering grounds in the North Pacific. Some counts have recorded numbers as great as 60 000 individuals passing every hour, with over 18 million birds making the trek. At this time a number of birds are	No	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				washed up on beaches and die as a result of exhaustion, sickness and bad weather. 6 database records. Unlikely to fly low over or land on subject site.		
Macronectes giganteus	Southern Giant-Petrel	E*	E	Has a circumpolar pelagic range from Antarctica to approximately 20° S and is a common visitor off the coast of NSW. An opportunistic scavenger and predator, and scavenges from fishing vessels and animal carcasses on land. Breeds on six subantarctic and Antarctic islands in Australian territory; Macquarie Island, Heard Island and McDonald Island in the Southern Ocean, and Giganteus Island, Hawker Island, and Frazier Island in the Australian Antarctic Territories. 2 database records. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No
Pterodroma leucoptera leucoptera	Gould's Petrel	E*	V	A pelagic marine species, spending much of its time foraging at sea and coming ashore only to breed. The Australian subspecies breeds and roosts on two islands off NSW, Cabbage Tree and Boondelbah Islands, and the at-sea distribution is poorly known. 3 database records. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No
Pterodroma neglecta neglecta	Kermadec Petrel (west Pacific subspecies)	V*	V	A pelagic seabird that occurs in tropical, subtropical and temperate waters of the Pacific Ocean. It has been recorded in waters of 15–25 °C in the subtropics and in colder waters in temperate regions, with one bird sighted in the northern Pacific Ocean in waters of about 6 °C. It breeds on islands, atolls and islets in the southern Pacific Ocean. 19 database records. Breeds on Ball's Pyramid and is seen flying over the ocean around Lord Howe Island. Small potential for individuals to fly low over the subject site, although most likely to be seen at sea.	**Yes**	**Yes**
Pterodroma nigripennis	Black-winged Petrel		V	Within the Australasian region, has been observed over warm waters and in cool seas where there were intrusions of warm water. Flocks have been sighted over the Gascoyne Seamount in the Tasman Sea, where lower sea surface-temperature (20.3°C) indicated upwelling of nutrient-rich water. Breeds on subtropical and tropical islands and inlets in the south-western Pacific Ocean. Breeding grounds are usually vegetated coastal slopes or rugged terrain inland . The species nests on higher ground in	No	**Yes**

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				burrows or rock crevices, with the entrance hidden by scrub (eg. *Olearia*), tussocks (eg. *Mariscus*) or grassy mats (eg. *Microlaena*). These burrows may be a metre long in sandy soil but are usually shorter in stony, volcanic soil. 388 database records. On Lord Howe Island, performs courtship flights around nests on cliffs from Ned's Beach to Blinky Beach, and at Mt Eliza and Erskine Valley. Observed flying low over the subject site during the February and March 2016 surveys.		
Pterodrama solandri	Providence Petrel	J	V	A marine, pelagic seabird that inhabits the subtropical and tropical waters of the south-west Pacific Ocean. Its sea surface temperature preferences during the breeding season are not known, but it appears more common over the warm waters off eastern Australia. During the non-breeding season the species ranges over widely varying sea temperatures, from 3.5–28 °C, concentrating over convergences of cold and warm currents At sea, prefers to forage over warmer waters, such as those off the east Australian coast. Flocks of up to 50 individuals have been observed. Reportedly forages near fishing boats, but do not commonly follow them. breed only in Australian territories. Once bred in large numbers on Norfolk Island, but was driven to extinction between 1790 and 1800 by human predation and introduced mammals such as Pigs (*Sus scrofa*) and Goats (*Capra hircus*). It was discovered breeding on nearby Phillip Island in 1985, where a small colony remains. Likewise, the species was once common on Lord Howe Island, but suffered a severe reduction in numbers following the establishment of human settlements, and the arrival of pigs and rats. Continues to survive and breed on Lord Howe Island, winter nesting occurring around the southern mountains, but was possibly more widespread before the arrival of pigs. Lord Howe Island is the world's last remaining breeding stronghold. 914 database records. Potential to fly over the subject site during the winter nesting period.	**Yes**	**Yes**
Family Oceanitidae						
Fregatta grallaria	White-bellied Storm-petrel	V*	V	In Australia, the species is recorded in the non-breeding season near the edge of the continental shelf, 10-25 km offshore. The continental margin of north and central NSW is a favoured feeding area of Lord Howe Island	No	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				birds. Nests within chambers in caves, cliffs and rock crevices, on boulder beaches, slopes and plateaux. 68 database records. Feeds out at sea and is only usually seen near Lord Howe Island when taking a boat trip to Ball's Pyramid. Nests on islets offshore of the main island. Unlikely to fly low over the subject site.		
Oceanites oceanicus	Wilson's Storm-petrel	J		In Australia, most reports are from the edge of the continental shelf and during autumn. Known to breed on Heard Island, where it is described as abundant. Common off the coast of Queensland during May to September, but scarce off south-east Queensland during the north and southwards migrations. During this time, the species is recorded more regularly off NSW, Victoria, Tasmania and South Australia; with maximum abundances in March to June and October to November. Off WA and the NT, Wilson's Storm-Petrels are mainly observed along the coast during migration (Marchant & Higgins 1990). 1 database record. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No
Family Fregatidae						
Fregata ariel	Lesser Frigatebird	C, J, K		Major breeding populations of the Lesser Frigatebird are found in tropical waters of the Indian and Pacific Ocean (excluding the east Pacific), as well as one population in the South Atlantic (Trinidade and Martim Vaz, Brazil). Outside the breeding season it is sedentary, with immature and non-breeding individuals dispersing throughout tropical seas, especially of the Indian and Pacific Oceans. 4 database records. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No
Family Sulidae						
Sula dactylatra	Masked Booby	J, K	V	Widespread in tropical waters between 30°N and 30°S in the Pacific, Indian and Atlantic Oceans. Often observed far from land over deep tropical and subtropical waters. The distribution of the species may be related to the distribution of flying fish. When breeding in the Tropical Zone, individuals have been sighted foraging at upwellings of cool nutrient-rich waters. Breeding colonies are usually situated on tropical oceanic islands, atolls and cays, far from the mainland.	**Yes**	**Yes**

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				1,156 database records. Resident on Lord Howe Island all year round. Nests at Muttonbird Point and on islets offshore of Lord Howe Island. May occasionally fly low over the subject site.		
Sula leucogaster	Brown Booby	C, J, K		In Australia, the Brown Booby is found from Bedout Island in Western Australia, around the coast of the Northern Territory to the Bunker Group of islands in Queensland with occasional reports further south in New South Wales and Victoria. The species is reported further south to Tweed Heads, NSW, and to near Onslow, Western Australia and may be becoming more common in these areas. 3 database records. A rare visitor to waters around Lord Howe Island. Unlikely to fly over or land on subject site.	No	No
Family Phaethonitidae						
Phaethon lepturus	White-tailed Tropicbird	C, J		In Australia, the White-tailed Tropicbird (Indian Ocean) breeds in the Cocos-Keeling Islands (on North Keeling Island and, formerly, on West Island [Pulu Panjang] in the main atoll, where breeding was last recorded in 1941) and at Ashmore Reef (on West, Middle and East Islands) and Rowley Shoals off the northern coast of Western Australia. Over the past few years, birds have been sighted with increased frequency on West Island and Home Island (also in the main atoll) in the Cocos-Keeling Islands. However, there have been no recent breeding records. The White-tailed Tropicbird (Indian Ocean) ranges widely over the oceans surrounding its breeding locations. Appears to be a moderately common visitor to the seas off northern Western Australia, to the west of the continental shelf. It is occasionally sighted close to the Western Australia mainland 8 database records. A rare visitor to waters around Lord Howe Island. Unlikely to fly over or land on subject site.	No	No
Phaethon rubricauda	Red-tailed Tropicbird	C	V	Feeds mostly on fish, especially flying-fish, and large quantities of squid. Crustaceans are also taken in places. Prey is caught by plunge-diving, but flying-fish can be taken in flight. Breeding is seasonal in places, taking place in loose colonies on small, remote oceanic islands mostly on inaccessible cliffs. No regular migrations are known and adults can be found in the vicinity of colonies all year round. 220 database records. On Lord Howe Island, seen flying off the cliffs during summer and autumn, from Malabar to North Head, around the	**Yes**	**Yes**

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				mountains and Ball's Pyramid. Observed flying low over the subject site during the February and March 2016 surveys.		
Rallidae						
Gallirallus sylvestris	Lord Howe Woodhen	V*	E	Occurs all over Lord Howe Island, including gardens in the settlement area, wherever there are palms and water. Feeds on earthworms, molluscs and other invertebrates present under leaf litter. Nests of grass, moss and palm tree fibre are located under tree roots or in Providence Petrel burrows. 4,045 database records. Potential to occur in palm forested areas along the proposed access track to the subject site. One individual observed on the forest edge along the southern boundary of the cleared paddock during the February 2016 survey period.	**Yes**	**Yes**
Family Ardeidae						
Ardea ibis	Cattle Egret	C, J		Occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. It has occasionally been seen in arid and semi-arid regions however this is extremely rare. High numbers have been observed in moist, low-lying poorly drained pastures with an abundance of high grass; it avoids low grass pastures. It has been recorded on earthen dam walls and ploughed fields. It is commonly associated with the habitats of farm animals, particularly cattle, but also pigs, sheep, horses and deer. The Cattle Egret is known to follow earth-moving machinery and has been located at rubbish tips. It uses predominately shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation and abundant aquatic flora. They have sometimes been observed in swamps with tall emergent vegetation. 11 database records. Breeds in northern NSW, overwintering in New Zealand. Some individuals on migration stop briefly on Lord Howe Island, where they are most often seen in paddock areas with grazing cattle. Potential to fly over or land on the subject site, particularly the cleared paddock area.	**Yes**	No
Botaurus poiciloptilus	Australasian Bittern	E*	E	Favours permanent freshwater wetlands with tall, dense vegetation, particularly bullrushes (*Typha* spp.) and spikerushes (*Eleocharis* spp.). Hides during the day amongst dense reeds or rushes and feed mainly at	No	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				night on frogs, fish, yabbies, spiders, insects and snails. Breeding occurs in summer from October to January; nests are built in secluded places in densely-vegetated wetlands on a platform of reeds; there are usually six olive-brown eggs to a clutch. 1 database record. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.		
Family Threskiornithidae						
Plegadis falcinellus	Glossy Ibis	C		Within Australia, the Glossy Ibis is generally located east of the Kimberley in Western Australia and Eyre Peninsula in South Australia. The species is also known to be patchily distributed in the rest of Western Australia. The species is rare or a vagrant in Tasmania. Preferred habitats for foraging and breeding are fresh water marshes at the edges of lakes and rivers, lagoons, flood-plains, wet meadows, swamps, reservoirs, sewage ponds, rice-fields and cultivated areas under irrigation. The species is occasionally found in coastal locations such as estuaries, deltas, saltmarshes and coastal lagoons 1 database record. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No
Family Haematopodida						
Haematopus longirostris	Australian Pied Oystercatcher		E	Occurs on tidal mudflats, estuaries, sewage ponds, shallow river margins, brackish or saline inland lakes, flooded pastures and airfields. 2 database records. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No
Haematopus fuliginosus	Sooty Oystercatcher		V	Favours rocky headlands, rocky shelves, exposed reefs with rock pools, beaches and muddy estuaries. Forages on exposed rocks or coral at low tide. Breeds almost exclusively on offshore islands and occasionally on isolated promontories. The nest is a shallow scrape on the ground, or mounds of pebbles, shells or seaweed when nesting among rocks. 1 database record. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
Family Charadriidae						
Charadrius leschenaultii	Greater Sand-plover	C, J, K	V	Occurs on wide, sandy or shelly beaches; sandspits, tidal mudflats, reefs, sand cays, among mangroves, saltmarsh, dune wilderness and occasionally in bare paddocks. Seldom found far inland. 6 database records. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No
Charadrius mongolus	Lesser Sand-plover	C, J, K	V	Occurs on tidal mudflats and sandflats; gently sloping and shelly beaches, saltmarsh, estuaries, atolls, reefs, in mangroves, and on airfields. Occasionally found on inland lakes, swamps and bore drains. 15 database records. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No
Charadrius veredus	Oriental Plover	J, K		A non-breeding visitor to Australia, where the species occurs in both coastal and inland areas, mostly in northern Australia. Most records are along the north-western coast, between Exmouth Gulf and Derby in Western Australia, and there are records at a few scattered sites elsewhere, mainly along the northern coast, such as in the Top End, the Gulf of Carpentaria and on Cape York Peninsula. The species also often occurs further inland on the 'blacksoil' plains of northern Western Australia, the Northern Territory and north-western Queensland ('the Gulf Country'). It is seldom recorded in southern Australia. The species has also been recorded as a vagrant on Lord Howe Island and Christmas Island (Indian Ocean). 4 database records. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No
Pluvialis fulva	Pacific Golden Plover	C, J, K		In non-breeding grounds in Australia this species usually inhabits coastal habitats, though it occasionally occurs around inland wetlands. Pacific Golden Plovers usually occur on beaches, mudflats and sandflats (sometimes in vegetation such as mangroves, low saltmarsh such as *Sarcocornia,* or beds of seagrass) in sheltered areas including harbours, estuaries and lagoons, and also in evaporation ponds in saltworks. The species is also sometimes recorded on islands, sand and coral cays and exposed reefs and rocks. They are less often recorded in terrestrial habitats, usually wetlands such as fresh, brackish or saline lakes,	**Yes**	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				billabongs, pools, swamps and wet claypans, especially those with muddy margins and often with submerged vegetation or short emergent grass. Other terrestrial habitats inhabited include short (or, occasionally, long) grass in paddocks, crops or airstrips, or ploughed or recently burnt areas, and they are very occasionally recorded well away from water. 26 database records. Regular visitor to Lord Howe Island. Observed foraging in cleared paddock of the subject site during the February and March 2016 survey periods.		
Pluvialis squatarola	Grey Plover	C, J, K		Found on mudflats and in saltmarsh; tidal reefs and estuaries. Rarely found inland. 2 database records. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No
Family Rostratulidae						
Rostratula australis	Australian Painted Snipe	E*	E	Generally inhabits shallow terrestrial freshwater (occasionally brackish) wetlands, including temporary and permanent lakes, swamps and claypans. They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with rank emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of lignum *Muehlenbeckia* or canegrass or sometimes tea-tree (*Melaleuca*). Sometimes utilises areas that are lined with trees, or that have some scattered fallen or washed-up timber. 1 database record. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No
Family Scolopacidae						
Actitis hypoleucos	Common Sandpiper	C, J, K		Occurs along shallow, pebbly, muddy or sandy edges of rivers and streams, coastal to far inland; dams, lakes, sewage ponds; margins of tidal rivers; waterways in mangroves or saltmarsh; mudflats; rocky or sandy beaches; and on man-made structures such as causeways, street gutters, drains and riverside lawns.	No	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				11 database records. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.		
Arenaria interpres	Ruddy Turnstone	C, J, K		Found singly or in small groups along the coastline and only occasionally inland. They are mainly found on exposed rocks or reefs, often with shallow pools, and on beaches. In the north, they are found in a wider range of habitats, including mudflats. 36 database records. Most common migratory shorebird on Lord Howe Island. Often seen foraging for invertebrates on mowed lawn at Lord Howe Island Airport. Potential to occur on or over the subject site, particularly in cleared paddock.	**Yes**	No
Calidris acuminata	Sharp-tailed Sandpiper	C, J, K		Prefers the grassy edges of shallow inland freshwater wetlands. It is also found around sewage farms, flooded fields, mudflats, mangroves, rocky shores and beaches. Its breeding habitat in Siberia is the peat-hummock and lichen tundra of the high Arctic. 11 database records. Irregular visitor to Lord Howe Island. Potential to occur on or over the subject site, particularly in cleared paddock.	**Yes**	No
Calidris canutus	Red Knot	E*, C, J, K		Gather in large flocks on the coast in sandy estuaries with tidal mudflats. 6 database records. Irregular visitor to Lord Howe Island. Potential to fly low over the subject site, particularly over cleared paddock.	**Yes**	No
Calidris ferruginea	Curlew Sandpiper	CE*, C, J, K	E	Found on intertidal mudflats of estuaries, lagoons, mangroves, as well as beaches, rocky shores and around lakes, dams and floodwaters. Its breeding habitat is the lowland tundra of Siberia. 13 database records. Irregular visitor to Lord Howe Island. Potential to occur on or over the subject site, particularly in cleared paddock.	**Yes**	**Yes**
Calidris melanotos	Pectoral Sandpiper	J, K		In Australasia, prefers shallow fresh to saline wetlands. The species is found at coastal lagoons, estuaries, bays, swamps, lakes, inundated grasslands, saltmarshes, river pools, creeks, floodplains and artificial wetlands. Also occasionally found further inland, preferring wetlands that have open fringing mudflats and low, emergent or fringing vegetation, such as grass or samphire. 4 database records. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
Calidris ruficollis	Red-necked Stint	C, J, K		In Australia, Red-necked Stints are found on the coast, in sheltered inlets, bays, lagoons, estuaries, intertidal mudflats and protected sandy or coralline shores. They may also be seen in saltworks, sewage farms, saltmarsh, shallow wetlands including lakes, swamps, riverbanks, waterholes, bore drains, dams, soaks and pools in saltflats, flooded paddocks or damp grasslands. They are often in dense flocks, feeding or roosting. 12 database records. Regular visitor to Lord Howe Island, but visits only in small numbers. Potential to occur on or over the subject site, particularly in cleared paddock.	**Yes**	No
Calidris subminuta	Long-toed Stint	C, J, K		In Australia, the Long-toed Stint occurs in a variety of terrestrial wetlands. They prefer shallow freshwater or brackish wetlands including lakes, swamps, river floodplains, streams, lagoons and sewage ponds. The species is also fond of areas of muddy shoreline, growths of short grass, weeds, sedges, low or floating aquatic vegetation, reeds, rushes and occasionally stunted samphire. It has also been observed at open, less vegetated shores of larger lakes and ponds and is common on muddy frindges of drying ephemeral lakes and swamps. The Long-toed Stint also frequents permanent wetlands such as reserviors and artificial lakes. They are uncommon, but not unknown, at tidal estuaries, saline lakes, saltponds and bore swamps. 1 database record. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No
Calidris tenuirostris	Great Knot	C, J, K	V	Recorded around the entirety of the Australian coast, with a few scattered records inland. It is now absent from some sites along the south coast where it used to be a regular visitor. The greatest numbers are found in northern Australia; where the species is common on the coasts of the Pilbara and Kimberley, from the Dampier Archipelago to the Northern Territory border, and in the Northern Territory from Darwin and Melville Island, through Arnhem Land to the south-east Gulf of Carpentaria. Other important sites include the Broad Sound-Shoalwater Bay area, the Mackay region and Moreton Bay in Queensland. The species is much less common in south-west Australia, South Australia, Victoria and Tasmania. In Australasia, the species typically prefers sheltered coastal habitats, with large intertidal mudflats or sandflats. This includes inlets, bays, harbours,	No	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				estuaries and lagoons. They are occasionally found on exposed reefs or rock platforms, shorelines with mangrove vegetation, ponds in saltworks, at swamps near the coast, saltlakes and non-tidal lagoons. The Great Knot rarely occurs on inland lakes and swamps 1 database record. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.		
Gallinago hardwickii	Latham's Snipe	C, J, K		Usually found on soft wet ground or in shallow water that contains grass tussocks or other green or dead vegetation. Also occurs in wet paddocks, seepage areas below dams, irrigated areas, in scrub or open woodland areas, saltmarshes and along the fringes of mangroves. 16 database records. Regular visitor to Lord Howe Island, but visits only in small numbers. Potential to occur on or over the subject site, particularly in cleared paddock.	**Yes**	No
Limosa lapponica	Bar-tailed Godwit	C, J, K		Inhabits estuarine mudflats, beaches and mangroves. They are common in coastal areas around Australia. They are social birds and are often seen in large flocks and in the company of other waders. 25 database records. On Lord Howe Island, forages for food on sandy shores and in swampy paddocks. Potential to occur on or over the subject site, particularly in cleared paddock.	**Yes**	No
Limosa limosa	Black-tailed Godwit	C, J, K	V	Occurs on tidal mudflats, estuaries, sewage ponds, shallow river margins, brackish or saline inland lakes, flooded pastures and airfields. 6 database records. Vagrant to the Lord Howe Island Catchment Management Sub-region. Unlikely to fly over or land on subject site.	No	No
Numenius madagasariensis	Eastern Curlew	CE*, C, J, K		Found on intertidal mudflats and sandflats, often with beds of seagrass, on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons. 13 database records. Regular visitor to Lord Howe Island where it forages and roosts on the beach, rocky seashore, in swamps and short grassy areas such as the golf course or short grassy areas. One or two individuals observed foraging in cleared paddock area of subject site during February and March 2016 survey periods.	**Yes**	No
Numenius minutus	Little Curlew	C, J, K		Little Curlews generally spend the non-breeding season in northern Australia from Port Hedland in Western Australia to the Queensland coast.	No	No

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				There are records of the species from inland Australia, and widespread but scattered records on the east coast. The species has also been recorded on Lord Howe Island, Cocos-Keeling Island and Christmas Island. The species is recorded in Australia between September and April and there are few winter records. Generally, foraging is in relatively short grass (around 20 cm tall) as the birds avoid dense tall grasses. Foraging sites are usually within 5 km of daytime roosting sites, as birds move between grassland and wetland, most feeding in drier grassland occurring during the first few hours after dawn and the late afternoon. The Little Curlew is known to fly up to 10 km for available water then return to feeding grounds; therefore the availability of drinking water is an important habitat requirement. When resting during the heat of day, the Little Curlew congregates around pools, river beds and water-filled tidal channels, and shallow water at edges of billabongs. The species prefers pools with bare dry mud (including mud banks in shallow water) and they do not use pools if they are totally dry, flooded or heavily vegetated. 9 database records. Vagrant to Lord Howe Island. Unlikely to fly over or land on subject site.		
Numenius phaeopus	Whimbrel	C, J, K		Found mainly on the coast, on tidal and estuarine mudflats, especially near mangroves. They are sometimes found on beaches and rocky shores. 42 database records. Occurs in remote grassy paddocks and on rocky seashores on Lord Howe Island. Two individuals observed foraging in the cleared paddock area of the subject site during the February & March 2016 survey periods.	**Yes**	No
Tringa brevipes	Grey-tailed Tattler	C, J, K		Usually seen in small flocks on sheltered coasts with reefs and rock platforms or with intertidal mudflats. They are also found in intertidal rocky, coral or stony reefs, platforms and islets that are exposed at high tide, also shores of rock, shingle, gravel and shells and on intertidal mudflats in embayments, estuaries and coastal lagoons, especially those fringed with mangroves. 18 database records. Regular visitor to Lord Howe Island. Mainly seen feeding at low tide on sea grass beds at North Bay, usually as single	**Yes**	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				individuals, occasionally two or three together. Small potential for individuals to fly low over subject site.		
Tringa incana	Wandering Tattler	J		Prefers coral islands and cays of the Great Barrier Reef, where it occurs mainly on rocky reefs, wave-washed rocks and rock platforms. Occasionally occurs in other tidal areas. 15 database records. Regular visitor to Lord Howe Island. Mainly seen on the rocky shore of the main island and offshore islets, on seaweeds of the surf zones; usually alone, occasionally 2 or 3 together. Small potential for individuals to fly low over subject site.	**Yes**	No
Tringa nebularia	Common Greenshank	C, J, K		Found both on the coast and inland, in estuaries and mudflats, mangrove swamps and lagoons, and in billabongs, swamps, sewage farms and flooded crops. 15 database records. Vagrant to Lord Howe Island. Unlikely to fly over or land on subject site.	No	No
Tringa stagnatalis	Marsh Sandpiper	C, J, K		Occurs in salty, brackish or freshwater wetlands; sewage ponds; commercial saltfields; bore drains, mangroves, tidal mudflats and estuaries. 4 database records. Vagrant to Lord Howe Island. Unlikely to fly over or land on subject site.	No	No
Xenus cinereus	Terek Sandpiper	C, J, K	V	Occurs on tidal mudflats and in estuaries; on shores and reefs of islands; in coastal swamps and on saltfields. 6 database records. Vagrant to Lord Howe Island. Unlikely to fly over or land on subject site.	No	No
Glareolidae						
Glareola maldivarum	Oriental Pratincole	C, J, K		Within Australia the Oriental Pratincole is widespread in northern areas, especially along the coasts of the Pilbara Region and the Kimberley Division in Western Australia, the Top End of the Northern Territory, and parts of the Gulf of Carpentaria. It is also widespread but scattered inland, mostly north of 20° S. There are occasional records in southern Australia, at sparsely scattered sites, with records in all states, including an unconfirmed report in Tasmania. The species has also been recorded on various outlying islands, including Lord Howe Island, and, in the Indian Ocean, Christmas Island and Cocos-Keeling Islands. Usually inhabits	No	No

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				open plains, floodplains or short grassland (including farmland or airstrips), often with extensive bare areas. They often occur near terrestrial wetlands, such as billabongs, lakes or creeks, and artificial wetlands such as reservoirs, saltworks and sewage farms, especially around the margins. The species also occurs along the coast, inhabiting beaches, mudflats and islands, or around coastal lagoons. 3 database records. Vagrant to Lord Howe Island. Unlikely to fly over or land on subject site.		
Stercorcariidae						
Stercorarius longicaudus	Long-tailed Jaeger	J		Breeds in the high Arctic of Eurasia and North America where it is the most widely distributed and most northerly breeding jaeger species. Spends the non-breeding season around the southern oceans, including off the coasts of southern South America and southern Africa. However, its exact winter distribution is not completely understood. Outside of the breeding season, the long-tailed jaeger spends most of its time at sea, rarely within sight of land. 2 database records. Vagrant to Lord Howe Island CMA Sub-region. Unlikely to fly over or land on subject site.	No	No
Family Laridae						
Anous stolidus	Brown (Common) Noddy	C, J		In Australia, the Common Noddy occurs mainly in ocean off the Queensland coast, but the species also occurs off the north-west and central Western Australia coast. The species is also rarely encountered off the coast of the Northern Territory, where only one breeding location with about 100-130 birds is known. The species also occurs on Norfolk, Lord Howe, Christmas and Cocos-Keeling Islands. During the breeding season, the Common Noddy usually occurs on or near islands, on rocky islets and stacks with precipitous cliffs, or on shoals or cays of coral or sand. When not at the nest, individuals will remain close to the nest, foraging in the surrounding waters. Birds may nest in bushes, saltbush, or other low vegetation. They may also nest on the ground in Pigface (*Carpobrotus* spp.) or grass, on bare rock, on top of rocks protruding above vegetation, on shingle beaches, among coral rubble or in sand	**Yes**	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				close to grassy areas. The species has also been recorded nesting in the forks of tall trees, at the top of Coconut Palms (*Cocos nucifera*), in holes in dead timber and on tree-stumps. On Lord Howe, Kermadec and Christmas Islands, many nests are built on cliff ledges. Although the species is obviously quite flexible in regards to nesting locations, pairs appear to select nesting habitat based on a hierarchy of preference. During the non-breeding period, the species occurs in groups throughout the pelagic zone (open ocean). 59 database records. At Lord Howe Island, seen at sea feeding in groups or at nesting colonies at Old Gulch, Blinkie Beach and offshore islands. Young birds loaf on beaches in late summer. Observed flying over the subject site during February 2016 surveys.		
Chlidonias leucopterus	White-winged Black Tern	C, J, K		Occurs on large coastal and inland wetlands, saltfields, sewage ponds, and in estuaries and coastal waters. 10 database records. Vagrant to Lord Howe Island CMA Sub-region. Unlikely to fly over or land on subject site.	No	No
Gelochelidon nilotica	Gull-billed Tern	C		Gull-billed Terns are found in freshwater swamps, brackish and salt lakes, beaches and estuarine mudflats, floodwaters, sewage farms, irrigated croplands and grasslands. They are only rarely found over the ocean. Although essentially an inland species, outside breeding season it shows a distinct preference for saltmarshes and lagoons near the coast. Movements are not fully understood but it is common and widespread in south-eastern Australia, and only a vagrant in Tasmania. It winters mainly in the north and substantial numbers migrate to New Guinea and perhaps Indonesia. 2 database records. Vagrant to Lord Howe Island CMA Sub-region. Unlikely to fly over or land on subject site.	No	No
Gygis alba	White Tern		V	Occurs widely in tropical and subtropical seas and islands. The subspecies on Lord Howe Island is rarely seen on the mainland but occurs on Norfolk and Kermadec Islands. Most breeding sites on Lord Howe Island are close to the lagoon in the settlement area. Vagrant birds occur in coastal NSW waters, particularly after storm events.	No	**Yes**

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				46 database records. Nesting colonies occur in trees along roadsides on Lord Howe Island. Observed flying low over subject site during the February and March 2016 bird surveys.		
Hydroprogne caspia	Caspian Tern	C, J		Usually found near the coast, in extensive wetlands, on coastal and interior beaches and sheltered estuaries. The Caspian Tern lives equally well in fresh water and saline environments. 4 database records. Vagrant to Lord Howe Island CMA Sub-region. Unlikely to fly over or land on subject site	No	No
Onychoprian fuscata	Sooty Tern		V	Breeds on flat, open, sparsely or heavily vegetated, oceanic or barrier islands of sand, coral or rock in productive tropical and subtropical offshore waters rich in plankton, fish and squid. Dispersive and migratory, but generally avoids cold-current seas. At most colonies adults leave for the open sea after breeding and become strongly pelagic for 2-3 months before returning to the breeding grounds. 5,510 database records. Most numerous of Lord Howe Island's seabirds and breeds on offshore islets, along the coast from Ned's Beach to Middle Beach, and at Mt Eliza. Observed flying low over subject site during the February and March 2016 bird surveys.	No	**Yes**
Procelsterna cerulea	Grey Ternlet		V	In Australia, occurs off the east coast between the Tropic of Capricorn and Bass Strait and is occasionally beach cast during stormy weather. Individuals are usually recorded off the east coast of Australian soon after breeding season between December and March. These sightings support the suggestion that some individuals may disperse to the east coast of Australia from breeding grounds on Lord Howe Island. Not migratory and are associated with tropical and subtropical islands where they roost and breed, feeding inshore and, occasionally, offshore. While at sea, they may settle and roost on the water, feeding around upwelling currents. Inshore, they roost and breed at inaccessible shoreline cliffs or, less often, in the shelter of rocky beaches or clumped or bushy vegetation. Nests are often made from a few shreds of matted grass and seaweed and located in pockets or small hollows along basalt cliff faces. 12 database records. In the Lord Howe Island CMA Sub-region, forages at sea in flocks, on the main island groups sit low down on the black basalt cliffs late in the day. Potential for individuals to fly low over subject site.	No	**Yes**

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
Sterna hirundo	Common Tern	C, J, K		In Australia, Common Terns are mainly found along the eastern coast, where they are widespread and common from south-eastern Queensland to eastern Victoria (extending south-west to Port Albert), though less often recorded south of Port Hacking in NSW. Breeds in North America and Eurasia. In Australia, they are recorded in all marine zones, but are commonly observed in near-coastal waters, both on ocean beaches, platforms and headlands and in sheltered waters, such as bays, harbours and estuaries with muddy, sandy or rocky shores. 5 database records. Vagrant to Lord Howe Island CMA Sub-region. Unlikely to fly over or land on subject site.	No	No
Sternula albifrons	Little Tern	C, J, K	E	Mainly coastal, being found on beaches, sheltered inlets, estuaries, lakes, sewage farms, lagoons, river mouths and deltas. 4 database records. Vagrant to Lord Howe Island CMA Sub-region. Unlikely to fly over or land on subject site.	No	No
Family Psittacidae						
Lathamus discolor	Swift Parrot	CE*	E	Breeds in Tasmania and migrates to mainland between March and September to feed on eucalypt blossoms. 1 database record. Lord Howe Island outside usual range of species. Unlikely to fly over or land on subject site.	No	No
Family Tytonidae						
Tyto novaehollandiae	Masked Owl		V	Extends from the coast where it is most abundant to the western plains. Overall records for this species fall within approximately 90% of NSW, excluding the most arid north-western corner. There is no seasonal variation in its distribution. Lives in dry eucalypt forests and woodlands from sea level to 1100 m. 100 database records. On Lord Howe Island, occurs in forest away from the settlement area. Unlikely to fly over or land on subject site.	No	No
Family Meropidae						
Merops ornatus	Rainbow Bee-eater	J		Occurs mainly in open forests and woodlands, shrublands, and in various cleared or semi-cleared habitats, including farmland and areas of human	No	No

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				habitation. It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water. It also occurs in inland and coastal sand dune systems, and in mangroves in northern Australia, and has been recorded in various other habitat types including heathland, sedgeland, vine forest and vine thicket, and on beaches. Also occurs in grasslands and, especially in arid or semi-arid areas, in riparian, floodplain or wetland vegetation assemblages. 1 database record. Vagrant to Lord Howe Island CMA Sub-region. Unlikely to fly over or land on subject site.		
Family Pachycephalidae						
Pachycephala pectoralis contempta	Golden Whistler (Lord Howe Island subspecies)		V	Widely distributed in the forests throughout Lord Howe Island. It is often seen feeding around houses throughout the settlement area. Hop from branch to branch looking for insects, spiders and insect larvae. They also forage in the leaf litter. Nest is an open cup-shaped structure made up of palm fibre, vines and leaves and lined with grass. Population is estimated to be between 100-1000 pairs. 37 database records. Individuals observed flying low over cleared paddock between forested areas in both February and March 2016 survey periods.	No	**Yes**
Family Artamidae						
Strepera graculina crissalis	Pied Currawong (Lord Howe Island subspecies)	V	V	Occurs in lowland, hill and mountain regions of Lord Howe Island. It is mainly found in tall natural rainforests and palm forests, typically undisturbed, but it also occurs in cleared and settled areas, remnant patches of forest and the ecotone between cleared land and forest. The subspecies also forages in colonies of seabirds on offshore islets. Breeds in rainforest and palm forest, mainly on hill-slopes and mountains, with all breeding territories including a section of stream or gully and with most nests near water. After breeding, in autumn and winter, tend to disperse from higher altitudes to the lowlands, with greater numbers in lowland forests and in cleared and settled areas of the island at this time.	**Yes**	**Yes**

Scientific Name	Common Name	EPBC Act Status	TSC Act Status	Habitat Requirements and Likelihood of Occurrence	EPBC Assessment Required?	Seven Part Test required?
				50 database records. Numerous observations of currawongs flying over cleared paddock on the subject site, moving between forested areas on either side of paddock.		
Family Zosteropidae						
Zosterops lateralis tephropleurus	Silvereye (Lord Howe Island subspecies)		V	Widely distributed in the forests of Lord Howe Island. Often seen feeding around island homes throughout the settlement area. They glean leaves and flowers for insects, visit flowers for nectar, and eat small seeds and fruits, including the exotic Cherry Guava. 22 database records. Numerous observations of Silvereyes flying over cleared paddock on the subject site, moving between forested areas on either side of paddock.	No	**Yes**

5. Potential Impacts

5.1 Introduction

This section evaluates if the proposed development would significantly impact on the status of bird taxa and their habitats, especially threatened species listed under the TSC and EPBC Acts, migratory species listed under the EPBC Act, and subspecies that are endemic to Lord Howe Island. It also recommends ways in which impacts can be minimised or avoided.

5.2 Analysis of Turbine Options for Lord Howe Island

5.2.1 Introduction

Section 5.3 of the present report compares the bird collision risks with each turbine design option if the turbines had been operating during the February, March and July 2016 bird survey periods. It assumes the worst-case scenario of a collision occurring if rotating turbine blades were in the observed flight paths of birds, and does not take into account that the turbines may not have been operational or that birds may have altered their flight path to avoid a collision.

O'Neill & Carlile (2016) recommended that a turbine(s) be located near the eastern end of the cleared paddock, close to where the weather monitoring mast is located, to minimise impacts on the Flesh-footed Shearwater. Therefore, the bird collision risk analysis considers the potential risk of collisions if the turbines are located at WT1 and WT2 (the proponent's preferred locations), and at site of the weather monitoring mast.

5.2.2 Options 1 and 2: 200 kW Vergnet Wind Turbine(s)

The number of observed bird flight paths observed in February, March and July 2016 that would have intersected with proposed blade rotational areas of a Vergnet Wind Turbine at WT1 (Option 2A), WT2 (Option 2B), turbines at both WT1 and WT2 (Option 1) and at the weather monitoring mast site are shown in Table 6.

Vergnet turbines located at WT1 and WT2 would have had lowest collision risk, with no birds observed flying through the proposed rotational blade area at WT2, and two flight events of one species (Red-tailed Tropicbird, a threatened species) at WT1. These two flight events represent 12.5% of observed Red-tailed Tropicbird flights over the subject site, but only 0.08% of observed flights of all bird species over the site.

The rotating blades of a Vergnet turbine located at the site of the weathering monitoring mast would have intersected with the observed flight paths of five species (Red-tailed Tropicbird, White Tern, Black-winged Petrel, Australian Kestrel and Lord Howe Island Pied Currawong). All these species, except for the Australian Kestrel, are listed threatened species. The Red-tailed Tropicbird would have been the species with the highest collision risk, with 31.2% of observed flights (five flight events) resulting in collisions with rotating turbine blades. About 0.5% of all observed flights of bird species over the subject site would have resulted in collisions with the turbine blades.

Therefore, a single Vergnet Turbine located at WT2 (Option 2B) would have had the least potential impact on birds flying over the subject site during the February, March and July 2016 bird surveys. A single turbine located at WT1 (Option 2A), or turbines located at both WT1 and WT2 (Option 1), would have had slightly greater impacts, and a turbine located at the weather monitoring site would have posed the greatest collision risk.

Table 6 **The number of bird flights observed during the February, March and July 2016 survey periods that would have potentially resulted in collisions with the rotating blades of a 200 kW Vergnet Wind Turbine (hub height 55 m, blade length 15 m) at three locations (WT1, WT2 & current location of weather monitoring mast).**

Species	No. Observed Flights	WT1		WT2		Weather Monitoring Mast	
		No. predicted collisions	% observed flights	No. predicted collisions	% observed total flights	No. predicted collisions	% observed flights
Red-tailed Tropicbird	16	2	12.5			5	31.2
White Tern	8					2	25.0
Black-winged Petrel	9					1	11.1
Australian Kestrel	44					3	6.8
Lord Howe Pied Currawong	48					1	2.1
Total	**125**	**2**	**0.08**	**0**	**0.0**	**12**	**0.5**
No. of Species		**1**		**0**		**5**	

5.2.3 Option 3A: 100 kW XANT Wind Turbine (hub height: 23 m)

The number of observed bird flight paths observed in February, March and July 2016 that would have intersected with proposed blade rotational areas of a 100 kw XANT Wind Turbine (hub height: 23 m) at WT1 and WT2, and at the weather monitoring mast site are shown in Table 7.

Sixteen bird taxa would have potentially collided with this type of turbine at WT1 and 14 taxa at WT2. Seven of these taxa (Lord Howe Silvereye, Sooty Tern, Red-tailed Tropicbird, Lord Howe Pied Currawong, White Tern, Black-winged Petrel and Little Shearwater) are listed as threatened, and four taxa (White-throated Needletail, Whimbrel, Red-tailed Tropicbird and Pacific Golden Plover) are listed under the EPBC Act as migratory species. In terms of numbers of flights over the subject site, the Lord Howe Silvereye (WT1: 2 flight events; WT2: 24 flight events), White-throated Needletail (WT1: 22 flight events) and Welcome Swallow (WT1: 7 flight events; WT2: 16 flight events) would have been most at risk of colliding with turbines at these locations. This is because these species were observed flying over the subject site in small flocks, and individuals of the latter two species circled over the site as they moved over it. In terms of proportions of observed flights over the subject site, the White Tern (100.0% at WT1), Little Shearwater (100.0% at WT2), Black Winged Petrel (33.3% at WT1; 22.2% at WT2) and Sooty Tern (35.7% at WT1; 7.1% at WT2) would have been most at risk. These four species were usually observed flying relatively low over the entire length of the cleared paddock as they moved in an easterly direction, gaining height as they flew over the top of Transit Hill. Overall, turbines located at WT1 and WT2 would have had the potential to result in 2.9% and 3.6%, respectively, of all observed bird flights (i.e. flights of all bird species) intersecting with the area of rotating blades.

A 23 m hub height XANT turbine located at the site of the weather monitoring mast would have had impacted on flights of nine bird taxa. Four of these taxa (Lord Howe Silvereye, Sooty Tern, Red-tailed Tropicbird and Lord Howe Pied Currawong) are listed as threatened, and two species (White-throated Needletail and Red-tailed Tropicbird) are listed under the EPBC Act as migratory species. In terms of number of flights over the subject site, the Australian Kestrel (16 flight events) and Lord Howe Silvereye (14 flight events) would have been most at risk at colliding with a XANT turbine at this location. Australian Kestrels were most often seen hovering low over the eastern half of the cleared paddock while foraging for prey. Lord Howe Silvereyes tended to fly higher over the eastern third of the cleared paddock in comparison with other paddock areas because canopy heights of forest trees along boundary areas at that location were also slightly higher. In terms of proportions of observed flights over the subject site, the Black Noddy (66.7%), Sooty Tern (42.8%) and Australian Kestrel (36.4%) would have been most at risk. Overall, 2.1% of all observed bird flights would have intersected with the rotational area of the blades of a 23 m hub height XANT turbine located at the site of the weather monitoring mast.

5.2.4 Option 3B: 100 kW XANT Wind Turbine (hub height: 31.8 m)

The number of observed bird flight paths observed in February, March and July 2016 that would have intersected with proposed blade rotational areas of a 100 kw XANT Wind Turbine (hub height: 31.8 m) at WT1 and WT2, and at the weather monitoring mast site are shown in Table 8.

Six bird taxa would have potentially collided with this type of turbine at WT1 and five taxa at WT2. Four of these taxa (Red-tailed Tropicbird, Lord Howe Pied Currawong, Sooty Tern and White Tern) are listed as threatened, and two taxa (Whimbrel and Red-tailed Tropicbird) are listed under the EPBC Act as migratory species. In terms of numbers of flights over the subject site, the Red-tailed Tropicbird (four flights over WT1 and six flights over WT2) would have been most at risk of colliding with turbines at these locations. In terms of proportions of observed flights over the subject site, the

Table 7 **The number of bird flights observed during the February, March and July 2016 survey periods that would have potentially resulted in collisions with the rotating blades of a 100 kW XANT Wind Turbine (Design A: hub height 23 m, blade length 10.5 m) at three locations (WT1, WT2 & current location of weather monitoring mast).**

Species	No. Observed Flights	WT1		WT2		Weather Monitoring Mast	
		No. predicted collisions	% observed flights	No. predicted collisions	% observed flights	No. predicted collisions	% observed flights
Lord Howe Silvereye	680	2	0.3	34	5.0	14	2.1
White-throated Needletail	105	22	20.9			6	5.7
Welcome Swallow	1273	7	0.5	16	1.2	7	0.5
Little Egret	12	4	33.3	1			
Masked Lapwing	8	3	37.5				
Whimbrel	46	3	6.5	3	6.5		
Sooty Tern	14	5	35.7	1	7.1	6	42.8
Red-tailed Tropicbird	16	4	25.0	3	18.8	2	12.5
Lord Howe Pied Currawong	48	1	2.1	7	14.6	5	10.4
Australian Kestrel	44	5	11.4	4	9.1	16	36.4
Pacific Golden Plover	41	1	2.4	2	4.9		
White Tern	5	5	100.0				
Magpie-lark	117	4		7	6.0		
Black-winged Petrel	9	3	33.3	2	22.2		
Little Shearwater	1			1	100.0		
White-faced Heron	27	1	3.7	5	18.5	1	3.7
Black Noddy	12	5	41.7	7	58.3	8	66.7
Total	**2458**	**75**	**2.9**	**93**	**3.6**	**55**	**2.1**
No. of Species	**17**	**16**		**14**		**9**	

Table 8

The number of bird flights observed during the February, March and July 2016 survey periods that would have potentially resulted in collisions with the rotating blades of a 100 kW XANT Wind Turbine (Design B: hub height 31.8 m, blade length 10.5 m) at three locations (WT1, WT2 & current location of wind monitoring mast).

Species	No. Observed Flights	WT1		WT2		Wind Monitoring Mast	
		No. predicted collisions	% observed flights	No. predicted collisions	% observed flights	No. predicted collisions	% observed flights
Welcome Swallow	1273	3	0.2				
Australian Kestrel	44	3	6.8	3	6.8	11	25.0
Whimbrel	46			1	2.2		
Black Noddy	12	1	8.3	2	16.7	5	41.7
Red-tailed Tropicbird	16	4	25.0	6	37.5	1	6.2
Lord Howe Pied Currawong	48			2	4.2		
Sooty Tern	14	3	21.4				
White Tern	5	3	60.0				
Total	**1458**	**17**	**0.6**	**14**	**0.5**	**17**	**0.6**
No. of Species		**6**		**5**		**3**	

White Tern (60.0% at WT1) and Red-tailed Tropicbird (25.0% at WT1; 37.5% at WT2) would have been most at risk. Overall, turbines located at WT1 and WT2 would have had the potential to result in 0.6% and 0.5%, respectively, of all observed bird flights intersecting with the area of rotating blades.

A 31.8 m hub height XANT turbine located at the site of the weather monitoring mast would have impacted on flights of three bird species. Only one species (Red-tailed Tropicbird) is a listed threatened and migratory species. In terms of number of flights over the subject site, the Australian Kestrel (11 flight events) would have been most at risk at colliding with a XANT turbine at this location. In terms of proportions of observed flights over the subject site, the Black Noddy (41.7% of flights) would have been at risk. Overall, 0.6% of all observed bird flights would have intersected with the rotational area of the blades of a 31.8 m hub height XANT turbine located at the site of the weather monitoring mast.

5.2.5 Option 3C: 100 kW XANT Wind Turbine (hub height: 38 m)

The number of observed bird flight paths observed in February, March and July 2016 that would have intersected with proposed blade rotational areas of a 100 kw XANT Wind Turbine (hub height: 38 m) at WT1 and WT2, and at the weather monitoring mast site are shown in Table 9.

Six bird taxa would have potentially collided with this type of turbine at WT1 and three taxa at WT2. Four of these taxa (Sooty Tern, Red-tailed Tropicbird, Lord Howe Pied Currawong and White Tern) are listed as threatened, and four species (White-throated Needletail, Whimbrel, Pacific Golden Plover and Red-tailed Tropicbird) are listed under the EPBC Act as migratory species. In terms of numbers of flights over the subject site, the Red-tailed Tropicbird (four flights over WT1 and two flights over WT2) would have been most at risk of colliding with turbines at these locations. In terms of proportions of observed flights over the subject site, the White Tern (60.0% at WT1) would have been most at risk. Overall, turbines located at WT1 and WT2 would have had the potential to result in 0.6% and 0.2%, respectively, of all observed bird flights intersecting with the area of rotating blades.

A 38 m hub height XANT turbine located at the site of the weather monitoring mast would have had impacted on flights of four bird species. Only one species (Red-tailed Tropicbird) is a listed threatened and migratory species. In terms of number of flights over the subject site, the Australian Kestrel (five flight events) would have been most at risk at colliding with a XANT turbine at this location. In terms of proportions of observed flights over the subject site, the White Tern (40.0% of flights) would have been at risk. Overall, 0.5% of all observed bird flights would have intersected with the rotational area of the blades of a 38 m hub height XANT turbine located at the site of the weather monitoring mast.

5.2.6 Conclusion

A single Vergnet turbine located at WT2 (Option 2B) would have had the least potential impact on birds flying over the subject site during the February, March and July 2016 bird surveys. A single Vergnet turbine located at WT1 (Option 2A), or two Vergnet turbines located at both WT1 and WT2 (Option 1: the proponent's preferred option), would have had marginally higher impacts on birds flying over the subject site.

Two XANT turbines with a hub height of 23 m located at WT1 and WT2 would have had the most significant impact on birds observed flying over the subject site in February, March and July 2016. Although the other two XANT turbine options (31.8 and 38 m hub heights) would have had lower

Table 9

The number of bird flights observed during the February, March and July 2016 surveys that would have potentially resulted in collisions with the rotating blades of a 100 kW XANT Wind Turbine (Design C: hub height 38 m, blade length 10.5 m) at three locations (WT1, WT2 & current location of wind monitoring mast).

Species	No. Observed Flights	WT1		WT2		Wind Monitoring Mast	
		No. predicted collisions	% observed flights	No. predicted collisions	% observed flights	No. predicted collisions	% observed flights
Welcome Swallow	1273	3	0.2				
White-throated Needletail	105			2	1.9		
Australian Kestrel	44					5	11.4
Whimbrel	46			1	2.2		
Pacific Golden Plover	41	1	2.4				
Sooty Tern	14	3	21.4				
Black Noddy	12					3	25.0
Red-tailed Tropicbird	16	4	25.0	2	12.5	3	18.8
Lord Howe Pied Currawong	48	1	2.1				
White Tern	5	3	60.0			2	40.0
Total	**1604**	**15**	**0.6**	**5**	**0.2**	**13**	**0.5**
No. of Species		**6**		**3**		**4**	

impacts on birds flying over the site, their impacts would have been greater than all the Vergnet turbine options.

These conclusions are based on observations of all bird species except for the Flesh-footed Shearwater, which was not considered in the present study. O'Neill & Carlile (2016) observed Flesh-footed Shearwaters using the airspace above the middle and lower (western) end of the paddock, where WT1 and WT2 are located, more than the upper (eastern) end. Consequently, they recommended placement of turbines at the eastern end of the paddock, near where the weather monitoring mast is located, or at another location entirely on the island.

The field studies conducted by Ambrose Ecological Services Pty Ltd in February and March 2016 were late in the breeding season of most diurnal seabird species that were observed flying over or near the subject site at those times. It is possible that flight patterns of those species over the subject site (e.g. trajectories, duration and timing, abundance of individuals, flight behaviours) may be different earlier in the breeding season, as a result of aerial courtships, exploratory flights of non-breeding or pre-breeding birds, or chasing. Therefore, it is important to conduct surveys of flight patterns of diurnal birds, especially seabirds, early in the breeding season (September-December) to further assess potential impacts of the turbines on the status of Lord Howe Island's bird populations.

5.3 Bird Impacts of Wind Turbines in Other Studies

The present study has demonstrated that the proposed development has the potential to impact on the status of seven seabird species that fly over the subject site (Flesh-footed Shearwater, Little Shearwater, Black-winged Petrel, Red-tailed Tropicbird, Black Noddy, Sooty Tern and White Tern), seven terrestrial bird species and their habitats (White-throated Needletail, Welcome Swallow, Australian Kestrel, Magpie-lark, Lord Howe Pied Currawong, Lord Howe Silvereye and Lord Howe Woodhen), two migratory shorebirds (Whimbrel and Pacific Golden Plover) and one heron species (White-faced Heron).

Known fauna fatalities as a result of collisions with turbines at south-eastern Australian wind farms are summarised and discussed by Smales (2015). The results of his survey are shown in Table 10. While Smales is confident his analysis is robust, he cautions that the survey results do not take into account the variations in species' distributions and abundances, availability of habitats, sizes of wind farms, and differences in efforts and methods used at wind farms to detect carcasses. Australian Magpies account for almost one quarter of all detected fatalities and slightly more than one quarter were comprised of two small raptors (Australian Kestrel and Brown Falcon). Two bird species (Swamp Harrier and Wedge-tailed Eagle) each represented between 6 and 8% of the total detected deaths. Each of the other species represented 1–2% of all fatalities and 16 of these were represented by a single individual. Smales assumed that 6% for the combined group 'raven species' was comprised of up to three *Corvus* species. These data demonstrate that bird species from a broad range of ecological niches have collided with turbine blades, but the majority of bird collisions involved a small number of bird species, and the incidence of collisions is very low for the majority of species.

Table 10 Documented wind turbine collision fatalities of all bird and bat taxa and percentage that each taxon represents of the total for eight wind farms in south-erastern Australia (from Smales 2015).

Common Name	Scientific Name	No. documented fatalities	Percentage of all documented fatalities
BIRD SPECIES			
Little Eagle	*Hieraaetus morphnoides*	2	2
Wedge-tailed Eagle	*Aquila audax*	8	6
Brown Falcon	*Falco berigora*	15	12
Swamp Harrier	*Circus approximans*	9	7
Australian Kestrel	*Falco cenchroides*	19	15
Whistling Kite	*Haliastur sphenurus*	2	2
Southern Boobook	*Ninox novaeseelandiae*	1	1
Hoary-headed Grebe	*Poliocephalus poliocephalus*	1	1
Australian Shelduck	*Tadorna tadornoides*	1	1
Grey Teal	*Anas gracilis*	1	1
Straw-necked Ibis	*Threskiornis spinicollis*	1	1
Cockatoo/corella species	*Cacatua* spp.	1	1
Little Buttonquail	*Turnix velox*	1	1
Silver Gull	*Chroicocephalus novehollandiae*	3	2
Common Diving Petrel	*Pelecanoides urinatrix*	1	1
Fairy Prion	*Pachyptila turtur*	1	1
Horsfield's Bronze-cuckoo	*Chalcites basilis*	1	1
Dusky Woodswallow	*Artamus cyanopterus*	1	1
Eurasian Skylark	*Alauda arvensis*	1	1
White-throated Needletail	*Hirundapus caudacutus*	1	1
Raven species	*Corvus* spp.	7	6
Magpie-lark	*Grallina cyanoleuca*	1	1
Australian Magpie	*Cracticus tibicen*	31	24
Welcome Swallow	*Hirundo neoxena*	1	1
BAT SPECIES			
White-striped Freetail Bat	*Nyctinomus australis*	10	8
Lesser Long-eared Bat	*Nyctophilus geoffroyi*	1	1
Chocolate Wattled Bat	*Chalinolobus morio*	2	2
Gould's Wattled Bat	*Chalinolobus gouldii*	3	2

Hull *et al*. (2013a) and Smales (2015) also report that there are many species that regularly fly within the rotational height ranges of turbine blades, but are rarely or never involved in collisions. For instance, species that fly short distances, directly between two points, or for short periods of time in the air are less prone to colliding with turbines. Conversely, species that spend more time in the air, and which spend time circling or soaring at rotational blade height (e.g. raptors) are at risk of colliding with turbines. This is supported by the data collected in the present study and by O'Neill & Carlile (2016), identifying the Australian Kestrel, Red-tailed Tropicbird and Flesh-footed Shearwater (three species seen soaring or circling over the subject site) and terns (flying in a predominantly west-east

direction over the cleared paddock, i.e. longer flying times over the paddock) as species most at risk of colliding with turbines in the absence of mitigation or avoidance measures. However, Hull *et al*. (2013b) and Hull & Muir (2013) showed that Wedge-tailed Eagles learned quickly to avoid collisions with turbines at a wind farm in Tasmania, suggesting that bird populations can adapt quickly to turbines being present. Moreover, data collated by Smales (2015), together with those collected in the present study suggest that there will be few bird fatalities from collisions with turbines on Lord Howe Island, especially if Vergnet turbines (Options 1, 2A or 2B) are used and the recommendations in Section 6 of the present report are implemented.

Martin (2011) also speculates that visual acuity of birds, allowing them to avoid collisions while in flight, varies considerably between species. Therefore, some species may have a greater capacity than others to judge turbines as a potential collision risk. This was evidenced in the present study in relation to Black-winged Petrels flying over the subject site during the February 2016 surveys. Four Black-winged Petrels flew in a west-east direction over the site, the individual in front of the flock collided with the guy wires of the weather monitoring mast before continuing its flight, the other three individuals altered their course to avoid colliding with the wires. Moreover, O'Neill & Carlile (2016) observed Flesh-footed Shearwaters colliding with these guy wires on a number of occasions during their monthly surveys from October 2014 to April 2015. However, no such collisions were observed in the present study in February and March 2016, despite the observer being present on the site when the shearwaters circled overhead before returning to their roosts at the end of the day. This suggests that Flesh-footed Shearwaters had learned to avoid collisions with the guy wires by the time the 2016 surveys were conducted.

5.4 Impacts on Threatened Bird Species

Ten threatened bird taxa have been observed flying across the cleared paddock during the bird survey periods (O'Neill & Carlile 2016; present study). An additional four threatened bird taxa have the potential to fly low over the subject site, but were not observed during the bird survey periods in February, March and July 2016 (see Section 4.3). The flightless Lord Howe Woodhen also has the potential to use the small area of forest that would be cleared for widening the access track to the subject site.

Seven-part tests of significance for NSW threatened species (Appendix I) and Assessments of Significance for nationally-threatened species (Appendix J: Tables J1 & J2) conclude that significant impacts would be avoided if Vergnet turbines are used, and the avoidance and mitigation measures recommended in Section 6 of the present report are implemented.

Each XANT wind turbine design has potential to impact more significantly on the status of threatened bird species as a result of individuals flying over the subject site, especially if XANT Design A (hub height: 23 m) turbines were located at WT1 and WT2. While XANT turbines are unlikely to lead to the extinction of locally viable populations of threatened bird species or their NSW status', there is a risk of significant bird mortality, particularly among seabird populations and endemic flying land bird species, which is far less likely to occur with the Vergnet turbines.

However, impacts on threatened diurnal seabird species need to be reassessed once surveys of their flight patterns over the early part of their breeding season (September-December) have been conducted.

5.5 Impacts on Nationally-listed Migratory Bird Species

Seven listed migratory bird taxa were observed in or flying across the cleared paddock during the bird survey periods. An additional 14 migratory bird taxa have the potential to occur on or above the subject site, but were not observed during the bird survey periods in February, March and July 2016 (See Section 4.4).

National Assessments of Significance for listed migratory species (Appendix J: Tables J3 & J4) conclude that significant impacts would be avoided if Vergnet turbines are used, and the avoidance and mitigation measures recommended in Section 6 of the present report are implemented.

Each XANT wind turbine design has potential to impact more significantly on the status of migratory bird species as a result of individuals flying over the subject site, especially if XANT Design A (hub height: 23 m) turbines were located at WT1 and WT2. While XANT turbines are unlikely to lead to the extinction of locally viable or national populations of migratory bird species, there is a risk of significant bird mortality, particularly among seabird, shorebird populations and White-throated Needletails, which is far less likely to occur with the Vergnet turbines.

However, impacts on migratory diurnal seabird species need to be reassessed once surveys of their flight patterns over the early part of their breeding season (September-December) have been conducted.

6. Recommendations

Turbine Design Option

- Use the preferred wind turbine option (Option 1): Vergnet wind turbines at locations WT1 and WT2.

Pre-construction Period

- Conduct surveys of flight patterns of diurnal birds, especially seabirds, early in their breeding season (September-December) to further assess potential impacts of the turbines on the status of Lord Howe Island's bird populations. These surveys should be conducted monthly, over three consecutive days per month. They will help assess the potential impacts of each turbine option on diurnal birds involved in aerial courtship flights, nest site exploratory flights and territorial chases.

Construction Period

- Instructions regarding the biodiversity importance of the subject site and adjacent areas, and the measures to be employed by project workers to minimise biodiversity risks while on, and travelling to and from, the worksite should be a key component of the worksite induction program.

- Construction materials and any additional vehicles brought to Lord Howe Island for the project must be washed with anti-fungal solutions to prevent the further introduction of *Phytophthora* onto the island, and checked for the presence of African Big Ants, rodents and other pests prior to transportation to the subject site. The presence of introduced pests among construction material must be reported immediately to the Lord Howe Island Board and appropriate pest eradication measures implemented.

- It is preferable that the construction of the turbines on the subject site, including blasting and construction of the concrete pads, to be conducted outside the breeding season of the Flesh-footed Shearwater (November to April) to avoid disturbances to brooding adults and chicks.

- Construction wastes should be managed appropriately to prevent accidental discharge of chemicals or other pollutants into forested areas adjacent to the subject site. Construction materials should not be stored on or adjacent to the subject site once construction has been completed so that the risk of weed outbreaks in important bird habitat areas within nearby forested is minimised.

Post-construction Period

The following strategies should be included in an Adaptive Bird Management Plan that must be in place before the start of the operational phase of the project. Measures for reducing or avoiding bird fatalities from turbine collisions should be reviewed and, if necessary revised as part of the Adaptive Bird Management Plan, at least annually, or more frequently in circumstances of high bird mortality.

Turbine Operation

Strategy No. 1

- Turbine operation should be curtailed during the peak daily return period of Flesh-footed Shearwaters to the nesting and roosting colony, i.e. from 30 minutes before dusk to 3 hours after dusk (the period of peak flight activity above and adjacent to the breeding colony) during the Flesh-footed Shearwater breeding season (October – April, inclusive).

- The subject site and adjacent areas must be inspected daily for dead carcasses throughout the first breeding season post-construction. The frequency of these inspections in subsequent breeding seasons should be determined as part of the Bird Adaptive Management Plan. Any birds found dead must be sent for autopsy as soon as possible, and records kept of any deaths or injury.

- The nocturnal behaviour & movements of Flesh-footed Shearwaters in the air space above and adjacent to the site must be monitored monthly, sampling over at least three successive nights each month of the breeding cycle (October – April) to determine if there are any collisions with the turbines and their cables. Strategy Nos. 2 and/or 3 should be employed immediately in place of Strategy No. 1 under the Bird Adaptive Management Plan if significant mortality or injury to Flesh-footed Shearwaters is detected by the monitoring and site inspections.

Strategy No. 2

- Turbine operation should be curtailed each night of the Flesh-footed Shearwater breeding season (October – April, inclusive), from 30 minutes before dusk until at least 60 minutes after dawn to avoid shearwaters from colliding with rotating turbine blades. The majority of the Flesh-footed shearwaters return to the breeding colony within the first two hours after sunset, but up to 30% of the birds, many of which are non-breeding birds, fly into or out of the colony throughout the night. Curtailing turbine operation throughout the night would provide added protection to those shearwaters that are active at this time from potential collisions with rotating turbine blades.

- Monitoring of nocturnal flight patterns of Flesh-footed Shearwaters and searches for carcasses on and around the subject site should be conducted in the same manner as described for Option 1.

Strategy No. 3

Biodiversity Offsetting

Create additional nesting habitat for Flesh-footed Shearwaters in suitable habitat areas away from the turbine site as a biodiversity offset. Artificial burrows would need to be provided and monitored regularly throughout the breeding season for at least three years, as well as nests in the existing breeding colony adjacent to the turbine site, to determine the extent of breeding success and the effectiveness of compensating for mortality to Flesh-footed Shearwaters from turbine collisions. The size of the biodiversity offset and the number of artificial burrows required need to be calculated by an accredited biodiversity offset specialist in consultation with an expert in seabird ecology.

Biodiversity offsetting is recommended as a contingency measure under the Adaptive Bird Management Plan if Strategy Nos. 1 and 2 of the Plan are not successful in avoiding significant numbers of Flesh-footed Shearwater collisions with turbines.

Reporting

The results of collision and nest site monitoring should be made available at least annually to the Office of Environment and Heritage.

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Flesh-footed Shearwater Impact Report (O'Neill & Carlile, 2016)

Report to the Lord Howe Island Board on Avifauna Monitoring for the Lord Howe Island Hybrid Renewable Energy Project

Dr Lisa O'Neill and Nicholas Carlile

September 2016

Revision	Date	Prepared by (name)
Draft	8 November 2015	Lisa O'Neill
Final	23 August 2016	Lisa O'Neill
Final	7 September 2016	Lisa O'Neill
Final	9 September 2016	Lisa O'Neill

This report is prepared for the Lord Howe Island Board (LHIB), in line with a contract to monitor impacts on avifauna of a proposed aerial mast on Lord Howe Island as quoted in a preparatory document from Dr Lisa O'Neill dated September 2014.

This proposal is based on the project details as outlined in the Wind and Avifauna Monitoring Mast Installation, Geotechnical Investigations and Access Track Upgrade: Statement of Environmental Effects prepared by GHD Pty Ltd for the Lord Howe Island Board (LHIB) in August 2014. The document describes a monitoring mast proposed to be constructed in the centre of an area currently used as a cattle paddock, Special Lease 101, on a ridge-line of Transit Hill on Lord Howe Island. The mast is the first stage of a proposed Hybrid Renewable Energy Project, which would include erection of 2 wind turbines in the immediate vicinity of this mast. The monitoring mast is proposed to stay in place for a period after commissioning of the turbines, with an estimated time for removal in 2018. This would result in three aerial structures for the first few years of the proposed renewable energy project.

A draft environmental report prepared by NGH Environmental in August 2016 outlines further options to the above proposal, including an option to install a single turbine only, and to various options on solar arrays as part of the Hybrid renewable proposal.

Monitoring was targeted to record any interactions between seabirds using the airspace over this section of the island. Particular attention was given to use of the area by the Flesh-footed Shearwater, which is classified as a Vulnerable species under NSW legislation. The closest populations of FFSW are listed as "At Risk Declining" in New Zealand (Miskelly et al 2008) and globally, FFSW are listed as "Least Concern" by the IUCN.

Lord Howe Island (LHI) is the only breeding island for Flesh-footed Shearwaters (FFSW) on the east coast of Australia, and is a significant breeding site for this species globally. The largest colony of FFSW breeding on LHI (7,800 breeding pairs in 2003) is immediately adjacent to the site proposed for the wind turbine project (Priddel et al 2006). FFSW from this colony are known to use the airspace above the paddock, particularly to access the breeding site.

Recent surveys and modelling studies suggest that populations of FFSW in New Zealand, previously estimated at about 10,000 pairs (Baker et al 2010), are declining (Waugh et al 2014). The population in Western Austalia is also declining due to longline fishing bycatch (Powell et al 2007). On LHI, 36% of nesting habitat has been lost since 1978, with a consequent decline in breeding numbers (Priddel et al 2006). Other factors, such as road mortality and longline fishing bycatch are increasing mortality of FFSW on LHI (Reid et al 2013) and recent survey data from 2014 suggests that the local LHI population has declined since previous surveys (Chris Wilcox pers. comm.). A model published in 2005 using bycatch rates current at the time, suggested that current longline fishery impacts would cause a 50% decline in the LHI FFSW population of FFSW within 55 years (Baker & Wise 2005).

In this uncertain environment, the FFSW colony adjacent to the proposed renewable energy project is globally significant.

Methods

Observations of use of the airspace by seabirds were made in each month from October 2014 to April 2015 on site in Special Lease 101. Monitoring data was collected in 2014 from 2-4 October, 17-19 November and 11-13 December, and in 2015 from 28-30 January, 12 February, 25-27 February, 8-10 March, 10 April and 27-29 April. The mast was erected in November 2014 during that monitoring period.

Counts were made of seabirds using the airspace over the paddock, with a focus on the areas proposed for turbine positions – in the centre and lower sections of the paddock.

Observations were made at dawn at least once during each monthly visit, from one hour prior to dawn until there was no further activity. Observations were made around dusk on at least 3 evenings during each month of the monitoring period. Dusk monitoring started prior to dusk and continued until visibility was too restricted for reasonable observation. On most evenings this was about an hour of observations. From November, the number of birds using the airspace was counted at one minute intervals. Airspace was divided into low and high levels, estimated to correspond to below the range of turbine blades (low) and within the range of turbine blades (high).

Motion activated cameras (Buckeye XD70) were installed adjacent to three of the cable bundles supporting the monitoring mast to allow visual recording of any interactions between birds and the cables or mast. Two of the cameras were set to take 2 still images upon trigger of the motion sensor, which was programmed to activate from a half hour prior to sunset for two hours. The third camera was programmed to take video footage for one hour from sunset. The cameras were aligned to look up along the cable bundle toward the mast. While the cameras were capable of a view along the length of the cable all the way to the mast (up to 30m) during daylight or dusk, the infrared flash necessary for night images was only effective over a distance of a few metres.

Sound-recording equipment (SongMeter 2, Wildlife Acoustics) was installed on the monitoring mast to record vocalisations of seabirds using the airspace around the monitoring mast. The songmeter was set to record from half an hour prior to sunset for 2 hours and for one hour in the morning prior to dawn.

Data were downloaded from all of these devices at each monthly site visit, and analysed for bird presence and interactions.

Results

After initial observations in October 2014 before the mast was erected, we were concerned at the considerable number of birds using the airspace above the lower and mid part of the paddock where the mast site was proposed. We suggested the site for the monitoring mast be re-located to the upper part of the paddock, which we had observed to have lower bird use. The mast was subsequently installed in this upper part of the paddock. And lower sections of the cable were covered with coloured foam or other brightly coloured materials in an attempt to reduce the effect of any potential impacts and reduce the number of impacts by increasing visibility of the cabling.

Dawn observations

At dawn, small numbers of FFSW were observed to walk uphill into the paddock from the adjacent forest, prior to flying low over the forest to the north-east and out to the ocean. Many of these birds used a particular area in the centre of the paddock where there was a wedge of native vegetation extending into the paddock and a grassed slope on the lower part of the paddock from where the birds launched themselves over the forest canopy. Very few birds were observed to use the upper airspace over the island at dawn.

Observed behaviour at dawn did not vary during the monitoring period. The largest number of birds observed to be using the paddock (walk or flutter from the adjacent native vegetation into the paddock prior to launching low over the canopy) was 237 birds on 20 November 2014. Appendix 1 shows numbers of FFSW entering the paddock in Special Lease 101 from the adjacent forest.

Dusk observations

Numbers of birds using the airspace differed over the months of observation. In general though, birds were first observed above the paddock soon after sunset. Numbers increased to peak about 30 minutes after sunset and then declined slowly after that. Observations ceased when visibility was too poor to allow reasonable observations, usually about 1 hour after sunset. By this time there were few birds using the airspace.

Birds were generally observed to fly into the paddock from the eastern side of the island, rather than crossing the lagoon and the island. Many birds entered the airspace at high elevation then circled one or more times to reduce height before flying low into the forest over or under the fenceline of the paddock into the colony. Birds were observed to enter the colony earlier on days of heavy cloud cover or poor light.

There were a few bird collisions with the mast cables heard during dusk monitoring sessions. A small number of collisions were observed. None of these resulted in the bird losing flight control or falling to the ground. No birds were found injured or dead despite searches immediately after these incidents.

There were 2 birds found dead in or adjacent to the Special Lease 101 paddock during regular daytime searches of the paddock and colony edges. Both of these were sent for autopsy at Taronga Zoo. One was too decomposed for any assessment on cause of death. It was found on 19 November only a couple of days after the mast was erected. Given the extreme level of decomposition reported it is likely that this bird died prior to erection of the mast. The second bird was reported to have been injured by blunt trauma, then apparently died from brain injury. The body was found immediately beside a wooden fence that had been erected to protect the cable anchor from cattle grazing in the paddock. It seems likely that this bird died from collision with the wooden fence rather than from interaction with a cable or the mast. A cable would have been expected to deal a more acute than blunt injury on collision.

It was difficult to find any pattern to use of the airspace by the birds. There appeared to be no relation to wind direction, wind speed or cloud cover in general. Observations did not occur over a sufficient range of times within the moon phases to make any assessment of this variable. However, shearwaters are often known to prefer full darkness and fewer may return on evenings of full moon. Birds were noted to return relatively earlier on days of heavy cloud and poor natural light.

Appendix 1 shows numbers of FFSW flights observed within the airspace above the centre of the paddock in Special Lease 101 around dusk.

One observation period early in the FFSW breeding season stood out as unusual and concerning. On 19 November there was a very large concentration of birds circling high above the paddock. Several hundred and possibly up to one thousand birds were observed for several minutes to circle in the airspace before drifting away en masse. This high concentration of aerial birds occurred at a time of unusual wind direction (20^0 average wind direction at 38 metres, wind data supplied by Jacobs, LHIBs Engineers). Although this was a solitary observation, it is one of great significance. A single congregation of such a large number of birds in the immediate area proposed for a wind turbine has the potential for a mass bird strike event.

Most of the FFSW passing through the airspace were non-vocalising individuals passing once or twice through the area before descending into the forest. However, in the early months of monitoring, small groups of very vocal birds (up to 15) where seen to drift over the forest and the airspace in the Special Lease 101 for some minutes at a time. It is suspected that these were non-breeders attracting other non-breeders before eventually descending in the forest. Such groups would pose a serious collision risk as they remain in the airspace over the forest area for significant periods of time, rather than coming in directly to land as with breeding adults.

Other species observed or heard to use the airspace above the paddock included Black-winged petrels, Providence petrels, Lord Howe currawongs and Sooty terns. The petrels tended to remain high above the paddock, and rarely came to a level where there was potential for collision with the proposed turbine. The currawongs tended to remain low in the paddock, and rarely flew high enough for potential for collision. The terns passed relatively high over the paddock and only solitary birds, with few overall.

Cameras

The two still cameras took over 70,000 images, largely triggered by wind movement of the cables. Trigger incidents were difficult to detect with the limited flash capability of the cameras at night. The video camera recorded 115 hours of recordings. There were no clear recorded interactions between the seabirds using the airspace and the cables from the camera records.

Sound equipment

The data from the sound equipment was often very poor, due to wind on site making recordings too noisy for useful analysis. There were over 230 hours of sound recording, which yielded records of some bird strikes with the cables, although none of these resulted in discovery of a dead bird afterward. Some of these strikes occurred while on-site observations were being made and birds were seen to fly away after collision with the cable.

Interpretation and Recommendations

We anticipate that the greatest risk to the FFSW will arise from the turbine blades spinning within the airspace used by the birds to access their breeding grounds.

The current proposal for two wind turbines placed at the mid and lower sections of Special Lease 101 immediately adjacent to the largest breeding colony of the threatened FFSW on LHI has the strong potential to significantly impact adult survival within a proportion of the largest sub-colony of the species on the island. The uncommon but very large aggregation of birds observed in the upper airspace above the paddock is of serious concern. Although an aggregation of between 500 and 1000 birds was observed only once out of 23 evening observations during the survey period, and then only for about 5 minutes, the number of birds present at that time poses serious potential for a dramatic impact on a large number of individuals in a single incident.

Using the Precautionary Principle we recommend a combination of mitigating measures to reduce the potential risk, as outlined below. However, even with all the measures below applied, there is still potential for significant risk. If all these measures fail to remove the risk, the only solution may be shutdown of the turbine/s from dusk to dawn throughout the breeding season of the Flesh-footed Shearwater.
If the turbines were shut down from dusk to dawn throughout the breeding season, we would not anticipate the turbines to be a significant risk to the largely nocturnal FFSW when overland.

Risk Mitigation Measures

- Turbine placement

The FFSW were observed to use the airspace in the middle and lower end of the paddock far more than the upper end of the paddock. We therefore suggest that any turbine/s be placed as far as possible from the central and lower area. The sections of the paddock at the extreme top and lower western side of the Special Lease 101 paddock were the least used by the FFSW during our observations.

Our first preference would be for the existing monitoring mast to be moved to a site lower in the paddock to make room for a single turbine at the upper extremity of the paddock where bird activity was observed to be lower. A single turbine in the area of least bird use should provide the lowest risk scenario for the FFSW using this area.

Our second preference would be for a single turbine at the lower extremity of the site (near WTG1 in Jacobs Proposed Layout, Draft Environmental Report), an area used less by the FFSW than the centre of the site.

The proposed layout of two turbines at WTG1 and WTG2 are the highest risk options for the FFSW and even with other mitigation measures, could lead to significant risk to the local population.

- Regular turbine shutdown in times of highest risk

A daily shutdown of the turbine during the period of highest risk of bird strike is recommended. In this situation, a shut-down of the turbines from 15 min prior to sunset until two hours after sunset for the duration of the FFSW breeding season, 15 September to 15 May, would greatly reduce the risk of bird strike. Most birds leave well before dawn without using the upper airspace in the paddock, so a morning shut down is not considered necessary. Even with a dusk shutdown, collision risk would still remain for birds accessing the colony over the paddock during the night. From studies carried out during the chick provisioning period (which extends from late January to early May), Thulmann (2005) indicated that 'The first 2 hours from sunset accounted for 71.5% of all returning birds.' This would indicate that even a two-hour shutdown after sunset would still leave potentially 30% of breeding FFSW at risk from the movement of turbine blades during this chick provisioning period. The timing of return of breeding birds during the remaining courtship and incubation periods (September – January) is unknown. Non-breeding birds may be at greater risk of collision as they may spend more time circling in the air over the paddock than breeding birds, and during different times of night. It wasn't possible to determine the breeding status of the birds observed in the air.

- Habitat regeneration and offset

  While construction of new FFSW habitat or regeneration of damaged habitat cannot compensate for a mass bird strike incident from turbine collision, it may provide some level of offset against low level mortality due to a turbine, and potentially be a long-term advantage to the LHI FFSW population. There is potential for regeneration of habitat on and around the walking track from Middle Beach to The Clear Place, including the Valley of the Shadows. A raised pathway, for instance a wooden or metal grid platform walkway (300 mm above ground level) and regeneration of compacted substrate or installation of artificial nesting habitat, would enable FFSW to burrow under the walkway, thereby increasing habitat along the length and width of the path passing through prime FFSW habitat. It should also reduce the risk of burrow collapse from people varying off the established trail, which is a regular cause of burrow destruction at the moment. We estimate construction of a raised walkway directly above the existing track could boost the area of potential prime habitat by over 2000 m^2 (a 2.5% increase in available habitat within this subcolony).

- Adaptive Management Plan

  We recommend development of an adaptive management plan considering potential losses and appropriate responses to these. Such a plan must be prepared prior to installation and be regularly consulted and updated in line with actual responses of FFSW and other avifauna and bats to any turbines.

  The plan should be prepared in consultation with experts on these species, and specifically these species on LHI if possible. The plan should consider known natural levels of fertility and mortality, and other mortality factors as a background upon which all levels of potential risk from, and response to, the renewables project are considered. Specific triggers for temporary or longer-term shutdown of turbines should be set.

- Site monitoring

  We recommend ongoing monitoring commence during and continue after installation of turbines. It is essential that any bird interactions be monitored, and results referred to the prepared adaptive management plan for assessment of their risk and required response.

  Searches around the mast and turbines must be regular, preferably daily initially then weekly or fortnightly if more regular searches show no mortality. Any birds found dead must be sent for autopsy as soon as possible, and records kept of any deaths or injury.

  If any low numbers of deaths or injuries occur early after installation, it may be necessary to install equipment to monitor how these are occurring, to inform what type and what level of response is required.

A maximum impact trigger for dead or injured birds (as set out in the adaptive management plan) would trigger an immediate turbine shutdown pending further investigation. It is possible that the turbines could not be activated again at night until an adequate solution is found to counter a specific risk.

- FFSW colony monitoring
  Long-term monitoring of the breeding success and range of the colony immediately adjacent to the turbine area is also necessary. We recommend monitoring of breeding success annually for three years after the renewables installation, then every three years thereafter. This localized breeding success should be measured against the same breeding success monitored at other FFSW sites on the island, both within the Clear Place colony and at other islands colonies to look for signs of change over time or differences between colonies that may relate to the renewables project. The same breeding success measure should be monitored within the habitat offset area to try to gauge the success of the offset and whether it is an effective mitigation against any low level mortality caused by the turbines or other aspects of the renewable project adjacent to the FFSW breeding colony.

Situation of Solar renewables

Part of Solar area C identified in the NGH document (Figure 2.3) is within in an area used daily by the FFSW as a launch area, and for landing when entering the forest. We recommend that Area C be reduced to exclude the area most used by the FFSW. On Figure 2.3 this would be roughly from the rightmost blue mark within Solar Area C directly upward into the protruding vegetation and the whole of the area to the right. We consider the risk of FFSW hitting the solar arrays and any surrounding fencing to be high in this zone.

New technologies

New technologies are coming onto the market overseas where wind farms have become more common, particularly in Europe. Different turbine designs exist that greatly reduce the potential for bird strike, such as enclosed turbines and egg-beater style blades.

Ornithological radar is being trialled at some windfarm sites, as a means of detecting aggregations of birds, which then triggers a shutdown in the turbines. This could be investigated as a potential tool to assist in collision risk reduction.

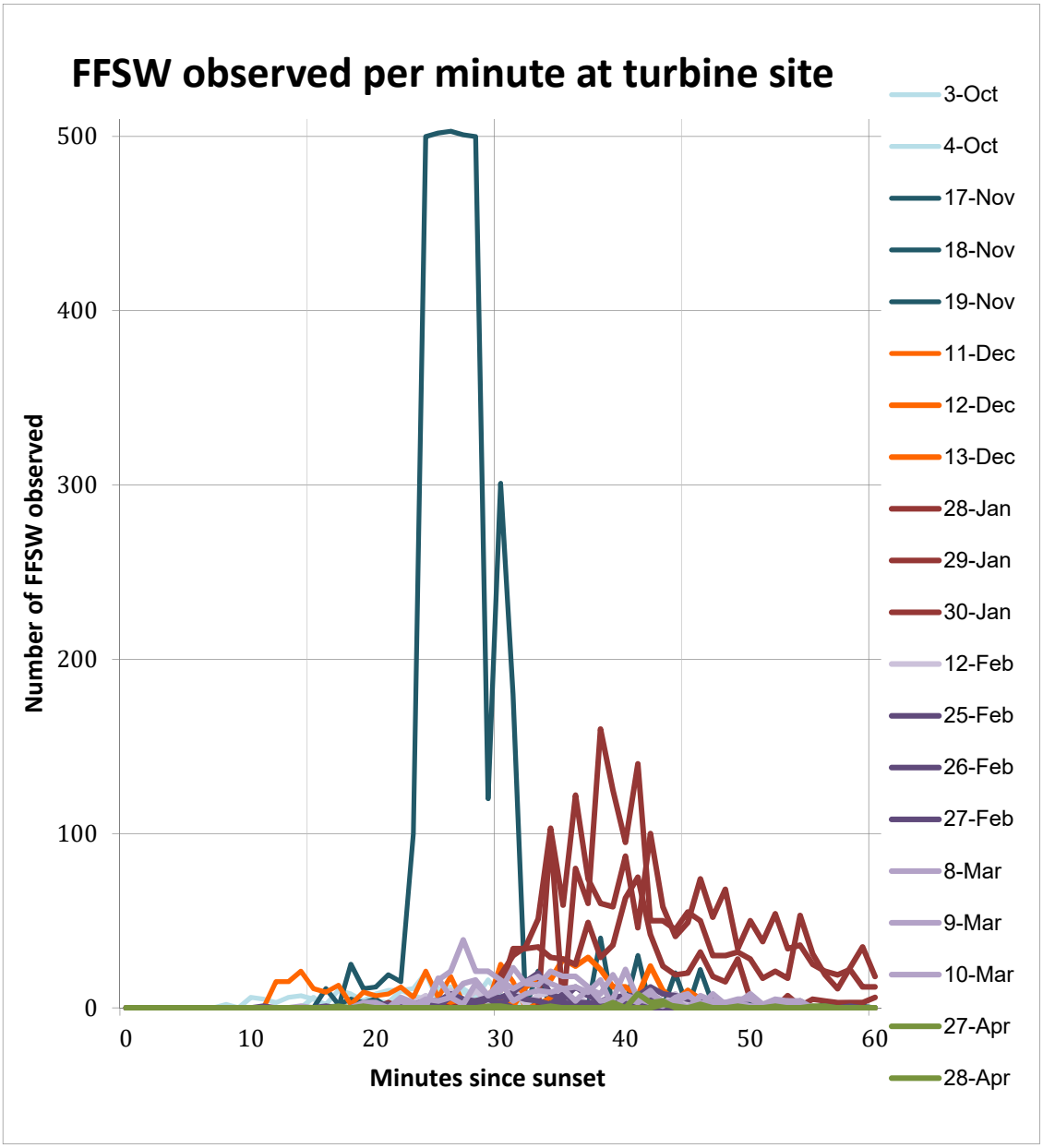
Further technological risk reduction strategies may need to be investigated if mortality levels are unacceptable.

Appendix 1 - Monitoring Results

Dawn observations of FFSW entering the Special Lease 101 paddock

November 2014		237
December		67
January 2015	132	
February		57
March	10	

Dusk observations of FFSW flights within the airspace above the Special Lease 101 paddock. Observations are number of passes through the space per minute from sunset.



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Directions of Bird Flights Over Subject Site, February, March and July 2016

Table B1 Directions and altitudinal ranges of observed bird flights over the open paddock, 21-25 February 2016.

Species	No. Observed Flights	Altitudinal Range (m)	Direction of Movement			
			N-S, S-N	E-W, W-E	NW–SE, SE-NE	NE-SW, SW-NE
Welcome Swallow	284	0-40	230	6	12	36
Lord Howe Silvereye	281	2-18	270		6	5
Australian Kestrel	38	4-70	24	4	5	5
White-throated Needletail	30	2-15	30			
Whimbrel	27	0-30	16	3	5	3
Magpie-lark	23	0-30	22			1
Pacific Golden Plover	14	0-10	10		3	1
White-faced Heron	13	0-20	8	4		1
Black Noddy	9	20-30	3	4		2
Red-tailed Tropicbird	8	15-60	6	1		1
Lord Howe Pied Currawong	8	8-50	4	2	1	1
Pacific Black Duck	8	30-50	8			
Black-winged Petrel	7	25-60	7			
Sacred Kingfisher	5	2-10	5			
Sooty Tern	5	10-20	3	1		1
Eastern Curlew	3	0-20	1		2	
Emerald Dove	4	0-2	4			
Lord Howe Golden Whistler	3	2-10	3			
White Tern	3	12-20		3		
Buff-banded Rail	2	0-1	1		1	
Eurasian Blackbird	2	2-8	2			
Common Noddy	2	20	2			
Lord Howe Woodhen	1	0				
Total bird flights	**779**		**659**	**28**	**35**	**57**
% grand total of observed flights.			**84.6**	**3.6**	**4.5**	**7.3**

Table B2 Directions and altitudinal ranges of observed bird flights over the open paddock, 15-17 March 2016.

Species	No. Observed Flights	Altitudinal Range (m)	Direction of Movement			
			N-S, S-N	E-W, W-E	NW–SE, SE-NE	NE-SW, SW-NE
Lord Howe Silvereye	178	1-18	175		1	2
White-throated Needletail	69	1-30	67			2
Welcome Swallow	47	0-15	35	7		5
Lord Howe Pied Currawong	31	0-20	21	4	5	1
Magpie-lark	27	0-16	19	5	3	
Pacific Golden Plover	27	0-12	14	10		3
Whimbrel	19	0-15	6	5	5	3
Sacred Kingfisher	18	0-10	16			2
Lord Howe Golden Whistler	12	0.5-8	9	3		
Sooty Tern	9	12-30	5	1		3
Eurasian Blackbird	8	1-10	5		3	
White-faced Heron	8	0-15	4	1	2	1
Red-tailed Tropicbird	8	25-60	6			2
Australian Kestrel	6	10-20	3	2		1
Eastern Curlew	6	0-12	2			4
White Tern	5	20-30	2			3
Emerald Dove	4	1-12	4			
Black-winged Petrel	2	12-15				2
Buff-banded Rail	2	0-1	2			
Little Shearwater	1	12-16	1			
Total bird flights	**487**		**396**	**38**	**19**	**34**
% grand total of observed flights.			**81.3**	**7.8**	**3.9**	**7.0**

Table B3 Directions and altitudinal ranges of observed bird flights over the open paddock, 3-7 July 2016.

Species	No. Observed Flights	Altitudinal Range (m)	Direction of Movement			
			N-S, S-N	E-W, W-E	NW–SE, SE-NE	NE-SW, SW-NE
Welcome Swallow	942	0 - 20	591	236	38	77
Lord Howe Silvereye	221	0.5 - 20	185	0	18	18
Magpie--lark	77	0 - 25	41	17	9	10
Sacred Kingfisher	28	0 -10	26	0	1	1
Lord Howe Golden Whistler	19	0.5 - 8	17	0	1	1
Little Egret	12	0 - 30	11	1	0	0
Lord Howe Pied Currawong	9	4 - 18	6	0	3	0
Masked Lapwing	8	0 - 20	4	0	4	0
White-throated Needletail	6	18 -20	3	0	0	3
White-faced Heron	5	0 - 15	3	0	1	1
Emerald Dove	5	1 - 6	3	0	1	1
Eurasian Blackbird	5	4 - 6	4	0	1	0
Australian Kestrel	1	12 - 15	0	0	0	1
Total bird flights	**1338**		**894**	**254**	**77**	**113**
% grand total of observed flights.			**66.8**	**19.0**	**5.8**	**8.4**

Bird Flights Over Each Survey Area on Subject Site, February, March and July 2016

Table C1 **No. of observed bird flights over each survey area in the open paddock at Transit Hill, 21-25 February 2016.**
NB: Some individual bird flights were recorded in more than one survey area.

Species	Survey Area								Total
	VP1 (East)	VP2	VP3	VP4	VP5	VP6	VP7	VP8 (West)	
Lord Howe Silvereye	14	74	88	68	18	4	1	14	281
Welcome Swallow	18	39	66	54	52	15	25	15	284
White-throated Needletail				30					30
Whimbrel			3	6	1	10	5	2	27
Australian Kestrel	4	11	7	2		8	3		35
Magpie-lark		2	6	5	2	1	5	1	22
White-faced Heron	1		1	1	3	1	1	2	10
Pacific Golden Plover			2	4	1	9	4		20
Sooty Tern	3	1					1		5
Lord Howe Pied Currawong			1	1	2	2	2		8
Sacred Kingfisher	2	1	1		1				5
Red-tailed Tropicbird	2	1	2	2	1	3	2	4	17
Pacific Black Duck								8	8
Black Noddy	4	4	4	4	6	4	4	4	34
Eastern Curlew						2		1	3
Black-winged Petrel			1				4		5
Emerald Dove		2		1	1				4
Lord Howe Golden Whistler			1	2					3
Buff-banded Rail	1	1							2
White Tern	3	3	3	3	3	3	3	3	24
Eurasian Blackbird				1	1				2
Common Noddy							2		2
Lord Howe Woodhen	1								1
Total bird flights	**53**	**139**	**186**	**184**	**92**	**62**	**62**	**54**	**832**
% grand total of observed flights.	**6.4**	**16.7**	**22.4**	**22.1**	**11.1**	**7.4**	**7.4**	**6.5**	

Table C2 **No. of observed bird flights over each survey area in the open paddock at Transit Hill, 15-17 March 2016.**
NB: Some individual bird flights were recorded in more than one survey area.

Species	Survey Area								Total
	VP1 (East)	VP2	VP3	VP4	VP5	VP6	VP7	VP8 (West)	
Lord Howe Silvereye	23	9	49	56	17	6	1	17	178
White-throated Needletail	6		8	2		45	1	8	70
Welcome Swallow	2	4	8	18	3	3	6	3	47
Lord Howe Pied Currawong	1	7	1	7	8		3	4	31
Magpie-lark	4	2	1	5	3	5	6	3	29
Pacific Golden Plover	2		2	4	14	4	1		27
Australian Kestrel	2	3	4	3	2	2	2	2	20
Whimbrel				3	6	1	9		19
Sacred Kingfisher	7	1	3	1	4		1	1	18
Sooty Tern	3	1	2	1	1	1	1	4	14
Lord Howe Golden Whistler	1	2	1	2				7	13
White-faced Heron		2	3	2	2	1			10
Red-tailed Tropicbird	3						1	5	9
White Tern						3	6		9
Eurasian Blackbird		2		2		2	1	1	8
Eastern Curlew		2	2				2		6
Emerald Dove			1				1		2
Black-winged Petrel				2					2
Buff-banded Rail							1	1	2
Little Shearwater				1					1
Total bird flights	**54**	**35**	**85**	**109**	**60**	**73**	**43**	**56**	**515**
% grand total of obs. flights.	**10.5**	**6.8**	**16.5**	**21.2**	**11.6**	**14.1**	**8.3**	**10.9**	

Table C3 **No. of observed bird flights over each survey area in the open paddock at Transit Hill, 3-7 July 2016.**
NB: Some individual bird flights were recorded in more than one survey area.

Species	Survey Area								Total
	VP1 (East)	VP2	VP3	VP4	VP5	VP6	VP7	VP8 (West)	
Welcome Swallow	12	73	276	285	274	170	70	100	1260
Lord Howe Silvereye	8	27	49	54	45	31	3	3	220
Magpie--lark	0	1	7	19	18	16	27	27	115
Sacred Kingfisher	4	9	11	2	0	1	0	0	27
Lord Howe Golden Whistler	0	4	6	4	2	2	0	2	20
Little Egret	2	1	2	3	1	2	8	1	20
Lord Howe Pied Currawong	0	3	1	1	2	1	0	0	8
Masked Lapwing	0	0	0	0	2	4	0	0	6
White-throated Needletail	0	0	0	0	0	0	6	0	6
White-faced Heron	0	0	0	2	1	0	2	0	5
Emerald Dove	1	1	1	0	2	0	0	0	5
Eurasian Blackbird	0	0	0	2	2	0	0	0	4
Australian Kestrel	0	0	0	1	0	0	0	0	1
Total bird flights	**27**	**119**	**353**	**373**	**349**	**227**	**116**	**133**	**1697**
% grand total of obs. flights.	**1.6**	**7.0**	**20.8**	**22.0**	**20.6**	**13.4**	**6.8**	**7.8**	

Altitudinal Distributions of Bird Flights Over the Subject Site , February, March and July 2016

Table D1 **No. of observed bird flights across a range of altitudes over the open paddock at Transit Hill, 21-25 February 2016.**
NB: Some individual bird flights were recorded in more than one altitude category.

Species	Altitude of bird flights (m)							Total
	0.0-4.0	4.1-8.0	8.1-12.0	12.1-16.0	16.1-20.0	20.1-24.0	> 24.0	
Lord Howe Silvereye	60	173	172	37	4			446
Welcome Swallow	244	65	39	19	16	14	2	399
White-throated Needletail	6	30	24	18				78
Whimbrel	16	20	18	8	4	1	1	68
Australian Kestrel		2	6	10	6	8	24	56
Magpie-lark	20	16	6				1	43
White-faced Heron	7	4	6	3	1			21
Pacific Golden Plover	12	5	3					20
Sooty Tern			1	4	5			10
Lord Howe Pied Currawong			2	3	2		2	9
Sacred Kingfisher	1	4	4					9
Red-tailed Tropicbird				2	1	1	5	9
Pacific Black Duck							8	8
Black Noddy					2		4	6
Eastern Curlew	1	1	1	1	2			6
Black-winged Petrel							4	4
Emerald Dove	4							4
Lord Howe Golden Whistler	1	1	2					4
Buff-banded Rail	2	1	1					4
White Tern				1	2			3
Eurasian Blackbird	1	1	1					3
Common Noddy					2			2
Lord Howe Woodhen	1							1
Total bird flights	**376**	**323**	**286**	**106**	**47**	**24**	**51**	**1213**
% grand total of observed flights.	**31.0**	**26.7**	**23.6**	**8.7**	**3.9**	**2.0**	**4.2**	

Table D2 **No. of observed bird flights across a range of altitudes over the open paddock at Transit Hill, 15-17 March 2016.**
NB: Some individual bird flights were recorded in more than one altitude category.

Species	Altitude of bird flights (m)							Total
	0.0-4.0	4.1-8.0	8.1-12.0	12.1-16.0	16.1-20.0	20.1-24.0	> 24.0	
Lord Howe Silvereye	42	68	122	21	4			257
White-throated Needletail	11	10	34	46	23		2	126
Welcome Swallow	32	16	7	1				56
Lord Howe Pied Currawong	9	10	13	12	5			49
Whimbrel	16	10	13					39
Magpie-lark	18	8	11	1				38
Pacific Golden Plover	23	4	8					35
White-faced Heron	5	4	8	4	2			23
Sacred Kingfisher	11	7	4					22
Lord Howe Golden Whistler	10	8						18
Sooty Tern				6	1	3	3	13
Red-tailed Tropicbird							9	9
White Tern						4	4	8
Emerald Dove	3	2	2	1				8
Eurasian Blackbird	3	3	1					7
Australian Kestrel			2	2	2			6
Eastern Curlew	2	2	2					6
Black-winged Petrel				2				2
Buff-banded Rail	2							2
Little Shearwater			1					1
Total bird flights	**187**	**152**	**228**	**96**	**37**	**7**	**18**	**725**
% grand total of observed flights.	**25.8**	**21.0**	**31.4**	**13.2**	**5.1**	**1.0**	**2.5**	

Table D3 **No. of observed bird flights across a range of altitudes over the open paddock at Transit Hill, 3-7 July 2016.**
NB: Some individual bird flights were recorded in more than one altitude category.

Species	Altitude of bird flights (m)							Total
	0.0-4.0	4.1-8.0	8.1-12.0	12.1-16.0	16.1-20.0	20.1-24.0	> 24.0	
Welcome Swallow	873	88	32	4	2	0	0	999
Lord Howe Silvereye	43	123	100	11	5	0	0	282
Magpie--lark	51	38	22	11	3	0	1	126
Sacred Kingfisher	21	9	0	0	0	0	0	30
Little Egret	4	3	6	6	1	0	1	21
Masked Lapwing	6	4	4	5	2	0	0	21
Lord Howe Golden Whistler	17	2	2	0	0	0	0	21
Lord Howe Pied Currawong	2	1	6	0	0	0	0	9
White-faced Heron	4	1	1	2	0	0	0	8
White-throated Needletail	0	0	0	0	6	0	0	6
Emerald Dove	4	1	0	0	0	0	0	5
Eurasian Blackbird	2	1	0	0	0	0	0	3
Australian Kestrel	0	0	0	0	1	0	0	1
Total bird flights	**1027**	**271**	**173**	**39**	**20**	**0**	**2**	**1532**
% grand total of observed flights.	**67.0**	**17.7**	**11.3**	**2.5**	**1.3**	**0.0**	**0.1**	

Predicted Bird Collisions with 200 kW Vergnet Turbine, February, March and July 2016

The number of bird flights observed 21-25 February 2016 (Table E1) and 15-17 March 2016 (Table E2) that would have potentially resulted in collisions with the rotating blades of a 200 kW Vergnet Wind Turbine (hub height 55 m, blade length 15 m) at three locations (WT1, WT2 & current location of wind monitoring mast).

NB: None of the bird flights observed 3-7 July 2016 would have potentially resulted in collisions with the rotating blades of a 200 kW Vergnet Wind Turbine.

Table E1: 21-25 February 2016

Species	No. Observed Flights	WT1		WT2		Wind Monitoring Mast	
		No. predicted collisions	% observed flights	No. predicted collisions	% observed total flights	No. predicted collisions	% observed flights
Australian Kestrel	38					3	7.9
Red-tailed Tropicbird	8					3	37.5
Lord Howe Pied Currawong	7					1	14.3
Black-winged Petrel	7					1	14.3
Total	**60**	**0**	**0.0**	**0**	**0.0**	**8**	**1.0**
No. of Species		**0**		**0**		**4**	

Table E2: 15-17 March 2016

Species	No. Observed Flights	WT1		WT2		Wind Monitoring Mast	
		No. predicted collisions	% observed flights	No. predicted collisions	% observed total flights	No. predicted collisions	% observed flights
Red-tailed Tropicbird	8	2	25.0			2	25.0
White Tern	5					2	40.0
Total	**13**	**2**	**0.4**	**0**	**0.0**	**4**	**0.8**
No. of Species		**1**		**0**		**2**	

Predicted Bird Collisions with 100 kW XANT Turbine (Hub Ht 23 m), February, March and July 2016

Table F1

The number of bird flights observed 21-25 February 2016 that would have potentially resulted in collisions with the rotating blades of a 100 kW XANT Wind Turbine (Design A: hub height 23 m, blade length 10.5 m) at three locations (WT1, WT2 & current location of wind monitoring mast).

Species	No. Observed Flights	WT1		WT2		Wind Monitoring Mast	
		No. predicted collisions	% observed flights	No. predicted collisions	% observed flights	No. predicted collisions	% observed flights
Lord Howe Silvereye	296	2	0.6	13	4.4	9	3.0
Welcome Swallow	292	4	1.4	13	4.6	5	1.8
Australian Kestrel	38	3	7.9	3	7.9	13	34.2
Whimbrel	27	1	3.7	3	11.1		
Pacific Golden Plover	14	1	7.1	2	14.3		
White-faced Heron	13	1	7.7	2	15.4	1	7.7
Black Noddy	12	5	41.7	7	58.3	8	66.7
Red-tailed Tropicbird	8	3	37.5	1	12.5	2	25.0
Black-winged Petrel	7	3	42.8				
Lord Howe Pied Currawong	7			1	14.3		
Sooty Tern	6	1	16.8			5	83.3
Total	**720**	**24**	**3.0**	**45**	**5.7**	**43**	**5.4**
No. of Species		**10**		**9**		**7**	

Table F2

The number of bird flights observed 15-17 March 2016 that would have potentially resulted in collisions with the rotating blades of a 100 kW XANT Wind Turbine (Design A: hub height 23 m, blade length 10.5 m) at three locations (WT1, WT2 & current location of wind monitoring mast).

Species	No. Observed Flights	WT1		WT2		Wind Monitoring Mast	
		No. predicted collisions	% observed flights	No. predicted collisions	% observed flights	No. predicted collisions	% observed flights
Lord Howe Silvereye	178			12	6.7	5	2.8
White-throated Needletail	69	16	23.2			6	8.7
Welcome Swallow	47	3	6.4	1	2.1		
Whimbrel	19	2	10.5				
Sooty Tern	9	4	44.4	1	11.1	1	11.1
Red-tailed Tropicbird	8	1	12.5	2	25.0		
Lord Howe Pied Currawong	31	1	3.2	6	19.4	5	16.1
Australian Kestrel	6	2	33.3			3	50.0
White Tern	5	5	100.0				
Magpie-lark	27			2	7.4		
Black-winged Petrel	2			2	100.0		
Little Shearwater	1			1	100.0		
White-faced Heron	8			2	25.0		
Total	**410**	**34**	**7.0**	**29**	**6.0**	**20**	**4.1**
No. of Species		**8**		**9**		**5**	

Table F3

The number of bird flights observed 3-7 July 2016 that would have potentially resulted in collisions with the rotating blades of a 100 kW XANT Wind Turbine (Design A: hub height 23 m, blade length 10.5 m) at three locations (WT1, WT2 & current location of wind monitoring mast).

Species	No. Observed Flights	WT1		WT2		Wind Monitoring Mast	
		No. predicted collisions	% observed flights	No. predicted collisions	% observed flights	No. predicted collisions	% observed flights
Welcome Swallow	942			2	0.2	1	0.1
Lord Howe Silvereye	221			9	4.1		
Magpie-lark	77	4	5.2	5	6.5		
Little Egret	12	4	33.3	1	8.3		
Masked Lapwing	8	3	37.5				
White-throated Needletail	6	6	100.0				
White-faced Heron	5			1	20.0		
Australian Kestrel	1			1	100.0		
Total	**1272**	**17**	**1.2**	**19**	**1.4**	**1**	**0.07**
No. of Species		**4**		**6**		**1**	

Predicted Bird Collisions with 100 kW XANT Turbine (Hub Ht 31.5 m), February, March and July 2016

The number of bird flights observed 21-25 February 2016 (Table G1) and 15-17 March 2016 (Table G2) that would have potentially resulted in collisions with the rotating blades of a 100 kW XANT Wind Turbine (Design B: hub height 31.5 m, blade length 10.5 m) at three locations (WT1, WT2 & current location of wind monitoring mast).

NB: None of the bird flights observed 3-7 July 2016 would have potentially resulted in collisions with the rotating blades of a 100 kW XANT Wind Turbine (Design B).

Table G1 (21-25 February 2016)

Species	No. Observed Flights	WT1		WT2		Wind Monitoring Mast	
		No. predicted collisions	% observed flights	No. predicted collisions	% observed flights	No. predicted collisions	% observed flights
Welcome Swallow	292	3	1.1				
Australian Kestrel	38	3	7.9	3	7.9	11	28.9
Whimbrel	27			1	3.7		
Black Noddy	12	1	8.3	2	16.7	5	41.7
Red-tailed Tropicbird	8	2	25.0	4	50.0	1	12.5
Lord Howe Pied Currawong	7			2	28.6		
Total	**384**	**9**	**1.1**	**12**	**1.5**	**17**	**2.1**
No. of Species		**4**		**5**		**3**	

Table G2 (15-17 March 2016)

Species	No. Observed Flights	WT1		WT2		Wind Monitoring Mast	
		No. predicted collisions	% observed flights	No. predicted collisions	% observed flights	No. predicted collisions	% observed flights
Sooty Tern	9	3	33.3				
Red-tailed Tropicbird	8	2	25.0	2	25.0		
White Tern	5	3	60.0				
Total	**22**	**8**	**0.6**	**2**	**0.4**	**0**	**0.0**
No. of Species		**3**		**1**		**0**	

Predicted Bird Collisions with 100 kW XANT Turbine (Hub Ht 38 m), February, March and July 2016

The number of bird flights observed 21-25 February 2016 (Table H1) and 15-17 March 2016 (Table H2) that would have potentially resulted in collisions with the rotating blades of a 100 kW XANT Wind Turbine (Design C: hub height 38 m, blade length 10.5 m) at three locations (WT1, WT2 & current location of wind monitoring mast).

NB: None of the bird flights observed 3-7 July 2016 would have potentially resulted in collisions with the rotating blades of a 100 kW XANT Wind Turbine (Design C).

Table H1 (21-25 February 2016)

Species	No. Observed Flights	WT1		WT2		Wind Monitoring Mast	
		No. predicted collisions	% observed flights	No. predicted collisions	% observed flights	No. predicted collisions	% observed flights
Welcome Swallow	292	3	1.1				
Australian Kestrel	38					5	13.2
Whimbrel	27			1	3.7		
Pacific Golden Plover	14	1	7.1				
Black Noddy	12					3	25.0
Red-tailed Tropicbird	8	1	12.5			1	12.5
Lord Howe Pied Currawong	7	1	14.3				
Total	**398**	**6**	**0.8**	**1**	**0.1**	**9**	**1.1**
No. of Species		**4**		**1**		**3**	

Table H2 (15-17 March 2016)

Species	No. Observed Flights	WT1		WT2		Wind Monitoring Mast	
		No. predicted collisions	% observed flights	No. predicted collisions	% observed flights	No. predicted collisions	% observed flights
White-throated Needletail	69			2	2.9		
Sooty Tern	9	3	33.3				
Red-tailed Tropicbird	8	3	37.5	2	25.0	2	25.0
White Tern	5	3	60.0			2	40.0
Total	**22**	**9**	**1.8**	**4**	**0.8**	**4**	**0.8**
No. of Species		**3**					

Seven-part Tests of Significance

APPENDIX I
SEVEN-PART TESTS OF SIGNIFICANCE

INTRODUCTION

The Seven-Part Test is a standard set of questions devised by the Scientific Committee established under the *Threatened Species Conservation Amendment Act 2002.* The Test should be applied individually to all threatened species, populations and ecological communities and their habitats that are to be, or likely to be, on the site to be developed.

The results of a Seven-Part Test help determine the nature and significance of impacts of the proposed development or activity on threatened species, populations or ecological communities, or their habitats, and whether the preparation of *Species Impact Statement* (SIS) is required.

An SIS provides a more detailed assessment of threatened biota issues and proposes measures to manage and mitigate adverse impacts on the threatened species, populations or ecological communities, or their habitats, resulting from the proposal.

Appendix I provides Seven-part tests for threatened bird taxa listed below in relation to the proposed development. These tests assume that the recommendations for minimising or avoiding bird impacts, discussed in Section 6 of the present report, are implemented.

Family Procellaridae (Shearwaters and Petrels)

- Little Shearwater (*Puffinus assimilis*)
- Flesh-footed Shearwwater (*Ardenna carneipes*)
- Kermadec Petrel (west Pacific subspecies) (*Pterodroma neglecta neglecta*)
- Black-winged Petrel (*Pterodroma nigripennis*)
- Providence Petrel (*Pterodroma solandri*).

Other Coastal Seabirds (Families Sulidae, Phaethontidae & Laridae)

- Masked Booby (*Sula dactyla*)
- Red-tailed Tropicbird (*Phaethon rubricauda*)
- White Tern (*Gygis alba*)
- Sooty Tern (*Onychoprian fuscata*)
- Grey Ternlet (*Procelsterna cerulea*)

Migratory Shorebirds

- Eastern Curlew (*Numenius madgascariensis*)
- Curlew Sandpiper (*Calidris ferruginea*)

Terrestrial birds

- Lord Howe Woodhen (*Gallirallus sylvestris*)
- Lord Howe Golden Whistler (*Pachycephala pectoralis contempta*)
- Lord Howe Pied Currawong (*Strepera graculina crissalis*)
- Lord Howe Silvereye (*Zosterops lateralis tephropleurus*).

SHEARWATERS AND PETRELS (FAMILY PROCELLARIDAE)

1. SPECIES PROFILES

Little Shearwater (*Puffinus assimilis*).

This shearwater has the typically "shearing" flight of the genus, dipping from side to side on stiff wings with few beats, the wingtips almost touching the water, though in light winds it has a more flapping flight than that of its larger relatives. In flight it looks cross-shaped, with its wings held at right angles to the body, its coloration changing from black to white as the black upperparts and white underparts are alternately exposed as it travels low over the sea. At 25–30 cm in length, with a 58–67 cm wingspan, it is like a small Manx shearwater but has proportionally shorter and broader wings, with a pale area on the inner flight feathers. Its bill is more slender than that of Manx, and its dark eye stands out against the surrounding white area.

This species occurs throughout the oceans south of the Tropic of Capricorn. It breeds in colonies on islands and coastal cliffs, nesting in burrows which are only visited at night to avoid predation by large gulls. It is a gregarious species, which can been seen in large numbers from boats or headlands, especially on migration in autumn. It feeds on fish and molluscs. It does not follow boats. It is silent at sea, but at night the breeding colonies are alive with raucous cackling calls.

mtDNA cytochrome *b* sequence data indicate that the former North Atlantic little shearwater group (Boyd's shearwater, *P. boydi* and Barolo shearwater, *P. baroli*) is closer to Audubon's shearwater, (although many taxonomists now consider them to be distinct species), and Rapa shearwater (*P. myrtae*), being closer to the Newell's and possibly Townsend's shearwater. Heinroth's shearwater was also sometimes considered a subspecies of this bird; the relationship between the little and Audubon's shearwater is probably not as close as long believed. The subantarctic shearwater was also considered conspecific.

Threats to the status of this species in NSW include:

- Weed infestation of nesting habitat, particularly by Asparagus Fern.
- Predation by rodents at the nesting grounds.
- Potential effects of invasion by exotic species and/or pathogens.
- Big-headed ants, why prey upon chicks and disturb nests.

Flesh-footed Shearwater (*Ardenna carneipes*).

This species is a large blackish-brown shearwater with flesh-coloured feet. The large bill is straw coloured with a dark tip and the eyes are brown.

Flesh-footed Shearwaters breed on 41 islands off the coast of south-western Australia, on Smith Island off the south-eastern coast of the Eyre Peninsula in South Australia, on Philip Island, off Norfolk Island and on Lord Howe Island. Extralimitally, it breeds on St Paul Island in the Indian Ocean and on islands off New Zealand of which 10 are important (Marchant & Higgins 1990; Priddel *et al.* 2010). On Lord Howe Island, at least 5 ha of breeding habitat has been lost through clearing (Fullagar & Disney 1981) and the remaining breeding grounds have contracted from 37.8 ha in 1978 to 24.3 ha in 2002 (Priddel *et al*. 2006).

At sea, western birds are thought to migrate through the Indian Ocean and Indonesia to join birds from the east in the north-west Pacific Ocean (BirdLife International 2011a).

Burbidge & Fuller (1996) estimated the population to be about 350,000 pairs, mostly in WA where the population was estimated at 100,000 – 310,000 pairs in 1996. However, Lavers (2014) estimated the world population to be as little as 74,000 pairs. The population on Lord Howe Island was estimated at 17,500 pairs (Priddel *et al*. 2006), in SA about 150 pairs (Copley 1996), and on St Paul Island and around New Zealand 10,000 pairs (Baker *et al.* 2011). The population on Lord Howe Island declined by around 19% from 1978 to 2002-2003 (Priddel *et al*. 2006) with further declines subsequently (Reid 2010). The fishing effort has been sufficient to cause a decline of 50% within 55 years (Baker & Wise 2005). The Flesh-footed Shearwater sub-colony at Clear Place (i.e. in forested areas immediately adjacent to the proposed turbine site) could be as much as 10% of the species' global population (see Priddel *et al.* 2006, Figure 1).

Flesh-footed Shearwaters nest in burrows under trees or shrubs. On Lord Howe Island it favours the flatter areas in the central lowlands (Priddel *et al*. 2006). Most feeding occurs offshore over continental shelves where it feeds on fish and squid, caught mostly by pursuit-plunging (Marchant & Higgins 1990). They readily take baits from longlines (Baker & Wise 2005). A generation time of 18.3 years (BirdLife International 2011a) is derived from an average age at first breeding of 5.8 years and an annual survival of adults of 92.0%, both extrapolated from congeners.

Threats to the status of this species in NSW include:

- Increased mortality rates due to the ingestion of floating plastic while foraging.
- Taking of Flesh-footed Shearwater as a by-catch by Long-line fishing vessels.
- Urbanisation and spread of development within and extending the settlement area - takes over breeding areas and disturbs breeding areas.
- Conflict with Island residents through birds burrowing under homes.
- Trampling of breeding grounds by grazing cattle.
- Invasion of burrows by Kikuyu.
- Herbicide use near breeding areas.
- Predation by dogs.
- Increased mortality due to road kills (mostly on Ned's Beach Road, Anderson Road, Muttonbird Drive and Skyline Drive on Lord Howe Island).
- Potential for predation on chicks / eggs at nests.

Kermadec Petrel (west Pacific subspecies) (*Pterodroma neglecta neglecta*)

This is a medium-sized petrel. Several colour phases from dark brown over the whole body, with a few flecks of grey on the face to a lighter form which is sooty brown above with pale grey head and white underparts. The darker form is characteristic at Lord Howe Island. Tail short and square cut. There are white markings on upper wings. The bill is short and black, the legs and feet flesh-coloured, and the eyes are dark brown.

This subspecies ranges over subtropical and tropical waters of the South Pacific. Balls Pyramid (near Lord Howe Island) and Phillip Island (near Norfolk Island) are the only known breeding sites in Australian waters.

Small numbers (10-100 pairs) nest on Ball's Pyramid, south of Lord Howe Island and on Phillip Island near Norfolk Island (10-100 pairs; Priddel *et al*. 2010). It was last recorded nesting on Lord Howe Island in 1913 (McAllan et al. 2004).

Kermadec Petrels typicall nests on the surface in loose colonies among rocks and vegetation. On Ball's Pyramid it nests only on steep cliffs above 400 m (Brown 1979). On Phillip Island it nests

under stands of African Olive (*Olea europea cuspidata*) (Priddel *et al*. 2010). This species is marine and highly pelagic, rarely approaching land except at colonies. Little is known about its diet, though squid and crustaceans have been recorded as prey (Marchant & Higgins 1990). A generation time of 15.9 years (Birdlife International 2011b) is derived from the average age at first breeding of 6.1 years and an annual survival of adults of 89.5%, both extrapolated from congeners.

Threats to the status of this species in NSW include:

- Possible introduction of the Black Rat to offshore islands.
- Risk of local extinction due to small population size.

Black-winged Petrel (*Pterodroma nigripennis*)

This species is a small petrel, pale grey above and white below with bold black markings under the wing and a black patch around each eye. Bill black, legs and feet pale flesh coloured, eye brown.

Black-winged Petrels range throughout the Tasman Sea and Central Pacific Ocean, breeding at various island groups including Lord Howe Island. In recent years they have expanded their range.

Nests at numerous sites on Lord Howe Island: North Head, New Gulch, Dawson's Ridge, Malabar, Ned's Beach, Jim's Point, Transit Hill, adjacent to Muttonbird Point, Red Point and Ball's Pyramid. The nest is in a burrow, up to a metre long in sandy soil, but shorter in stony volcanic soil. The burrow is located on higher ground, and the entrance is usually hidden amongst bushes.

Threats to the status of this species in NSW include:

- Masked Owl predation.
- Impact of weeds, particularly Asparagus Fern on habitat.
- Predation by introduced rodents.
- Potential effects of invasion by exotic species / pathogens.
- African big-headed ants; eat and kill small chicks on the nest.

Providence Petrel (*Pterodroma solandri*)

The Providence Petrel is a robustly built petrel, dark grey in general colour with a brown-grey head with fine, white scalloping on the face and forehead and cream triangular patches under the wing. Bill is stout and black, eyes dark brown and feet are generally black, sometimes with pale grey webbing.

The species ranges across the eastern Pacific. The only known breeding sites are at Lord Howe Island and Philip Island, offshore from Norfolk Island. It also bred previously on main Norfolk Island, but was extinct there by 1800.

Approximately 32,000 pairs nest on Mt Gower and Mt Lidgbird (Bester 2003) with some nesting on lower slopes and on Northern Hills. Only 10-100 pairs nest on Phillip Island (Priddel *et al*. 2010). The population on Norfolk Island was once very large: from 1790 to 1793 about one million adults and young were harvested (Medway 2002).

Providence Petrels breed in burrows in the ground, often within rainforest. At sea they generall prefer warm waters for foraging, taking fish, cephalopods, crustaceans and offal, and will forage near fishing boats (Marchant & Higgins 1990). A generation time of 15.9 years (BirdLife International

2011c) is derived from the average age at first breeding of 6.1 years and an annual survival of adults of 89.5%, both extrapolated from congeners.

Threats to the status of this species in NSW include:

- Predation of eggs and young by rodents at the nesting grounds.
- Disturbance of birds and habitat by tourist activities.
- The species is susceptible to extinction via stochastic processes due to its small known population size and restricted distribution.
- Entry of unknown pathogens / exotic species to the island - potential to cause local extinction in a short timeframe.
- Pet cats and feral populations prey on nest contents and adults.

2. SEVEN-PART TEST

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

Little Shearwater

In Australia, the Little Shearwater is estimated to occur in two sub-populations that, based on the biology of the taxon, are probably genetically-isolated. Earlier estimates of between 1000 and 10 000 breeding pairs, including 4000 pairs on Roach Island in the Lord Howe group are believed to be over-estimates. More recent estimates put the population on Roach Island at between 400 and 1000 pairs, and the total population in the Lord Howe group at approximately 4000 pairs.

One individual was observed flying over the subject site during the March 2016 surveys. Although the Little Shearwater has been recorded nesting on Transit Hill, the main breeding sites on Lord Howe Island are Roach Island, Muttonbird Island, Blackburn Island and on the main Island at Muttonbird Point. The proposed development will not impact on these main breeding areas.

Small numbers of Little Shearwaters are likely to fly over the subject site while moving between breeding colonies and oceanic foraging areas. The risk of collision with the turbines is considered negligible because Little Shearwaters are likely to be flying above the height of the Vergnet turbines, operation of the turbines would be curtailed during the peak periods around dusk when shearwaters are returning to their colonies for the night, and the turbine blades and guy wides would be made more visible through the use of red flashing lights. Therefore, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of Little Shearwaters such that the local viable population would be placed at risk of extinction.

Flesh-footed Shearwater

Most breeding populations of the Flesh-footed Shearwater within Australian jurisdiction are poorly known. This lack of information makes it difficult to assess which breeding populations are most important for the persistence of the species within Australian waters. Of the breeding populations whose numbers have been estimated, the most important, based purely on size, are those on Sandy Island (300 000 pairs), Lord Howe Island (17 462 pairs), Eclipse Island (6000–8000 pairs), Breaksea Island (1000–5000 pairs), Flat Island (1000–1500 pairs) and Wickham Island (1000–1500) pairs. The breeding population on Lord Howe Island consisted of an estimated 20 000–40 000 pairs in 1978 and an estimated 17 462 pairs in 2002–2003. Estimates of the total number of nesting burrows

present on the island at these times suggest that the breeding population declined by around 19% from 1978 to 2002–2003. This declining trend continues.

The Lord Howe Island colony occurs in forest from Ned's Beach to Clear Place, including forest areas down-slope (west) of the cleared paddock. The Flesh-footed Shearwater sub-colony at Clear Place (i.e. in forested areas immediately adjacent to the proposed turbine site) could be as much as 10% of the species' global population. These areas would be protected provided that the construction footprint is contained within the cleared paddock area and along the parts of the access track that need to be widened. Foraging areas on the ocean will not be impacted by the proposed development. Breeding behaviour on Lord Howe Island is unlikely to be impacted provided that turbine construction occurs outside the peak breeding periods.

Many Flesh-footed Shearwaters repeatedly soar or circle over the subject site upon their return to the colony around dusk. It is proposed to curtail the use of turbines for up to 4 hours around dusk (two hours prior to dusk to two hours after dusk) during the breeding season to avoid shearwater collisions with the turbine blades. It is also recommended that the turbine blades and guy wires be fitted with rows of small flashing red navigation lights to make the turbines more visible to birds, especially during periods of inclement weather and low cloud cover.

The risk of collisions with turbines would be minimised through the use of Vergnet turbines, curtailing the turbine use during the peak colony arrival times around dusk each day (Strategy No. 1) or throughout the entire night (Strategy 2) during the breeding season (September to April), as part of the Adaptive Bird Management Plan (see Section 6 of main report: Recommendations – Post-construction Period). If either of these two strategies does not avoid significant mortality or injury to Flesh-footed Shearwaters, then it is proposed to create additional nesting areas for the Flesh-footed Shearwaters, through the provision of artificial burrows, in suitable habitat areas away from the subject site (biodiversity offsetting). Flesh-footed Shearwaters use artificial burrows readily for nesting. The provision and use of additional nesting areas by Flesh-footed Shearwaters would be sufficiently set up to offset the mortality impacts of turbine operation, if those impacts occurred.

Foraging areas at sea will not be impacted by the proposed development.

Construction materials and any additional vehicles brought to Lord Howe Island for the project must be washed with anti-fungal solutions to prevent the further introduction of *Phytophthora* onto the island, and checked for the presence of African Big Ants, rodents and other pests prior to transportation to the subject site. The presence of introduced pests among construction material must be reported immediately to the Lord Howe Island Board and appropriate pest eradication measures implemented.

If the above-mentioned mitigation and avoidance measures are implemented, then the construction and operation of the wind turbines have a minimal risk of adversely impacting the status of Flesh-footed Shearwaters such that the local viable population would be placed at risk of extinction.

<u>Kermadec Petrel (western Pacific subspecies)</u>

Small numbers (10-100 pairs) nest on Ball's Pyramid, south of Lord Howe Island, the only known nesting colony in NSW waters. It was last recorded nesting on Lord Howe Island in 1913. The proposed development would not impact on breeding colonies.

This species spends most of its time at sea and, although it has the potential to fly over Lord Howe Island, the likelihood of individuals flying low over the subject site is minimal. Kermadec Petrels are

likely to be flying above the height of the Vergnet turbines, operation of the turbines would be curtailed during the peak periods around dusk when petrels are returning to their colony on Ball's Pyramid for the night, and the turbine blades and guy wides would be made more visible through the use of red flashing lights. Therefore, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of Kermadec Petrels such that the local viable population would be placed at risk of extinction.

Black-winged Petrel

There are no population estimates for this species in NSW or over a broader geographical region. The Lord Howe Island breeding colony is likely to be part of a larger population that breeds in the south-west Pacific, from Lord Howe Island and eastern Australia in the west, New Caledonia in the north, the Chatham Island in the south and Austral Islands (French Polynesia) in the east. Outside the breeding season it migrates to the north and east Pacific, being common in the north-west Pacific in July - November, and particularly abundant between the Hawaiian Islands and Peru. It nests at numerous sites on Lord Howe Island: North Head, New Gulch, Dawson's Ridge, Malabar, Ned's Beach, Jim's Point, Transit Hill, adjacent to Muttonbird Point, Red Point and Ball's Pyramid. Although the subject site is not breeding habitat, Black-winged Petrels are known to nest in burrows in forested areas adjacent to it. The proposed development would not impact on these forested habitats provided that construction and operational activities are confined to the subject site.

Black-winged Petrel individuals have been observed performing courtship flights during the day above the subject site early in the breeding season. Therefore, individuals engaged in this activity are at risk of colliding with the turbines. However, the numbers of Black-winged Petrels that fly over the subject site are likely to be a negligible proportion of the total NSW population and not all these flight paths would intersect with the rotational areas of the turbine blades. Observations made during the 2016 survey periods also suggest that Black-winged Petrels have the ability to alter their flight paths to avoid human-built structures. The use of Vergnet turbines at WT1 and WT2 are also likely to minimise collisions because they would be below the flight heights of Black-winged Petrels observed flying over the subject site during the 2016 surveys.

Therefore, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of Black-winged Petrels such that the local viable population would be placed at risk of extinction.

Providence Petrel

The total population size of the Providence Petrel is estimated to be just over 100 000 birds. Approximately 32,000 pairs nest on Mt Gower and Mt Lidgbird with some nesting on lower slopes and on Northern Hills. The proposed development would not impact on these nesting habitats or their use by the Providence Petrel.

No Providence Petrels have been observed flying over the subject site during bird surveys. However, there is potential for small numbers to do so while moving between breeding colonies and oceanic foraging areas, or when involved in courtship flights. The numbers of Providence Petrels that may fly over the subject site are likely to be a negligible proportion of the total NSW population and not all these flight paths would intersect with the rotational areas of the turbine blades. The use of Vergnet turbines at WT1 and WT2 are also likely to minimise collisions because they would be below the expected flight heights of Providence Petrels at that location.

Therefore, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of Providence Petrels such that the local viable population would be placed at risk of extinction.

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

Not applicable. The shearwaters and petrels are listed as threatened species rather than endangered populations.

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
- **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Not applicable. The seabird species are listed as threatened species rather than as an endangered or critically endangered ecological community.

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

(i) No known habitat of shearwaters and petrels would be removed or modified by the proposed development.

(ii) No shearwater or petrel habitat would become fragmented or isolated as a result of the proposed development.

(iii) No important habitat of shearwaters or petrels would be removed, modified or fragmented.

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

No critical habitats for shearwaters and petrels have been listed for the Lord Howe Island CMA Sub-region under the schedules of the TSC Act.

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

<u>Little Shearwater</u>

Priority actions proposed by OEH for the recovery of the Little Shearwater in NSW are:

- Control and eradicate introduced rodents.
- Control introduced weeds, particularly Asparagus Fern in habitat of the Little Shearwater.

The proposed development is in compliance with these objectives and actions.

Flesh-footed Shearwater

Priority actions proposed by OEH for the recovery of the Flesh-footed Shearwater in NSW are:

- Control domestic dogs.
- Fence areas of nesting habitat to exclude cattle.
- Control introduced weeds, particularly Kikuyu, around Flesh-footed Shearwater burrows.
- Take strict precautions during the use of herbicides and consider alternatives where available.
- Protect Flesh-footed Shearwater nesting habitat from clearing or development.
- Support efforts to reduce plastic use and encourage appropriate disposal of plastic waste.
- Support measures to prevent the detrimental threats of long-line fishing on seabirds.
- Take care when driving near areas of nesting habitat to avoid roadkills and support measures to reduce incidents of road kill.
- Investigate means of deterring Flesh-footed Shearwater from burrowing under homes.

The proposed development is in compliance with these objectives and actions.

Kermadec Petrel (west Pacific subspecies)

Priority actions proposed by OEH for the recovery of the Kermadec Petrel (western subspecies) in NSW are:

- Control and eradicate introduced rodents on Lord Howe Island.
- Establish rodent baiting stations on key offshore islands to prevent establishment of rodents.
- Monitor status of population.

The proposed development is in compliance with these objectives and actions.

Black-winged Petrel

Priority actions proposed by OEH for the recovery of the Black-winged Petrel in NSW are:

- Control and work towards eradication of the Masked Owl population.
- Control and eradicate introduced rodents.
- Control introduced weeds, particularly Asparagus Fern in habitat of the Black-winged Petrel.

The proposed development is in compliance with these objectives and actions.

Providence Petrel

Priority actions proposed by OEH for the recovery of the Providence Petrel in NSW are:

- Control and eradicate introduced rodents.
- Manage tourist activities to minimise disruption to birds.

The proposed development is in compliance with these objectives and actions.

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

Little Shearwater

Threats to the status of the Little Shearwater in NSW include:

- Weed infestation of nesting habitat, particularly by Asparagus Fern.
- Predation by rodents at the nesting grounds.
- Potential effects of invasion by exotic species and/or pathogens.
- Big-headed ants, why prey upon chicks and disturb nests.

The proposed development is unlikely to contribute to these threats provided that all construction materials are checked for the presence of Big-headed Ants before they are taken to the subject site. If Big-headed Ants are found among construction materials, then they will be reported and adequately controlled using the methods prescribed by the Lord Howe Island Board.

Flesh-footed Shearwater

Threats to the status of the Flesh-footed Shearwater in NSW include:

- Increased mortality rates due to the ingestion of floating plastic while foraging.
- Taking of Flesh-footed Shearwater as a by-catch by Long-line fishing vessels.
- Urbanisation and spread of development within and extending the settlement area - takes over breeding areas and disturbs breeding areas.
- Conflict with Island residents through birds burrowing under homes.
- Trampling of breeding grounds by grazing cattle.
- Invasion of burrows by Kikuyu.
- Herbicide use near breeding areas.
- Predation by dogs.
- Increased mortality due to road kills (mostly on Ned's Beach Road, Anderson Road, Muttonbird Drive and Skyline Drive on Lord Howe Island).
- Potential for predation on chicks / eggs at nests.

The proposed development is unlikely to contribute to these threats provided that vehicular traffic to and from the subject site during the construction period is adequately policed.

Kermadec Petrel (western Pacific subspecies)

Threats to the status of the Kermadec Petrel (western Pacific subspecies) in NSW include:

- Possible introduction of the Black Rat to offshore islands.

- Risk of local extinction due to small population size.

The proposed development is unlikely to contribute to these threats provided that all construction materials are checked for the presence of Black Rats before they are off-loaded onto Lord Howe Island. If rats are found among construction materials, then they will be reported and adequately controlled using the methods prescribed by the Lord Howe Island Board.

Black-winged Petrel

Threats to the status of the Black-winged Petrel in NSW include:

- Masked Owl predation.
- Impact of weeds, particularly Asparagus Fern on habitat.
- Predation by introduced rodents.
- Potential effects of invasion by exotic species / pathogens.
- African big-headed ants; eat and kill small chicks on the nest.

The proposed development is unlikely to contribute to these threats provided that all construction materials are checked for the presence of African Big-headed Ants and rodents before they are off-loaded onto Lord Howe Island. If introduced pests are found among construction materials, then they will be reported and adequately controlled using the methods prescribed by the Lord Howe Island Board.

Providence Petrel

Threats to the status of the Providence Petrel in NSW include:

- Predation of eggs and young by rodents at the nesting grounds.
- Disturbance of birds and habitat by tourist activities.
- The species is susceptible to extinction via stochastic processes due to its small known population size and restricted distribution.
- Entry of unknown pathogens / exotic species to the island - potential to cause local extinction in a short timeframe.
- Pet cats and feral populations prey on nest contents and adults.

The proposed development is unlikely to contribute to these threats provided that all construction materials are checked for the presence of African Big-headed Ants and rodents before they are off-loaded onto Lord Howe Island. If introduced pests are found among construction materials, then they will be reported and adequately controlled using the methods prescribed by the Lord Howe Island Board.

3. CONCLUSION

The proposed development would not significantly impact on the status of the Little Shearwater, Flesh-footed Shearwater, Kermadec Petrel (western Pacific subspecies), Black-winged Petrel or the Providence Petrel, and their habitats in NSW. Therefore, a Species Impact Statement is NOT required for these taxa.

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OTHER COASTAL SEABIRDS

1. SPECIES PROFILES

Masked Booby (*Sula dactyla*)

This species is a large, white seabird with black tips to the flight feathers and a black mask on the face. The bill is yellow with a black base. The Lord Howe Island population has brownish eyes, compared with birds at most other locations which have yellow eyes, and is known as a separate sub-species (*Sula dactylatra tasmani*).

It is distributed widely through the tropical and subtropical seas of the world. The breeding population on Lord Howe Island is the most southerly breeding colony in the world. Individuals remain at Lord Howe Island year round but range widely for food and some juveniles wander before returning to breed. Young birds banded on Lord Howe Island have been recovered as far away as the Solomon Islands.

Masked Boobies breed on high open areas where they can take off directly into the wind. Breeding sites on Lord Howe Island include King Point and Muttonbird Point on the main Island and also Ball's Pyramid, Muttonbird Island and the Admiralty Islets. The nest is a rough platform of trodden grass.

Threats to the status of this species in NSW include:

- Taking of foraging birds as a by-catch by long-line fishing vessels.
- Predation of eggs and young by rodents at the nesting grounds.
- Introduction of pest species to the island (e.g. Green and Brown Tree snakes, possums, ferrets).
- Big headed ants - aggravating adults to the point where they abandon nests. As soon as chick hatches and it is wet, they are vulnerable to ant predation.

Red-tailed Tropicbird (*Phaethon rubricauda*)

This species is a large white seabird, often with long red tail streamers and red bill. Juveniles are mottled above, tail streamers missing, bill black.

It is distributed throughout tropical and subtropical zones of the Indian and West Pacific Oceans, breeding on oceanic islands. Lord Howe Island is said to have the greatest breeding concentration in the world.

The largest sub-populations are estimated at 1,400 pairs at Christmas Island, 500-100 pairs in the Lord Howe Island group, about 200 pairs on Norfolk Island and 500 pairs on the Herald Cays. There are small numbers elsewhere (Marchant & Higgins 1990; McAllan *et al*. 2004; Baker & Holdsworth 2009). The removal of feral and domestic cats from Lord Howe Island appears to have resulted in an increase from 300 pairs in 1974 (McAllan *et al*. 2004).

Red-tailed Tropicbirds nest alone or in loose colonies on inaccessible islands, stacks, atolls, cays or coastal cliffs. On Lord Howe Island, it nests on cliffs of the northern hills and southern mountains. It is a pelagic feeder, preferring waters of intermediate salinity and temperature, mainly taking fish and squid (Marchant & Higgins 1990). A generation time of 13.0 years (BirdLife International 2011d) is derived from the average age at first breeding of 3.0 years and an annual survival of adults of 90.0% (Schreiber & Burger 2002).

Threats to the status of this species in NSW include:

- Invasion of breeding habitat on Lord Howe Island by weeds, particularly Bitou Bush.
- Juveniles often succumb to a disease causing growths on the head which is always fatal. Impact on the species is unknown.
- Potential for invasion by exotic species and/or pathogens.
- African big-headed ants. - Same eradication program
- Likely to predate nests and constrain reproductive success / recruitment.

White Tern (*Gygis alba*)

The White Tern is medium-sized tern with all-white plumage. The tail is long with a shallow fork. The eyes, eye-rings and bill are black and the legs and feet greyish.

The species occurs widely in tropical and subtropical seas and islands. The subspecies on Lord Howe Island is a recent arrival, only breeding there since the 1960s. It is rarely seen on the Australian mainland but occurs on Norfolk and Kermadec Islands. Vagrant birds occur in coastal NSW waters, particularly after storm events.

Most breeding sites on Lord Howe Island are close to the lagoon in the settlement area. White Terns nest in the high branches of trees. On Lord Howe Island it nests in the introduced Norfolk Island Pine as well as native Sallywood, Blackbutt, Greybark, Banyan and Pandanus. They do not build a nest but select a depression or damaged area on the branch of a tree on which to balance their egg. Breeding and non-breeding birds roost in the trees during the night.

Threats to the status of this species in NSW include:

- Predation of adults and juveniles by the introduced Masked Owl.
- Removal of introduced mature Norfolk Pines used for nesting.

Sooty Tern (*Onychoprian fuscata*)

The Sooty Tern (formerly *Sterna fuscata*) is a largish black tern with white underparts, forehead and tail streamers. There is a thin white leading edge to the inner wing. Juveniles are similar but greyer with white scallops above and a grey breast.

The Sooty Tern is found over tropical and sub-tropical seas and on associated islands and cays around Northern Australia. In NSW, it is only known to breed at Lord Howe Island. It is occasionally seen along coastal NSW, especially after cyclones.

Large flocks can be seen soaring, skimming and dipping but seldom plunging in off shore waters. The species breeds in large colonies in sand or coral scrapes on offshore islands and cays including Lord Howe and Norfolk Islands. It is the most numerous of Lord Howe Island's seabirds and breeds on offshore islets, along the coast from Ned's Beach to Middle Beach, and at Mt Eliza.

Threats to the status of this species in NSW include:

- Predation on breeding grounds by domestic dogs and introduced rats.
- Trampling and disturbance of breeding grounds by tourists.
- Encroachment by inappropriate development.

- Invasion of breeding grounds by exotic weeds.

Grey Ternlet (*Procelsterna cerulea*)

The Grey Ternlet is a small noddy tern with pale blue-grey plumage and slate-grey wingtips. The bill and legs are black and the feet are black with yellowish webbing. The large black eyes have a ring around them, black in front and white behind.

The species is distributed widely in the southern Pacific Ocean, breeding on oceanic islands including Lord Howe Island. Vagrant birds occasionally occur in coastal NSW waters, particularly after storm events.

It breeds on Lord Howe Island on seacliffs of northern hills and southern mountains, and also on offshore islands including Admiralty Islets, Muttonbird Island and Ball's Pyramid. This species makes a rough nest of seaweed and grass in pockets and hollows along cliff faces. Food consists of small fish, crustaceans and squid taken from the water's surface.

Threats to the status of this species in NSW include:

- Predation of eggs and young by rodents at nesting sites on Lord Howe Island main island.
- Possible introduction of rodents to offshore islands in Lord Howe Island group.
- Potential for competition for nest sites with Feral Pigeon on sea cliffs of northern hills on Lord Howe Island.
- Intensive fishing operations in feeding grounds.

2. SEVEN-PART TEST

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

Masked Booby

The Lord Howe Island population of Masked Boobies is likely to be part of a larger population that occurs in tropical waters of the Pacific, Indian and Atlantic Oceans, north and south of the equator. The total Australian Masked Booby population is estimated to be between 3750–4270 breeding pairs

The Lord Howe Island colony is the southernmost breeding colony of Masked Boobies in the world. Masked Boobies breed on high open areas where they can take off directly into the wind. Breeding sites on Lord Howe Island include King Point and Muttonbird Point on the main Island and also Ball's Pyramid, Muttonbird Island and the Admiralty Islets. There are no precise estimates of the number of breeding pairs of Masked Boobies on Lord Howe Island, but it is believed to be in the hundreds.

No Masked Boobies have been observed flying over the subject site during bird surveys. However, there is potential for small numbers to do so while moving between breeding colonies and oceanic foraging areas, or when involved in courtship flights. The numbers of Masked Boobies that may fly over the subject site are likely to be a negligible proportion of the total NSW population and not all these flight paths would intersect with the rotational areas of the turbine blades. The use of Vergnet turbines at WT1 and WT2 are also likely to minimise collisions because they would be below the expected flight heights of Providence Petrels at that location.

Therefore, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of Masked Boobies such that the local viable population would be placed at risk of extinction.

Red-tailed Tropicbird

The Red-tailed Tropicbird is distributed throughout tropical and subtropical zones of the Indian and West Pacific Oceans, breeding on oceanic islands. Lord Howe Island is said to have the greatest breeding concentration in the world. The largest sub-populations are estimated at 1,400 pairs at Christmas Island, 500-100 pairs in the Lord Howe Island group, about 200 pairs on Norfolk Island and 500 pairs on the Herald Cays. There are small numbers. The removal of feral and domestic cats from Lord Howe Island appears to have resulted in an increase from 300 pairs in 1974.

This species nests on cliffs along the island's coast from Malabar to Mt Eliza, North Head, and on Mt Lidgbird and Mt Gower. It forages in coastal waters around the island. Habitats in these areas will not be impacted by the proposed development.

Red-tailed Tropicbirds were observed soaring at high altitudes and actively flying over the subject site. Therefore, individuals engaged in this activity are at risk of colliding with the turbines. However, the numbers of Red-tailed Tropicbirds that fly over the subject site are likely to be a negligible proportion of the total NSW population and not all these flight paths would intersect with the rotational areas of the turbine blades. The use of Vergnet turbines at WT1 and WT2 are also likely to minimise collisions because they would be below most of flight heights of Red-tailed Tropicbirds observed flying over the subject site during the 2016 surveys.

Therefore, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of Red-tailed Tropicbirds such that the local viable population would be placed at risk of extinction.

White Tern

There are no measures of White Tern abundance. The species has a distribution across the tropics of the world, being found year-round on islands in the south Atlantic Ocean, the Indian Ocean, and the western and central Pacific. It is also a seasonal visitor to islands in the south-central and eastern Pacific off the coast of Mexico. The sub-population on Lord Howe Island is likely to be part of a larger population that occurs within the Pacific region.

Most breeding sites on Lord Howe Island are close to the lagoon in the settlement area. White Terns nest in the high branches of trees. On Lord Howe Island it nests in the introduced Norfolk Island Pine as well as native Sallywood, Blackbutt, Greybark, Banyan and Pandanus. The proposed development would not impact on these areas.

Small numbers of White Terns were observed flying over the subject site during 2016 bird surveys. The numbers of White Terns that fly over the subject site are likely to be a negligible proportion of the total NSW sub-population and the more inclusive Pacific population, not all these flight paths would intersect with the rotational areas of the turbine blades. The use of Vergnet turbines at WT1 and WT2 are also likely to minimise collisions because they would be below the observed flight heights of White Terns over Transit Hill.

Therefore, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of White Terns such that the local viable population would be placed at risk of extinction.

Sooty Tern

The global population is estimated to number 21-22 million individuals, while the population in Japan has been estimated at less than 100,000 breeding pairs, and less than 1,000 individuals on migration. The Sooty Tern is found over tropical and sub-tropical seas and on associated islands and cays around Northern Australia. The Australian sub-population is likely to be part of the larger population that occurs in the tropical regions of the Indian and Pacific Oceans. In NSW, it is only known to breed at Lord Howe Island. It is occasionally seen along coastal NSW, especially after cyclones.

The Sooty Tern is the most numerous of Lord Howe Island's seabirds and breeds on offshore islets, along the coast from Ned's Beach to Middle Beach, and at Mt Eliza. These breeding areas would not be impacted by the proposed development.

Small numbers of Sooty Terns were observed flying over the subject site during 2016 bird surveys. The numbers of Sooty Terns that fly over the subject site are likely to be a negligible proportion of the total NSW sub-population and the more inclusive Indian-Pacific population, not all these flight paths would intersect with the rotational areas of the turbine blades. The use of Vergnet turbines at WT1 and WT2 are also likely to minimise collisions because they would be below the observed flight heights of Sooty Terns over Transit Hill.

Therefore, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of Sooty Terns such that the local viable population would be placed at risk of extinction.

Grey Ternlet

The species is distributed widely in the southern Pacific Ocean, breeding on oceanic islands including Lord Howe Island. Vagrant birds occasionally occur in coastal NSW waters, particularly after storm events. There are no precise measures of abundance in NSW, Australia or over the broader geographical region.

It breeds on Lord Howe Island on seacliffs of northern hills and southern mountains, and also on offshore islands including Admiralty Islets, Muttonbird Island and Ball's Pyramid. The proposed development would not impact on these areas.

No Grey Ternlets have been observed flying over the subject site during bird surveys. However, there is potential for small numbers to do so while moving between breeding colonies and oceanic foraging areas, or when involved in courtship flights. The numbers of Grey Ternlets that may fly over the subject site are likely to be a negligible proportion of the total Pacific population and not all these flight paths would intersect with the rotational areas of the turbine blades. The use of Vergnet turbines at WT1 and WT2 are also likely to minimise collisions because they would be below the expected flight heights of Grey Ternlets at that location.

Therefore, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of Grey Ternlets such that the local viable population would be placed at risk of extinction.

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

Not applicable. The coastal seabirds are listed as threatened species rather than endangered populations.

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

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

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

Not applicable. The coastal seabirds are listed as threatened species rather than as an endangered or critically endangered ecological community.

(d) In relation to a habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

(i) No known habitat of coastal seabirds would be removed or modified by the proposed development.

(ii) No coastal seabird habitat would become fragmented or isolated as a result of the proposed development.

(iii) No important habitat of coastal seabird habitat would be removed, modified or fragmented.

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

No critical habitats for have been listed for the Lord Howe Island CMA Sub-region under the schedules of the TSC Act.

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

<u>Masked Booby</u>

Priority actions proposed by OEH for the recovery of the Masked Booby in NSW are:

- Control and eradicate introduced rodents.
- Monitor status of breeding population on Lord Howe Island.

- Support measures to prevent the detrimental threats of long-line fishing on seabirds.

The proposed development is in compliance with these objectives and actions.

Red-tailed Tropicbird

Priority actions proposed by OEH for the recovery of the Red-tailed Tropicbird in NSW are:

- Control introduced weeds near breeding habitat on Lord Howe Island.
- Monitor status of breeding population on Lord Howe Island.

The proposed development is in compliance with these objectives and actions.

White Tern

Priority actions proposed by OEH for the recovery of the White Tern in NSW are:

- Control and eradicate the Masked Owl population.
- Manage Norfolk Island Pine removal to maintain significant trees.

The proposed development is in compliance with these objectives and actions.

Sooty Tern

Priority actions proposed by OEH for the recovery of the Sooty Tern in NSW are:

- Control domestic pets.
- Regulate tourist access using public education programs.
- Eradicate introduced rodents on Lord Howe Island.
- Restrict inappropriate development.
- Monitor and prevent imports of exotic weeds.
- Research and monitor population size.

The proposed development is in compliance with these objectives and actions.

Grey Ternlet

Priority actions proposed by OEH for the recovery of the Grey Ternlet in NSW are:

- Control and eradicate introduced rodents on Lord Howe Island.
- Establish rodent baiting stations on key offshore islands in Lord Howe Island group to prevent establishment of rodents.
- Control and eradicate Feral Pigeons on Lord Howe Island.
- Monitor status of population.
- Support sustainable fishing practices.

The proposed development is in compliance with these objectives and actions.

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

Masked Booby

Threats to the status of the Masked Booby in NSW include:

- Taking of foraging birds as a by-catch by long-line fishing vessels.
- Predation of eggs and young by rodents at the nesting grounds.
- Introduction of pest species to the island (e.g. Green and Brown Tree snakes, possums, ferrets).
- Big headed ants - aggravating adults to the point where they abandon nests. As soon as chick hatches and it is wet, they are vulnerable to ant predation.

The proposed development is unlikely to contribute to these threats provided that all construction materials are checked for the presence of introduced pests before they are taken to the subject site. If introduced pests are found among construction materials, then they will be reported and adequately controlled using the methods prescribed by the Lord Howe Island Board.

Red-tailed Tropicbird

Threats to the status of the Red-tailed Tropicbird in NSW include:

- Invasion of breeding habitat on Lord Howe Island by weeds, particularly Bitou Bush.
- Juveniles often succumb to a disease causing growths on the head which is always fatal. Impact on the species is unknown.
- Potential for invasion by exotic species and/or pathogens.
- African big-headed ants. - Same eradication program
- Likely to predate nests and constrain reproductive success / recruitment.

The proposed development is unlikely to contribute to these threats provided that all construction materials are checked for the presence of introduced pests before they are taken to the subject site. If introduced pests are found among construction materials, then they will be reported and adequately controlled using the methods prescribed by the Lord Howe Island Board.

White Tern

Threats to the status of the White Tern in NSW include:

- Predation of adults and juveniles by the introduced Masked Owl.
- Removal of introduced mature Norfolk Pines used for nesting.

The proposed development is unlikely to contribute significantly to these threats.

Sooty Tern

Threats to the status of the Sooty Tern in NSW include:

- Predation on breeding grounds by domestic dogs and introduced rats.
- Trampling and disturbance of breeding grounds by tourists.
- Encroachment by inappropriate development.
- Invasion of breeding grounds by exotic weeds.

The proposed development is unlikely to contribute to these threats provided that construction materials and construction waste are not stock-piled on the subject site or in adjacent areas for lengthy time periods.

Grey Ternlet

Threats to the status of the Grey Ternlet in NSW include:

- Predation of eggs and young by rodents at nesting sites on Lord Howe Island main island.
- Possible introduction of rodents to offshore islands in Lord Howe Island group.
- Potential for competition for nest sites with Feral Pigeon on sea cliffs of northern hills on Lord Howe Island.
- Intensive fishing operations in feeding grounds.

The proposed development is unlikely to contribute to these threats provided that all construction materials are checked for the presence of African Big-headed Ants and rodents before they are off-loaded onto Lord Howe Island. If introduced pests are found among construction materials, then they will be reported and adequately controlled using the methods prescribed by the Lord Howe Island Board.

3. CONCLUSION

The proposed development would not significantly impact on the status of Masked Booby, Red-tailed Tropicbird, White Tern, Sooty Tern or Grey Ternlet, and their habitats in NSW. Therefore, a Species Impact Statement is NOT required for these species.

4. REFERENCES

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MIGRATORY SHOREBIRDS

1. SPECIES PROFILES

Eastern Curlew (*Numenius madagascariensis*)

The Eastern Curlew is a large wader (55-61 cm). They have a very long down-curved black bill which is pink at the base. They are streaked dark brown and buff above The chin and throat are whitish and there is a prominent white eye-ring; the iris is dark brown and they have a pale eyebrow. They are streaked dark brown and buff above with the feathers of the upper parts of the body brown, with blackish centres, and have broad pale rufous or olive-brown edges or notches. They have a long neck and long blue/grey legs.

Within Australia, the Eastern Curlew has a primarily coastal distribution. The species is found in all states, particularly the north, east, and south-east regions including Tasmania. Eastern Curlews are rarely recorded inland. In NSW the species occurs across the entire coast but is mainly found in estuaries such as the Hunter River, Port Stephens, Clarence River, Richmond River and ICOLLs of the south coast.

The Eastern Curlew breeds in Russia and north-eastern China but its distribution is poorly known. During the non-breeding season a few birds occur in southern Korea and China, but most spend the non-breeding season in north, east and south-east Australia.

Non-breeding birds migrate to estuaries, mangroves, saltmarshes and intertidal flats, particularly those with extensive seagrass (Zosteraceae), where they feed on marine invertebrates, especially crabs and small molluscs (Higgins & Davies 1996).

The global population has been estimated at *c*. 38,000 individuals (Wetlands International 2006), including 28,000 in Australia (Bamford *et al.* 2008). But numbers have subsequently declined including *c*. 1,800 which disappeared after reclamation of tidal flats at Saemangeum in the South Korean Yellow Sea in 2006 (Moores 2006).

The dominant threats to the Eastern Curlew are associated with development pressure and human disturbance in foraging sites in coastal areas, both in Australia and especially their staging grounds during migration. Their tidal feeding grounds on the Yellow Sea are undergoing a rapid rate of transformation due to land reclamation, agriculture and industry with about 10% of the world's human population occupying the river catchments draining into the Yellow Sea. Eastern Curlews are also likely to be displaced from foraging and roosting sites by heavy human recreational use of beaches, shorelines and estuaries. Hydrological changes to estuaries and similar water bodies may also modify or remove important areas of suitable habitat.

Curlew Sandpiper (*Calidris ferruginea*)

The Curlew Sandpiper is a small (18-23 cm), highly-gregarious, migratory shorebird with a medium-length, down-curved bill and longish black legs. During most of their time in Australia, adult birds are in non-breeding plumage, which is a nondescript mottled grey above and paler below, with indistinct white eyebrows and a white rump. In flight there is a white line along the centre of the upper-wings. In breeding plumage the face and underparts are chestnut, and the upperparts are mottled chestnut and black. The down-curved bill distinguishes it from the other similar-sized sandpipers. Many other shorebirds of this size have similar colouration and are easily cofused with the Curlew Sandpiper,

but they differ in bill shape, length or colour; leg colour or length; and some lack a white wing bar or white rump.

The Curlew Sandpiper is distributed around most of the Australian coastline (including Tasmania). It occurs along the entire coast of NSW, particularly in the Hunter Estuary, and sometimes in freshwater wetlands in the Murray-Darling Basin. Inland records are probably mainly of birds pausing for a few days during migration.

The Curlew Sandpiper breeds in Siberia and migrates to Australia (as well as Africa and Asia) for the non-breeding period, arriving in Australia between August and November, and departing between March and mid-April.

The species generally occupies littoral and estuarine habitats, and in NSW is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. Roost sites are shingle, shell or sand beaches; spits or islets on the coast or in wetlands; or sometimes in salt marsh, among beach-cast seaweed, or on rocky shores. Birds breed at 2 years of age and the oldest recorded bird is 19 years old. Most birds caught in Australia are between 3 and 5 years old.

The global population has been estimated to be 1,850,000 individuals and the flyway population to be 180,000 (Wetlands International 2006), including 115,000 in Australia (Bamford *et al.* 2008). However, there were significant declines in abundance between 1983 and 2008, by up to 83% in the size of the Australian population (AWSG Database), especially in the latter 10 years of that period. Models suggest that the decline is a result of the reduction in adult survival rates (Rogers & Gosbell 2006).

The dominant threats to Curlew Sandpipers are associated with development pressure and human disturbance in foraging sites in coastal areas, both in Australia and especially their staging grounds during migration. Their tidal feeding grounds on the Yellow Sea are undergoing a rapid rate of transformation due to land reclamation, agriculture and industry with about 10% of the world's human population occupying the river catchments draining into the Yellow Sea.

Curlew Sandpipers are also likely to be displaced from foraging and roosting sites by heavy human recreational use of beaches, shorelines and estuaries.

Major floodplain wetlands in the Murray-Darling Basin have had up to 60% reduction in flow, and consequently 40-77% of their area has been destroyed or degraded over the past century.

Climate Change has also been proposed as a potential threat to migratory shorebirds in their breeding grounds. Average temperatures in the arctic have risen at almost twice the rate of the rest of the world and may detrimentally affect species such as the Curlew Sandpiper that nest in open tundra.

2. SEVEN-PART TEST

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

Eastern Curlew

Eastern Curlews occur only in small numbers on Lord Howe Island, and are likely to be part of the population that visits Australia after migratory along the East Asian-Australasian Flyway. The global population has been estimated at *c*. 38,000 individuals, including 28,000 in Australia. But numbers have subsequently declined including *c*. 1,800 which disappeared after reclamation of tidal flats at Saemangeum in the South Korean Yellow Sea in 2006.

One Eastern Curlew was observed foraging in the open paddock on the subject site during the 2016 bird surveys. However, this is considered marginal habitat, with more suitable foraging habitat occurring on sand flats and rocky coastal areas on the island. Most of the marginal foraging habitat on the subject site would be retained. The proposed development would not impact on intertidal habitats around the island.

It is unlikely that large numbers of Eastern Curlews would fly over the subject site, and are more likely to move along the island's coastline while moving between suitable habitat areas. Not all flight paths of individuals that use the site for foraging would intersect with the rotational areas of the turbine blades. The use of Vergnet turbines at WT1 and WT2 are also likely to minimise collisions because they would be taller the observed flight heights of Eastern Curlews over the subject site.

Migratory shorebirds do not breed in Australia. Therefore, the proposed development would not impact on breeding habitat or breeding success of this species.

Therefore, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of Eastern Curlews such that the local viable population would be placed at risk of extinction.

Sharp-tailed Sandpiper

Sharp-tailed Sandpipers occur only in small numbers on Lord Howe Island, and are likely to be part of the population that visits Australia after migratory along the East Asian-Australasian Flyway. The global population has been estimated to be 1,850,000 individuals and the flyway population to be 180,000, including 115,000 in Australia. However, there were significant declines in abundance between 1983 and 2008, by up to 83% in the size of the Australian population, especially in the latter 10 years of that period. Models suggest that the decline is a result of the reduction in adult survival rates.

The species generally occupies littoral and estuarine habitats, and in NSW is mainly found in intertidal mudflats of sheltered coasts. It also occurs in non-tidal swamps, lakes and lagoons on the coast and sometimes inland. It forages in or at the edge of shallow water, occasionally on exposed algal mats or waterweed, or on banks of beach-cast seagrass or seaweed. Roost sites are shingle, shell or sand beaches; spits or islets on the coast or in wetlands; or sometimes in salt marsh, among beach-cast seaweed, or on rocky shores. The proposed development would not impact on intertidal habitats around the island. It is unlikely that Sharp-tailed Sandpipers would use the subject site for foraging or roosting.

It is unlikely that large numbers of Curlew Sandpipers would fly over the subject site, and are more likely to move along the island's coastline while moving between suitable habitat areas. Not all flight paths of individuals over the site would intersect with the rotational areas of the turbine blades. The use of Vergnet turbines at WT1 and WT2 are also likely to minimise collisions because they would be taller the observed flight heights of Sharp-tailed Sandpipers over coastal roost and foraging sites.

Migratory shorebirds do not breed in Australia. Therefore, the proposed development would not impact on breeding habitat or breeding success of this species.

Therefore, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of Eastern Curlews such that the local viable population would be placed at risk of extinction.

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

Not applicable. The migratory shorebirds are listed as threatened species rather than endangered populations.

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
- **(i) is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or**
- **(ii) is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.**

Not applicable. The migratory shorebirds are listed as threatened species rather than as an endangered or critically endangered ecological community.

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

(i) A small area of marginal foraging habitat for the Eastern Curlew would be removed from the cleared paddock for the location of two wind turbines. Potential foraging habitat around the turbines would be retained.

(ii) No migratory shorebird and marine bird habitat would become fragmented or isolated as a result of the proposed development.

(iii) The subject site is likely to be marginal foraging or roosting habitat for Eastern Curlews. It is unlikely to be used by Sharp-tailed Sandpipers.

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

No critical habitats for have been listed for the Lord Howe Island CMA Sub-region for these species under the schedules of the TSC Act.

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

Eastern Curlew

Priority actions proposed by OEH for the recovery of the Eastern Curlew in NSW are:

- Control dogs on beaches and in estuaries.
- Raise visitor awareness of the presence of this and other threatened shorebird species; provide information on how visitors' actions will affect the species' survival.
- Conduct searches for the species in suitable habitat in proposed development areas.
- Manage estuaries, inland water bodies and the surrounding landscape to maintain the natural hydrological regimes.
- Protect coastal areas from pollution.
- Protect and maintain known or potential habitat; implement protection zones around recent records.
- Protect foraging and roosting areas from disturbance or inappropriate development.
- Assess the importance of sites to the species' survival, including linkages provided between ecological resources across the broader landscape.

The proposed development is in compliance with these objectives and actions.

Curlew Sandpiper

Priority actions proposed by OEH for the recovery of the Curlew Sandpiper in NSW are:

- Control dogs on beaches and in estuaries.
- Raise visitor awareness of the presence of this and other threatened shorebird species; provide information on how visitors' actions will affect the species' survival.
- Conduct searches for the species in suitable habitat in proposed development areas.
- Manage estuaries, inland water bodies and the surrounding landscape to maintain the natural hydrological regimes.
- Protect coastal areas from pollution.
- Protect and maintain known or potential habitat; implement protection zones around recent records.
- Protect foraging and roosting areas from disturbance or inappropriate development.
- Assess the importance of sites to the species' survival, including linkages provided between ecological resources across the broader landscape.

The proposed development is in compliance with these objectives and actions.

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

The dominant threats to the Eastern Curlew and Curlew Sandpiper are associated with development pressure and human disturbance in foraging sites in coastal areas, both in Australia and especially their staging grounds during migration. Their tidal feeding grounds on the Yellow Sea are undergoing a rapid rate of transformation due to land reclamation, agriculture and industry with about 10% of the world's human population occupying the river catchments draining into the Yellow Sea. Both species are also likely to be displaced from foraging and roosting sites by heavy human recreational use of beaches, shorelines and estuaries. Hydrological changes to estuaries and similar water bodies may

also modify or remove important areas of suitable habitat. The proposed development is unlikely to contribute to these threats.

3. CONCLUSION

The proposed development would not significantly impact on the status of the Eastern Curlew and Curlew Sandpiper and their habitats in NSW. Therefore, a Species Impact Statement is NOT required for these species.

4. REFERENCES

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TERRESTRIAL BIRD SPECIES

1. SPECIES PROFILE

Lord Howe Woodhen (*Gallirallus sylvestris*)

The Lord Howe Woodhen is a medium-sized bird. Colour is a dull olive brown with paler markings on face. The bill is pinkish-grey, slender and down-curved and around same length as head. Legs are thick and pinkish-grey.

The species is confined to Lord Howe Island. It is currently found throughout the main Island except for the northern hills area. Typical habitat is mountain and lowland rainforest and also palm and pandanus forest, particularly Kentia Palm forest on basaltic soils. On Mt Gower they occur in gnarled mossy forest. However, it is also found in gardens around houses in the settlement area where they are fed by people.

When discovered in 1788 it was described as common and distributed from sea-level to the tops of Mt Gower and Mt Lidgbird. From the mid-19th century Woodhens were confined to the summit regions of the two mountains (Hutton 1991). At its nadir in the 1970s, the population comprised fewer than 10 breeding pairs (Brook *et al*. 1997). Following control of threats, captive-bred birds were reintroduced to lowland sites in the 1980s (Miller & Mullette 1985). The current population is estimated to be 220-230 birds and 71-74 breeding pairs and stable, having reached carrying capacity within five years of the threats being removed (NPWS 2002). The island's total carrying capacity has been estimated at 220 individuals (Brook *et al.* 1997).

The Lord Howe Woodhen is sedentary and flightless. Birds forage mainly among litter on forest floor for earthworms, molluscs and other invertebrates. They nest on the ground under thick vegetation or in petrel burrows. Woodhens mate during late spring-early summer. The incubation period is 20–23 days, a number of clutches may be laid each year. Adult Woodhens pair for life and each pair defends a territory of about 3 hectares. The young birds are driven out of the natal territory by their parents, and only become established and active in the population if they can find a new territory or take over an existing one.

Threats to the status of this species in NSW include:

- Risk of extinction due to small population size and restricted distribution.
- Potential for introduction of non-native invertebrates (eg Fire/Crazy Ant).
- Potential further introductions of exotic species.
- Impact of weeds on habitat.
- Predation on Woodhen eggs by the Black Rat.
- Competition and predation from the Buff-banded Rail.
- Small population size may lead to inbreeding.
- Predation by domestic dogs.
- Predation by the introduced Masked Owl.
- Roadkill due to vehicles and bicycles.
- Risk of poisoning from baits used in rat eradication program.

Lord Howe Golden Whistler (*Pachycephala pectoralis contempta*)

The male has a black head and face, with a broad yellow collar. The throat is white with a black band below. The breast and belly are bright yellow. In contrast, the female has olive-grey upperparts and

is grey under, with a yellowish tinge. The Lord Howe subspecies differs from the mainland subspecies by its broader yellow collar on the male, a yellowish-grey belly on the female, and both sexes have a stouter bill.

The subspecies is found only in the forests of Lord Howe Island, ranging from sea level to the mountain tops. There are no precise measures of abundance, but the population is estimated at 100 - 1,000 pairs.

These birds hop from branch to branch looking for insects, spiders and insect larvae. They also forage in the leaf litter. Breeding occurs from September to January, producing two pale, spotted eggs. The nest is an open cup-shaped structure made up of palm fibre, vines and leaves and lined with grass.

Threats to the status of this species in NSW include:

- Clearing of lowland forest areas.
- Possible competition for food resources from the introduced Blackbird and Song Thrush.
- Potential for introduction of non-native invertebrates (eg Fire/Crazy Ant).
- Risk of extinction due to small population size.
- Invasion of habitat by introduced weeds.
- Direct predation on eggs and chicks and competition or destruction for food resources by rats.
- Risk of extinction due to restricted distribution.

Lord Howe Pied Currawong (*Strepera graculina crissalis*)

The Lord Howe Currawong is a subspecies of the Pied Currawong, which occurs in eastern mainland Australia. The Lord Howe Currawong is a fairly large, crow-like bird, slightly bigger than an Australian Magpie (*Cracticus tibicen*), with a long, robust and pointed bill, and bright, golden-yellow eyes. It is glossy black with a white tip to the tail, and conspicuous white patches on the outer wings, at the base of the upper tail, on the lower under-body, and base of the under tail. The Lord Howe Currawong differs from most other subspecies by its slightly longer and more slender bill, and smaller white patches and narrower white tail-tip.

The Lord Howe Currawong is restricted to Lord Howe Island. It is distributed across the island, though more widespread and more abundant in the southern mountains and northern hills. They also occur on some associated islets, including those of the Admiralty Group, off the northern tip of Lord Howe Island itself.

The subspecies occurs in lowland, hill and mountain regions of the island. It is mainly found in tall natural rainforests and palm forests, typically undisturbed, but it also occurs in cleared and settled areas, remnant patches of forest and the ecotone between cleared land and forest. It also forages in colonies of seabirds on offshore islets.

They breed in rainforest and palm forest, mainly on hill-slopes and mountains, with all breeding territories including a section of stream or gully and with most nests near water. After breeding, in autumn and winter, Currawongs tend to disperse from higher altitudes to the lowlands, with greater numbers in lowland forests and in cleared and settled areas of the island at this time. Lord Howe Currawongs occur singly, in pairs, small family groups after breeding and, in the non-breeding season, in small flocks of up to 15 birds. Their flight is distinctively undulating.

Most breeding occurs in late spring and early summer (September or October to December), though there is some evidence of breeding occasionally occurring as early as July. The clutch is three eggs, though there are few records of clutch-size; in mainland Australia, clutches are of one to four eggs, usually three or four. Nests are usually placed high in trees and are often inaccessible. The nest is a large, rough open bowl-shape made of sticks, twigs and vines, and with a neat inner cup of fine vegetation, such as grass and palm thatch. Nestlings remain in the nest for about 30 days, and then stay with their parents for another 50 or so days until they are independent. There are few data on breeding success. In the 2005-06 breeding season, five of twelve clutches observed produced at least one fledgeling, and one pair successfully reared two broods (a total of five fledglings). Successful broods usually consist of one or two young but, in some seasons, pairs may not rear a brood at all. The age at which Lord Howe Currawongs first breed is not known, nor is the life expectancy of the subspecies. However, on the mainland, individuals have been known to live for more than 20 years.

Birds defend territories in the breeding season, with some territories defended throughout the year. Territories are usually about 6 ha in area, with some up to 10 ha, and territorial boundaries may vary with population. The population is thought to be stable, and is estimated at 215 ± 11 birds, based on a banding study in 2006 (Carlile & Priddel 2007).

Threats to the status of this species in NSW include:

- Risk of extinction owing to its small population size. The total population of the Lord Howe Currawong is estimated to be 200 individuals (from surveys in 2005-06).

- Introduction of exotic predators or pathogens could have a significant adverse impact on the single and small population of this taxon.

- Human persecution owing to the Currawong's habit of attacking native and domestic birds, in particular predation on the iconic and endemic Lord Howe Woodhen (*Gallirallus sylvestris*) and the White Tern (*Gygis alba*); the latter, and a fairly recent coloniser of Lord Howe Island, is a favourite of residents and visitors alike. Currawongs were often shot historically and shooting still occurs occasionally.

- There is some risk of secondary or non-target poisoning of Currawongs during baiting programs for Black Rats (*Rattus rattus*) and House Mice (*Mus musculus*) as Currawongs often take poisoned rats and mice.

- The fact that the subspecies is restricted to a small isolated island, Lord Howe Island, places it at risk from stochastic and other impacts with no opportunities for natural recolonisation.

Lord Howe Silvereye (*Zosterops lateralis tephropleurus*)

This small, yellow-brown bird is named for the white ring of feathers around its eye. It is the smallest land bird on Lord Howe Island. It is a more robust bird than the mainland Silvereye, having a heavier build, larger feet and claws and a longer bill.

The subspecies is found only on Lord Howe Island where it ranges from sea level to the mountains. It is distributed widely in the forests of the main island. It is often seen feeding around island homes throughout the settlement area. They glean leaves and flowers for insects, visit flowers for nectar, and eat small seeds and fruits, including the exotic Cherry Guava.

The nest is a small cup shape made of palm fibre, grass and spider webs, apparently nesting out of reach of most predators (Hutton 1991). 2-4 small eggs are laid in spring and summer.

The population is estimated to be between 100-1000 pairs.

Threats to the status of this species in NSW include:

- Clearing of lowland forest areas.
- Invasion of habitat by introduced weeds.
- Potential for introduction of non-native invertebrates (eg Fire/Crazy Ant).
- Edge effects and dieback.
- Risk of extinction due to small population size and restricted distribution.
- Competition and predation from other introduced species.
- Rodents are preying on eggs and chicks.

2. SEVEN-PART TEST

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

Lord Howe Woodhen

This species is confined to Lord Howe Island. It is currently found throughout the main Island except for the northern hills area. Typical habitat is mountain and lowland rainforest and also palm and pandanus forest, particularly Kentia Palm forest on basaltic soils. On Mt Gower they occur in gnarled mossy forest. However, it is also found in gardens around houses in the settlement area where they are fed by people.

The current population is estimated to be 220-230 birds and 71-74 breeding pairs and stable, having reached carrying capacity within five years of the threats being removed. The island's total carrying capacity has been estimated at 220 individuals.

There is no significant habitat for the Lord Howe Woodhen in the paddock area of the subject site. However one individual was observed in the forest edge near the south-eastern corner of the site during the February 2016 surveys.

A small area of lowland forest would be cleared to widen the access track to the subject site. The amount of forest to be cleared is a negligible proportion of forest habitat available for the Lord Howe Woodhen. Habitat clearance will also be offset by widening other areas of forest habitat along the boundaries of the cleared paddock. Therefore there would not be a significant reduction in the habitat status for this species in relation to the proposed development.

Construction materials would be checked for the presence of introduced pests before they are brought onto the island. There will be no long-term stock-piling of construction material or construction waste on the subject site or in adjacent areas to reduce the risk of invasive species (weeds, rodents and ants) becoming established.

The Lord Howe Woodhen is a flightless species. Therefore, there is no risk of individuals colliding with the turbine blades.

Therefore, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of Lord Howe Woodhen such that its population would be placed at risk of extinction.

Lord Howe Golden Whistler

The subspecies is found only in the forests of Lord Howe Island, ranging from sea level to the mountain tops. There are no precise measures of abundance, but the population is estimated at 100 - 1,000 pairs.

Lord Howe Golden Whistlers fly across the open paddock area on the subject site, predominantly in north-south or south-north directions between forested areas adjacent to the site. However, they fly low to the ground, below the forest canopy height. The observed altitudinal height range of Golden Whistlers crossing the paddock in the 2016 survey periods was 0.5 to 10 m, which is below the blade height range of the turbines. Therefore, it is unlikely that Golden Whistlers would collide with the rotating blades.

A small area of lowland forest would be cleared to widen the access track to the subject site. The amount of forest to be cleared is a negligible proportion of forest habitat available for the Lord Howe Golden Whistler. Habitat clearance will also be offset by widening other areas of forest habitat along the boundaries of the cleared paddock. Therefore there would not be a significant reduction in the habitat status for this species in relation to the proposed development.

Consequently, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of Lord Howe Golden Whistler such that its population would be placed at risk of extinction.

Lord Howe Pied Currawong

The Lord Howe Currawong is restricted to Lord Howe Island. It is distributed across the island, though more widespread and more abundant in the southern mountains and northern hills. They also occur on some associated islets, including those of the Admiralty Group, off the northern tip of Lord Howe Island itself. The total population of the Lord Howe Currawong is estimated to be 200 individuals (from surveys in 2005-06).

The subspecies occurs in lowland, hill and mountain regions of the island. It is mainly found in tall natural rainforests and palm forests, typically undisturbed, but it also occurs in cleared and settled areas, remnant patches of forest and the ecotone between cleared land and forest. It also forages in colonies of seabirds on offshore islets.

Small flocks of Pied Currawongs (maximum flock size of six birds) were observed crossing the cleared paddock during the 2016 surveys. All observed flight heights across the paddock except for one (altitude: 50 m) were below 20 m (below the rotational blade height of the Vergnet turbine), and 8.4% of flights were below 16 m. This is because the currawongs were usually moving between forested areas on either side of the paddock and they flew below the maximum height of the tree canopy (18 m). The altitudes of flights of currawongs were generally lower than observed flights over forested areas where individuals often flew high above the tree canopy. Therefore, the risk of Lord Howe Pied Currawongs colliding with rotating turbine blades is considered to be extremely low.

A small area of lowland forest would be cleared to widen the access track to the subject site. The amount of forest to be cleared is a negligible proportion of forest habitat available for the Lord Howe

Pied Currawong. Habitat clearance will also be offset by widening other areas of forest habitat along the boundaries of the cleared paddock. Therefore there would not be a significant reduction in the habitat status for this species in relation to the proposed development.

Consequently, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of Lord Howe Pied Currawong such that its population would be placed at risk of extinction.

Lord Howe Silvereye

The subspecies is found only on Lord Howe Island where it ranges from sea level to the mountains. It is distributed widely in the forests of the main island. It is often seen feeding around island homes throughout the settlement area. They glean leaves and flowers for insects, visit flowers for nectar, and eat small seeds and fruits, including the exotic Cherry Guava. The population is estimated to be between 100-1000 pairs.

Lord Howe Silvereyes fly across the open paddock area on the subject site, usually in small flocks, predominantly in north-south or south-north directions between forested areas adjacent to the site. However, they fly low to the ground, below the forest canopy height. The observed altitudinal height range of Lord Howe Silvereyes crossing the paddock in the 2016 survey periods was 1 to 18 m, which is below the blade height range of the Vergnet turbines. Therefore, it is unlikely that the Silvereyes would collide with the rotating blades.

A small area of lowland forest would be cleared to widen the access track to the subject site. The amount of forest to be cleared is a negligible proportion of forest habitat available for the Lord Howe Silvereye. Habitat clearance will also be offset by widening other areas of forest habitat along the boundaries of the cleared paddock. Therefore there would not be a significant reduction in the habitat status for this species in relation to the proposed development.

Consequently, it is unlikely that the construction and operation of the wind turbines would adversely impact on the status of Lord Howe Silvereye such that its population would be placed at risk of extinction.

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

Not applicable. The Lord Howe Island taxa are listed as threatened species rather than endangered populations.

(c) In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

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

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

Not applicable. The Lord Howe Island taxa are listed as threatened species rather than as an endangered or critically endangered ecological community.

(d) In relation to a habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and

(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.

(i) A small area of lowland forest would be cleared to widen the access track to the subject site. The amount of forest to be cleared is a negligible proportion of forest habitat available for endemic land-birds of Lord Howe Island. Habitat clearance will also be offset by widening other areas of forest habitat along the boundaries of the cleared paddock. Therefore there would not be a significant reduction in the habitat status for this species in relation to the proposed development.

(ii) No endemic land-bird habitat would become fragmented or isolated as a result of the proposed development.

(iii) The habitat to be removed is likely to contain foraging and dispersal habitat for endemic land-bird species. However, it is a negligible amount of habitat that is available for these species and its removal is unlikely to significantly impact on the status of their populations.

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

No critical habitats for have been listed for the Lord Howe Island CMA Sub-region for these taxa under the schedules of the TSC Act.

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

<u>Lord Howe Island Woodhen</u>

Priority actions proposed by OEH for the recovery of the Lord Howe Island Woodhen are:

- Control domestic dogs.
- Ensure Woodhens are not impacted by rodent bait during rodent control programmes.
- Control and eradicate the Masked Owl population.
- Eradicate the Black Rat.
- Undertake weed control in known habitat.
- Implement and monitor the quarantine plan.
- Investigate the impact of the introduced Buff-banded Rail on the Lord Howe Woodhen.
- Monitor the status of the population and threats.

The proposed development is in compliance with these objectives and actions.

<u>Lord Howe Island Golden Whistler</u>

Priority actions proposed by OEH for the recovery of the Lord Howe Golden Whistler are:

- Assist with the control of introduced weeds in areas of habitat.
- Protect lowland forest habitat from clearing.
- Monitor the status of populations.
- Implement and monitor the quarantine plan.
- Investigate the impact of the introduced Blackbird and Song Thrush on the Lord Howe Island Golden Whistler.
- Research into ecology of the species to provide information to assist in its

Lord Howe Island Pied Currawong

Priority actions proposed by OEH for the recovery of the Lord Howe Pied Currawong are:

- Ensure adequate quarantine procedures are in place to eliminate the risk of introduction of exotic predators or pathogens (Such action is required for the entire suite of endemic taxa occurring on Lord Howe Island.)
- Investigate impacts on Lord Howe Currawongs of current rodent control programs, and develop and use appropriate methodologies to ensure the species is not impacted on.
- Monitor populations to identify trends in size and health of populations, especially declines in population levels or evidence of disease.
- Encourage an appreciation of the importance of the Lord Howe Currawong as a native forest predator, and the only native predator of vertebrates in the island group. Promoting knowledge of the important role of the Lord Howe Currawong in the island's ecosystem will potentially do much to reduce human impacts and negative attitudes towards this subspecies.
- Retain native vegetation and undertake relevant revegetation and weed control, especially in lowland habitat.
- Monitor the impacts of climate change and develop strtaegies to alleviate any potential impacts.
- Evaluate the implementation of the Lord Howe Island Biodiversity Management Plan.
- Undertake further surveys and research into the ecology of the subspecies to develop adequate knowledge of the subspecies to ensure its conservation.
- Studies are needed to determine if this isolated island form should be treated as a distinct species.

Lord Howe Island Silvereye

Priority actions proposed by OEH for the recovery of the Lord Howe Island Silvereye are:

- Assist with the control of introduced weeds in areas of habitat.
- Protect lowland forest habitat from clearing.
- Implement and monitor the quarantine plan.
- Monitor the status of populations.
- Research into ecology of the species to provide information to assist in its conservation.

A small area of lowland forest will be cleared to widen the access track to the subject site. The amount of forest to be cleared is a negligible proportion of forest habitat available for endemic land-bird species on Lord Howe Island. Habitat clearance will also be offset by widening other areas of forest habitat along the boundaries of the cleared paddock. Therefore the will not be a significant reduction in the habitat status for this species in relation to the proposed development.

The proposed development is in compliance with other priority actions and objectives for the recovery of each Lord Howe Island bird taxon.

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

Lord Howe Woodlhen

Threats to the status of this species on Lord Howe Island include:

- Risk of extinction due to small population size and restricted distribution.
- Potential for introduction of non-native invertebrates (eg Fire/Crazy Ant).
- Potential further introductions of exotic species.
- Impact of weeds on habitat.
- Predation on Woodhen eggs by the Black Rat.
- Competition and predation from the Buff-banded Rail.
- Small population size may lead to inbreeding.
- Predation by domestic dogs.
- Predation by the introduced Masked Owl.
- Roadkill due to vehicles and bicycles.
- Risk of poisoning from baits used in rat eradication program.

Lord Howe Island Golden Whistler

Threats to the status of this species on Lord Howe Island include:

- Clearing of lowland forest areas.
- Possible competition for food resources from the introduced Blackbird and Song Thrush.
- Potential for introduction of non-native invertebrates (eg Fire/Crazy Ant).
- Risk of extinction due to small population size.
- Invasion of habitat by introduced weeds.
- Direct predation on eggs and chicks and competition or destruction for food resources by rats.
- Risk of extinction due to restricted distribution.

Lord Howe Island Pied Currawong

Threats to the status of this species on Lord Howe Island include:

- Risk of extinction owing to its small population size. The total population of the Lord Howe Currawong is estimated to be 200 individuals (from surveys in 2005-06).

- Introduction of exotic predators or pathogens could have a significant adverse impact on the single and small population of this taxon.

- Human persecution owing to the Currawong's habit of attacking native and domestic birds, in particular predation on the iconic and endemic Lord Howe Woodhen (*Gallirallus sylvestris*) and the White Tern (*Gygis alba*); the latter, and a fairly recent coloniser of Lord Howe Island, is a favourite of residents and visitors alike. Currawongs were often shot historically and shooting still occurs occasionally.

- There is some risk of secondary or non-target poisoning of Currawongs during baiting programs for Black Rats (*Rattus rattus*) and House Mice (*Mus musculus*) as Currawongs often take poisoned rats and mice.

- The fact that the subspecies is restricted to a small isolated island, Lord Howe Island, places it at risk from stochastic and other impacts with no opportunities for natural recolonisation.

Lord Howe Island Silvereye

Threats to the status of this species on Lord Howe Island include:

- Clearing of lowland forest areas.
- Invasion of habitat by introduced weeds.
- Potential for introduction of non-native invertebrates (eg Fire/Crazy Ant).
- Edge effects and dieback.
- Risk of extinction due to small population size and restricted distribution.
- Competition and predation from other introduced species.
- Rodents are preying on eggs and chicks.

The proposed development is unlikely to contribute to Lord Howe Woodhen roadkills provided that vehicular traffic to and from the subject site during the construction period is adequately policed.

A small area of lowland forest will be cleared to widen the access track to the subject site. The amount of forest to be cleared is a negligible proportion of forest habitat available for endemic land-bird species on Lord Howe Island. Habitat clearance will also be offset by widening other areas of forest habitat along the boundaries of the cleared paddock. Therefore the will not be a significant reduction in the habitat status for these species in relation to the proposed development.

The proposed development is unlikely to contribute to threats posed by introduced pests provided that all construction materials are checked for pests before they are taken to the subject site. If introduced pests are found among construction materials, then they will be reported and adequately controlled using the methods prescribed by the Lord Howe Island Board.

3. CONCLUSION

The proposed development would not significantly impact on the status of the Lord Howe Woodhen, Lord Howe Golden Whistler, Lord Howe Pied Currawong, Lord Howe Silvereye and their habitats in NSW. Therefore, a Species Impact Statement is NOT required for these species.

4. REFERENCES

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Impacts on Matters of National Environmental Significance: Threatened and Migratory Species Listed under the EPBC Act.

APPENDIX J NATIONALLY THREATENED SPECIES

LISTED ENDANGERED AND CRITICALLY ENDANGERED SPECIES

Under the EPBC Act, a nationally endangered or critically-endangered species is significantly impacted on if a proposal is likely to:

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

An assessment of potential impacts of the proposed development on the following nationally endangered or critically-endangered bird species is provided in Appendix J:

- Curlew Sandpiper (*Calidris ferruginea*); and
- Eastern Curlew (*Numenius madagascariensis*).

These tests assume that the recommendations for minimising or avoiding bird impacts, discussed in Section 6 of the present report, are implemented.

LISTED VULNERABLE SPECIES

Under the EPBC Act, a nationally vulnerable species is significantly impacted on if a proposal is likely to:

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

An assessment of potential impacts of the proposed development on the following nationally vulnerable bird species is provided in Appendix J:

- Kermadec Petrel (western Pacific subspecies) (*Pterodroma neglecta neglecta*);
- Lord Howe Woodhen (*Gallirallus sylvestris*); and
- Lord Howe Pied Currawong (*Strepera graculina crissalis*).

These tests assume that the recommendations for minimising or avoiding bird impacts, discussed in Section 6 of the present report, are implemented.

LISTED MIGRATORY SPECIES

Under the EPBC Act an action is likely to have a significant impact on a migratory species if there is a real chance or possibility that it will:

- substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species;

- result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species; or

- seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.

An assessment of potential impacts of the proposed development on the following nationally vulnerable bird species is provided in Appendix J:

Migratory Species Detected at Subject Site

- White-throated Needletail (*Hirundapus caudacutus*);
- Flesh-footed Shearwater (*Ardenna carneipes*);
- Red-tailed Tropicbird (*Phaethon rubricauda*);
- Pacific Golden Plover (*Pluvialis fulva*);
- Eastern Curlew (*Numenius madgascariensis*);
- Whimbrel (*Numenius phaeopus*); and
- Common (Brown) Noddy (*Anous stolidus*).

Other Migratory Bird Species With Potential to Occur on Subject Site

- Fork-tailed Swift (*Apus pacificus*);
- Wedge-tailed Shearwater (*Ardenna pacificus*);
- Providence Petrel (*Pterodroma solandri*);
- Masked Booby (*Sula dactyla*);
- Cattle Egret (*Ardea ibis*);
- Ruddy Turnstone (*Arenaria interpres*);
- Sharp-tailed Sandpiper (*Calidris acuminata*);
- Red Knot (*Calidris canutus*);
- Curlew Sandpiper (*Calidris ferruginea*);
- Red-necked Stint (*Calidris ruficollis*);
- Latham's Snipe (*Gallinago hardwickii*);
- Bar-tailed Godwit (*Limosa lapponica*);
- Grey-tailed Tattler (*Tringa brevipes*); and
- Wandering Tattler (*Tringa incana*).

These tests assume that the recommendations for minimising or avoiding bird impacts, discussed in Section 6 of the present report, are implemented.

Table J1 Endangered and Critically-endangered Bird Species

	Eastern Curlew	Curlew Sandpiper
There is potential for the proposed development to:		
lead to a long-term decrease in the size of a population.	No. The subject site is marginal foraging habitat for the Eastern Curlew and unlikely to provide habitat for the Curlew Sandpiper. Individuals of both species are from populations that occur throughout coastal Australia. Their sub-populations on Lord Howe Island are negligible proportions of the total numbers found around Australia. The risk of Eastern Curlews or Curlew Sandpipers colliding with wind turbines on Lord Howe Island is considered negligible.	
reduce the area of occupancy of a species.	No.	
fragment an existing population into two or more populations.	No. Both species are highly mobile and the turbines will not act as a significant barrier to their movements between foraging and roosting habitats on the island, or longer-range movements.	
adversely affect habitat critical to the survival of a species.	No. One Eastern Curlew was observed on the subject site during the Feb & March 2016 surveys. However, the subject site does not represent significant foraging or roosting habitat for this species.	No. The subject site does not represent significant foraging or roosting habitat for this species.
disrupt the breeding cycle of a population	No. These two species do not breed in Australia.	
modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	No.	No.
result in invasive species that are harmful to a endangered species becoming established in the endangered species' habitat.	No.	No.
interfere substantially with the recovery of a species.	No. The proposed development is compliant with the objectives and actions for the national recovery of these two species.	

Table J2 Vulnerable Bird Species

	Kermadec Petrel (western Pacific subspecies)	Lord Howe Woodhen	Lord Howe Pied Currawong
There is potential for the proposed development to:			
lead to a long-term decrease in the size of an important population of a species.	No. Kermadec Petrels spend most of their time foraging at sea. The turbines are not located near breeding colonies. Individuals may very occasionally fly over Lord Howe Island, but are likely to fly at altitudes that are higher than the turbines.	No. No significant habitat for the Lord Howe Woodhen on the subject site.	No. The preferred turbine option provides to minimal collision risk to Pied Currawongs. Individual Currawongs are likely to avoid the turbines by flying above forest canopy height or around the turbine sites.
reduce the area of occupancy of an important population.	No. There is no potential habitat for this species on the subject site.	No. Both species occur in palm forest areas across the island. A negligible area of forest would be cleared for widening an access track to the subject site.	
fragment an existing important population into two or more populations.	No. This species is highly mobile and the turbines will not act as a significant barrier to its movements between foraging and roosting habitats, or longer-range movements.	No.	No. This species is highly mobile and the turbines will not act as a significant barrier to its movements between foraging and roosting habitats, or longer-range movements.
adversely affect habitat critical to the survival of a species.	No. There are no listed critical habitats for these species on Lord Howe Island.		
disrupt the breeding cycle of an important population.	No. Kermadec Petrels do not breed on Lord Howe Island.	No. Both species breed in forested areas of the island. A negligible area of forest would be cleared for widening an access track to the subject site.	
modify, destroy, remove, isolate or decrease the availability or quality of habitat to the extent that the species is likely to decline.	No. There is no habitat for Kermadec Petrels on the subject site.	A small area of lowland forest will be cleared to widen the access track to the subject site. The amount of forest to be cleared is a negligible proportion of forest habitat available for endemic land-bird species on Lord Howe Island. Habitat clearance will also be offset by widening other areas of forest habitat along the boundaries of the cleared paddock. Therefore the will not be a significant reduction in the habitat status for these species in relation to the proposed development.	
result in invasive species that are harmful to a vulnerable species becoming established in the vulnerable species' habitat.	No.	No, provided that construction materials are checked for the presence of introduced pests before they are brought onto the island. There will be no long-term stock-piling of construction material or construction waste on the subject site or in adjacent areas to reduce the risk of invasive species (weeds, rodents and ants) becoming established.	
interfere substantially with the recovery of a species.	No. The proposed development is compliant with the objectives and actions for the national recovery of these species.		

Table J3 Listed Migratory Bird Species Detected at Subject Site

	White-throated Needletail	Flesh-footed Shearwater	Red-tailed Tropicbird	Pacific Golden Plover	Eastern Curlew	Whimbrel	Common Noddy
There is potential for the proposed development to:							
substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.	No. There is no suitable habitat for this species on the subject site. Individuals may very occasionally fly over the subject site in front of storm fronts. Observed flying over the subject site during the February & march 2016 surveys.	No. The nesting habitat of this species occurs in forest from Ned's Beach to Clear Place, including forest areas downslope (west) of the cleared paddock. These areas will be protected provided that the recommendations in Section 6 of the present report are implemented. Foraging areas on the ocean will not be impacted by the proposed development.	No. This species nests on cliffs along the island's coast from Malabar to Mt Eliza, North Head, and on Mt Lidgbird and Mt Gower. It forages in coastal waters around the island. Habitats in these areas will not be impacted by the proposed development.	No. Small numbers of each of these species were observed foraging in the open paddock. However, this is considered marginal habitat, with more suitable foraging habitat occurring on sand flats and rocky coastal areas on the island. Most of this foraging habitat will be retained.			No. This species breeds on rocks and low bushes around the cliffs and on offshore islands. It forages in coastal waters around the island. Habitats in these areas will not be impacted by the proposed development.
result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.	No, provided that construction materials are checked for the presence of introduced pests before they are brought onto the island. There will be no long-term stock-piling of construction material or construction waste on the subject site or in adjacent areas to reduce the risk of invasive species (weeds, rodents and ants) becoming established.						
seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No. White-throated Needletails do not breed in Australia. The species is regarded as a vagrant on Lord Howe Island. Individuals visiting the island are likely to be a negligible proportion of a larger population that occurs throughout eastern Australia. Therefore, the proposed development would not impact on an	No. Most breeding populations of the Flesh-footed Shearwater within Australian jurisdiction are poorly known. This lack of information makes it difficult to assess which breeding populations are most important for the persistence of the species within Australian jurisdiction. Of the breeding	No. The proposed development would not impact on the breeding, feeding and resting behaviour of this species. There are an estimated 500-1000 pairs on the Lord Howe Island Group and there are over 3000 pairs nesting in Australian waters. Red-tailed Tropicbirds soar or glide over the subject site, mostly at heights greater than the surrounding forest canopy. The proportion of individuals	No. Migratory shorebirds do not breed in Australia. Small numbers of each of these species were observed foraging in the open paddock. However, this is considered marginal habitat, with more suitable foraging habitat occurring on sand flats and rocky coastal areas on the island. Most of this foraging habitat will be retained. Individuals of these species are from populations that occur throughout coastal Australia. Their sub-populations on Lord Howe Island are negligible proportions of the total numbers found around Australia. The risk of Pacific Golden Plovers,		No. The proposed development would not impact on the breeding, feeding and resting behaviour of this species. In 1996, the total Australian population of the Common Noddy was estimated to be between 174 480 and 214 130 breeding pairs. A 2012 IUCN assessment of the species' conservation status noted that the global population size

	White-throated Needletail	Flesh-footed Shearwater	Red-tailed Tropicbird	Pacific Golden Plover	Eastern Curlew	Whimbrel	Common Noddy
	ecologically significant proportion of the population of this species.	populations whose numbers have been estimated, the most important, based purely on size, are those on Sandy Island (300 000 pairs), Lord Howe Island (17 462 pairs), Eclipse Island (6000–8000 pairs), Breaksea Island (1000–5000 pairs), Flat Island (1000–1500 pairs) and Wickham Island (1000–1500) pairs. Breeding behaviour on Lord Howe Island is unlikely to be impacted provided that turbine construction occurs outside the period breeding periods. The risk of collisions with turbines would be minimised through the use of Vergnet turbines, fitting turbine blades and guy ropes with flashing red lights to make the visible to birds, and curtailing the turbine use during the peak arrival times around dusk each day. Foraging areas at sea will not be impacted by the proposed development.	flying over the subject site are likely to be a negligible proportion the larger population that occurs in Australian waters. The risk of collisions with turbines would be minimised through the use of Vergnet turbines located at WT1 & WT2. Therefore, the proposed development would not impact on an ecologically significant proportion of the population of this species.	significant numbers of Eastern Curlews and Whimbrels colliding with wind turbines on Lord Howe Island is considered negligible.			was estimated between 180 000 and 1 100 000 individuals; no estimated proportion of the population residing in Australia was given. Brown Noddies soar or glide over the subject site, mostly at heights greater than the surrounding forest canopy. The proportion of individuals flying over the subject site are likely to be a negligible proportion the larger population that occurs in Australian waters. The risk of collisions with turbines would be minimised through the use of Vergnet turbines located at WT1 & WT2. Therefore, the proposed development would not impact on an ecologically significant proportion of the population of this species.

Table J4 Listed Migratory Bird Species Potentially Occurring at Subject Site

	Fork-tailed Swift	Wedge-tailed Shearwater	Providence Petrel	Masked Booby	Cattle Egret	Ruddy Turnstone	Sharp-tailed Sandpiper
There is potential for the proposed development to:							
substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.	No. There is no suitable habitat for this species on the subject site. Individuals may very occasionally fly over the subject site in front of storm fronts.	No. The proposed development would not impact on the breeding habitat along the lagoon dunes, at Signal Point or on offshore islands, or foraging habitat at sea.	No. The proposed development would not impact on the breeding habitat on the southern mountains, or foraging habitat at sea.	No. The proposed development would not impact on the breeding habitat at Muttonbird Point or on offshore islands, or foraging habitat at sea.	No. Small numbers of Cattle Egrets may very occasionally forage in the open paddock. Most of this foraging habitat will be retained.	No. There is no suitable habitat for these species on the subject site. Individuals may very occasionally fly over the subject site when moving between foraging and roost site areas in coastal areas of the island.	
result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.	No, provided that construction materials are checked for the presence of introduced pests before they are brought onto the island. There will be no long-term stock-piling of construction material or construction waste on the subject site or in adjacent areas to reduce the risk of invasive species (weeds, rodents and ants) becoming established.						
seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No. Fork-tailed Swifts do not breed in Australia. The species is regarded as a vagrant on Lord Howe Island. Individuals visiting the island are likely to be a negligible proportion of a larger population that occurs throughout eastern Australia. Therefore, the proposed development would not impact on an ecologically significant proportion of the population of this species.	No. these species spend most of their time foraging at sea. The turbines are not located near breeding colonies. Individuals may very occasionally fly over the subject site, but are likely to fly at altitudes that are higher than the turbines.			No. Cattle Egrets visiting Lord Howe Island are likely to be a negligible proportion of a larger population that occurs throughout eastern Australia. Therefore, the proposed development would not impact on an ecologically significant proportion of the population of this species.	No. There is no suitable habitat for these species on the subject site. Individuals may very occasionally fly over the subject site when moving between foraging and roost site areas in coastal areas of the island.	

Table J4 Listed Migratory Bird Species Potentially Occurring at Subject Site (continued)

	Red Knot	Curlew Sandpiper	Red-necked Stint	Latham's Snipe	Bar-tailed Godwit	Grey-tailed Tattler	Wandering Tattler
There is potential for the proposed development to:							
substantially modify (including by fragmenting, altering fire regimes, altering nutrient cycles or altering hydrological cycles), destroy or isolate an area of important habitat for a migratory species.	No. There is no suitable habitat for these species on the subject site. Individuals may very occasionally fly over the subject site when moving between foraging and roost site areas in coastal areas of the island.						
result in an invasive species that is harmful to the migratory species becoming established in an area of important habitat for the migratory species.	No, provided that construction materials are checked for the presence of introduced pests before they are brought onto the island. There will be no long-term stock-piling of construction material or construction waste on the subject site or in adjacent areas to reduce the risk of invasive species (weeds, rodents and ants) becoming established.						
Seriously disrupt the lifecycle (breeding, feeding, migration or resting behaviour) of an ecologically significant proportion of the population of a migratory species.	No. Migratory shorebirds do not breed in Australia. The subject site is not significant foraging or roosting habitat for these seven shorebird species. Individuals may very occasionally fly over the subject site when moving between foraging and roost site areas in coastal areas of the island, but are likely to avoid the turbines by flying above forest canopy height or around the turbine sites.						