

Twin Hills Wind Farm

Bird and Bat Utilisation Survey Report



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Executive Summary

Twin Hills Wind Farm Pty Ltd, care of Wind Prospect Pty Ltd (Wind Prospect) commissioned Stantec Australia Pty Ltd (Stantec) to undertake bird and bat utilisation surveys (BBUS; 'the Survey') of the Twin Hills Survey Area (the Survey Area) commencing in December 2023 and occurring quarterly for two years. This report presents a desktop assessment and the results of the Survey for the two-year duration. The Survey Area encompasses 9,993 hectares (ha) located approximately 260 kilometers (km) north of Perth in the Geraldton Sandplains Bioregion of Western Australia (WA). 12,769 ha of area additional to the Survey Area (hereafter, Additional Area') was surveyed during the Survey. Information from the Additional Area, including habitat mapping and species records, has been provided for local context. Additionally, survey effort was conducted in road reserves and a nature reserve near the Survey Area, which are intended as reference sites.

The BBUS methods were developed and implemented based on the *Onshore Wind Farm Guidance: Best practice approaches when seeking approval under Australia's national environment law (Draft)*, *Onshore Wind Farms: Interim Guidance on Bird and Bat Management*, an assessment of surveys undertaken for previous wind turbine assessments, and a review of national and international best-practice approaches. The purpose of the Survey is to build a robust baseline dataset to determine at-risk bird species and inform subsequent before-after-control-impact (BACI) monitoring.

Supplementary targeted fauna survey effort was also conducted during the separate basic and targeted fauna survey, and species records and relevant survey effort from these surveys are consolidated within this report.

Significant Species

The desktop assessment comprised five database searches and review of seven fauna surveys completed in the vicinity of the Survey Area. A total of 31 significant bird species and zero significant bat species listed under the EPBC Act 1999 or the BC Act 2016 were identified as having potential to occur within the Survey Area.

Two significant bird species was recorded during the Survey and during the basic and targeted fauna survey: Carnaby's Black-Cockatoo (*Zanda latirostris*; En, En) and Peregrine Falcon (*Falco peregrinus*) (OS). There were 5,661 observations of Carnaby's Black-Cockatoo during the Survey (repeated observations of the same individuals from a group of approximately 400) and all observations were below (0-40 m) Rotor Sweep Area (RSA) (40-300 m). The basic and targeted fauna surveys identified one Carnaby's Black-Cockatoo roost within a nature reserve bounded by the Survey Area (approximately 1.9 km from the Survey Area) and no confirmed breeding trees within the Survey Area. Additional to the data collected during the Survey, contextual regional information related to Carnaby's Black-Cockatoo range, movement and risk from wind turbines has been provided by expert ornithologists Ron and Christine Johnstone and is presented in **Appendix D**. There was one observation of Peregrine Falcon recorded opportunistically within the Survey Area during the Q4 2024 BBUS, foraging within RSA height.

Additionally, one long unused Malleefowl (*Leipoa ocellata*; Vu, Vu) mound was recorded within the Survey Area, in Low Eucalypt Woodland. The mound was approximately 2.5m x 1m, with a low, flat profile and no evidence of recent use. Small pieces of eggshell and a thin layer of incubating material were observed but do not appear recent. Based on the age of the mound, the lack of other mounds/activity within the Survey Area, and the age/prevalence of records of Malleefowl in the vicinity of the Survey Area from the Desktop assessment, this species was assessed as possible to occur within the Survey Area. If the species is present within the Survey Area, it will be at very low risk of interaction with wind turbines.

Additionally, based on the findings of the desktop assessment, the following significant bird species are considered likely to occur within the Survey Area:

- Fork-tailed Swift (*Apus pacificus*) (Mi; Mi); and
- Blue-billed Duck (*Oxyura australis*) (P4).

Four significant bird species (in addition to Malleefowl) considered possible to occur are:

- Grey Falcon (*Falco hypoleucos*) (Vu; Vu);
- Southern Whiteface (*Aphelocephala leucopsis*) (Vu);
- Glossy Ibis (*Plegadis falcinellus*) (Mi; Mi); and



- Eastern Cattle Egret (*Bubulcus ibis*) (Mi).

Survey Effort

The Survey was undertaken at 18 fixed points (FP). Of these, six FPs are considered potential impact sites and are located within the Survey Area, four FPs are reference sites and are located outside the Survey Area (1.9 – 9.9 km from the Survey Area), and eight FPs are located in the Additional Area and were not surveyed for the entire two-year program. FP locations were evenly distributed across the Survey Area to aim for maximum coverage where wind turbines were likely to be situated. FPs were positioned on high ground where possible and provide vantage of up to a 2 km radius, and locations were selected to ensure vantage of all habitat types represented within the Survey Area. The following methods were utilised at each FP per quarter: Counts with two zoologists (both experienced in conducting bird and bat surveys) recording all birds heard and observed for a minimum of 45 minutes across morning, midday and afternoon periods (2 hours 15 minutes per quarter); an echolocation recording unit (bat unit) deployed for two nights; and an acoustic recording unit (bird unit) deployed for two nights. This comprised a total of 234 hours of FP counts during the two-year period. In addition, bird and bat units were deployed at targeted locations not co-located with FPs. This comprised a total of 208 nights of acoustic data and 206 of echolocation data during the two-year period. Opportunistic records of potentially at-risk birds were also recorded.

A total of 114 bird and seven bat species were recorded during the BBUSs and the basic and targeted fauna survey.

Observations and Flight Heights

Flight height, location, direction and flight behaviour were recorded every 30 seconds for birds and flocks observed during FP counts. In total, 19,980 bird observations with were recorded during FP counts within the Survey Area, Additional Area and reference sites. Carnaby's Black-Cockatoos, Galahs (*Eolophus roseicapilla*) and Little Corellas (*Cacatua sanguinea*) collectively accounted for 63.23% of all observations.

A total of 18,507 of the observations had associated flight heights recorded (most of the remaining observations being birds that were heard only). Of these 18,507 observations, 1,968 (10.63%) were within the proposed RSA height (40-300 m). A total of 27 species were recorded flying within RSA height. The Little Corella accounted 44.00% of all observations within RSA height, and the Tree Martin accounted for 19.00% of all observations within RSA height. Of the 27 species recorded flying within the RSA height, seven were raptors, five were aerial foragers, one was a shorebird, six were waterbirds, six were other species of potential risk and two were bush birds.

Within the Survey Area (excluding the Additional Area and reference sites), a total of 7,203 observations with associated flight heights were recorded. Of the of 7,203 observations within the Survey Area, 917 (12.73%) were within the proposed RSA (40-300 m).

Preliminary Risk Model

A preliminary Ecological Risk Model (ERM) was developed and risk scores calculated for the 97 bird species for which flight heights were recorded during the FP counts and opportunistic observations. Based on the existing data and preliminary ecological risk model, two species, Carnaby's Black-Cockatoo and Australian Pelican (*Pelecanus conspicillatus*), were assessed as medium risk in accordance with risk modelling guidance for offshore wind farms (adapted to an onshore context). The remaining bird species observed during the FP counts were assessed as low risk. The 14 most at-risk species included three raptors, seven waterbirds, one shorebird and three other species of potential risk, comprised of Carnaby's Black-Cockatoo, Australian Pelican (*Pelecanus conspicillatus*), Wedge-tailed Eagle (*Aquila audax*), Peregrine Falcon (*Falco peregrinus*), Little Pied Cormorant (*Microcarbo melanoleucos*), Straw-necked Ibis (*Threskiornis spinicollis*), Banded Lapwing (*Vanellus tricolor*), Little Eagle (*Hieraaetus morphnoides*), Red-tailed Black-Cockatoo (*Calyptorhynchus banksii escondidus*), Little Black Cormorant (*Phalacrocorax sulcirostris*), Western Corella (*Cacatua pastinator*), Australasian Grebe (*Tachybaptus novaehollandiae*), Eurasian Coot (*Fulica atra*) and Pacific Black Duck (*Anas superciliosa*).



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1. Introduction

1.1 Project Description

Stantec Australia Pty Ltd (Stantec) was engaged by Twin Hills Wind Farm Pty Ltd, care of Wind Prospect Pty Ltd (Wind Prospect) to undertake technical ecological work to support the development application process for the proposed Twin Hills Wind Farm development (the Proposal).

The Twin Hills Survey Area (the Survey Area) is located in the Geraldton Sandplains Bioregion of Western Australia (WA) (**Figure 1-1**) approximately 260 kilometers (km) north of Perth. The Survey Area is comprised of 9,993 hectares (ha) of land that is primarily cleared for crops and livestock grazing with interspersed patches of remnant native vegetation. The infrastructure for the Proposal consisting of 93 proposed wind turbines, and ancillary permanent and temporary infrastructure associated with the wind farm are to be established entirely within the Survey Area.

The bird and bat utilisation survey (BBUS; the Survey) method was developed and implemented based on the *Onshore Wind Farm Guidance: Best practice approaches when seeking approval under Australia's national environment law (Draft)* (DCCEEW 2024a), *Onshore Wind Farms: Interim Guidance on Bird and Bat Management* (DAWE 2021), a desktop assessment of previous surveys undertaken for previous wind turbine projects, and a review of national and international best-practice approaches to bird and bat utilisation surveys for wind farms. The purpose of the Survey was to build a robust baseline dataset to inform a preliminary risk assessment, including an ecological risk model (ERM) and determine at-risk bird species (groups considered to be at risk from wind turbines include open-air foraging bats, raptors, aerial foraging birds, waterbirds, shorebirds and other species known to fly at height). The Survey compiles baseline data to inform a subsequent before-after-control-impact (BACI) monitoring program, as required by DAWE (2021) to monitor potential impacts to bird and bat species from the Proposal.

A preliminary fauna site inspection (9 – 13 October 2023) and basic and targeted fauna survey (23 February – 1 March 2024; 21 – 29 October 2024) were also conducted (Stantec 2025). The habitat mapping, relevant species records and relevant survey effort from these surveys are consolidated within this report.

1.2 Objectives and Scope

The overarching objective of this work was to conduct a desktop assessment, bird and bat utilisation survey (the Survey), and preliminary risk assessment including an ecological risk model (ERM) with the aim to enhance knowledge of bird and bat utilisation of the Survey Area, determine at-risk bird species and inform a future Bird and Bat Management Plan to mitigate impacts to at-risk species from the Proposal.

The specific objectives included the following:

- Complete a desktop assessment, involving:
 - Database searches and literature review to develop a list of bird and bat species that have been recorded within and in the vicinity of the Survey Area, including significant species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), *Biodiversity Conservation Act 2016* (BC Act), as well as the Department of Biodiversity, Conservation and Attractions (DBCA) Priority Fauna List, and bird and bat groups that are likely to be at greater risk from wind farm developments;
 - A likelihood of occurrence assessment for species of significance; and
 - Preliminary mapping of fauna habitats, including the identification of habitats with potential to support species of significance.
- Conduct the Survey, involving:
 - Use of fixed point (FP) counts to record bird occurrence and utilisation within the Survey Area, and flight metrics including height relative to rotor sweep area (RSA) height;
 - Use of bird and bat acoustic and echolocation recording units to determine presence within the Survey Area; and



- Quarterly survey events over a two-year period (eight total survey events) to capture seasonal and annual variation in species utilisation, in accordance with best practice guidance DAWE (2021).
- Develop and run a preliminary ERM for bird species with available flight height data.
- Deliver a technical report which presents the findings of the desktop assessment, Survey and ERM, and inform the continued delivery of BBUSs in 2025.

1.3 Regulatory Guidelines and Technical Documents

The Survey approach aligned with the following guidelines and technical documents, where applicable:

- Onshore Wind Farms: Interim Guidance on Bird and Bat management (DAWE 2021);
- Onshore Wind Farm Guidance: Best practice approaches when seeking approval under Australia's national environment law (Draft for consultation and feedback - May 2024) (DCCEEW 2024a);
- EPBC Act Policy Statement 2.3 Wind Farm Industry (DEWHA 2009);
- Environmental Factor Guideline – Terrestrial Fauna (EPA 2016);
- Technical Guidance: Terrestrial vertebrate fauna surveys for environmental impact assessment (EPA 2020);
- Significant Impact Guidelines – Matters of National Environmental Significance (DoE 2013);
- Statement of Environmental Principles, Factors, Objectives and Aims of EIA (EPA 2023);
- Survey Guideline for Australia's Threatened Birds (DEWHA 2010);
- Referral Guideline for 3 WA Threatened Black-Cockatoo Species (DAWE 2022b); and
- National Malleefowl Monitoring Manual: Standards, Protocols and Monitoring Procedures (National Malleefowl Recovery Team 2020).



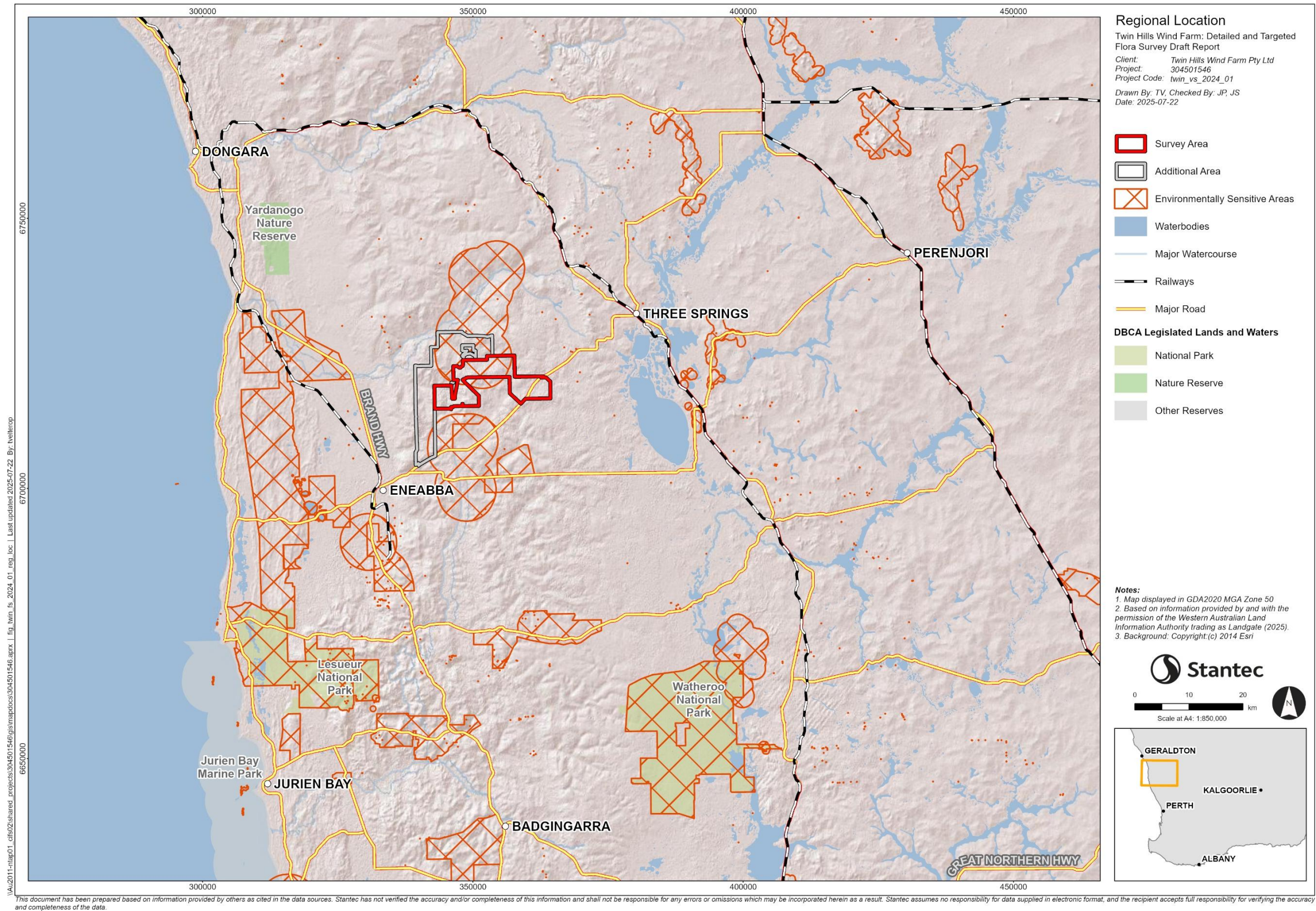


Figure 1-1: Regional location of the of the Survey Area.

2. Existing Environment

2.1 Biophysical Environment

2.1.1 Biogeographical Location

The Survey Area is located within the Lesueur Sandplain subregion of the Geraldton Sandplains bioregion (GES67), as defined by the Interim Biogeographic Regionalisation of Australia (IBRA) (**Figure 2-1**). The Geraldton Sandplains bioregion covers an area of 3,142,149 ha (DAWE 2022a) and comprises the central and northern Perth Basin, the Pinjarra Orogen, and the south end of the Carnarvon Basin (McKenzie *et al.* 2003). The bioregion is characterised by semi-arid warm Mediterranean conditions supporting mainly proteaceous scrub heaths, rich in endemics, with extensive York Gum and Jam woodlands on outwash plains associated with drainage (Thackway and Cresswell 1995).

The Lesueur Sandplain subregion encompasses 1,172,152 ha within the Geraldton Sandplains bioregion, comprising a mosaic of lateritic mesas, sandplains and coastal sands on Jurassic siltstones and sandstones of the central Perth Basin (DAWE 2022a). The dominant land-use in the subregion is dry-land agriculture (69.34%), with lesser areas of conservation (17.6%) and Unallocated Crown Land and Crown Reserves (12.5%) (Desmond and Chant 2001). The subregion exhibits extremely high floristic endemism, with a large number of distinct, species rich and geographically restricted communities occurring in the Mt Lesueur and Coomallo area (Desmond and Chant 2001).

2.1.2 Land Systems

Land systems are defined as an area or group of areas throughout which there is a recurring pattern of topography, soils and vegetation (Tille 2006). An understanding of land systems provides an indication of the occurrence and distribution of vegetation types and fauna habitats within and surrounding the Survey Area.

Five land systems were identified as occurring within the Survey Area, with the most extensive being the Coalara System (64.29% of the Survey Area) (**Table 2-1**). The Survey Area typically comprises undulating sandplains, lateritic plateaus and breakaways, rises and low hills, and sandy drainage lines and springs (**Table 2-1**; **Figure 2-2**). These land systems support a range of vegetation including scrub heath, and *Eucalyptus tottiana* and Banksia woodland (**Table 2-1**). One additional land system occurs within the Additional Area (**Table 2-1**).

Table 2-1: Description of land systems and their extent within the Survey Area.

Land System	Description	Land System Vegetation	Extent in the Survey Area		Extent in the Additional Area	
			ha	%	ha	%
Coalara System	Partially dissected plateau with lateritic caps and intervening sandy drainage lines; Pale and yellow deep sand, sandy gravels and sand over gravel	Heath, scrub heath with Banksia and <i>Eucalyptus tottiana</i> open low woodland	6,424.98	64.29	92.63	0.73
Otorowiri System	Undulating to rolling sandplain and low hills. Gentle to moderately steep valley sides at margins of Mooladara Hill System. Spring lines are a common occurrence	<i>Eucalyptus tottiana</i> woodland with river red gum woodland in valley floors	2,515.35	25.17	2,020.47	15.82
Mount Adams System	Gently undulating sandplain with low gravel ridges and occasional laterite breakaways.	Scrub heath	1,045.98	10.47	9,275.73	72.64



Land System	Description	Land System Vegetation	Extent in the Survey Area		Extent in the Additional Area	
			ha	%	ha	%
Mooladara Hill System	Sandplain with dissected lateritic outcrops on margins and prominent dry valleys and drainages; west of Three Springs; Yellow, pale and brown deep sands, sand over gravel, minor sandy gravel, sandy duplexes; Banksia woodland and scrub heath	Banksia woodland and scrub heath	6.97	0.07	1,015.74	7.95
Boothendarra System	Subdued stripped lateritic plateau, undulating and gently undulating rises; Sandy duplexes, pale deep sand, sandy and loamy gravels and minor clays	Wandoo woodland, <i>Eucalyptus tottiana</i> and Banksia low open woodland, scrub heath some mallee	0	0	364.08	2.85
Total			9,993.28	100	12,771.22	100



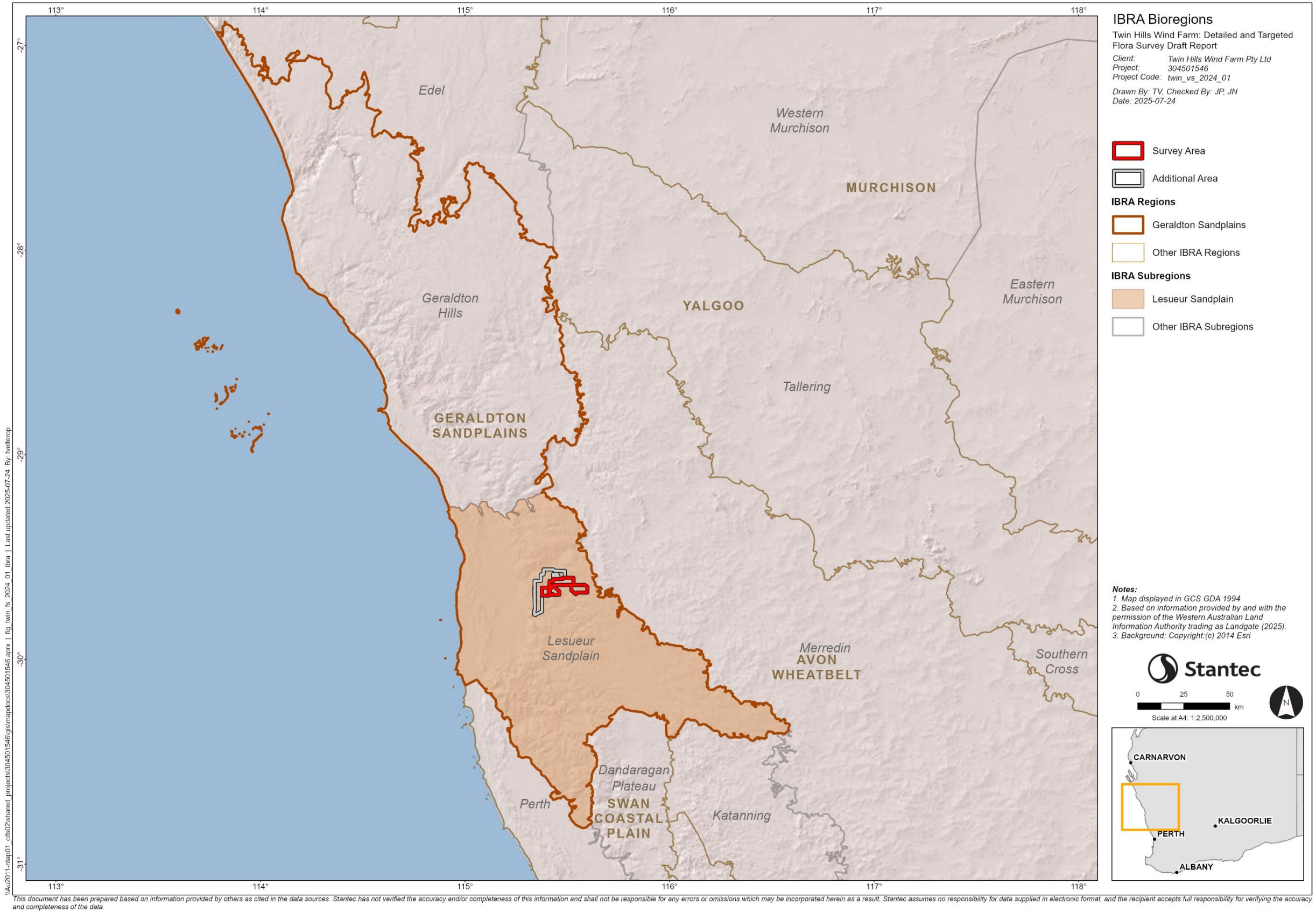


Figure 2-1: IBRA bioregions and subregions associated with the Survey Area.

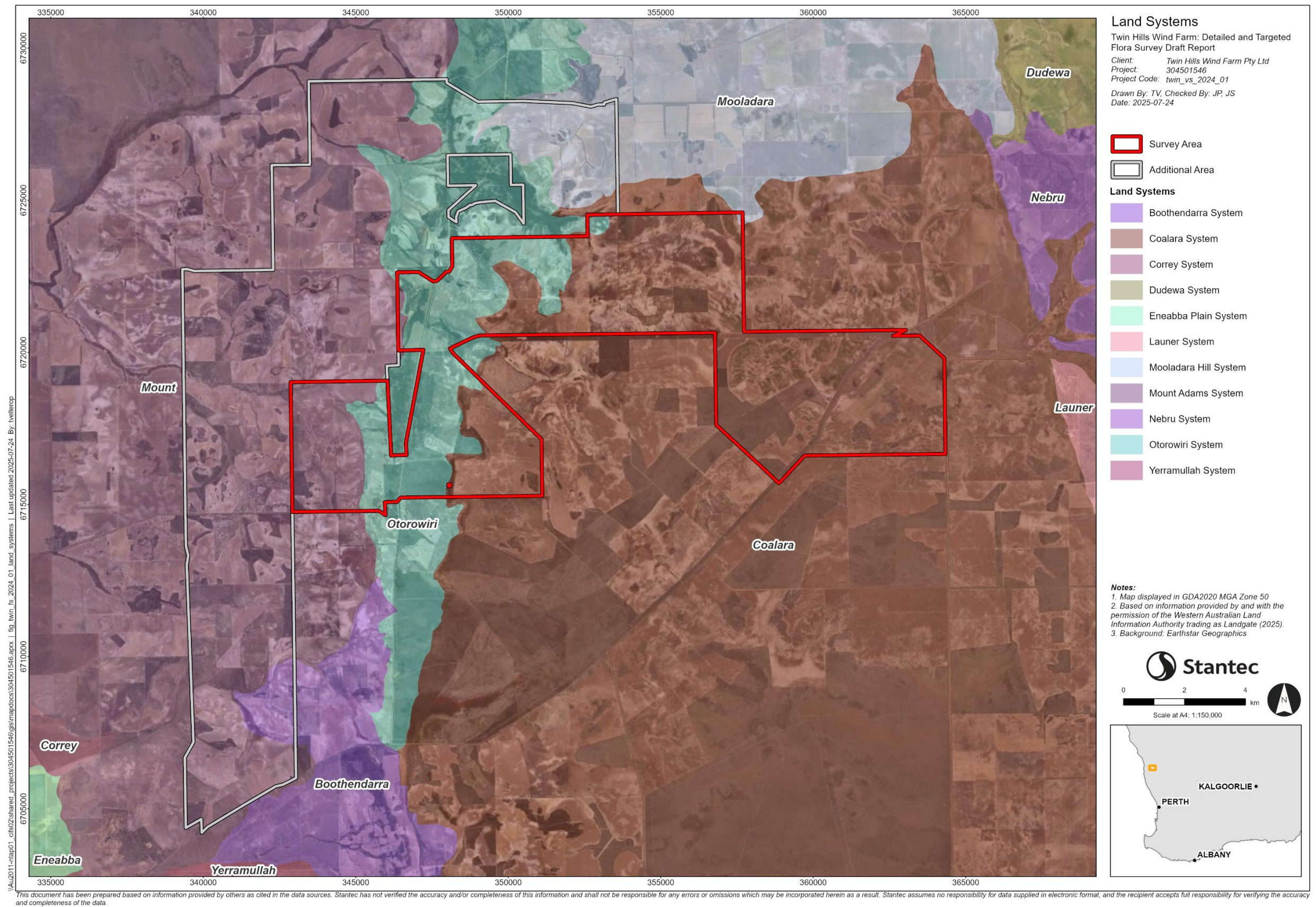


Figure 2-2: Land systems of the Survey Area.

2.2 Physical Environment

2.2.1 Climate

The Survey Area is located within the Lesueur subregion of the Geraldton Sandplains Bioregion of Western Australia, which is characterized by a semi-arid Mediterranean climate (**Section 2.1.1**). The nearest active Bureau of Meteorology (BoM) weather station with long term rainfall data is Carnamah Station (station no. 008025), which is approximately 35 km east of the Survey Area. Based on the long-term rainfall data from Carnamah Station, the mean annual rainfall since 1901 is 376.2 mm. The majority of rainfall is in winter, between the months of May and August (BoM 2023).

Carnamah Station is also the nearest BoM weather station with long-term temperature data. Based on the long-term temperature data from Carnamah Station, the warmest months of the year are between November and March, with daily maximum temperatures averaging above 30°C (**Figure 2-3**). The coolest months occur during winter are from June to August, with minimum temperatures consistently falling below 9°C. The long-term mean maximum temperature since 1901 is 26.8°C, and the long-term mean minimum temperature is 12.6°C (BoM 2023).

Morning winds are most commonly easterly with speeds between 0 and 10 kmph (BoM 2023) (**Figure 2-4**). Afternoon winds are more variable in direction but most commonly westerly with speeds between 0 and 10 kmph.

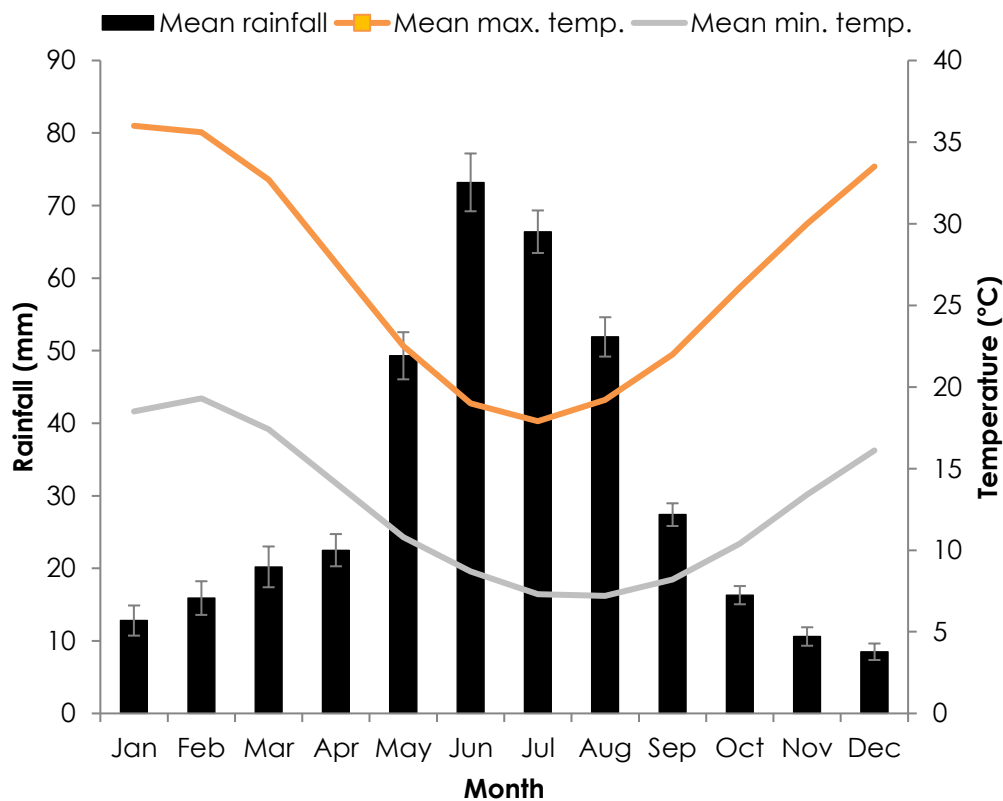
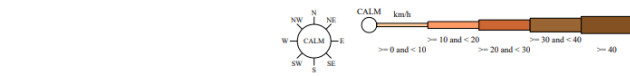


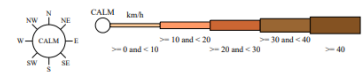
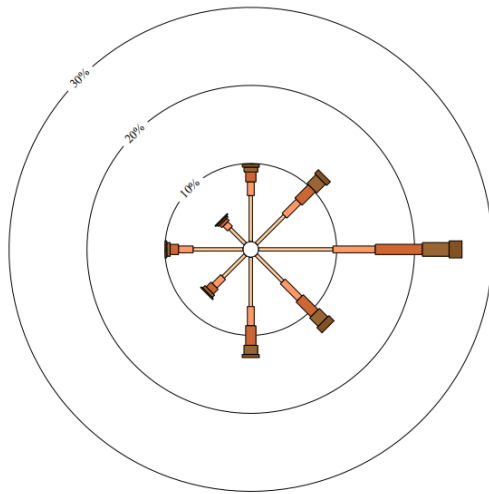
Figure 2-3: Long-term (1901-2023) rainfall (mm) and temperature (°C) from the Carnamah Weather Station (No.008025) (BoM 2023).





9 am
17273 Total Observations

Calm 5%



3 pm
10863 Total Observations

Calm 7%

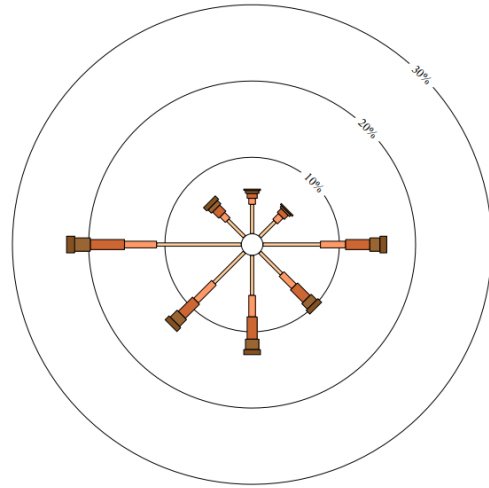


Figure 2-4: Wind roses showing 9am and 3pm annual average wind speed and direction at the Carnamah Weather Station (No.008025) (BoM 2023).

2.2.2 Surface Water and Hydrology

The Survey Area occurs within the Arrowsmith River Catchment and the Hill River Catchment. The southern extension of the Additional Area is within the Indoonlogue Catchment. The Survey Area does not intersect the Arrowsmith River or any other major watercourses, but it does intersect numerous smaller tributaries (**Figure 2-5**).



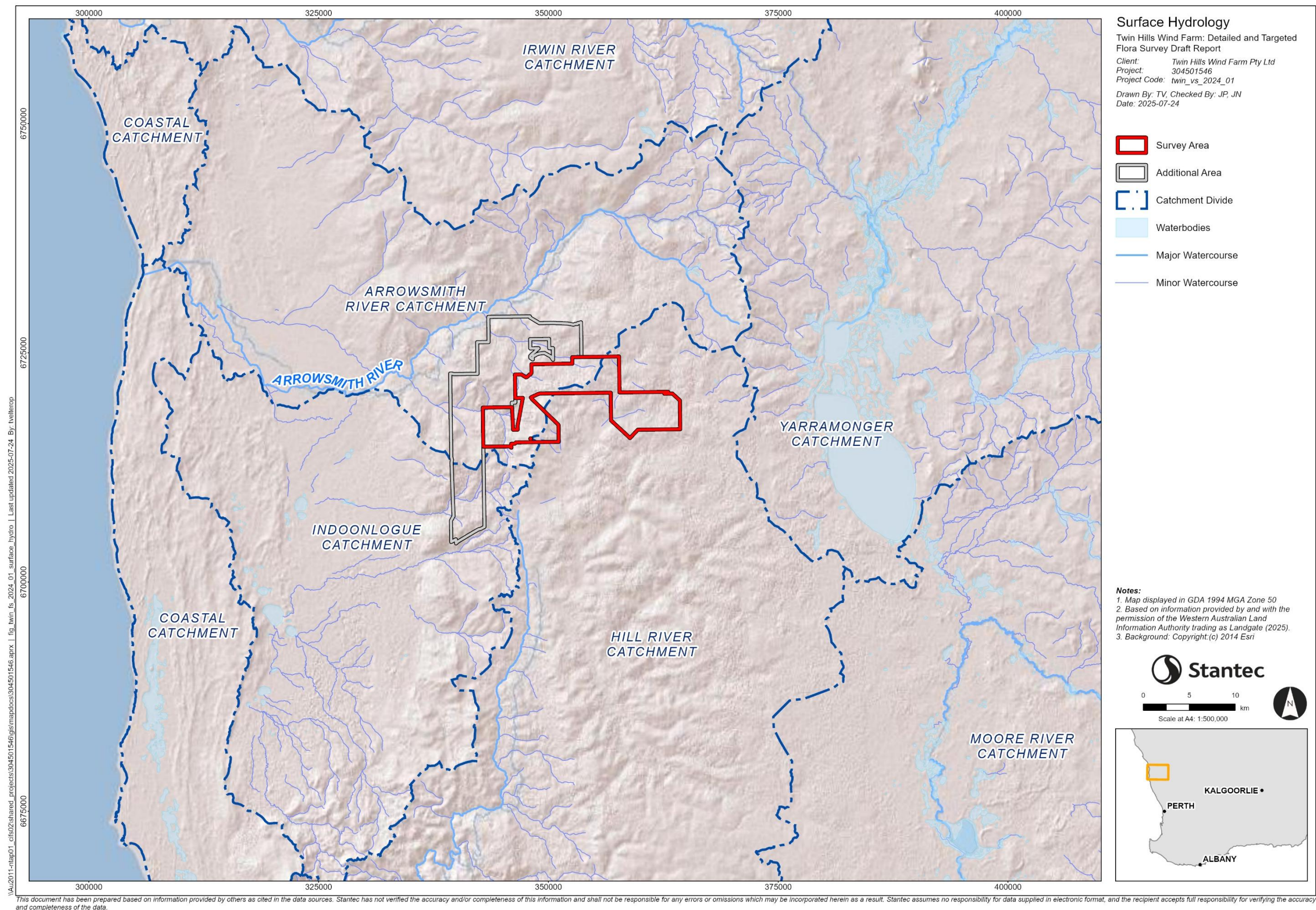


Figure 2-5: Surface hydrology in relation to the Survey Area.

2.2.3 Conservation Reserves and Environmentally Sensitive Areas

2.2.3.1 National Parks, Nature Reserves and other Protected Areas

The Survey Area does not directly overlap with any conservation reserves, however one small unnamed nature reserve (R 48098) borders the Survey Area (**Figure 2-6**). The next closest conservation reserves are R 12705 (450 m north, bounded by the Additional Area), Wilson Nature Reserve (adjacent to the north of the Additional Area) and Depot Hill Nature Reserve (adjacent to the south of the Additional Area). Other conservation reserves in the vicinity of the Survey Area include the Wotto Nature Reserve (1.5 km south of the Survey Area), White Gums Nature Reserve (7.5 km south), Tathra National Park (10 km south-east), and Leda Nature Reserve (10 km east) (DCCEEW 2020).

2.2.3.2 Environmentally Sensitive Areas

It is an offence under the *Environmental Protection Act 1986* (EP Act) to clear native vegetation unless under a clearing permit or where an exemption applies. Under section 51B of the EP Act the Minister for Environment may declare an area or class of areas to be an Environmentally Sensitive Area (ESA). Once declared, the exemptions to clear native vegetation under the regulations do not apply in these areas unless the clearing is a requirement by law. The types of areas which are declared as ESAs are listed in the Environmental Protection (Environmentally Sensitive Areas) Notice 2005 (Government of Western Australia 2005), but one example is any area covered by a threatened ecological community (TEC).

The Survey Area intersects the buffers of two ESAs, both declared due to the presence of the TECs '*Ferricrete floristic community (Rocky springs type)*'; and '*Assemblages of organic mound springs of the Three Springs area*' (DWER 2023) (**Figure 2-6**). The buffer for the Ferricrete TEC covers an approximate area of 17,000 ha and intersects a small area of the southern extension of the Survey Area. The buffer for the mound springs TEC covers an approximate area of 32,000 ha and overlaps with the northern extent of the Survey Area.

There is an ESA for a declared rare flora (50 m buffer) within a segment of DBCA managed land, which is surrounded by the Survey Area but does not directly overlap it.

2.2.4 Land Tenure and Use

The Survey Area is within the Shire of Three Springs. The southern extent of the Additional Area is within the Shire of Carnamah. Land uses within Survey Area are predominantly cropping and paddock. The major land uses in the Geraldton Sandplains, in order of extent, are dry land agriculture, conservation, grazing of native pastures and other Crown Lands (**Figure 2-7**) (McKenzie *et al.* 2003). Non-exclusive native title exists over the whole of the Survey Area, as determined by the Yamatji Nation tribunal case 9,993 ha or 100% of the Survey Area) (National Native Title Tribunal 2022).



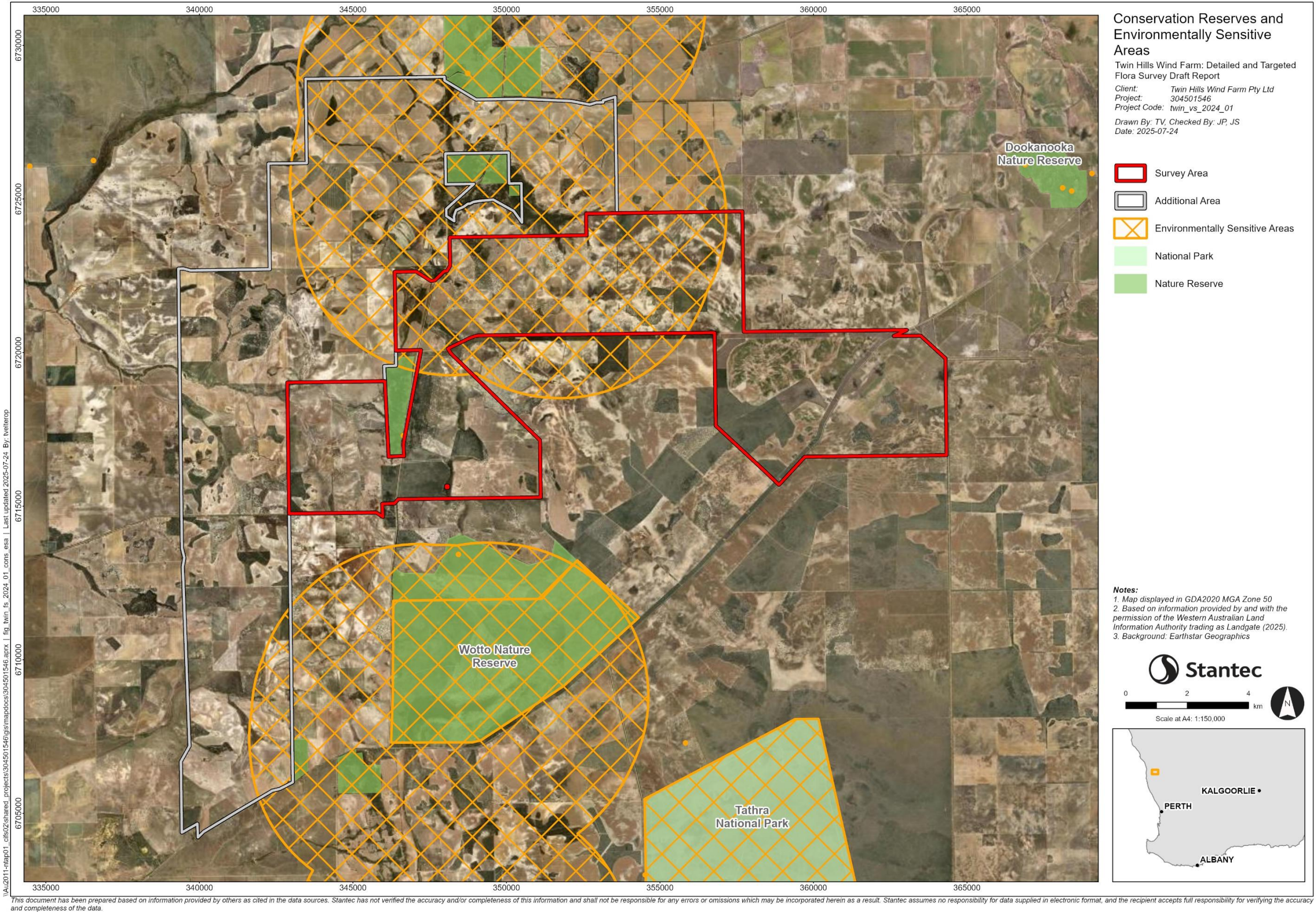


Figure 2-6: Conservation reserves and environmentally sensitive areas in relation to Survey Area.

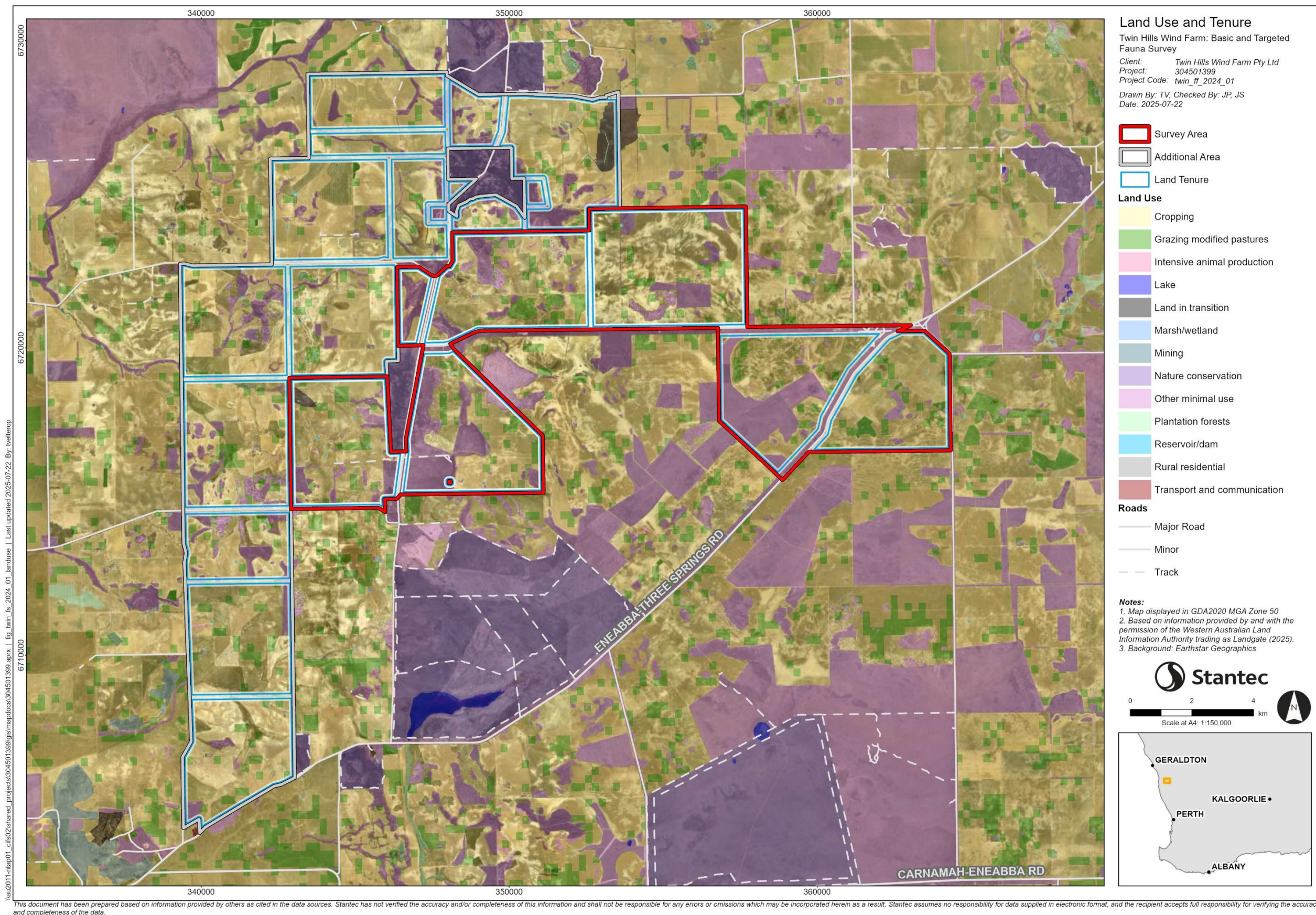


Figure 2-7: Land use in relation to the Survey Area.

3. Desktop Assessment

3.1 Approach and Context

A desktop assessment, comprising database searches and a literature review, was undertaken to gather contextual information on the Survey Area. The purpose of the desktop assessment was to identify bird and bat species potentially occurring within, and in the vicinity of the Survey Area, with a particular focus on species of significance and those known to be at higher risk from wind farm developments including raptors, aerial foragers, shorebirds, waterbirds, and other groups that are known to be relatively high-flying. A broader literature review was also conducted to review bird- and bat-specific surveys for wind farms to understand the survey methods, effort and intensity (**Appendix C**).

Significance classifications are consistent with the *Environmental Protection and Biodiversity Conservation Act 1999* (Cth) (EPBC Act), *Biodiversity Conservation Act 2016* (WA) (BC Act), as well as the Department of Biodiversity, Conservation and the Attractions (DBCA) priority list (**Appendix A**).

3.2 Desktop Methods

3.2.1 Database Searches

Database searches were completed to generate a list of terrestrial fauna previously recorded within, and in the vicinity of the Survey Area, with an emphasis on bird and bat species of significance. Five database searches were conducted according to the Survey Area shapefile, or a central coordinate within the Survey Area (-29.64952, 115.41003) (**Table 3-1**). Appropriate search buffers were applied depending on the technical capabilities (maximum buffer, accuracy of data) of the databases and the ecological features of the Survey Area.

Table 3-1: Database searches conducted for the desktop assessment.

Custodian	Database name	Method of search	Buffer
DBCA (2023a)	NatureMap	Central Point	40 km
DCCEEW (2024b)	Protected Matters Search Tool	Survey Area shapefile	
DBCA (2023b)	Threatened and Priority Fauna		
Birdlife Australia (2023)	Birdlife Bird Data		
ALA (2023)	Occurrence Search		

3.2.2 Literature Review

The literature review consisted of seven previous terrestrial fauna surveys undertaken within 30 km of the Survey Area between 2012 and 2021, comprised of:

- Bamford (2022a), Arrowsmith Hydrogen Project Black-Cockatoo Assessment;
- Bamford (2022b), Fauna Assessment of Arrowsmith North;
- Strategen (2021), Ocean Hill 3D Seismic Survey: Terrestrial Fauna and Black Cockatoo Habitat Assessment; and
- Western Wildlife (2021), Eneabba Phase 3 Project: Basic Vertebrate Fauna Survey and Cockatoo Habitat Survey;
- Bancroft and Bamford (2020), Beach Energy's Zemira 3D Seismic Survey: Fauna Values Assessment;
- Infinite Green Energy (2020), Arrowsmith Hydrogen Project AHP1 Fauna Management Plan; and



- ENV Australia (2013), Preliminary Flora and Vegetation and Fauna Assessment of Twin Hills and One Tree Hill, Eneabba.

Two of these surveys (Bancroft and Bamford 2020; ENV Australia 2013) intersect the Survey Area (**Figure 3-1**). A summary of the survey timing, methods, and results of these surveys are presented in **Table 3-2**.

In addition, Stantec reviewed three previous bird and bat surveys for wind farm proposals undertaken within the region and neighbouring regions 2010 and 2023, to inform methods and survey effort (**Table 3-3**). These three surveys were in addition to a more general review by Stantec of survey effort for bird and bat surveys completed across Australia prior to and following the release of the DAWE (2021) interim guidance (**Appendix C**). The three regional surveys reviewed were:

- ERM (2023), HyEnergy Bird and Bat Field Surveys;
- RPS (2010a), Waddi Wind Farm Avifauna Assessment; and
- RPS (2010b), Yandin Wind Farm Avifauna Assessment.



Table 3-2: Fauna surveys completed in the vicinity of the Survey Area.

Reference	Survey Details	Proximity to Survey Area	Area (ha)	Survey Timing	Survey Effort	Fauna Habitats	Bird and Bat Assemblages Recorded	Significant Bird and Bat Species Recorded	Limitations
Bamford (2022a)	Project: Arrowsmith Hydrogen Project Client: Arrowsmith Survey Type: Black-Cockatoo Assessment	28 km north-west of Survey Area	1,930	5 th – 6 th December 2021 (2 days)	3 hours site visit by five black-cockatoo specialists: Identify foraging habitat - Evening observations from several vantage points	4 habitat types were identified: - Acacia shrubland - Banksia woodland/Shrubland - Eucalypt woodland - Heathland	2 bird species: - Carnaby's Black-Cockatoo - Inland Red-tailed Black-Cockatoo (<i>Calyptrorhynchus banksii escondidus</i>)	Carnaby's Black-Cockatoo (<i>Zanda latirostris</i>) (En; En)	Not Stated
Bamford (2022b)	Project: Arrowsmith North Project Fauna Assessment Client: Arrowsmith Survey Type: Basic and Targeted Fauna Surveys with systematic trapping at selected locations, Black-Cockatoo Assessment	26 km north-west of Survey Area	1,726	18 th November 2018 (1 day) 23 rd – 25 th October 2019 (3 days) 1 st – 9 th December 2021 (9 days, in conjunction with detailed survey of nearby project)	- Systematic trapping: 120 pitfall trap night 36 funnel nights 120 bird census events - Black-Cockatoo habitat assessment: Breeding tree assessment Foraging habitat assessment Roosting habitat assessment - Motion cameras (40 camera nights) - Bird ARUs (106 unit nights) - Opportunistic invertebrate collection - Opportunistic observations	4 habitat types were identified: - Kwongan heath - Dense riparian thickets - Open, low woodland of <i>Banksia</i> sp. - Cleared land	4 bat species 35 bird species	Carnaby's Black-Cockatoo 15km outside the Arrowsmith North Survey Area	None
Strategen (2021)	Project: Ocean Hill 3D Seismic Survey Client: Strike Energy Survey Type: Fauna Habitat Assessment and Black-Cockatoo Assessment	4 km south of Survey Area	27,610	16 th – 20 th November 2021 (5 days)	- Fauna habitat assessments (number not specified) - Black-Cockatoo Assessment: Breeding tree assessment Foraging habitat assessment Roosting habitat assessment	4 habitat types were identified: - Sparse open woodland - Shrublands and scrub heath - Drainage lines - Cleared	No records	No records	Scope limited to habitat assessment and Black-Cockatoo Assessment
Western Wildlife (2021)	Project: Eneabba Mineral Sands Phase 3 Project Client: Iluka Resources Limited Survey Type: Basic Fauna Survey and Black-Cockatoo Assessment	11 km south-west of Survey Area	687	12 th – 13 th July 2021 (2 days)	33 fauna habitat assessments - Black-Cockatoo Assessment: Breeding tree assessment Foraging habitat assessment Roosting habitat assessment - Opportunistic observations	7 habitat types were identified: - Kwongan heath (uplands) - Kwongan heath (lowlands) - Minor drainages - Rehabilitation (shrubs and heaths) - Rehabilitation (planted Eucalypts) - Rehabilitation (farmlands) - Cleared	32 bird species	Carnaby's Black-Cockatoo recorded roosting and foraging	Fauna may not be recorded because they are difficult to trap or observe, or because they are only present on the site for part of the year
(Bancroft and Bamford 2020)	Project: Zemira 3D Seismic Survey	0-30 km west of Survey Area (in part,	96,703	21 st – 22 nd February 2020 (2 days)	Black-Cockatoo Assessment: Foraging habitat assessment Roosting habitat assessment	8 vegetation and substrate associations broadly described, in lieu of habitat types:	18 bird species	No records	No in-depth breeding tree assessment



Reference	Survey Details	Proximity to Survey Area	Area (ha)	Survey Timing	Survey Effort	Fauna Habitats	Bird and Bat Assemblages Recorded	Significant Bird and Bat Species Recorded	Limitations
	Client: Beach Energy Survey Type: Black-Cockatoo Assessment	intersects the Survey Area)			Broad assessment of the area's suitability for breeding Opportunistic fauna observations	- Treeless Banksia heathland (Kwongan) on sands - Banksia heathland with tree banksias and/or <i>Eucalyptus tottiana</i> on sands with some outcropping limestone - Treeless mixed heathlands on sands - Acacia shrublands on sands/loams - Low mixed heathlands associated with laterite <i>Eucalyptus erythrocorys</i> open woodland associated with outcropping limestone - Drainage lines or claypan areas, with <i>Callitris arenaria</i> and/or large <i>Eucalyptus</i> sp. - Cleared or largely cleared agricultural land			
Infinite Green Energy (2020)	Project: Arrowsmith Hydrogen Project Client: Infinite Green Energy Survey Type: Basic Fauna Survey	28 km north-west of Survey Area	1,930	12 th – 16 th October 2020 (5 days)	- Opportunistic bird observations - Active searches - Tree hollow inspections - Spotlighting - Motion cameras - Songmeter acoustic recorders Specific survey effort was not listed	8 habitat types were identified: - Tall heath on sandplain - Mallee woodland - Pastoral plain of farmland - Riparian <i>Eucalyptus camaldulensis</i> - Tall shrubland of Acacia - Waterbody (seasonal) - Wetland - Low Eucalypt woodland	5 bat species 42 bird species	- Carnaby's Black-Cockatoo - Sharp-tailed Sandpiper (<i>Calidris acuminata</i>) (Mi;Mi)	Not Stated
ENV Australia (2013)	Project: Twin Hills and One Tree Hill Wind Farms Client: Wind Prospect Survey Type: Preliminary Flora and Fauna Assessment including targeted methods and Black-Cockatoo Assessment	0-20 km from Survey Area (in part, Intersects Survey Area) Both Twin Hills and One Tree Hill Survey Areas intersect the Survey Area	20,507 (Twin Hills) 16,670 (One Tree Hill)	25 th – 29 th June 2012 (5 days)	17 fauna habitat assessments (10 at Twin Hills, 7 at One Tree Hill) - Targeted searches for Carnaby's Black-Cockatoo (<i>Zanda latirostris</i>), Western Spiny-tailed Skink (<i>Egernia stokesii badia</i>), Malleefowl (<i>Leipoa ocellata</i>), Shield-backed Trapdoor Spider (<i>Idiosoma nigrum</i>) - Black-Cockatoo Assessment: - Breeding tree assessment - Foraging habitat assessment - Bat ARUs (2 unit nights) - Motion cameras (3 camera nights) - Opportunistic observations	3 habitat types were identified: - Paddock - Scattered trees – (<i>Eucalyptus tottiana</i>) - Proteaceous heathland	Twin Hills: 3 bat species 38 bird species One Tree Hill: 3 bat species 36 bird species	13 individual Carnaby's Black-Cockatoos (En;En)	- Access was limited via vehicle due to planted crops - Seasonal conditions were considered sub-optimal with low temperatures and showers



Table 3-3: Bird and bat surveys for wind farms in region and neighbouring regions, reviewed for method and survey effort context.

Reference	Survey Details	Proximity to Survey Area	Area (ha)	Survey Timing	Survey Effort	Fauna Habitats	Bird and Bat Assemblages Recorded	Significant Bird and Bat Species Recorded (BC Act; EPBC Act conservation status)	Limitations
ERM (2023)	Project: Hyenergy Green Energy Hub Client: Province Resources Survey Type: BBUSs	439 km north of Survey Area	595,848 (wind turbine array is part thereof)	16th – 25th November 2022 (10 days) 6th – 15th March 2023 (10 days) 29th May – 4th June 2023 (6 days) 8th – 16th August 2023 (9 days) Further surveys to be undertaken to ensure all sites are assessed over a two year period	62 vantage points (VPs) 1 hr count at each VP, recording metrics including flight height and direction - Different VPs visited during the two survey events (each of the 62 VPs visited once) 20 min 2 ha counts at each habitat assessment sites. Number of habitat assessments not specified 3 opportunistic shorebird assessments - Bat units deployed across the Survey Area for 5 nights per unit per season (2 nights per unit). Number of units not specified. Units deployed on ground and on meteorological masts	6 habitat types were identified: - Tussock shrubland - Triodia grassland - Drainage (River) - Clay pan mosaic - Dunes - Chenopod low shrublands	10 bat species 66 bird species	- Black-tailed Godwit (<i>Limosa limosa</i>) (- ; En, Mi) - Bar-tailed Godwit (<i>Limosa lapponica</i>) (Cr, Mi; Cr, Mi) - Eastern Curlew (<i>Numenius madagascariensis</i>) (Vu, Mi; Cr, Mi) - Red Knot (<i>Calidris canutus</i>) (Mi; En, Mi) - Grey Plover (<i>Pluvialis squatarola</i>) (Mi; Mi) - Broad-billed Sandpiper (<i>Calidris falcinellus</i>) (Mi; Mi) - Sharp-tailed Sandpiper - Australian Fairy Tern (<i>Sterna nereis nereis</i>) (Vu; Vu)	Interim report with no repeat visits to VPs
RPS (2010a)	Project: Waddi Wind Farm Client: Wind Prospect Survey Type: Avifauna Assessment	80 km south of Survey Area	Not provided	All surveys combined Waddi and Yandin Wind Farms 29th October – 7th November 2008 (10 days) 18th – 26th November 2008 (9 days) 15th – 16th January 2009 (2 days)	16 impact census sites 7 control census sites (shared with Yandin Wind Farm) 20 min 1 ha count at each site, recording metrics including flight height - Targeted Carnaby's Black-Cockatoo survey - Wetland bird surveys - Call playback for nocturnal birds - Spotlighting - Avifauna habitat assessments - Opportunistic observations	4 habitat types were identified: - Open pasture/cultivation areas - Remnant healthland vegetation - Woodland remnants /elements - Areas where various combinations of heathland and/or woodland area associated with areas dominated by open pasture /cultivation habitats	44 bird species	Species lists combined for Waddi and Yandin Wind Farms: - Carnaby's Black-Cockatoo - Peregrine Falcon (<i>Falco peregrinus</i>) (OS; -) - Red-necked Stint (<i>Calidris ruficollis</i>) (Mi; Mi) - Gull-billed Tern (<i>Gelochelidon nilotica</i>) (-; Mi)	- Conducted prior to the release of current interim guidance for bird and bat surveys (DAWE 2021) - Some ephemeral wetlands were dry during surveys
RPS (2010b)	Project: Yandin Wind Farm Client: Wind Prospect Survey Type: Avifauna Assessment	106 km south of Survey Area	Not provided		20 census sites 7 control census sites (shared with Waddi Wind Farm) 20 min 1 ha count at each site, recording metrics including flight height - Targeted Carnaby's Black-Cockatoo survey - Wetland bird surveys - Call playback for nocturnal birds - Spotlighting - Avifauna habitat assessments - Opportunistic observations	- Open pasture/cultivation areas - Remnant healthland vegetation - Woodland remnants /elements - Areas where various combinations of heathland and/or woodland area associated with areas dominated by open pasture /cultivation habitats	61 bird species		

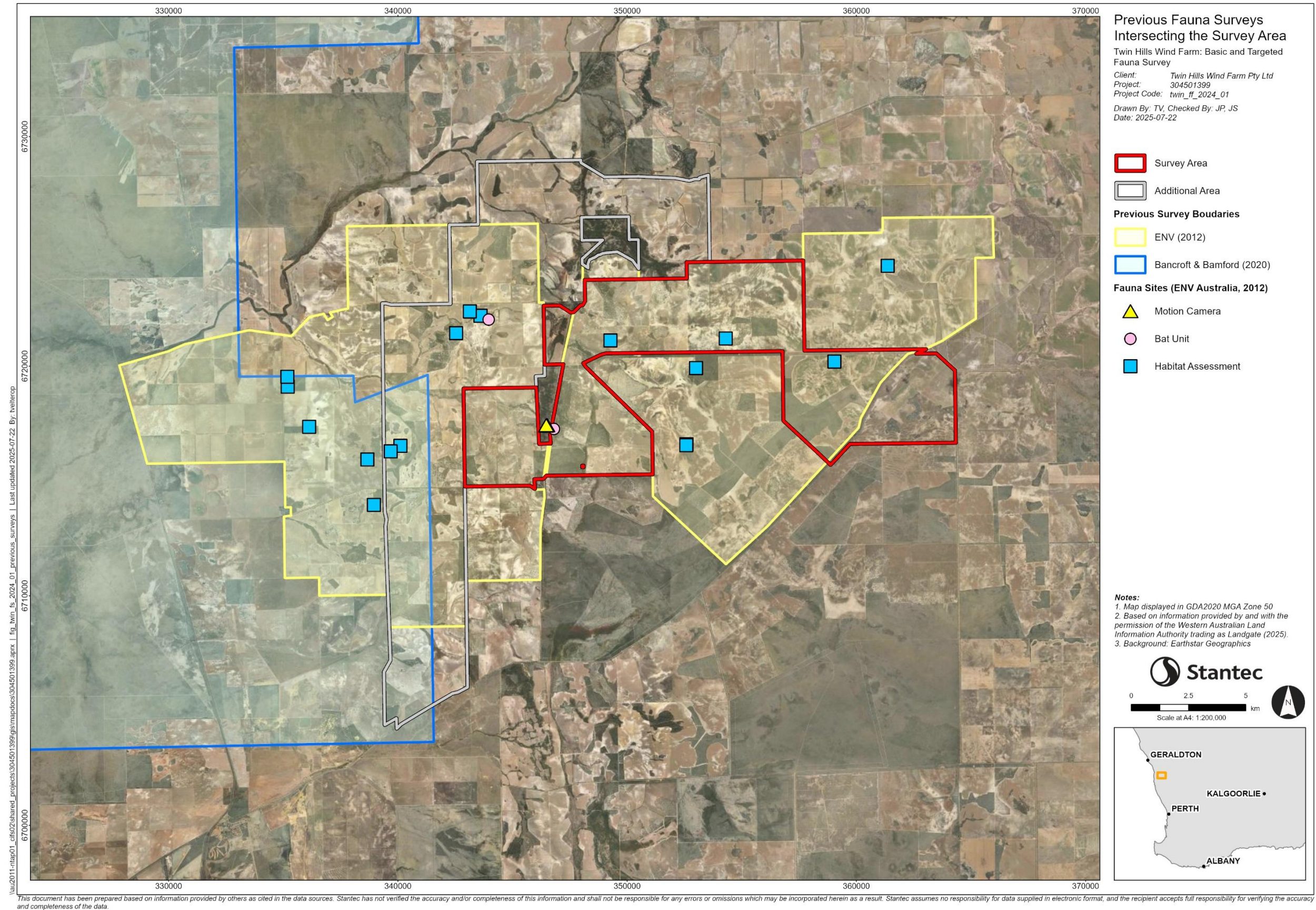


Figure 3-1: Previous fauna surveys that intersect the Survey Area.

3.2.3 Likelihood of Occurrence

Significant fauna species were assessed on their likelihood to occur within the Survey Area, based on the proximity and age of records and the presence of suitable habitat. The likelihood of occurrence rankings are assigned using the following criteria in **Table 3-4**.

Table 3-4: Likelihood of Occurrence Definition.

Potential to Occur	Description
Confirmed	The species has been recorded unambiguously during the last ten years (i.e., during recent surveys or from reliable records obtained via database searches) in the Survey Area.
Likely	There is a medium to high likelihood that the species uses the Survey Area as it occurs within the known species distribution, contains suitable habitat (either year-round or intermittently, such as temporary water sources or features that are only relied upon during certain times of the year) and the species has been recorded recently nearby.
Possible	There is a potential for the species to use the Survey Area as: • The species has not been recorded recently nearby however; • The species may not have been detected during previous surveys e.g. is rare, patchily distributed, highly mobile, or has an extensive foraging range; and • The species is known to be cryptic and may not have been detected despite extensive surveys. • The species has been recorded recently nearby and species presence cannot be ruled out due to factors such as species ecology or distribution; • Doubt remains over taxonomic identification. • The majority of habitat does not appear suitable; and • Coordinates are doubtful
Unlikely	There is an outward potential for the species to use the Survey Area as: • The Survey Area lacks critical habitat, only supports marginally suitable habitat, or is severely degraded; and/or • There are few historic record/s and no other current records in the local area
Not Present	The species does not use the Survey Area as: • The species is not known to occur within the bioregion based on the current literature and distribution; • The Survey Area lacks important habitat for a species that has highly selective habitat requirements; and • The species has been historically recorded within Survey Area or locally: however, it is considered locally extinct due to significant habitat changes such as land clearing and/or introduced predators.



3.3 Desktop Assessment Results

3.3.1 Bird and Bat Fauna

The desktop assessment (including database searches and the literature review) identified a total of nine bats, 228 native birds and two introduced birds, which were recorded and/or have the potential to occur within the Survey Area (**Table 3-5; Appendix B**). The bird species identified are from the following functional groups:

- 22 raptors;
- nine aerial foragers;
- 34 waterbirds;
- 29 shorebirds;
- 26 seabirds;
- 26 other species of potential risk; and
- 84 bush birds (including two introduced doves).

Many of these species are unlikely to occur in the Survey Area as records are old, erroneous or from a large area encompassing a wide range of habitats, many of which do not occur within the Survey Area. Many birds can occur as regular migrants, occasional visitors or vagrants.

Table 3-5: Summary of bird and bat species recorded during the desktop assessment.

Fauna Group	Database Searches					Relevant Regional Reports*						Total
	Threatened and Priority Fauna (DBCA 2023b)	Protected Matters Search Tool (DCCEEW 2024b)	Atlas of Living Australia (ALA 2023)	Birddata (BirdLife Australia 2023)	NatureMap (DBCA 2023a)	Twin Hills Preliminary Assessment (ENV Australia 2013)	One Tree Preliminary Assessment (ENV Australia 2013)	Arrowsmith North (Bamford 2022b)	Eneabba Mineral Sands (Western Wildlife 2021)	Ocean Hill Fauna Assessment (Strategen 2021)	Arrowsmith Hydrogen (Infinite Green Energy 2020)	
Bats	0	1	7	0	0	0	0	0	0	1	0	7
Birds (native)	22	35	108	181	23	39	38	8	29	55	3	228
Birds (non-native)	0	0	1	2	0	0	0	2	0	0	1	2
Total	22	36	116	183	23	41	39	58	37	73	8	237

*Species lists were not available for two reports assessed during the literature review (Bamford 2022a; Bancroft and Bamford 2020).

3.3.2 Significant Fauna

Of the of 237 bird and bat species identified as previously recorded and/or having the potential to occur within the Survey Area, 58 were significant fauna, comprising one bat and 57 birds (**Appendix B**).

A total of 27 significant fauna species identified in the desktop assessment were not assessed against the likelihood of occurrence criteria, as species is not known to occur within the bioregion based on the current literature and distribution, is considered locally extinct, or because they were recorded in the desktop searches only from coastal or marine habitats that do not occur in the Survey Area (**Section 5.3.3**). Following the exclusion of the above species, 31 significant fauna species were known and/or have the potential to occur within the Survey Area. All 31 significant species were birds (**Table 3-6**).



Records of significant species from the desktop assessment are presented in **Figure 3-2**. Records of Carnaby's Black-Cockatoo include records identified as "White-tailed Black-Cockatoo sp.", as Baudin's Black-Cockatoo is not known from the region.

Table 3-6: Summary of significant birds recorded during the desktop assessment. Species in bold are known to occur in the Survey Area.

Scientific Name	Common Name	BC Act Status	EPBC Act Status
18 migratory shorebirds (incl. Sandpipers, Plovers etc.)		Critically Endangered, Endangered, Vulnerable, Priority 4, Migratory	Critically Endangered, Endangered, Vulnerable, Priority 4, Migratory
<i>Zanda baudinii</i>	Baudin's Black-Cockatoo	Endangered	Endangered
<i>Zanda latirostris</i>	Carnaby's Cockatoo	Endangered	Endangered
<i>Leipoa ocellata</i>	Malleefowl	Vulnerable	Vulnerable
<i>Falco hypoleucos</i>	Grey Falcon	Vulnerable	Vulnerable
<i>Aphelocephala leucopsis</i>	Southern Whiteface	-	Vulnerable
<i>Falco peregrinus</i>	Peregrine Falcon	Other Specially Protected	-
<i>Apus pacificus</i>	Fork-Tailed Swift	Migratory	Migratory
<i>Motacilla cinerea</i>	Grey Wagtail	Migratory	Migratory
<i>Pandion haliaetus</i>	Osprey	Migratory	Migratory
<i>Plegadis falcinellus</i>	Glossy Ibis	Migratory	Migratory
<i>Bubulcus ibis</i>	Eastern Cattle Egret	-	Migratory
<i>Elanus scriptus</i>	Letter-winged Kite	Priority 4	-
<i>Oxyura australis</i>	Blue-billed Duck	Priority 4	-



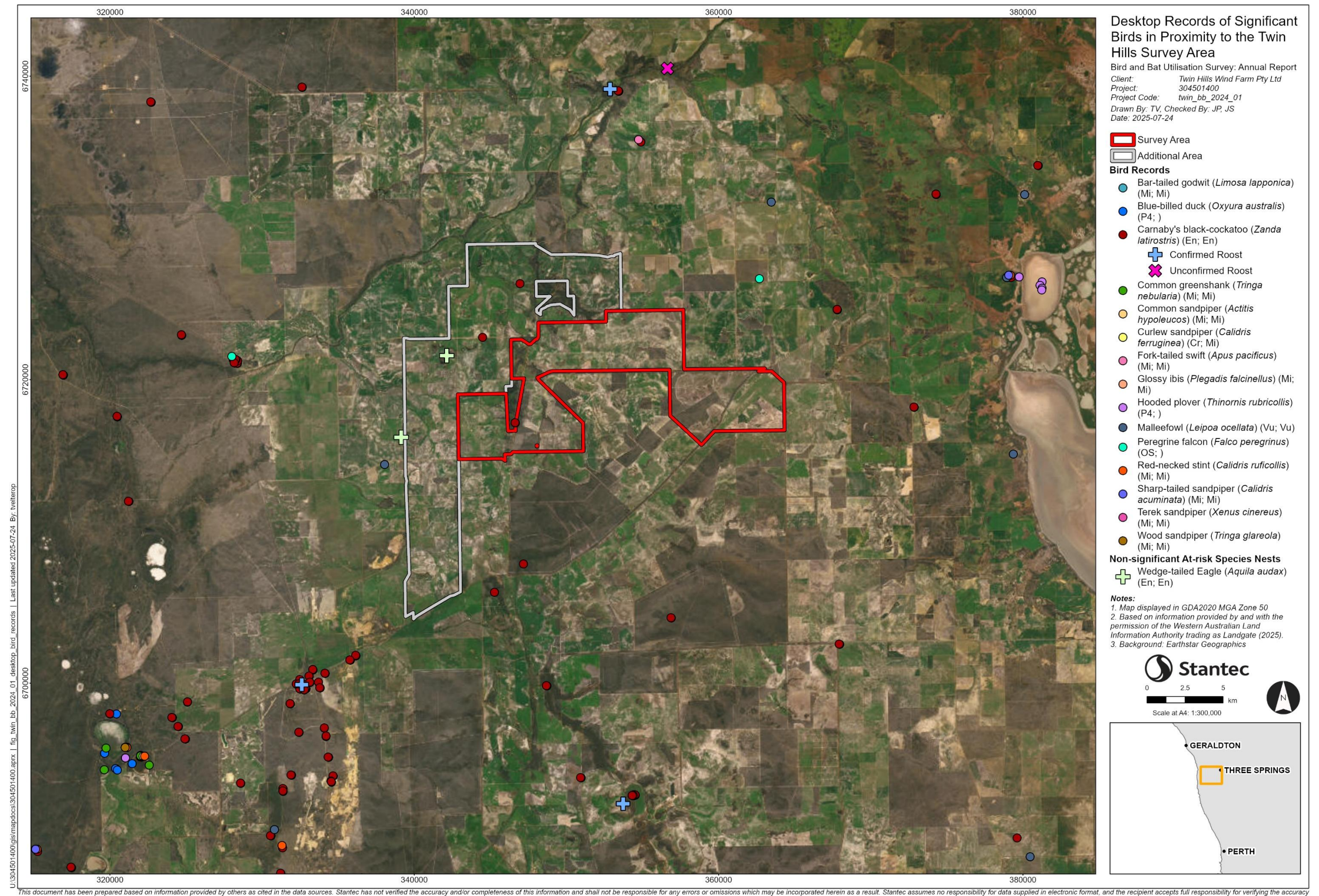


Figure 3-2: Records of significant bird species from the desktop assessment.

4. Bird and Bat Survey Methods

4.1 Field Assessment

4.1.1 Survey Timing and Personnel

Eight quarterly BBUSs were undertaken between December 2023 and July 2025 (**Table 4-1**), and were conducted by experienced zoologists Joseph Sollis (technical and survey lead; 8 years' experience), Robert Hemsworth (17 years' experience), Georgia Volck (9 years' experience), Katelyn Gibson (7 years' experience), Bill Webeck (7 years' experience), Jasmine Ridley (4 years' experience), Jasmin Pratt (3 years' experience), Lachlan Wild (2 years' experience), Rebecca Quah (2 years' experience) and (**Table 4-1**). All field team members have sound technical knowledge and experience undertaking bird surveys throughout Western Australia.

Bird acoustic data and bat echolocation data were analysed by subject matter experts Nick Leseberg from Adaptive NRM, Jasmin Pratt from Stantec and Lachlan Wild from Stantec (bird data) and by SME Bob Bullen of Bat Call WA (bat data).

Table 4-1: Survey timing and personnel.

Survey quarter	Survey period	Days	Zoologists
Q4 2023	11 – 18 December 2023	8 days	One team, two personnel: - Joseph Sollis - Katelyn Gibson
Q1 2024	6 – 13 March 2024	8 days	One team, two personnel: - Joseph Sollis - Rebecca Quah
Q2 2024	21 – 27 May; 2024 24 – 25 June 2024	9 days	One team, two personnel: - Joseph Sollis - Jasmin Pratt
Q3 2024	5 – 11 August 2024	7 days	One team, two personnel: - Joseph Sollis - Robert Hemsworth
Q4 2024	30 September – 6 October 2024	7 days	One team, two personnel: - Georgia Volck - Jasmin Pratt
Q1 2025	17 – 21 February 2025	5 days	One team, two personnel: - Jasmin Pratt - Bill Webeck
Q2 2025	19 – 23 May 2025	5 days	One team, two personnel: - Jasmine Ridley - Lachlan Wild
Q3 2025	7 – 12 July 2025	6 days	One team, two personnel: - Jasmin Pratt - Joey Laugharne



4.1.2 Temperature and Rainfall

To understand the influence of weather conditions and rainfall on the Survey, weather data was considered and collated from active weather stations in the vicinity of the Survey Area. Based on availability of data and proximity to the Survey Area, rainfall data and temperature data were collected from Carnamah Station (station no. 008025) (BoM 2024). Carnamah Station is located approximately 35 km east of the Survey Area.

During June 2023 to July 2025, total rainfall was 737.70 mm. Total rainfall in 2023 and 2024 was slightly below the long-term average. In contrast, total rainfall in 2025 exceeded the long-term average. From June 2023 to May 2024 and September 2024 to May 2025, with the exception of February 2024, October 2024, and November 2024, all months received lower rainfall than the long-term average, but between June 2024 to August 2024 and June 2025 to July 2025, monthly rainfall was higher than the long-term average (**Figure 4-1**).

During June 2023 to July 2025, the mean maximum monthly temperature ranged from 17.3°C to 41.2°C with highest maximums occurring in February 2024, January 2024 and January 2025 (41.2°C, 39.8°C and 38.0°C respectively). The mean minimum monthly temperature ranged from 5.4°C to 20.7°C with the lowest minimums occurring in June 2023, July 2023 and July 2025 (5.4°C, 6.1°C and 6.4°C respectively).

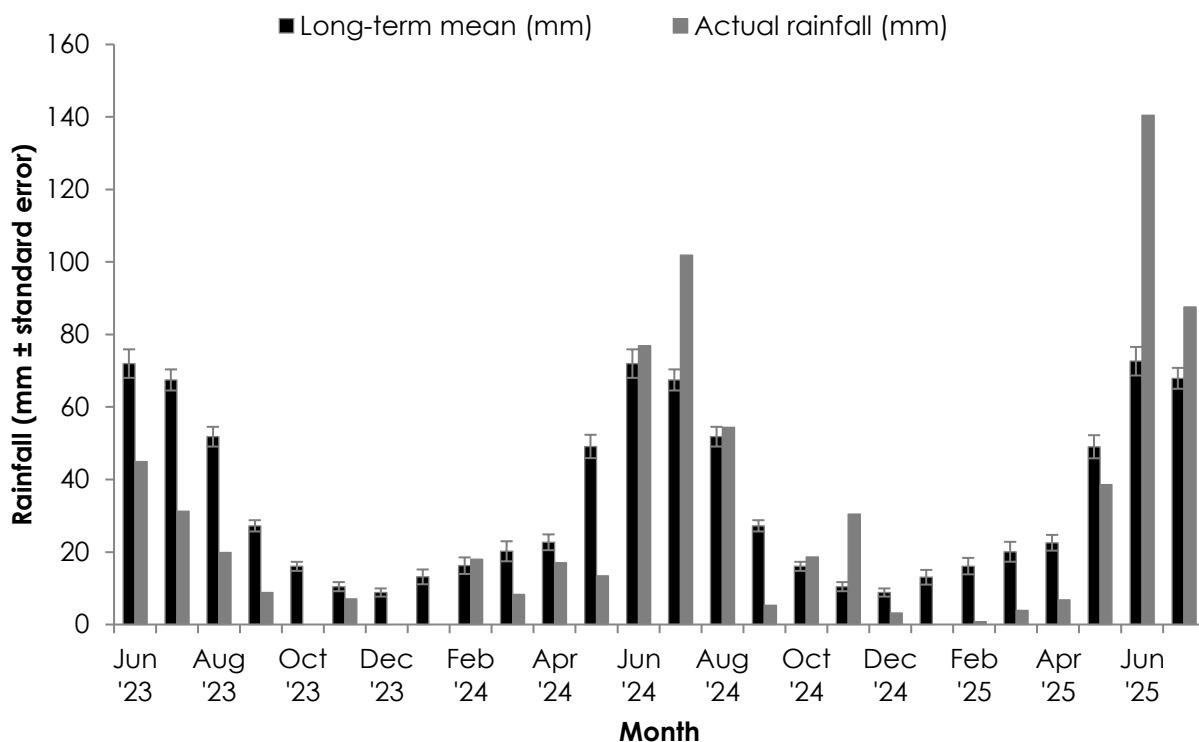


Figure 4-1: Long-term (1901 – 2024) mean monthly rainfall (mm) at Carnamah BoM weather station (No. 008025), and the monthly rainfall (mm) received in June 2023 – July 2025.

Weather conditions during the Q4 2023 Survey were hot and dry (**Table 4-2**), with no rainfall being recorded during the period. The maximum daily recorded temperature ranged from 34.0°C to 41.2°C, whilst minimum daily recorded temperatures ranged from 15.5°C to 19.0°C.

Weather conditions during the Q1 2024 Survey were warm, with scattered rainfall (**Table 4-2**), which is typical for the time of year. The maximum daily recorded temperature ranged from 31.8°C to 36.0°C, whilst minimum daily recorded temperatures ranged from 15.0°C to 24.5°C. 8.3 mm of rainfall was recorded during the Q1 2024 Survey.

During the Q2 2024 Survey were mild and dry (**Table 4-2**), with the rainfall being low for the time of year. The maximum daily recorded temperature ranged from 20.0°C to 28.0°C, whilst minimum daily recorded temperatures ranged from 5.5°C to 14.0°C. No rainfall was recorded during the Q2 2024 Survey.



During the Q3 2024 Survey, temperatures were cool and rainfall was lower than the long-term average (**Table 4-2**). Maximum daily recorded temperatures ranged from 20.0°C to 25.0°C, whilst minimum daily recorded temperatures ranged from 5.0°C to 12.0°C. (**Table 4-2**). 1.8 mm of rainfall was recorded during the Q3 2024 Survey.

Weather conditions during the Q4 2024 Survey were mild, with moderate rainfall (**Table 4-2**). Maximum daily recorded temperatures ranged from 18.5°C to 33.0°C, whilst minimum daily temperatures ranged from 5.5°C to 12°C (**Table 4-2**). 12.2 mm of rainfall was recorded during the Q4 2024 Survey.

Weather conditions during the Q1 2025 Survey were hot and dry, with scattered rainfall (**Table 4-2**). Maximum daily recorded temperatures ranged from 30.0°C to 39.5°C, whilst minimum daily recorded temperatures ranged from 17.0°C to 21.0°C (**Table 4-2**). 4.4 mm of rainfall was recorded during the Q1 2025 Survey.

During the Q2 2025 Survey, temperatures were mild and rainfall was limited (**Table 4-2**). Due to limited data availability, 27.0°C on the 22nd of May 2025 was the only recorded maximum temperature within the survey period, whilst minimum daily recorded temperatures ranged from 8.5°C to 10°C (**Table 4-2**). 2.5 mm of rainfall was recorded during the Q2 2025 Survey.

During the Q3 2025 Survey, temperatures were cool and rainfall was moderate (**Table 4-2**). Maximum daily recorded temperatures ranged from 16.5°C to 20.5°C, whilst minimum daily recorded temperatures ranged from 3.5°C to 5.5°C (**Table 4-2**). 10.2 mm of rainfall was recorded during the Q3 2025 Survey.

Table 4-2: Temperatures and rainfall recorded during the Survey. Blank cells indicate missing data.

Date	Temperature (°C)		Rainfall (mm)	Relative Humidity (%)	
	Min	Max		9:00 am	3:00 pm
Q4 2023					
11/12/2023	18.0	34.0	0.0	66	-
12/12/2023	19.0	38.0	0.0	66	-
13/12/2023	18.5	38.5	0.0	73	-
14/12/2023	15.5	38.0	0.0	42	-
15/12/2023	16.5	-	0.0	32	-
16/12/2023	-	-	0.0	-	-
17/12/2023	-	41.2	0.0	-	-
18/12/2023	18.0	36.5	0.0	41	-
Q1 2024					
6/03/2024	22.5	35.5	6.5	-	-
7/03/2024	24.5	-	0.0	96	-
8/03/2024	-	-	0.0	-	-
9/03/2024	-	-	0.0	-	-
10/03/2024	-	36.0	0.0	-	-
11/03/2024	15.0	31.8	0.0	-	-
12/03/2024	21.0	31.8	1.8	82	-
13/03/2024	21.0	34.0	0.0	74	-
Q2 2024					
21/05/2024	5.5	27.5	0.0	33	-
22/05/2024	13.0	26.0	0.0	31	-
23/05/2024	8.0	27.4	0.0	29	-
24/05/2024	14.0	-	0.0	15	-
25/05/2024	-	-	0.0	-	-



Date	Temperature (°C)		Rainfall (mm)	Relative Humidity (%)	
	Min	Max		9:00 am	3:00 pm
26/05/2024	-	28.0	0.0	-	-
27/05/2024	11.0	26.0	0.0	81	-
24/06/2024	13.0	20.8	0.0	-	-
25/06/2024	11.6	20.0	0.0	-	-
Q3 2024					
5/08/2024	-	21.0	0.0	71	-
6/08/2024	5.0	21.0	0.0	77	-
7/08/2024	12.0	20.0	0.8	95	-
8/08/2024	9.5	20.2	1.0	94	-
9/08/2024	6.5	-	0.0	84	-
10/08/2024	-	-	0.0	-	-
11/08/2024	-	25.0	0.0	-	-
Q4 2024					
30/09/2024	5.5	28.0	0.0	41	-
1/10/2024	12.0	-	0.0	60	-
2/10/2024	-	33.0	0.0	-	-
3/10/2024	10.0	18.5	0.0	60	-
4/10/2024	10.5	-	12.0	75	-
5/10/2024	-	-	0.2	-	-
6/10/2024	-	-	0.0	-	-
Q1 2025					
17/02/2025	19.0	35.0	0.0	50	-
18/02/2025	21.0	30.0	0.0	55	-
19/02/2025	19.5	39.5	0.0	45	-
20/02/2025	20.5	37.0	4.4	43	-
21/02/2025	17.0	-	0.0	49	-
Q2 2025					
19/05/2025	10.0	-	0.0	47	-
20/05/2025	-	-	0.0	-	-
21/05/2025	-	-	0.0	-	-
22/05/2025	-	27.0	0.0	-	-
23/05/2025	8.5	-	2.5	94	-
Q3 2025					
7/07/2025	-	20.5	0.0	-	-
8/07/2025	5.1	-	10.1	94	-
9/07/2025	-	16.5	0.0	-	-
10/07/2025	3.5	17.5	0.1	75	-
11/07/2025	5.5	-	0.0	75	-
12/07/2025	-	-	0.0	-	-



4.2 Survey Approach

The Survey approach was developed based on the Onshore Wind Farms interim and draft guidance (DAWE 2021; DCCEEW 2024a), a review of best-practice approaches (Jenkins *et al.* 2015; Scottish Natural Heritage 2017) and assessment of surveys undertaken for previous wind turbine assessments (**Appendix C**). The methods adopted for the BUSs were also aligned with the following survey guidelines for significant species with the potential to occur:

- EPBC Act Policy Statement 3.21 – Industry guidelines for avoiding, assessing mitigating impacts on EPBC Act listed migratory shorebird species (DEE 2017);
- Survey Guidelines for Australia's Threatened Birds (DEWHA 2010);
- Environmental Factor Guideline: Terrestrial Fauna (EPA 2016);
- Technical Guidance: Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment (EPA 2020).

The Survey method consists of fixed point counts (**Section 4.2.1**), deployment of bird and bat acoustic and echolocation recording units (**Sections 4.2.2; 4.2.3**) and opportunistic records (**Section 4.2.4**) in accordance with the *Onshore Wind Farms: Interim guidance on bird and bat management* (DAWE 2021). Based on best-practice approaches (Jenkins *et al.* 2015; Scottish Natural Heritage 2017), Stantec adapted developed a method that focuses on the number of bird observations and species flying at different heights (e.g. above, below and within the rotor-swept area (RSA)), whilst also recording robust data on species utilisation. The RSA refers to the area physically swept by rotating turbine blades. As the turbine model to be installed had not been finalised at the time of the assessment, an RSA height of between 40 and 300 m above ground level was used for this assessment.

Bird and bat utilisation best practice survey requirements (DAWE 2021; DCCEEW 2024a), recommend that at least 24 months of site utilisation surveys are required to provide sufficient baseline data about a relevant species' potential to be utilised to inform the EIA for a proposed wind farm. In accordance with the guidance, BBUSs were undertaken in each consecutive season over two years (eight survey events)

4.2.1 Fixed-point Counts

Fixed point (FP) counts were undertaken at 18 FP sites (**Figure 4-2; Table 4-4**). Of these, six FPs are considered potential impact sites and are located within the Survey Area, four FPs are reference sites and are located outside the Survey Area on public land that is unlikely to be impacted by the proposal, and eight FPs are located in the Additional Area and were not surveyed for the entire two-year program. The reference sites were located between 1.9 – 9.9 km from the Survey Area and selected to comprise fauna habitat types most representative of those occurring within the Survey Area. Potential impact FP locations were evenly distributed within the Survey Area to aim for maximum visual coverage including proposed turbine locations. Fourteen of the FP sites were positioned on high ground and provided vantage of up to a 2 km radius whilst the remaining four FPs provided vantage of at least 1 km, and locations were selected to ensure vantage of all habitat types represented within the Survey Area.

FP counts were undertaken by two observers, with each observer watching a 180-degree field of view at each FP, recording all birds heard and observed in flight for a minimum of 2 hours 15 minutes over the duration of each quarterly Survey. FP counts were conducted across hours in which target bird species (particularly raptors, aerial foragers and other species of potential risk) were likely to be active, subject to safety constraints (i.e. avoidance of dawn and dusk driving). Each FP was visited three times for 45 minutes per instance: once in the morning (between sunrise and 10:00); once in the middle of the day (between 10:00 and 14:00); and once in the afternoon/evening (14:00 to sunset). This resulted in the FP sites that were accessible for the entire 24-month period receiving 18 hours of survey effort during the year, though some received less due to their being added or removed from the scope due to changes in accessibility to landholdings (a total of 234 hours of survey effort across the 18 FP sites during the 24-months) (**Table 4-4**).

For each bird observed in flight, weather and flight variables listed in **Table 4-3** were recorded. Flight variables (sighting distance and bearing; flight mode and behaviour; flight direction; flight height) were recorded every 30 seconds that a bird or flock was observed.

Table 4-3: Weather and flight variables recorded for each bird observation.

Weather Variables	Flight Variables
Visibility	Species



Cloud cover	Number of adults and sub-adults
Temperature	Initial sighting distance and bearing
Wind strength and direction	Flight direction
	Flight height in 20 m intervals
	Flight mode and behaviour

4.2.2 Bird Acoustic Recording Units

To supplement the FP counts, bird acoustic recording units (bird units) were deployed at each FP for two nights (**Table 4-4**). This method contributes to the list of species recorded at each site, and targets waterbirds and night flying species that would be unlikely to be recorded during daytime surveys.

In addition, one targeted bird unit (**Figure 4-3**) was deployed for two nights within a grove of paperbark trees in nature reserve R 12705 and at a semi-permanent pool on a creek line to record species that might be present in these microhabitats.

Units were set to begin recording one hour prior to sunset and to finish recording one hour after sunrise. This targeted peak calling times for non-breeding individuals, which tend to call close to dawn and dusk. This also allowed for the capture of potential calls associated with breeding birds, which may occur throughout the night and closer to sunset and sunrise (DPaW 2017).

4.2.3 Bat Echolocation Recording Units

Bat echolocation recording units (bat units) were deployed at each FP for two nights (**Table 4-4**) to build a species list and to gain an understanding of the use of the Survey Area and surrounds by bat species.

In addition, three targeted bat echolocation recording units (**Figure 4-3**) were deployed at targeted locations including a grove of paperbark trees in nature reserve R 12705 and semi-permanent pools on creek lines for two to three nights (seven targeted bat unit nights total) to record species that might be present in these microhabitats.

4.2.4 Opportunistic Records

Fauna species were opportunistically recorded whilst travelling through the Survey Area. These opportunistic records were used to build assemblage data which can be incorporated into future survey results. Opportunistic sightings included:

- Visual observations of species encountered whilst transversing the Survey Area at any time;
- Where feasible, opportunistic estimates of bird flight heights; and
- Observations of secondary evidence such as tracks, diggings, scats, bones and nests.



Table 4-4: Summary of survey effort at fixed point sites.

Fixed Point	Site Type	Accessibility by Quarter								Survey Effort		
		Q4 2023	Q1 2024	Q2 2024	Q3 2024	Q4 2024	Q1 2025	Q2 2025	Q3 2025	FP Count Survey Effort (Hours:Minutes)	Bat Unit Nights	Bird Unit Nights
1	Impact	✓	✓	✓	✓	✓	✓	✓	✓	18:00	16	16
2	Reference	✓	✓	✓	✓	✓	✓	✓	✓	18:00	16	16
3	Impact	✓	✓	✓	✓	✓	✓	✓	✓	18:00	16	16
4*	Additional Area	✓	✓	-	-	-	-	-	-	4:30	4	4
5*	Additional Area	✓	✓	-	-	-	-	-	-	4:30	4	4
6	Reference	✓	✓	✓	✓	✓	✓	✓	✓	18:00	16	16
7*	Additional Area	✓	✓	-	-	-	-	-	-	4:30	4	4
8*	Additional Area	✓	✓	-	-	-	-	-	-	4:30	4	4
9	Reference	✓	✓	✓	✓	✓	✓	✓	✓	18:00	16	16
10^	Additional Area	✓	✓	✓	✓	✓	-	-	-	11:15	8 (equipment failure Q4 2023)	10
11^	Additional Area	✓	✓	✓	✓	✓	-	-	-	11:15	10	10
12^	Additional Area	✓	✓	✓	✓	✓	-	-	-	11:15	10	10
13^	Additional Area	✓	✓	✓	✓	✓	-	-	-	11:15	10	10
14	Impact	✓	✓	✓	✓	✓	✓	✓	✓	18:00	16	16
15	Impact	✓	✓	✓	✓	✓	✓	✓	✓	18:00	16	16
16	Reference	✓	✓	✓	✓	✓	✓	✓	✓	18:00	14 (equipment failure Q1 2025)	16
17#	Impact	-	-	✓	✓	✓	✓	✓	✓	13:30	12	12
18#	Impact	-	-	✓	✓	✓	✓	✓	✓	13:30	12	12
Total										234:00	206	208

*FP sites on landholdings inaccessible following Q2 2024; ^FP sites on landholdings inaccessible following Q4 2024; #FP sites added to the Survey Area in Q2 2024



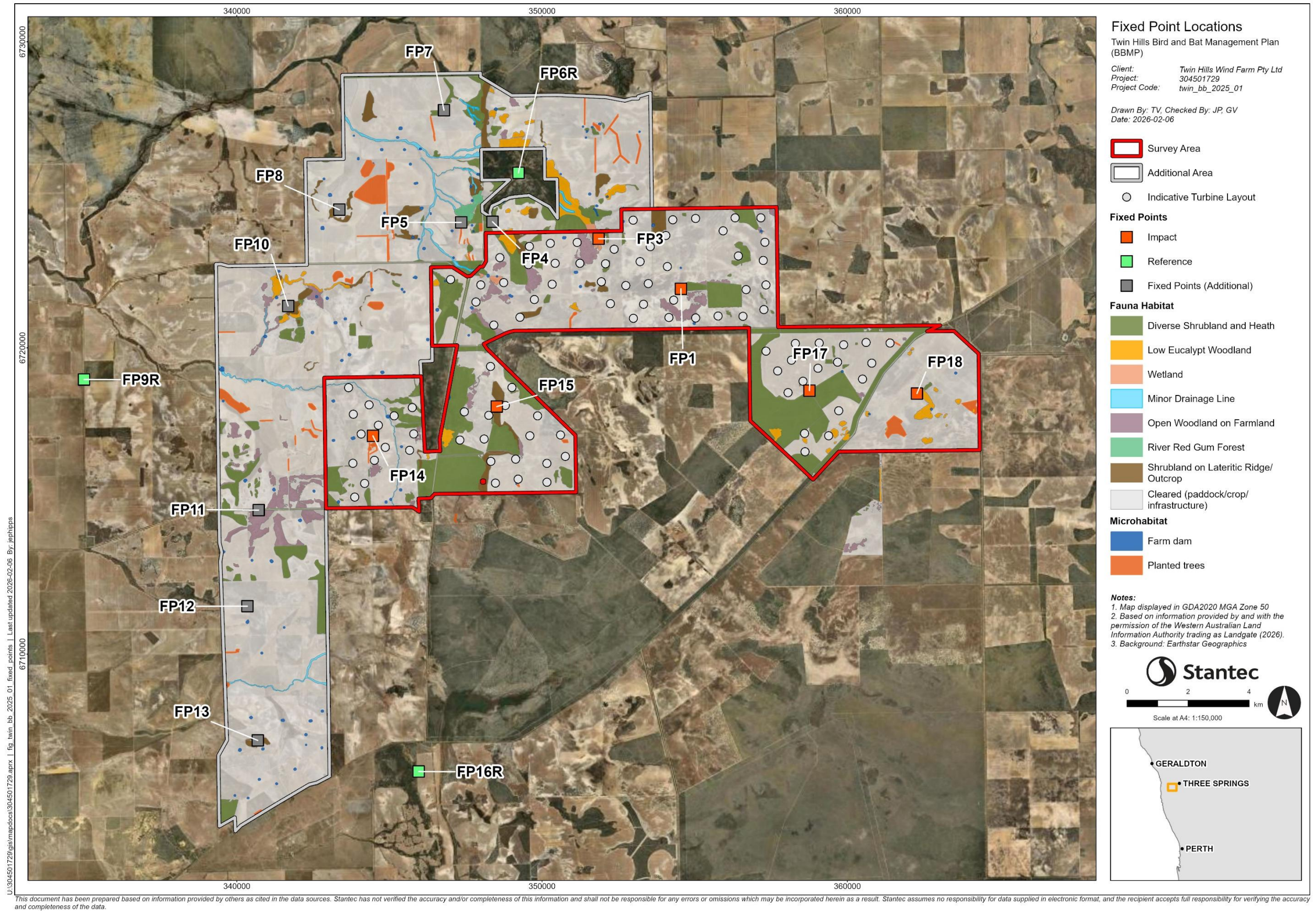


Figure 4-2: Bird and bat fixed point locations within and in the vicinity of the Survey Area.

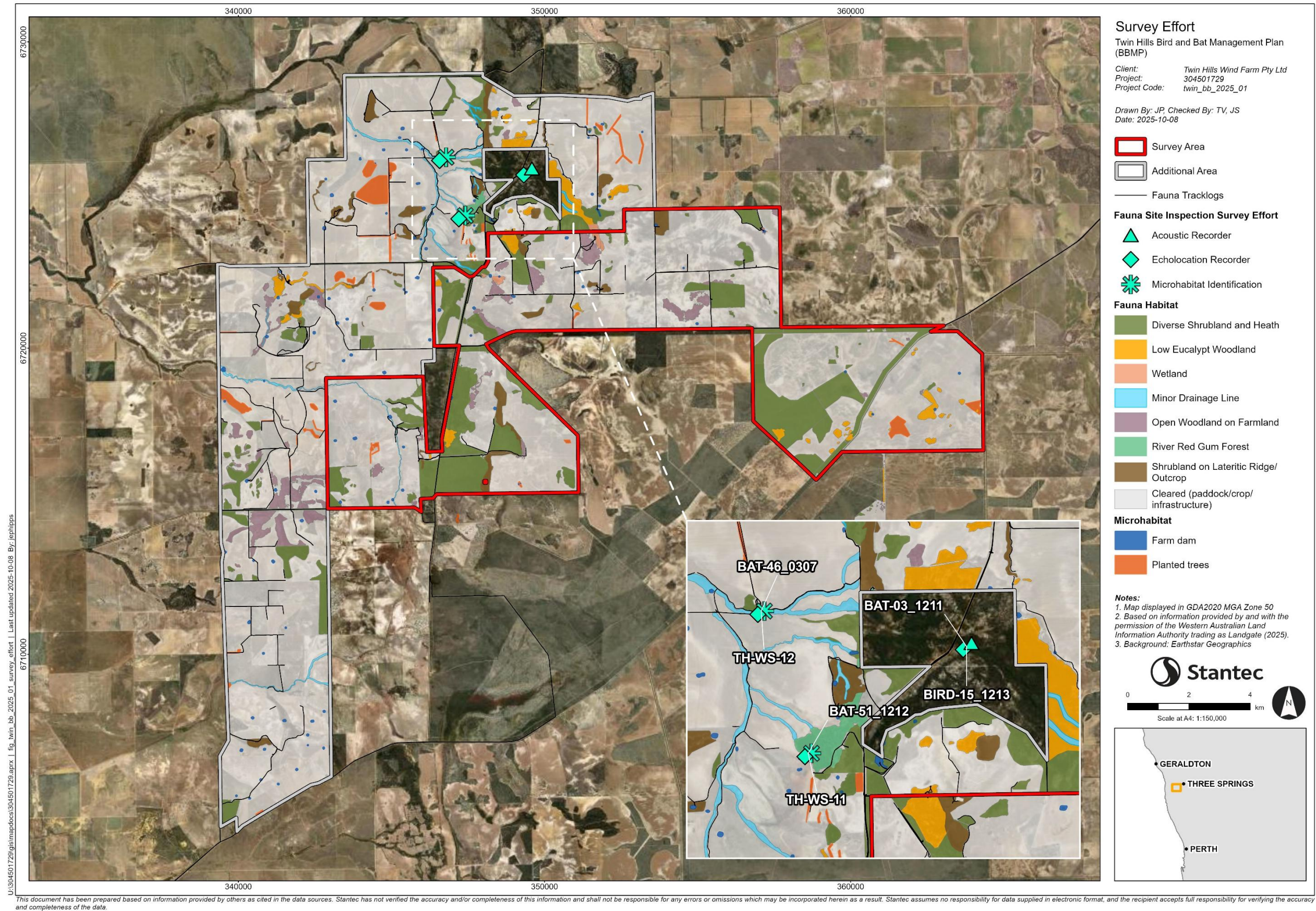


Figure 4-3: Targeted survey effort within the Survey Area.



4.3 Data Management

4.3.1 Acoustic Data

Bird acoustic recordings from the survey were analysed by subject matter experts (SMEs) Nick Leseberg from Adaptive NRM and Jasmin Pratt from Stantec, to identify recorded bird species.

4.3.2 Echolocation Data

Echolocation recordings from the survey were analysed by SME Bob Bullen of Bat Call WA to identify bat species diversity, using COOL EDIT 2000 (now available as AUDITION from Adobe Systems Inc.). Once identified, calls were compared to Bat Call WA's database of reference calls. The number of calls of each species per 30-minute interval were assessed, to inform utilisation of each site.

4.4 Ecological Risk Model

4.4.1 Approach

An ecological risk model (ERM) was developed and implemented to determine the relative risk from the proposed wind farm development to each bird species observed during the BUS. Risk in this sense refers to both the susceptibility of the species to negative interactions with wind turbines and the productivity of the species, which will impact the species' recovery following negative interactions (particularly rotor strike, but also disturbance) (Reid *et al.* 2022). The current findings are preliminary and will be finalised following the completion of the full bird and bat survey program. The final ERM and subsequent impact assessment will inform the development of a Bird and Bat Management Plan for the Project.

The ERM was based on the model described in the Department of Climate Change, Energy, the Environment and Water (DCCEEW) Impacts on Birds from Offshore Wind Farms in Australia (Reid *et al.* 2022). Although the model is designed for offshore projects, this guidance provides a comprehensive semi-quantitative method for determining risk to bird species based on a productivity and susceptibility score. This method has been amended slightly to account for State- and Commonwealth-level conservation listings.

4.4.2 Model Structure and Data

The two elements of the overall index score for each species – productivity (species with longer generation times and higher conservation status are less productive and therefore may be less likely to recover from impacts) and susceptibility (species that fly at RSA height, are less manoeuvrable and are highly specialised in terms of habitat use may be more susceptible to direct impacts) – are calculated based on the approach of Reid *et al.* (2022) where:

- Productivity = (Conservation Status x 1.5 + Generation Time) / 2
- As the conservation status for each species includes an assessment of population size, population trend and threats, it was given a higher weighting relative to the generation time.
- Susceptibility = (Flight Height + Flight Maneuverability + (Habitat Specialisation x 0.5)) / 3
- As the Flight Height and Maneuverability are directly relevant to each species' tendency to be in proximity to rotor strike, these attributes were given a higher weighting relative to the generation time.

For the two attributes that comprise productivity (conservation status and generation time) and three attributes that comprise susceptibility (flight height, flight manoeuvrability and habitat specialisation), each species was given a value of 1 to 5, where 1 is lowest risk and 5 is highest risk. The approach of applying and calculating these values, and the data sources for each, is described in **Table 4-5**.

For each species observed in the BUS, a risk index score was developed. This risk index score is based on the Euclidean distance of the point from the minimum possible risk index score on a two-dimensional plot of productivity against susceptibility (**Figure 4-4**).



Table 4-5: Values of attributes for ecological risk model.

Variable		Risk Rating Value (5-point Scale)					Data Source / Notes
		1	2	3	4	5	
Conservation Status	State	Not listed	Priority 1 – 4	Vulnerable	Endangered	Critically Endangered	- State: Threatened and Priority Fauna List (DBCA 2023c) - Commonwealth: EPBC Act List of Threatened Fauna (DCCEEW 2023b) - IUCN: IUCN Red List in Garnett <i>et al.</i> (2015) - Where there is a discrepancy between the State, Commonwealth and/or IUCN conservation status for a species, the highest status is used to ensure a precautionary approach. - Where not listed by the State or Commonwealth and not assessed under IUCN, a rating of 1 is assumed.
	Cwth	Not listed	-	Vulnerable	Endangered	Critically Endangered	
	IUCN	Least Concern	Near Threatened	Vulnerable	Endangered	Critically Endangered	
Generation Time		≤ 5 years	> 5 ≤ 10 years	> 10 ≤ 15 years	> 15 ≤ 20 years	>20 years	- Bird <i>et al.</i> (2020) - A longer generation time represents a species with lower productivity and therefore higher risk.
Flight Height		≤ 50	> 50 ≤ 100	> 100 ≤ 150	> 150 ≤ 200	> 200	- Data sourced directly from BUS results. Raw scores are from 0 - 300 are based on the following formula: $FH = A + (B \times 3) + (C \times 0.5)$ - Where FH is flight height risk. A is the percentage of observations that are below (0 – 40 m) rotor sweep height. B is the percentage of observations within (40 – 300 m) rotor sweep height. C is the percentage of observations above (>300 m) rotor sweep height. To account for the relative risk in each height category they are weighted as birds flying below rotor height are still likely to be impacted by the wind farm, through displacement and barrier effects, but at a lower level than direct collision. Birds flying at heights above the turbines are less likely to experience indirect disturbance impact than those flying below.
Flight Maneuverability		≤ 0.01	> 0.01 ≤ 0.02	> 0.02 ≤ 0.03	> 0.03 ≤ 0.04	> 0.04	- Tobias <i>et al.</i> (2022) - According to Furness <i>et al.</i> (2013) flight manoeuvrability is a consequence of morphology rather than behaviour. Raw scores are based on the following formula: $FM = \text{body mass} / (\text{wing length} \times \text{wing width})$



Habitat Specialisation	≥ 9	6, 7 or 8	4 or 5	2 or 3	1	• Garnett <i>et al.</i> (2015) • The number of habitat types that the taxon utilises for non-trivial feeding, of a total of 31 habitat types. Greater specialisation (lower number of habitats utilised) is considered higher risk.
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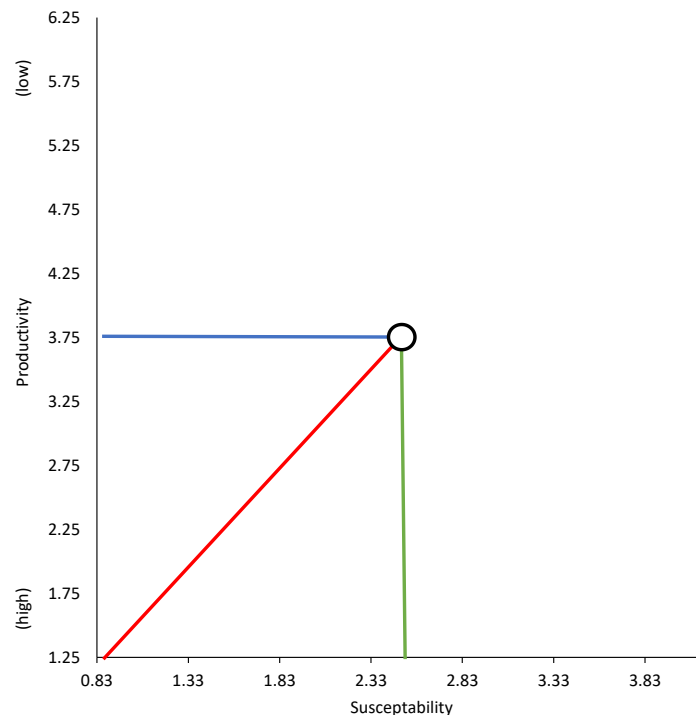


Figure 4-4: Example of risk index score calculation for a species (species demonstrated by point on graph). For a given productivity value (blue) and susceptibility value (green), the overall risk index score is the difference (Euclidean distance; red) from the lowest possible risk score.

4.4.3 Model Assumptions

Assumptions made in the Ecological Risk Model are summarised in **Table 4-6**.

Table 4-6: Ecological Risk Model assumptions.

Source of Assumption	Assumption
Assumed by Reid <i>et al.</i> (2022) in development of model	Weightings: - As the conservation status for each species includes an assessment of population size, population trend and threats, it was given a higher weighting relative to generation time. - As the Flight Height and Maneuverability are directly relevant to each species' tendency to be in proximity to rotor strike, these attributes were given a higher weighting relative to the generation time.
	Generation time: A longer generation time represents a species with lower productivity and therefore higher risk.
	Flight Height: Assumes birds flying within RSA height are three times as likely to be impacted than those flying below, and that birds flying above RSA height are half as likely to be impacted than those flying below, due to less disturbance impacts.
	Maneuverability: Assumes maneuverability is more a consequence of morphology than behaviour Furness <i>et al.</i> (2013).
Amendment made by Stantec	Risk Rating: Assumes arbitrary cut-offs for distinguishing between low, medium and high risk, based on percentiles of all possible risk scores. To address this limitation, Stantec also discussed the highest rated medium-risk species in Section 5.8.1 .
	Conservation Status: Accounts for State and Commonwealth-level conservation listings with priority given to the highest conservation status. Otherwise, State listings are given preference, followed by Commonwealth listings, with IUCN listings used only if the former are unavailable.

5. Results and Discussion

5.1 Fauna Habitats

In total, 39 habitat assessments (14 in the Survey Area; 25 in the Additional Area) and 11 microhabitat assessments (two in the Survey Area; nine in the Additional Area) were completed during the basic and targeted fauna survey (Stantec 2025). Eight fauna habitats were identified within the Survey Area and the Additional Area (**Figure 5-1; Table 5-1**). The habitats were classified as follows:

- Diverse Shrubland and Heath;
- Open Woodland on Farmland
- Low Eucalypt Woodland;
- Shrubland on Lateritic Ridge/Outcrop;
- Minor Drainage Line;
- River Red Gum Forest (present only in the Additional Area);
- Melaleuca Wetland; and
- Cleared (paddock/crop /infrastructure).

Two microhabitats were described and mapped during the survey (**Figure 5-1; Table 5-2**):

- Planted Eucalyptus trees; and
- Farm dams.

The majority of the Survey Area is Cleared (Paddock/Crop /Infrastructure) (7,416 ha, 74.21 %), with the next most common habitat being Diverse Shrubland and Heath (1,991 ha, 19.93 %). Habitat conditions range from pristine in some areas of Diverse Shrubland and Heath and Shrubland on Lateritic Ridge/Outcrop, to completely degraded in areas that have been subject to heavy grazing, clearing for agriculture, weed invasion and drought. Each of the fauna habitat types identified was defined in terms of distribution, significance and SRE potential according to the following criteria:

- **Distribution:** habitats uncommon and fragmented within the Survey Area were categorised as being of 'limited extent'; otherwise, they were categorised as 'widespread'. Five habitats were considered of limited extent and comprised of Low Eucalypt Woodland (142 ha, 1.42 %); Shrubland on Lateritic Ridge/Outcrop (166 ha, 1.66 ha); Wetland (22 ha, 0.22 %); and Minor Drainage Line (12 ha, 0.12 %). The remaining habitats were considered widespread
- **Significance:** fauna habitats considered important for significant fauna were categorised as 'significant on a local and regional scale'; otherwise, they were categorised as 'being of limited significance'. Five of the eight habitats were considered significant and may support significant avifauna. The remaining two habitats were of limited significance for supporting significant fauna. The majority of remnant habitat within the Survey Area was in good condition, with the most severe degradation mainly confined to areas of Open Woodland on Farmland, which were likely former shrubland but where only the overstorey of *Eucalyptus tottiana* remains after clearing and grazing.



Table 5-1: Fauna habitats identified in the Survey Area.

Habitat Distribution, Value and SRE Suitability	Broad Description and Relevance to Fauna	Condition	Disturbance Types	Extent within Survey Area		Representative Photos*
				ha	%	
Diverse Shrubland and Heath • Distribution: Widespread • Significance: Significant	This habitat was characterised by flat to undulating sandplains and slopes, dominated by diverse shrubland or heath. Shrubland and heath vegetation typically includes diverse proteaceous species such as <i>Banksia fraseri</i>, <i>B. sessilis</i>, <i>B. attenuata</i>., <i>Hakea auriculata</i>, <i>Adenanthos</i> spp., <i>Grevillea</i> spp., <i>Petrophile</i> sp., and other shrubs including <i>Acacia saligna</i>, <i>Allocasuarina</i> spp., <i>Calothamnus</i> sp., <i>Xanthorrea</i> sp. and <i>Eremaea pauciflora</i>. In some areas, <i>Eucalyptus tottiana</i> and <i>Nuytsia floribunda</i> scattered low trees or low open woodland are present. Tussock grasses, sedges and herbs including <i>Lomandra</i> sp. and <i>Ecdeiocolea monostachya</i> are present in scattered to very open distributions. Some otherwise undisturbed areas have been drought affected. Relevance to fauna: The diverse shrubland would provide foraging, shelter and dispersal opportunities for a range of small bird species. Areas with remnant understorey include foraging habitat for Carnaby's Black Cockatoo.	Pristine – Degraded	• Livesock grazing • Invasive weeds • Access tracks	1,991.26	19.93	
Open Woodland on Farmland • Distribution: Widespread • Significance: Not Significant	This habitat is generally Diverse Shrubland and Heath habitat that has been subject to significant degradation, especially grazing and/or clearing of understorey vegetation. In most areas <i>Eucalyptus tottiana</i> scattered low trees or low open woodland are the most common overstorey, with occasional <i>Nuytsia floribunda</i>, <i>E. loxophleba</i> and <i>E. accedens</i> in some areas. Relevance to fauna: This habitat type is unlikely to provide significant foraging or refuge potential. Carnaby's Black-Cockatoos have been observed perching in <i>E. tottiana</i> within this habitat.	Degraded – Completely Degraded	• Clearing • Livestock grazing • Invasive weeds • Access tracks	243.57	2.44	

Habitat Distribution, Value and SRE Suitability	Broad Description and Relevance to Fauna	Condition	Disturbance Types	Extent within Survey Area		Representative Photos*
				ha	%	
Low Eucalypt Woodland • Distribution: Limited • Significance: Significant	This habitat is characterised by sandplains, breakaways and gravel slopes generally with <i>Eucalyptus accedens</i> (Powderbark Wandoo) but occasionally <i>E. loxophleba</i> (York Gum) woodlands, either with or without a mixed medium to low shrub understory. Understorey species include <i>Allocasuarina campestris</i>, <i>Pericalymma ellipticum</i>, <i>Xanthorrea</i> sp. and rush and sedge species including <i>Ecdeiocolea monostachya</i>. The larger patches of this habitat are generally in excellent or very good condition. Some smaller patches lack understorey as a result of clearing or grazing. Relevance to fauna: Medium to small sized hollows were common within this habitat type which would provide breeding and refuge sites for microbats. In addition, larger hollows are present, and provide nesting sites for hollow-dependent birds, which may include Carnaby's Black-Cockatoo. Woody debris, leaf litter and scattered rocks of various sizes were common throughout this habitat and may provide potential mound-building substrate for Malleefowl.	Excellent – Degraded	• Livesock grazing • Invasive weeds • Access tracks	141.78	1.42	 
Shrubland on Lateritic Ridge/Outcrop • Distribution: Limited • Significance: Significant	This habitat was characterised by lateritic slopes and high ground with <i>Allocasuarina campestris</i> and <i>Melaleuca uncinata</i> (Brushwood) tall to low shrubland, with occasional <i>Eucalyptus accedens</i> and <i>Eucalyptus loxophleba</i> trees. Other shrub species in the habitat include <i>Pericalymma ellipticum</i>, <i>Hakea auriculata</i> and <i>Banksia fraseri</i>. Sedges and grass such as <i>Ecdeiocolea monostachya</i> are sparsely distributed. This habitat remains in small patches at higher elevation and is generally in pristine or excellent condition. Relevance to fauna: This habitat type consists of a dense shrub layer which would provide shelter, foraging and dispersal opportunities for small woodland bird species. Carnaby's Black-Cockatoos are known to forage in <i>A. campestris</i>.	Pristine – Good	• Livesock grazing • Invasive weeds • Access tracks	166.23	1.66	 
Wetland • Distribution: Limited • Significance: Significant	Low lying wetland areas, generally <i>Melaleuca raphiophylla</i> (Swamp Paperbark) low woodland over <i>Melaleuca uncinata</i> shrubland with an understorey of <i>Tecticornia</i> spp. (samphire), <i>Juncus acutus</i> (Spiny Rush) and patches of invasive grasses in some areas. Other areas lack Melaleuca overstorey and are dominated by <i>J. acutus</i> and grasses. This habitat is likely to temporarily hold water after rainfall events. Some small patches of wetland are fed by springs and are likely to be permanent or semi-permanent water sources. Relevant to fauna: This habitat type would provide foraging, shelter and dispersal opportunities for a range of ground dwelling fauna and avifauna species. Woody debris was rare in most areas of this habitat with some stag trees present suitable for microbat species.	Good – Degraded	• Runoff from agricultural land • Invasive Weeds • Livestock grazing	22.07	0.22	 

Habitat Distribution, Value and SRE Suitability	Broad Description and Relevance to Fauna	Condition	Disturbance Types	Extent within Survey Area		Representative Photos*
				ha	%	
Minor Drainage Line • Distribution: Limited • Significance: Not Significant	Minor drainage lines are smaller channels (<10m wide) which temporarily carry water after rainfall events. These typically consisting of clay substrate and are lined with a variety of tree and shrub species depending on the habitats they intersect. Some small sections of minor drainage lines are in excellent or very good condition, but most are degraded to completely degraded and lined with pastural grasses. Most minor drainage lines are unlikely to support water for long periods of time after rainfall. Some minor drainage lines are fed by springs and are likely to be permanent or semi-permanent water sources. Relevance to fauna species: Vegetation along the drainage lines may be important for roosting and nesting of avifauna.	Excellent – Completely Degraded	• Runoff from agricultural land • Livestock grazing • Invasive weeds • Access tracks	12.11	0.12	 
River Red Gum Forest • Distribution: Limited • Significance: Significant	Present in Additional Area only This habitat is characterised by tall and open Low Eucalypt Woodlands of <i>Eucalyptus camaldulensis</i> (River Red Gum) in low-lying areas close to Minor Drainage Lines and springs. The understorey is generally grazed and/or cleared. In some areas, native and non-native grasses cover most of the substrate. In other areas, most of the ground is covered in leaf litter. Relevance to fauna: Larger hollows are present, and provide nesting sites for hollow-dependent birds, which may include Carnaby's Black-Cockatoo.	Good – Degraded	• Livestock grazing • Invasive weeds • Access tracks	0	0	 
Cleared (paddock/crop /infrastructure) • Distribution: Widespread • Significance: Not Significant	Cleared paddocks used for livestock grazing and/or crop including wheat, oilseeds and legumes. Habitat values are limited with scattered paddock trees and areas of native and exotic grasses. Farm tracks, homesteads, sheds and other agricultural infrastructure are also present on cleared land. Relevance to fauna: Pasture with crop may provide some dispersal opportunities for small mammals and reptiles. Raptors, granivorous birds and larger mammal species forage in this habitat. Scattered paddock trees where present may also provide suitable habitat for raptors and other birds species including roosting and tree hollows that may be nesting habitat for Carnaby's Black-Cockatoo.	Completely Degraded	• Clearing • Livestock grazing • Invasive weeds • Access tracks	7,416.26	74.21	 
Total				9,993.29	100	

Table 5-2: Fauna microhabitats identified in the Survey Area.

Microhabitat Distribution and Value	Broad Description and Relevance to Fauna	Representative Photos
Planted Trees • Limited • Low to high value to conservation significant species, depending upon species and size of planted tree	Large planted introduced <i>Eucalyptus</i> spp. and a small number of introduced conifers along driveways, fencelines and around homesteads. Also, a small number of paddocks with rows of planted <i>Acacia</i> spp. and mallee eucalypts. Relevance to fauna species: Planted eucalypts may provide suitable habitat for raptors and other birds species including roosting and tree hollows that may be nesting habitat for Carnaby's Black-Cockatoo. Introduced conifers provide foraging habitat and potential roosting habitat for Carnaby's Black-Cockatoo (DAWE 2022b).	
Farm Dams • Limited • Moderate value to conservation significant species	Farm dams were scattered throughout the Survey Area. The farm dams contained varying levels of water and had little to no fringing woodland or aquatic vegetation with varying degree of sloping banks. Relevance to Fauna: The farm dams have limited habitat values for water birds due to the lack of suitable fringing vegetation required for refuge. However, waterbird species such as Australia wood duck (<i>Chenonetta jubata</i>), Australasian Grebe (<i>Tachybaptus novaehollandiae</i>) and Black-tailed Native-hen (<i>Tribonyx ventralis</i>) utilise this microhabitat.	



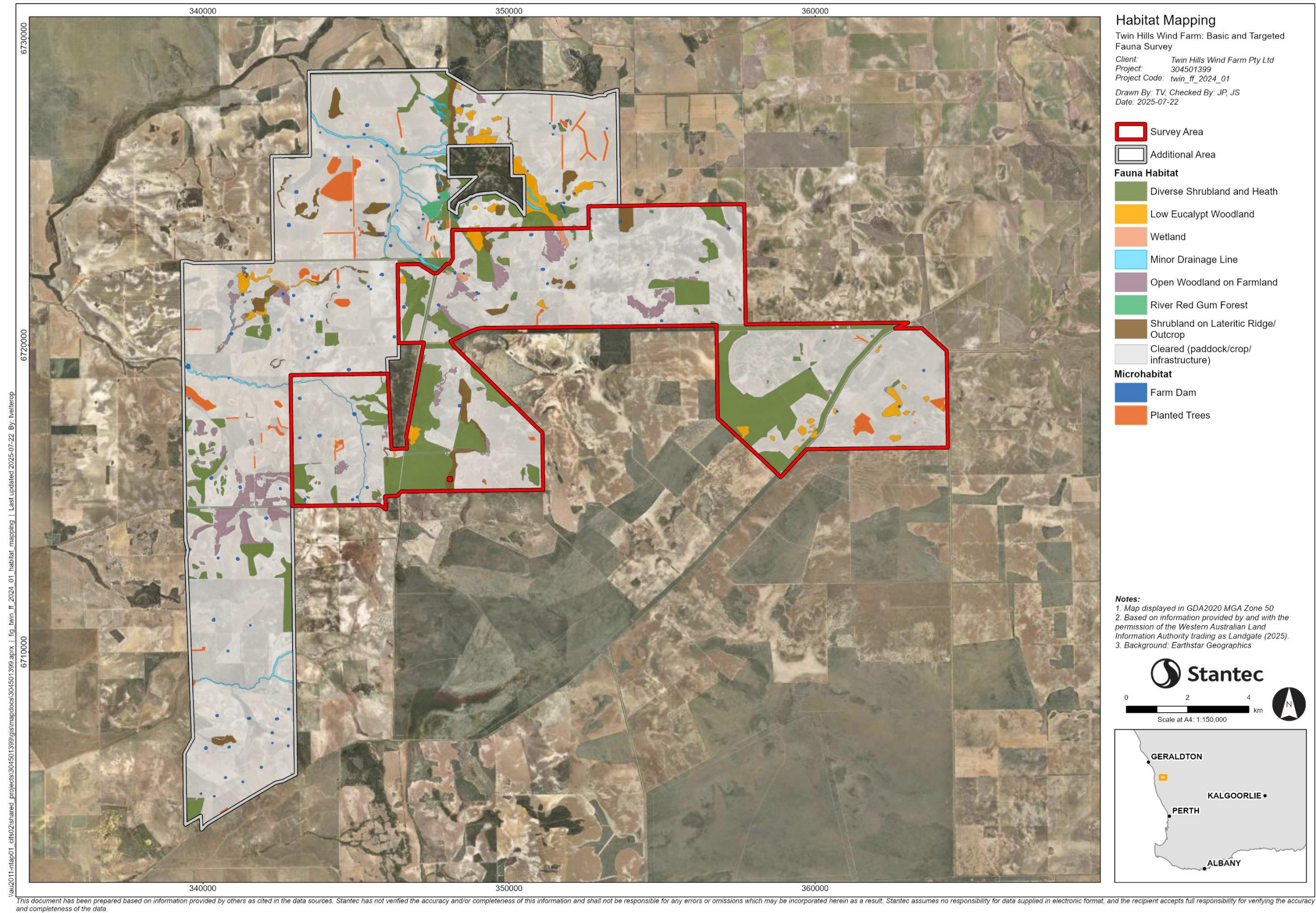


Figure 5-1: Fauna habitat mapping within the Survey Area.

5.2 Species Richness

During the BBUS and additional basic and targeted fauna survey (Stantec 2025), a total of 113 native birds, one introduced bird and seven native bats were recorded within the Survey Area, Additional Area and reference sites (**Table 5-3**). Species recorded during the BBUS were either recorded during FP counts, on autonomous units or opportunistically. All species recorded during the basic and targeted survey were observed opportunistically whilst transversing the Survey Area or during targeted searches for Black-Cockatoo tree hollows (Stantec 2025).

49.57% of all bird species identified during the desktop assessment were recorded during the BBUSs basic and targeted fauna survey (Stantec 2025). Two species were recorded that had not been previously identified during the desktop assessment: the Bush Stone Curlew (*Burhinus grallarius*) and Australian Spotted Crane (*Porzana fluminea*).

83.33% of all bat species identified during the desktop assessment were recorded during the BBUSs basic and targeted fauna survey (Stantec 2025), not including the Little Red Flying-fox (*Pteropus scapulatus*). Two species were recorded that had not been previously identified during the desktop assessment: the Northern Free-tailed Bat (*Ozimops lumsdenae*) and Inland Broad-nosed Bat (*Scotorepens balstoni*).

The species identified are from the following groups:

- 15 raptors;
- Eight aerial foragers;
- 16 waterbirds;
- Two shorebirds;
- 12 other species of potential risk;
- 61 bush birds (including one introduced species); and
- Seven bats.

Table 5-3: Bats and bird species recorded in the Survey Area during basic and targeted survey and BBUS. Significant species shown in bold. Species recorded within Additional Area and reference sites only are shaded grey.

Scientific Name	Common Name	Basic and Targeted Fauna Survey (Stantec 2025)	Bird and Bat Utilisation Surveys
Raptors			
<i>Accipiter fasciatus</i>	Brown Goshawk	✓	✓
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk	-	✓
<i>Aquila audax</i>	Wedge-tailed Eagle	✓	✓
<i>Circus assimilis</i>	Spotted Harrier	✓	✓
<i>Hamirostra isura</i>	Square-tailed Kite	✓	✓
<i>Haliastur spheurnus</i>	Whistling Kite	-	✓
<i>Hieraaetus morphnoides</i>	Little Eagle	-	✓
<i>Elanus axillaris</i>	Black-shouldered Kite	-	✓
<i>Falco berigora</i>	Brown Falcon	✓	✓
<i>Falco cenchroides</i>	Australian Kestrel	✓	✓
<i>Falco longipennis</i>	Australian Hobby	-	✓



Scientific Name	Common Name	Basic and Targeted Fauna Survey (Stantec 2025)	Bird and Bat Utilisation Surveys
<i>Falco peregrinus</i> *	Peregrine Falcon	-	✓
<i>Ninox boobook</i>	Boobook Owl	✓	✓
<i>Tyto alba</i>	Barn Owl	✓	✓
<i>Aegotheles cristatus</i>	Australian Owlet night-jar	-	✓
Aerial Foragers			
<i>Artamus cinereus</i>	Black-faced Woodswallow	✓	✓
<i>Artamus personatus</i>	Masked Woodswallow	-	✓
<i>Artamus superciliosus</i>	White-browed Woodswallow	-	✓
<i>Cheramoeca leucosternus</i>	White-backed Swallow	✓	✓
<i>Hirundo neoxena</i>	Welcome Swallow	✓	✓
<i>Petrochelidon ariel</i>	Fairy Martin	-	✓
<i>Petrochelidon nigricans</i>	Tree Martin	✓	✓
<i>Merops ornatus</i>	Rainbow Bee-eater	✓	✓
Waterbirds			
<i>Anas gracilis</i>	Grey Teal	✓	✓
<i>Anas superciliosa</i>	Pacific Black Duck	✓	✓
<i>Chenonetta jubata</i>	Australian Wood Duck	✓	✓
<i>Tadorna tadornoides</i>	Australian Shelduck	✓	✓
<i>Anhinga novaehollandiae</i>	Australasian Darter	-	✓
<i>Ardea alba</i>	Great Egret	-	✓
<i>Ardea pacifica</i>	White-necked Heron	-	✓
<i>Egretta novaehollandiae</i>	White-faced Heron	-	✓
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant	✓	✓
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant	-	✓
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe	✓	✓
<i>Fulica atra</i>	Eurasian Coot	-	✓
<i>Tribonyx ventralis</i>	Black-tailed Native-hen	✓	✓
<i>Threskiornis spinicollis</i>	Straw-necked Ibis	-	✓
<i>Porzana fluminea</i>	Australian Spotted Crake	-	✓
<i>Pelecanus conspicillatus</i>	Australian Pelican	-	✓
Shorebirds			
<i>Charadrius melanops</i>	Black-fronted Dotterel	✓	✓
<i>Vanellus tricolor</i>	Banded Lapwing	-	✓



Scientific Name	Common Name	Basic and Targeted Fauna Survey (Stantec 2025)	Bird and Bat Utilisation Surveys
Other Species of Potential Risk			
<i>Gymnorhina tibicen</i>	Australian Magpie	✓	✓
<i>Cacatua pastinator</i>	Western Corella	✓	✓
<i>Eolophus roseicapilla</i>	Galah	✓	✓
<i>Cacatua sanguinea</i>	Little Corella	✓	✓
<i>Calyptorhynchus banksii esconditus</i>	Red-tailed Black-Cockatoo	-	✓
<i>Zanda latirostris</i>**	Carnaby's Black-Cockatoo	-	✓
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike	✓	✓
<i>Lalage tricolor</i>	White-winged Triller	-	✓
<i>Corvus bennetti</i>	Little Crow	-	✓
<i>Corvus coronoides</i>	Australian Raven	✓	✓
<i>Barnardius zonarius</i>	Australian Ringneck	✓	✓
<i>Nymphicus hollandicus</i>	Cockatiel	-	✓
Bush Birds			
<i>Acanthiza apicalis</i>	Inland Thornbill	✓	✓
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill	✓	✓
<i>Acanthiza inornata</i>	Western Thornbill	✓	✓
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill	-	✓
<i>Calamanthus cauta</i>	Shy Heathwren	-	✓
<i>Calamanthus campestris</i>	Rufous Fieldwren	-	✓
<i>Coracina maxima</i>	Ground Cuckoo-shrike	-	✓
<i>Gerygone fusca</i>	Western Gerygone	✓	✓
<i>Sericornis maculatus</i>	Spotted Scrubwren	-	✓
<i>Smicrornis brevirostris</i>	Weebill	✓	✓
<i>Acrocephalus australis</i>	Australian Reed Warbler	-	✓
<i>Dacelo novaeguineae</i>	Laughing Kookaburra (naturalised)	✓	✓
<i>Todiramphus sanctus</i>	Sacred Kingfisher	✓	✓
<i>Cracticus nigrogularis</i>	Pied Butcherbird	✓	✓
<i>Cracticus torquatus</i>	Grey Butcherbird	-	✓
<i>Dromaius novaehollandiae</i>	Emu	✓	✓
<i>Burhinus grallarius</i>	Bush Stone-Curlew	-	✓
<i>Ocyphaps lophotes</i>	Crested Pigeon	✓	✓
<i>Phaps chalcoptera</i>	Common Bronzewing	✓	✓



Scientific Name	Common Name	Basic and Targeted Fauna Survey (Stantec 2025)	Bird and Bat Utilisation Surveys
<i>Streptopelia senegalensis</i>	Laughing Dove (introduced)	-	✓
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo	-	✓
<i>Chalcites basalis</i>	Horsfield's Bronze-cuckoo	✓	✓
<i>Chalcites lucidus</i>	Shining Bronze-cuckoo	-	✓
<i>Heteroscenes pallidus</i>	Pallid Cuckoo	-	✓
<i>Dicaeum hirundinaceum</i>	Mistletoebird	✓	✓
<i>Taeniopygia guttata</i>	Zebra Finch	✓	✓
<i>Megalurus mathewsi</i>	Rufous Songlark	-	✓
<i>Cincloramphus cruralis</i>	Brown Songlark	-	✓
<i>Malurus assimilis</i>	Purple-backed Fairywren	✓	✓
<i>Malurus leucopterus</i>	White-winged Fairywren	✓	✓
<i>Malurus splendens</i>	Splendid Fairywren	✓	✓
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater	-	✓
<i>Anthochaera carunculata</i>	Red Wattlebird	-	✓
<i>Anthochaera lunulata</i>	Western Little Wattlebird	-	✓
<i>Epthianura albifrons</i>	White-fronted Chat	✓	✓
<i>Epthianura tricolor</i>	Crimson Chat	✓	✓
<i>Gavicalis virescens</i>	Singing Honeyeater	-	✓
<i>Glyciphila melanops</i>	Tawny-crowned Honeyeater	-	✓
<i>Lichmera indistincta</i>	Brown Honeyeater	✓	✓
<i>Manorina flavigula</i>	Yellow-throated Miner	✓	✓
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater	✓	✓
<i>Phylidonyris nigra</i>	White-cheeked Honeyeater	-	✓
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater	✓	✓
<i>Purnella albifrons</i>	White-fronted Honeyeater	✓	✓
<i>Grallina cyanoleuca</i>	Magpie-lark	✓	✓
<i>Anthus australis</i>	Australian Pipit	✓	✓
<i>Colluricincla harmonica</i>	Grey Shrike-thrush	✓	✓
<i>Pachycephala pectoralis</i>	Western Whistler	-	✓
<i>Pachycephala rufiventris</i>	Rufous Whistler	✓	✓
<i>Pardalotus striatus</i>	Striated Pardalote	✓	✓
<i>Pardalotus punctatus</i>	Spotted Pardalote	-	✓
<i>Melanodryas cucullata</i>	Hooded Robin	-	✓



Scientific Name	Common Name	Basic and Targeted Fauna Survey (Stantec 2025)	Bird and Bat Utilisation Surveys
<i>Microeca fascinans</i>	Jacky Winter	-	✓
<i>Petroica goodenovii</i>	Red-capped Robin	✓	✓
<i>Petroica boodang</i>	Scarlet Robin	-	✓
<i>Eopsaltria georgiana</i>	White-breasted Robin	-	✓
<i>Coturnix pectoralis</i>	Stubble Quail	✓	✓
<i>Turnix velox</i>	Little Button-quail	-	✓
<i>Rhipidura albiscapa</i>	Grey Fantail	-	✓
<i>Rhipidura leucophrys</i>	Willie Wagtail	✓	✓
<i>Zosterops lateralis</i>	Silvereye	-	✓
Bats			
<i>Austronomus australis</i>	White-striped Free-tailed Bat	-	✓
<i>Ozimops lumsdenae</i>	Northern Free-tailed Bat	-	✓
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat	-	✓
<i>Chalinolobus morio</i>	Chocolate Wattled Bat	-	✓
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat	-	✓
<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat	-	✓
<i>Vespadelus regulus</i>	Southern Forest Bat	-	✓

* Listed as other specially protected fauna under the BC Act

**Listed Endangered under EPBC Act and BC Act

5.3 Fixed-point Counts

5.3.1 Sampling Adequacy

Species accumulation curves can be used to estimate the sampling adequacy of systematic observation techniques for a survey (EPA 2020). The species accumulation curve was created using FP count data collected during the BBUS from Q4 2023 to Q3 2025, excluding FP count data from the Additional Area.

Bird species richness estimators and Sobs accumulation curves steadily increased and are close to reaching an asymptote (**Figure 5-2**). This suggests that continued sampling using the same method may yield further species but is unlikely to be an efficient method to do so (although it remains valuable for determining temporal changes). Richness predictors indicate between 85.06% and 91.78% of bird species expected to be recorded using the FP count method were recorded during the BBUSs, and that between eight and 15 additional species may be recorded with ongoing survey effort (**Figure 5-2; Table 5-4**).



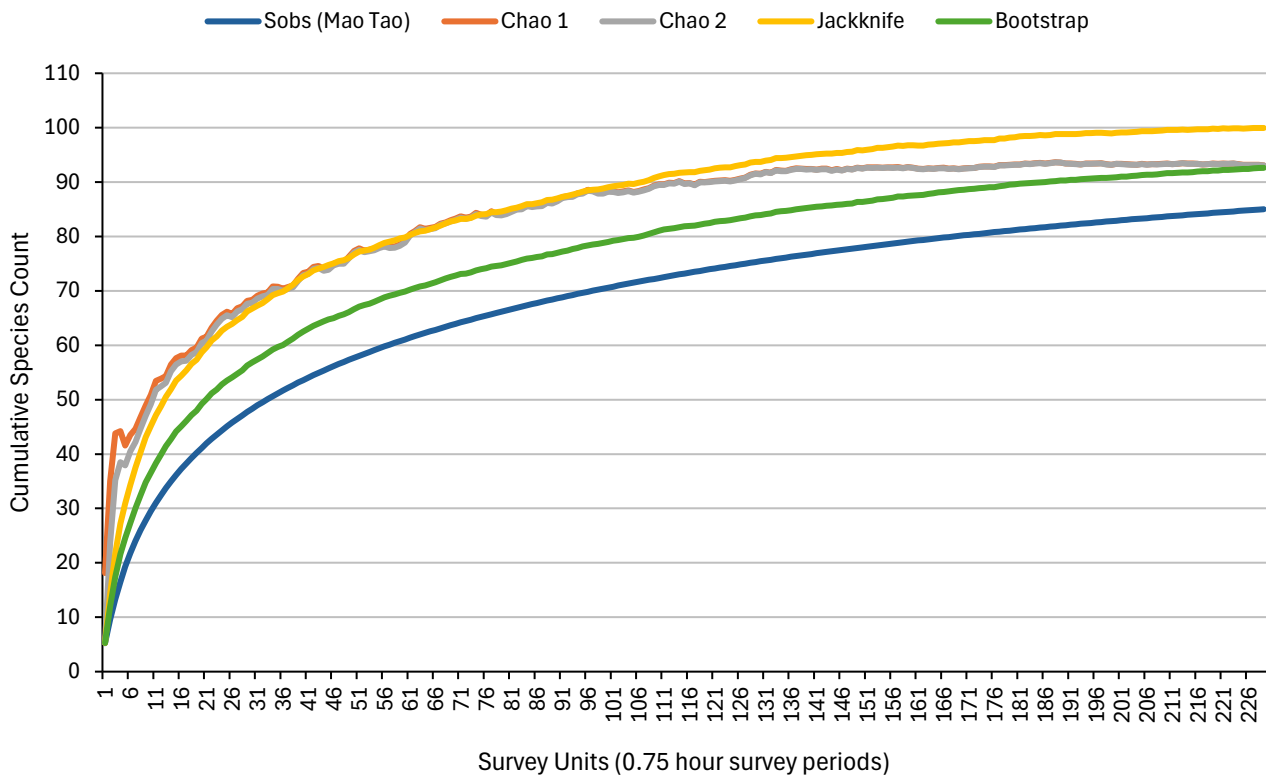


Figure 5-2: Species accumulation curves for avifauna recorded during FP counts (excluding Additional Area).

Table 5-4: Observed and predicted bird species richness at FP locations during the bird surveys (excluding Additional Area).

Observed vs. estimated		Species richness (n)	Proportion recorded (%)
Observed	Sobs	85	-
	Chao 1	93.07	91.33
Estimated	Chao 2	93.04	91.36
	Jackknife 1	99.93	85.06
	Bootstrap	92.61	91.78

5.3.2 Bird Observations

In total, 19,980 observations were recorded during FP Counts within the Survey Area, Additional Area and reference sites. Each “observation” represents a record of an individual bird. As many species were observed in flocks, and birds in flight were observed every 30 seconds that they were observable, the count of observations does not represent abundance. This comprised a total of 96 (92 sighted; four heard only) bird species (Q4 2023 = 62; Q1 2024 = 44; Q2 2024 = 46; Q3 2024 = 55; Q4 2024 = 59; Q1 2025 = 47; Q2 2025 = 46; Q3 2025 = 50) including eight raptors, seven aerial foragers, 11 waterbirds, two shorebird, 12 other species of potential risk and 55 bush birds (**Table 5-5**). The reduction in count of observations as of 2024 is partly due to the reduction in FP sites visited.

Three species, the Carnaby’s Black-Cockatoo (28.33%), Galah (*Eolophus roseicapilla*) (15.95%) and Little Corella (*Cacatua sanguinea*) (18.95%) made up most observations during the FP counts and collectively accounted for close to two thirds of all observations (63.23%). These three cockatoo species are conspicuous and move in large flocks, which



may account for their high proportion of observations, which is not necessarily indicative of abundance relative to other bird species. A large proportion of these cockatoo observations (46.20%) were recorded during the Q2 2024 survey in May and June 2024 (when a flock of up to 400 Carnaby's Black-Cockatoo was repeatedly observed), followed by the Q3 2025 survey (17.08%), Q3 2024 (13.87%), and Q1 2024 survey (10.24%) (**Table 5-5**).

Table 5-5: Number of bird observations according to group recorded during each quarter within the Survey Area.

Group	Q4 2023	Q1 2024	Q2 2024	Q3 2024	Q4 2024	Q1 2025	Q2 2025	Q3 2025	Total
Raptors	78	22	87	42	57	21	49	31	387
Aerial Foragers	362	364	48	124	64	183	79	201	1425
Other species of potential risk	564	1,567	6,187	1,919	432	167	1,139	2,279	14,254
Waterbirds	90	54	12	28	8	5	17	23	237
Shorebirds	161	0	0	0	2	0	0	6	169
Bush Birds	251	303	827	438	492	594	241	362	3,508
Total Observations	1,506	2,310	7,161	2,551	1,055	972	1,525	2,902	19,980

5.3.3 Proportion of Bird Observations within RSA

Of the total 19,980 observations recorded during FP counts, 18,507 observations with associated flight heights were recorded (most of the remainder being observations that were heard only). This comprised a total of 92 species, including eight raptors, seven aerial foragers, 12 waterbirds, one shorebird, 12 other species of potential risk (parrots, corvids, magpie, cuckoo-shrike and triller) and 51 bush birds. The remaining 22 species presented in **Section 5.2** were either heard only (no flight height data available) or were recorded during the basic and targeted fauna survey (e.g. on acoustic recording units) with no flight height data (Stantec 2025).

Of the of 18,507 observations, 1,968 (10.63%) were within the proposed RSA (40-300 m). A total of 27 species were at potential risk (recorded flying within RSA) (**Table 5-6**). The Little Corella accounted for 44.00% of all observations within RSA height, and the Tree Martin accounted for 19.00% of all observations within RSA height. Of the 27 species recorded flying within the RSA height, seven were raptors, five were aerial foragers, one was a shorebird, six were waterbirds, six were other species of potential risk and two were bush birds. All observations of the Endangered Carnaby's Black-Cockatoo were below RSA (0-40 m).

Within the Survey Area (excluding the Additional Area and reference sites), a total of 7,203 observations with associated flight heights were recorded. Of the of 7,203 observations within the Survey Area, 917 (12.73%) were within the proposed RSA (40-300 m). Species observed within RSA height outside the Survey Area (**Table 5-6**) are included in the ERM (**Section 5.7**) and impact assessment (**Section 5.8**) as they are likely to occur at RSA height within the Survey Area.



Table 5-6: Species recorded within the Rotor Swept Area (40-300 m) during Fixed Point Counts.

Species	Classification	Within Survey Area			Within Additional Area and reference sites		
		Number of observations within RSA	Total number of observations	Proportion of observations of that species within RSA (%)	Number of observations within RSA	Total number of observations	Proportion of observations of that species within RSA (%)
Little Eagle <i>Hieraaetus morphnoides</i>	Raptor	0	0	0	7	7	100.00
Australian Hobby <i>Falco longipennis</i>	Raptor	1	1	100.00	1	1	100.00
Brown Goshawk <i>Accipiter fasciatus</i>	Raptor	0	0	0	1	1	100.00
Wedge-tailed Eagle <i>Aquila audax</i>	Raptor	121	152	79.61	65	74	87.84
Banded Lapwing <i>Vanellus tricolor</i>	Shorebird	0	2	0	115	163	70.55
Tree Martin <i>Petrochelidon nigricans</i>	Aerial Forager	150	415	36.14	218	405	53.83
Rainbow bee-eater <i>Merops superciliosus</i>	Aerial Forager	0	1	0	6	17	35.29
Spotted Harrier <i>Circus assimilis</i>	Raptor	2	6	33.33	0	1	0
Little Corella <i>Cacatua sanguinea</i>	Other Species of Potential Risk	410	2,443	16.78	458	1253	36.55
Western Corella <i>Cacaua pastinator</i>	Other Species of Potential Risk	200	200	100.00	0	0	0
Little Crow <i>Corvus bennetti</i>	Other Species of Potential Risk	0	5	0	3	5	30.00
Welcome Swallow <i>Hirundo neoxena</i>	Aerial Forager	8	147	5.44	58	207	28.02



Species	Classification	Within Survey Area			Within Additional Area and reference sites		
		Number of observations within RSA	Total number of observations	Proportion of observations of that species within RSA (%)	Number of observations within RSA	Total number of observations	Proportion of observations of that species within RSA (%)
White-backed Swallow <i>Cheramoeca leucosterna</i>	Aerial Forager	12	65	18.46	0	5	0
Little Pied Cormorant <i>Microcarbo melanoleucos</i>	Waterbird	0	0	0	9	33	27.27
White-faced Heron <i>Egretta novaehollandiae</i>	Waterbird	1	4	25.00	0	2	0
Maggie Lark <i>Grallina cyanoleuca</i>	Bush Bird	0	47	0	4	15	26.67
Australian Kestrel <i>Falco cenchroides</i>	Raptor	13	62	20.97	7	61	11.48
Australian Raven <i>Corvus coronoides</i>	Other Species of Potential Risk	12	294	4.08	45	333	13.51
Little Black Cormorant <i>Phalacrocorax sulcirostris</i>	Waterbird	0	0	0	1	9	11.11
Fairy Martin <i>Petrochelidon ariel</i>	Aerial Forager	0	2	0	6	57	10.53
Brown Falcon <i>Falco berigora</i>	Raptor	0	3	0	1	10	10
Australian Magpie <i>Gymnorhina tibicen</i>	Other Species of Potential Risk	0	30	0	3	28	10.71
Grey Teal <i>Anas gracilis</i>	Waterbird	2	8	25.00	4	52	7.70
Pacific Black Duck <i>Anas superciliosa</i>	Waterbird	0	0	0	2	27	7.41
Australian Shelduck	Waterbird	4	22	18.18	0	16	0



Species	Classification	Within Survey Area			Within Additional Area and reference sites		
		Number of observations within RSA	Total number of observations	Proportion of observations of that species within RSA (%)	Number of observations within RSA	Total number of observations	Proportion of observations of that species within RSA (%)
<i>Tadorna tadornoides</i>							
Australian Pipit <i>Anthus australis</i>	Bush Bird	1	180	0.56	0	79	0
Galah <i>Eolophus roseicapilla</i>	Other Species of Potential Risk	1	1,417	0.07	20	1,714	1.17



5.3.4 Impact and Reference Sites

Observations, number of species and proportions of these metrics within RSA height are presented for each impact and reference site in **Table 5-7**.

Table 5-7: Comparison of impact and reference sites.

Date	Metrics	Impact Sites						Reference Sites			
		FP1	FP3	FP14	FP15	FP17	FP18	FP2R	FP6R	FP9R	FP16R
Q4 2023	Count of Species	6	10	8	9	0	0	5	10	13	10
	Count of species within RSA	0	5	4	0	0	0	1	1	0	0
	Count of Observations	19	37	384	30	0	0	38	49	41	38
	Count of Observations within RSA	0	9	84	0	0	0	3	1	0	0
	% observations within RSA	0	24.30	21.88	0	0	0	7.89	2.04	0.00	0.00
Q1 2024	Count of Species	10	7	7	7	0	0	8	6	9	7
	Count of species within RSA	2	2	3	1	0	0	0	1	0	1
	Count of Observations	164	68	161	31	0	0	41	15	24	106
	Count of Observations within RSA	46	20	17	1	0	0	0	2	0	8
	% observations within RSA	28.00	29.41	10.56	3.23	0	0	0.00	13.33	0.00	7.54
Q2 2024	Count of Species	3	10	11	4	9	14	6	9	8	5
	Count of species within RSA	1	1	3	0	0	1	1	1	0	0
	Count of Observations	14	24	469	11	65	611	55	3625	27	32
	Count of Observations within RSA	8	3	174	0	0	6	2	6	0	0
	% observations within RSA	57.10	12.50	37.10	0	0	0.98	3.64	0.17	0.00	0.00
Q3 2024	Count of Species	11	15	12	15	12	17	11	10	13	16
	Count of species within RSA	0	0	2	1	0	2	0	0	1	2
	Count of Observations	28	43	187	326	27	66	35	103	122	83
	Count of Observations within RSA	0	0	6	6	0	2	0	0	3	9
	% observations within RSA	0	0	3.21	1.84	0.00	3.03	0.00	0.00	2.46	10.84
Q1 2025	Count of Species	14	10	13	15	10	14	8	4	13	10
	Count of species within RSA	1	1	1	0	2	2	1	1	0	1
	Count of Observations	103	127	81	158	80	136	40	14	45	44
	Count of Observations within RSA	2	3	2	0	14	4	4	3	0	6
	% observations within RSA	1.94	2.36	2.47	0	17.50	2.94	10.00	21.43	0.00	13.63
Q2 2025	Count of Species	12	16	12	14	4	9	7	13	16	13
	Count of species within RSA	1	2	4	3	0	1	1	1	1	1
	Count of Observations	30	270	999	55	8	84	30	1238	77	248
	Count of Observations within RSA	2	6	220	23	0	12	5	2	14	9
	% observations within RSA	6.67	2.22	22.02	41.80	0.00	14.30	16.67	0.16	18.18	3.63
Q3 2025	Count of Species	11	19	11	10	7	16	10	11	12	9
	Count of species within RSA	1	1	0	1	1	0	0	1	0	0
	Count of Observations	57	67	848	748	77	61	32	655	100	36
	Count of Observations within RSA	1	1	0	240	20	0	0	1	0	0
	% observations within RSA	1.75	1.49	0.00	32.10	26.00	0.00	0.00	0.15	0.00	0.00



5.3.5 Flight Height and Behaviour of Observed Bird Species

The flight height and behaviour of bird species varied between bird groups: raptors, aerial foragers, waterbirds, shorebirds, other species of potential risk, and bush birds. The general behaviour of all bird groups recorded during the BBUSs is summarised below. Data presented below combines observations from the Survey Area, Additional Area and reference sites.

5.3.5.1 Raptors

Raptors are recognised internationally as one of the avian groups at greatest risk of colliding with wind turbines (Beston *et al.* 2016; Hull *et al.* 2013; Watson *et al.* 2018). However, a study looking at collisions at two wind farms in Tasmania suggests that not all raptor species are at equal risk (Hull and Muir 2013). It is thought that differences in morphology, ecology and behaviour affect collision risk. Raptor species, which rely heavily on wind and thermals for flight (e.g. eagles, some kites) appear to be at greater collision risk than those with a greater capacity for powered flight (De Lucas *et al.* 2008). Additionally, some species may engage in macro- or micro-avoidance behaviours which minimises their risk (Hull and Muir 2013). Raptors within the *Falco* genus have been identified as high collision risk across the globe (Smales 2015; Watson *et al.* 2018).

A total of 16 raptor species were recorded within the Survey Area, Additional Area and reference sites, eight of which were observed during FP counts, comprising 387 observations in total. One significant raptor species was confirmed within the Survey Area: the Peregrine Falcon recorded opportunistically within the Survey Area during the Q4 2024 BBUS, foraging within RSA height (**Section 5.5**).

The number of observations of raptors varied between seasons, with relatively even observations during the Q4 2023 (78 observations) and, Q2 2024 (87) BBUSs, but fewer observations during the Q1 2024 (22) and Q1 2025 (21) BBUS (22). During the Q1 2024, Q2 2024 and Q3 2025 BBUSs, only two raptor species (Wedge-tailed Eagle (*Aquila audax*) and Australian Kestrel (*Falco cenchroides*)) were observed during FP counts, suggesting other species were absent or sparsely distributed during these periods. The fluctuations in abundance may be due to a number of factors including changes in abundance of prey species, rainfall and presence of wheat and other crops that may support prey species during spring and early summer.

The Wedge-tailed Eagle was the most frequently observed raptor species, comprising 226 observations in total, with 37.17% recorded during the Q2 2024 BBUS.

The number of raptor observations was relatively low compared to the total number of all bird observations recorded during the FP counts. Raptors comprised 1.94% of all bird observations. Relative to their low observation frequency, they were frequently recorded at RSA height. Raptors accounted for 10.92% of all bird observations at RSA height and 55.56% of raptor observations were within RSA height.

Within the Survey Area, raptors were infrequently observed soaring and/or gliding at RSA height to scout for potential prey across all habitat types, including Cleared (paddock/crop /infrastructure) habitat. Some species were also observed hovering and soaring along ridges and outcrops where they conserve energy by utilising updrafts. Two Wedge-tailed Eagle nests have been identified within the Survey Area, and pairs of Wedge-tailed Eagle were observed hunting within proximity to these nests. The Australian Kestrel was more frequently observed below RSA height than within RSA height, as they tend to hover at lower heights in search of prey on the ground.

5.3.5.2 Aerial foragers

Aerial foragers are recognised as being at higher risk of wind turbine collision as they frequently forage at heights within the RSA (Hull *et al.* 2013). A total of eight species of aerial foragers (i.e. woodswallows, martins, swallows and bee-eater) were observed in the Survey Area, seven of which were observed during FP counts, comprising 1425 observations in total. No significant aerial forager species listed under the EPBC Act and/or BC Act were recorded within the Survey Area.

The number of observations recorded during the BBUSs varied between seasons, with little variation between the number of species. The highest number of aerial forager observations was recorded during the Q1 2024 (364 observations) and Q4 2023 (362 observations) BBUSs, followed by the Q3 2025 BBUS (201 observations), with the lowest recorded during the Q2 2024 survey (48 observations). The lower observations during Q2 align with the migratory behaviour of many aerial foragers which winter in warmer regions (Menkhorst *et al.* 2019)



The Tree Martin (*Petrochelidon nigricans*) was the most frequently observed aerial forager species, comprising 820 observations in total, followed by the Welcome Swallow (*Hirundo neoxena*) with a total of 358 observations and Black-faced Woodswallow (*Artamus cinereus*) with a total of 71 observations. The Fairy Martin (*Petrochelidon ariel*), Rainbow Bee-eater (*Merops ornatus*), Tree Martin, Welcome Swallow and White-backed Swallow (*Cheramoeca leucosterna*) were all observed within RSA height, with the remaining species (Black-faced Wood swallow and Masked Woodswallow) only observed below RSA height. 44.88% of Tree Martin observations, 18.44% of Welcome Swallow observations, 27.27% of Rainbow Bee-eater observations, 17.14% of White-backed Woodswallow observations and 10.17% of Fairy Martin observations were within RSA height. Tree Martins were observed foraging in large flocks of over 50 individuals.

Overall, aerial foragers accounted for 7.13% of all bird observations with associated flight heights within the Survey Area, Additional Area or reference sites and 32.14% of aerial foragers observations were within RSA height.

5.3.5.3 Waterbirds

Waterbirds are likely to move nocturnally and diurnally, and in mass in response to infrequent rainfall events across Western Australia (Halse *et al.* 2006). This may put these species at intermittent but high risk of rotor strike. A total of 16 species of waterbirds were observed in the Survey Area, 12 of which were observed during FP counts, comprising 239 observations in total. No significant waterbird species listed under the *EPBC Act* 1999 and/or *BC Act* 2016 were recorded within the Survey Area.

The number of observations and number of species recorded during the BBUSs varied between seasons. However, this is largely due to the changes in access to landholdings and one FP site located beside a large farm dam with dense reed beds was only accessible during Q4 2023 and Q1 2024, making the number of waterbird observations artificially high during these BBUSs. Therefore, no assumptions about seasonal variation are discussed.

The Australia Shelduck (*Tadorna tadornoides*) was the most frequently observed waterbird species, comprising 63 observations in total, followed by the Grey Teal (*Anas gracilis*) with a total of 60 observations and Little Pied Cormorant (*Microcarbo melanoleucos*) with a total of 33 observations. Six waterbird species were observed within RSA height: 27.27% of Little Pied Cormorant observations, 10% of Grey Teal observations, 6.35% of Australian Shelduck observations, 7.41% of Pacific Black Duck (*Anas superciliosa*) observations, 16.67% of white-necked Heron observations (*Ardea pacifica*) and 11.11% of Little Black Cormorant (*Phalacrocorax sulcirostris*) observations were within RSA height.

Overall, waterbirds accounted for 1.20% of all bird observations with associated flight heights within the Survey Area, Additional Area or reference sites and 9.62% of waterbird observations were within RSA height.

5.3.5.4 Shorebirds

Shorebirds are likely to move nocturnally and diurnally, and in mass in response to infrequent rainfall events across Western Australia (Halse *et al.* 2006). This may put these species at intermittent but high risk of rotor strike.

Two shorebird species were observed within the Survey Area. The Black-fronted Dotterel (*Charadrius melanops*) was observed only opportunistically during the targeted fauna surveys (Stantec 2025), generally on the banks of farm dams. It was not recorded during the BBUSs and therefore no flight height data from the Survey Area is available. The Banded Lapwing (*Vanellus tricolor*) was observed during FP counts.

The Banded Lapwing was observed in FP counts only during Q4 2023 and Q3 2025, although individuals were observed outside the Survey Area in other seasons, suggesting it may be present throughout the year. A total of 167 observations of Banded Lapwings were recorded, including three large flocks of between 35 and 80 individuals. These flocks passed within RSA height when flying across Cleared (paddock/crop /infrastructure) habitat.

Overall, the Banded Lapwing accounted for 0.84% of all bird observations with associated flight heights within the Survey Area, Additional Area or reference sites and 68.87% of all Banded Lapwing observations were within RSA height.

5.3.5.5 Other Species of Potential Risk

Other species of potential risk include birds that are known to fly at RSA height, including parrots, corvids, cuckoo-shrikes, magpie and triller. A total of 12 species were observed in the Survey Area, all of which were observed during FP counts, comprising 14,254 observations with associated flight heights. This group includes the Endangered (BC Act; EPBC Act) Carnaby's Black-Cockatoo.

This group accounted for the majority of bird observations: 71.34% of all bird observations with associated flight heights. Additionally, this group accounted for 58.54% of all bird observations within RSA height and includes large, conspicuous



birds that move in large flocks, which may account for their high proportion of observations, which is not necessarily indicative of abundance relative to other bird species.

The number of observations recorded during the BBUSs varied significantly between seasons. The highest number of observations was recorded during the Q2 2024 BBUS (6,187 observations), followed by the Q3 2025 BBUS (2,279 observations), Q3 2024 BBUS (1,919 observations), Q1 2024 BBUS (1,567 observations), Q2 2025 (1,139 observations), Q4 2023 (564 observations), Q4 2024 (432 observations) with the lowest recorded during the Q1 2025 BBUS (167 observations). This variation is due largely to a flock of up to 400 Carnaby's Black-Cockatoos that were observed multiple times during the Q2 2024 BBUS, and large flocks of Little Coreellas and Galahs that also appear less active or abundant during the Q4 2023 BBUS.

The Carnaby's Black-Cockatoo (**Plate 5-1**) was the most frequently observed species, comprising 5,661 observations in total, making up 28.33% of all observations. The high frequency of observations is likely due to the conspicuous nature of the species rather than an indication of total species abundance. All observations of Carnaby's Black-Cockatoo were below RSA height. The flight paths of this species are discussed in more detail in **Section 5.6.1**. The Galah accounted for 15.95% of all observations and the Little Corella accounted for 18.94%.

Six species from this group were observed flying within RSA height. The Little Corella accounted for 44.11% of all observations within RSA height, with 22.93% of observations of this species being within RSA height. Other species observed within RSA height included Australian Raven (*Corvus coronoides*), Galah, Australian Magpie (*Gymnorhina tibicen*), Western Corella (*Cacatua pastinator*) and Little Crow (*Corvus bennetti*).



Plate 5-1: A flock of Carnaby's Black-Cockatoos observed foraging on *Banksia* sp. and flocking during the Q2 2024 BBUS.

5.3.5.6 Bush Birds

Bush birds include species that are generally expected to fly below RSA height and typically within or just above vegetated woodlands areas, such as honeyeaters, wrens, kingfishers, robins, cuckoos, thornbills, finches, pigeons and doves. A total of 61 bush bird species were recorded within the Survey Area, of which 56 were observed during FP counts. No significant



bush bird species listed under the EPBC Act and/or BC Act were recorded within the Survey Area, Additional Area or reference sites.

Bush bird observations recorded during the BBUSs varied between seasons, with some variation between the number of species. The highest number of bush bird observations was recorded during the Q2 2024 BBUS (827 observations), followed by the Q1 2025 BBUS (594 observations), Q4 2024 BBUS (492 observations), Q3 2024 BBUS (438 observations), Q3 2025 BBUS (362 observations), Q1 2024 BBUS (303 observations), Q4 2023 BBUS (251 observations) with the lowest observations recorded during the Q2 2025 BBUS (241 observations).

The White-cheeked Honeyeater (*Phylidonyris nigra*) was the most frequently observed bush bird species, comprising 450 observations in total, making up 12.83% of all bush bird observations. This was followed by the Yellow-rumped Thornbill (*Acanthiza chrysorrhoa*), comprising 379 observations in total, making up 10.80% of all bush bird observations. Other commonly observed species included the Brown Honeyeater (*Lichmera indistincta*), Australian Pipit (*Anthus australis*), Tawny-crowned Honeyeater (*Glyciphila melanops*) and Splendid Fairy-wren (*Malurus splendens*).

Of the 56 species, only two were observed at RSA height: the Magpie-lark (*Grallina cyanoleuca*) (Four observations within RSA height) and Australian Pipit (One observation within RSA height). In total, bush bird observations comprised only 0.25% of observations within RSA height.



5.4 Bat Distribution

A total of seven insectivorous bat species were recorded on bat echolocation units during the survey (**Table 5-8**). Exact call numbers were not always analysed, due to some species calling continuously throughout the night. However, this analysis indicates that the most frequently recorded species were the White-striped Free-tailed Bat (*Austronomus australis*) and Gould's Wattled Bat (*Chalinolobus gouldii*). These species, and the Southern Forest Bat (*Vespadelus regulus*) were the only species recorded in all habitat types and during all quarterly surveys.

Table 5-8: Bat species recorded within the Survey Area.

Species	Presence by Habitat Type								Total Number of Habitats	Presence by Quarter							
	Diverse Shrubland and Heath	Open Woodland on Farmland	Low Eucalypt Woodland	Shrubland on Lateritic Ridge/Outcrop	Minor Drainage Line	Melaleuca Wetland	River Red Gum Forest (Additional Area only)	Cleared (paddock / crop / infrastructure)		Q4 2023	Q1 2024	Q2 2024	Q3 2024	Q4 2024	Q1 2025	Q2 2025	Q3 2025
White-striped Free-tailed Bat <i>Austronomus australis</i>	✓	✓	✓	✓	✓	✓	✓	✓	8	✓	✓	✓	✓	✓	✓	✓	✓
Northern Free-tailed Bat <i>Ozimops lumsdenae</i>	✓	✓	✓	✓	-	✓	-	-	5	✓	-	✓	✓	✓	-	✓	✓
Gould's Wattled Bat <i>Chalinolobus gouldii</i>	✓	✓	✓	✓	✓	✓	✓	✓	8	✓	✓	✓	✓	✓	✓	✓	✓
Chocolate Wattled Bat <i>Chalinolobus morio</i>	✓	✓	-	✓	-	✓	-	✓	5	✓	✓	✓	✓	✓	✓	✓	✓
Lesser Long-eared Bat <i>Nyctophilus geoffroyi</i>	✓	✓	✓	✓	-	✓	-	✓	6	✓	✓	✓	✓	✓	✓	✓	✓
Inland Broad-nosed Bat <i>Scotorepens balstoni</i>	-	✓	-	✓	-	✓	-	✓	4	✓	-	✓	-	✓	✓	✓	✓
Southern Forest Bat <i>Vespadelus regulus</i>	✓	✓	✓	✓	✓	✓	✓	✓	8	✓	✓	✓	✓	✓	✓	✓	✓

5.5 Likelihood of Occurrence

The desktop assessment identified a total of 58 significant bird and bat species with the potential to occur in the Survey Area, comprising 57 birds and one bat. Two species, the Carnaby's Black-Cockatoo (*Zanda latirostris*) (En; En) and the Peregrine Falcon (*Falco peregrinus*) (OS) were confirmed within the Survey Area. Carnaby's Black Cockatoos were recorded multiple times during the Survey including in large flocks. Records from within the Survey Area were also identified during the desktop assessment, and the species was recorded outside the Survey Area during the preliminary site inspection. One Peregrine Falcon was observed opportunistically within the Survey Area. Additionally, a long unused (National Malleefowl Recovery Team 2020) Malleefowl mound was recorded within the Survey Area during the Q2 BBUS. Based on the age of the mound, the lack of other mounds/activity within the Survey Area, and the activity of foxes and cats in the vicinity, the original likelihood assessment of "possible" is considered correct.

The likelihood of occurrence for each significant species was assessed against the criteria provided in **Section 3.2.3**, and are detailed in **Table 5-9**. In addition to the Carnaby's Black-Cockatoo confirmed present, three species were considered likely to occur within the Survey Area based on the presence of suitable habitat and nearby recent records. Five species were classified as possible to occur, and 22 species were classified as unlikely to occur.

In addition, 27 significant species were not assessed against the likelihood of occurrence criteria, as their current range is located outside of the Survey Area and no recent records were identified, or because they were recorded in the desktop searches only from coastal or marine habitats that do not occur in the Survey Area. The following species are considered not relevant within the context of this assessment:

- Ghost Bat (*Marcoderma gigas*) (Vu; Vu). The Survey Area is outside of the current range (van Dyck *et al.* 2013) and the only records are of fossils (DBCA 2022).
- Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) (Vu; Vu). The Survey Area is outside of the current range (Menkhorst *et al.* 2019) and the record (DBCA 2022) is suspected to be the non-listed subspecies *Calyptorhynchus banksii escondidus*.
- Night Parrot (*Pezoporus occidentalis*) (Cr; En). The Survey Area is outside of the current range (Menkhorst *et al.* 2019) and there are no recent records (DBCA 2022).
- Western Ground Parrot (*Pezopous flaviventris*) (Cr; Cr). The Survey Area is outside of the current range (Menkhorst *et al.* 2019) and there are no recent records (DBCA 2022).
- 23 species of pelagic birds (eight albatrosses, two noddies, eight terns, three petrels and two shearwaters). The records of these species in the desktop searches were from marine environments.



Table 5-9: Likelihood of occurrence assessment.

Common Name (<i>Scientific Name</i>)	Conservation Status		Key Threats and Reason for Listing	Habitat and Ecology	Likelihood of Occurrence and Reason for Likelihood
	BC Act	EPBC Act			
Aves					
18 migratory shorebirds; Bar-tailed Godwit (<i>Limosa lapponica</i>) Eastern Curlew (<i>Numenius madagascariensis</i>) Curlew Sandpiper (<i>Calidris ferruginea</i>) Australian Painted Snipe (<i>Rostratula australis</i>) Lesser Sand Plover (<i>Charadrius mongolus</i>) Grey-tailed Tattler (<i>Tringa brevipes</i>) Hooded Plover (<i>Charadrius mongolus</i>) Grey Plover (<i>Pluvialis squatarola</i>) Ruddy Turnstone (<i>Arenaria interpres</i>) Sharp-tailed Sandpiper (<i>Calidris acuminata</i>) Red Knot (<i>Calidris canutus</i>) Pectoral Sandpiper (<i>Calidris melanotos</i>) Red-necked Stint (<i>Calidris ruficollis</i>) Whimbrel (<i>Numenius phaeopus</i>) Wood Sandpiper (<i>Tringa glareola</i>) Common Sandpiper (<i>Actitis hypoleucos</i>) Common Greenshank (<i>Tringa nebularia</i>) Terek Sandpiper (<i>Xenus cinereus</i>)	Critically Endangered; Migratory Vulnerable; Migratory Vulnerable; Migratory Endangered; Migratory Endangered; Migratory Migratory; Priority 4 Priority 4 Migratory Migratory Migratory Migratory Migratory Migratory Migratory Migratory Migratory	Critically Endangered; Migratory Critically Endangered; Migratory Critically Endangered; Migratory Endangered Migratory Migratory Endangered; Migratory Migratory Migratory Migratory Migratory Migratory	These species migrate between Australia and Siberia, and through much of Asia. Therefore, protected under international agreements CAMBA, JAMBA and ROKAMBA. Habitat loss and degradation are the largest threats to these species, particularly the availability for foraging and roosting sites required for successful migration and breeding (Garnett and Baker 2022).	Species commonly associated with shallow aquatic habitats, including wetlands, marches, sewage ponds, river and creek line flats, tidal flats or grassy edges of wetlands (Menkhorst <i>et al.</i> 2019). Suitable habitat within the Survey Area may include: Farm dams	Unlikely The Survey Area may contain marginally suitable foraging habitat in the form of Minor Drainage Lines, wetlands and water sources and several species have been recorded at a location 20 km west of the Survey Area (Common Greenshank, Common Sandpiper, Sharp-tailed Sandpiper, Red-necked Stint, and Eastern Curlew) have been recorded at a location 20 km south-west of the Survey Area (BirdLife Australia 2023; DBCA 2023b). However, many of these records are over 10 years old and as such these species are considered unlikely to occur.
Baudin's Black-Cockatoo (<i>Zanda baudinii</i>)	Endangered	Endangered	The main threats include: - Extensive clearing of breeding habitat and a lack of regeneration of potential nest trees due to grazing by sheep and rabbits; - Competition for nest hollows with other birds and the feral European honeybee; - Death and injury resulting from vehicle strike; - Illegal shooting by orchardists and pine plantation owners; - Reduced food and water availability due to climate change; and - Death and injury resulting from extreme weather events exacerbated by climate change (DCCEEW 2023c).	Baudin's Black-Cockatoo occurs in south-west Western Australia. The range extends from Albany northward to Gidgeannup and Mundring, and inland to Stirling Ranges and near Kolonup. The species distribution is determined by the presence of Marri (<i>Corymbia calophylla</i>), Jarrah (<i>Eucalyptus marginata</i>) and Karri (<i>Eucalyptus diversicolor</i>) forests (DCCEEW 2023c). The species feeds on native shrubland vegetation including Banksia and Hakea species, and <i>Erodium botrys</i> and Dryandra species, as well as invertebrate larvae and fruit in orchards (DAWE 2022b). Baudin's Black-Cockatoo may roost in any tall trees, particularly in riparian areas, and may breed in any trees with suitable hollows (DAWE 2022b). Breeding habitat in the Survey Area may include: - Low Eucalypt Woodland - Planted Eucalyptus trees Roosting habitat in the Survey Area may include: - Low Eucalypt Woodland	Unlikely The Survey Area contains suitable foraging and potential breeding habitat. However, the Survey Area is outside the species known distribution which occurs in the south-west north to Gidgegannup (DAWE 2022b).



				• Minor Drainage Line • Planted Trees Foraging habitat in the Survey Area may include: • Diverse Shrubland and Heath • Open Woodland on Farmland • Low Eucalypt Woodland • Shrubland on Lateritic Ridge/Outcrop	
Carnaby's Black-Cockatoo (<i>Zanda latirostris</i>)	Endangered	Endangered		The species feeds on native shrubland vegetation, particularly flowers, seeds and nectar of proteaceous plants (e.g. Banksia, Hakea, Dryandra and Grevillea species), Marri and <i>Callistemon</i> spp. (DAWE 2022b). Carnaby's Black-Cockatoo may roost in any tall trees, particularly in riparian areas, and may breed in any trees with suitable hollows (DAWE 2022b). Breeding habitat in the Survey Area may include: • Low Eucalypt Woodland • <i>Eucalyptus loxophleba</i> (York Gum) within Shrubland on Lateritic Ridge/Outcrop • Planted Eucalyptus trees Roosting habitat in the Survey Area may include: • Low Eucalypt Woodland • Minor Drainage Line • Planted Trees Foraging habitat in the Survey Area may include: • Diverse Shrubland and Heath • Open Woodland on Farmland • Low Eucalypt Woodland • Shrubland on Lateritic Ridge/Outcrop	Confirmed The Survey Area contains suitable foraging habitat, potential breeding habitat and occurs within the known foraging distribution of the species. Carnaby's Black-Cockatoos were recorded multiple times during the Survey including in large flocks, records from within the Survey Area were identified during the desktop assessment, and the species was recorded outside the Survey Area during the preliminary site inspection. The species has also been recorded 26 times within 10 km of the Survey Area between 1999 and 2023 (BirdLife Australia 2023).
Malleefowl (<i>Leipoa ocellata</i>)	Vulnerable	Vulnerable	Threats include: • Clearing of land resulting in removal of Malleefowl habitat, habitat fragmentation and dryland salinity; • Grazing of land leading to less food availability and changing the structure and floristic diversity of habitats; and • Predation from dogs, cats and foxes. Particularly on newly hatched chicks (Benshemesh 2007).	Knowledge of specific habitat preferences are limited; however, the species tends to inhabit arid or semi-arid shrublands or woodlands dominated by long unburnt mallee, and may also occur in areas dominated by Acacia sp., wandoo, marri or mallet (Benshemesh 2007). Preferred substrate consists of sandy loams and loamy construction and may contain gravel or lateritic fragments. Diet is variable, including the seeds, flowers and fruits of shrubs (especially legumes), herbs, invertebrates, tubers and fungi (Benshemesh 2007). Habitat critical for survival of the species (Benshemesh 2007) in the Survey Area may include: • Low Eucalypt Woodland • Shrubland on Lateritic Ridge/Outcrop	Possible The Survey Area occurs within the species known range and supports suitable habitat for the species. The species has been recorded 21 times from 1964 to 2018, within a 40 km radius of the Survey Area (DBCA 2023b). During the Q2 2024 BBUS, one long unused (National Malleefowl Recovery Team 2020) Malleefowl mound was recorded within the Survey Area, in Low Eucalypt Woodland. Based on the age of the mound, the lack of other mounds/activity within the Survey Area (to be confirmed), and the activity of foxes and cats in the vicinity, the likelihood of "possible" is considered correct.
Grey Falcon (<i>Falco hypoleucos</i>)	Vulnerable	Vulnerable	The largest threat to this species is associated with clearing for agriculture, which has reduced habitat in semi-arid zones (Garnett and Baker 2022). Also gazing by exotic herbivores is likely to have reduced regeneration of trees in the arid zone, therefore reducing nesting habitat availability (Garnett and Baker 2022).	The species inhabits open plains with treed watercourses in inland arid regions (DCCEEW 2023c). Tends to forage near watercourses by ambushing flocks of smaller drinking birds (Menkhorst <i>et al.</i> 2019). Suitable foraging habitat in the Survey Area may include: • Minor Drainage Line	Possible The Survey Area contains suitable habitat for the species and the Survey Area is within the species habitat range. The species has been recorded in two locations, 35 km northwest on the coastline in 2017 and 11 km west of the Survey Area in 2012 (BirdLife Australia 2023). As such, the species is having the possibility to occur.
Southern Whiteface (<i>Aphelocephala leucopsis</i>)	-	Vulnerable	The main threats to the species are: habitat loss and degradation (Garnett and Baker 2022), climate change increasing frequency of droughts (Evans <i>et al.</i> 2017).	Inhabits sparsely treed woodlands and shrublands dominated by acacias or eucalypts with an understorey of grasses and shrubs. Considered sedentary though individuals may disperse to wetter areas outside their normal range during periods of low rainfall. They forage almost exclusively on the ground, feeding on	Possible The Survey Area occurs within the species known habitat and contains potentially suitable habitat. The species has been recorded 32 km northeast of the Survey Area in



			Reason for listing: Estimated 30-50% decline in population every ten years since 1999, with no indication that declines are slowing (Garnett and Baker 2022).	invertebrates and seeds (Antos and Bennett 2006; Higgins and Peter 2002). Critical habitat comprises essential foraging habitat, essential roosting and nesting habitat. Supporting habitat is defined as foraging habitat for this species. Habitat critical to the survival of the species (DCCEEW 2023a) in the Survey Area may include: - Diverse Shrubland and Heath - Shrubland on Lateritic Ridge/Outcrop - Low Eucalypt Woodland - Open Woodland on Farmland	2002 (BirdLife Australia 2023) and 20km southwest of the Survey Area in 2021 (ALA 2023). The species is considered possible to occur.
Peregrine Falcon <i>(Falco peregrinus)</i>	Other Specially Protected	-	The major threat to the species is habitat loss, particularly wooded areas which serve as nesting sites to the species in the absence of cliffs (DAWE 2020).	The species is found in most habitats from rainforests to arid zones, from the coast to alpine areas. The species prefer coastal and inland cliffs or open woodlands near water (BirdLife Australia 2023). The species occurs in habitats supporting nest sites, preferentially cliff-faces however also uses raptor stick nests (Menkhorst <i>et al.</i> 2019). Suitable foraging and breeding habitat in the Survey Area may include: - Open Woodland on Farmland - Shrubland on Lateritic Ridge/Outcrop - Minor Drainage Line	Confirmed There was one observation of Peregrine Falcon recorded opportunistically within the Survey Area during the Q4 2024 BBUS, foraging within RSA height. The Survey Area contains suitable habitat for the species and the Survey Area is within the species habitat range. The species has been recorded 6 times between 2002 and 2015 11 km to the west of the Survey Area and once in 2011, 5 km east of the Survey Area (BirdLife Australia 2023). With the most recent record recorded in 2021 in Lesueur National Park 37 km south of the Survey Area (ALA 2023).
Fork-tailed Swift <i>(Apus pacificus)</i>	Migratory	Migratory	Species migrates between Australia and much of Asia. Therefore, protected under international agreements CAMBA, JAMBA and ROKAMBA. There are no significant threats to the Fork-tailed Swift in Australia. Potential threats include habitat destruction and predation by feral animals (DCCEEW 2023c).	Aerial species, which forages high above the tree canopy and rarely lower (Menkhorst <i>et al.</i> 2019). Forage in high-flying flocks over a wide range of habitats, however, may be more abundant over inland plains (Menkhorst <i>et al.</i> 2019). The species tends to arrive in Australia between October and November, with numbers peaking in late summer, and migrate north in April (Menkhorst <i>et al.</i> 2019). Species is occasionally observed during winter (Menkhorst <i>et al.</i> 2019). Breeding habitat in the Survey Area may include: - None in Australia Foraging habitat in the Survey Area may include: - Aerial forager, no specific habitat in the survey Area	Likely This is a non-breeding visitor to Australia, is exclusively an aerial forager and has a large foraging range (Menkhorst <i>et al.</i> 2019). The Survey Area occurs within the species known range and the species was recorded in two locations within 30 km of the Survey area in 2019 (DBCA 2023b) and 7 km north of the Survey Area (date not recorded) (BirdLife Australia 2023). This species is likely to pass through the Survey Area.
Grey Wagtail <i>(Motacilla cinerea)</i>	Migratory	Migratory	Grey Wagtails are listed as rare vagrants of the Australian continent from the north. They inhabit areas associated with water including fast running water/streams, sewage ponds, swamp margins and saltmarshes and lawns, ploughed fields, paddocks, and airfields (Menkhorst <i>et al.</i> 2019). They forage on the ground and feed on insects (Johnstone and Storr 2004). The species does not breed in Australia.	This species occurs near fast-flowing water (Menkhorst <i>et al.</i> 2019). Foraging habitat in the Survey Area may include: Minor Drainage Line	Unlikely The species has not been recorded in the Survey Area or surrounds and the Survey Area occurs outside the species range and does not contain suitable habitat. As such the species is considered unlikely to occur.
Osprey <i>(Pandion haliaetus)</i>	Migratory	Migratory	Loss, degradation or alteration of habitat for urban or tourism development (DoE 2015).	Inhabits most types of habitats except closed forests, including coastal areas, near coastal area water bodies and along inland river systems (Menkhorst <i>et al.</i> 2019). Hunts fish and perches in exposed lookout areas (Menkhorst <i>et al.</i> 2019). Suitable habitat in the Survey Area may include: - Minor Drainage Line - Farm Dams	Unlikely The species has not been recorded in the Survey Area or surrounds (DBCA 2023b) and the Survey Area occurs outside of the species range (largely restricted to the coast) and does not contain suitable habitat. As such the species is considered unlikely to occur.



Glossy Ibis <i>(Plegadis falcinellus)</i>	Migratory	Migratory	Destruction or degradation of wetlands through water diversion and drainage, irrigation, and hydroelectric power production (DoE 2015).	Forages in shallow freshwater areas but may also forage in estuaries or dry grasslands (Menkhorst <i>et al.</i> 2019). Roosts in trees surrounding water (Menkhorst <i>et al.</i> 2019). Suitable habitat in the Survey Area may include: • Melaleuca Wetland • Farm Dams	Possible The Survey Area contains potentially suitable habitat where shallow freshwater and dry grasslands occur. The Survey Area occurs within the species known range and a recent sighting was recorded 20 km away in 2018 south of Lake Indoon (BirdLife Australia 2023). Therefore, the species has a possibility of occurring within the Survey Area.
Eastern Cattle Egret <i>(Bubulcus ibis)</i>	-	Migratory	The major threats facing cattle egrets are persecution of large colonies in urban areas, loss of breeding habitats through wetland degradation and destruction and predation from feral cats (DCCEEW 2023c).	The species occurs in tropical and temperate grasslands, wooded lands and terrestrial wetlands. Large numbers have been recorded within low-lying poorly drained pastures with an abundance of high grass. The species are commonly associated with livestock and earth-moving machinery whilst actively foraging (Menkhorst <i>et al.</i> 2019). The species are also known to use shallow, open and fresh wetlands including meadows and swamps with low emergent vegetation (DCCEEW 2023c). Suitable habitat in the Survey Area may include: • Melaleuca Wetland • Cleared land (particularly paddocks)	Possible The Survey Area is within the species habitat range. The Survey Area may contain suitable habitat with the presence of farm dams, wetlands, pasture and cropland. There are three historical records from 25-30 km east of the Survey Area (ALA 2023). The most recent record recorded in 2021 is located 117 km south of the Survey Area (ALA 2023).
Letter-winged Kite <i>(Elanus scriptus)</i>	Priority 4	-	A threat to this species is competition with introduced predators including foxes and feral cats (Woinarski and Legge 2013).	The Letter-winged Kite occupies open country and grasslands of arid and semi-arid Australia, where there are tree-lined streams or watercourses. When food is plentiful the species is known to disperse to higher rainfall coastal regions. The species is known to roost communally in leafy trees and hunts predominantly at night (Menkhorst <i>et al.</i> 2019). Suitable habitat in the Survey Area may include: • Minor Drainage Line • Diverse Shrubland and Heath	Unlikely The Survey Area contains suitable habitat for the species but is outside the species' usual range. The species has been recorded (date not disclosed) in the surrounding area and once within 7 km north of the Survey Area (BirdLife Australia 2023) although there is the potential for misidentification of the similar Black-shouldered Kite. The species is irruptive and may occasionally spread beyond its usual range in response to rodent plagues (Menkhorst <i>et al.</i> 2019) but is considered unlikely to occur.
Blue-billed Duck <i>(Oxyura australis)</i>	Priority 4	-	Threats include: • Destruction or degradation of breeding habitat through drainage, flood mitigation works and ground water extraction; and • Clearing and over grazing (OEH 2020).	Prefers deep water in large permanent wetlands and swamps with dense aquatic vegetation (Menkhorst <i>et al.</i> 2019). Partly migratory, with short-distance movements between breeding swamps, and overwintering lakes (OEH 2020). Suitable habitat in the Survey Area may include: • Melaleuca Wetland • Farm Dams	Likely The Survey Area contains potentially suitable habitat where watercourses with aquatic vegetations are present. The Survey Area occurs within the species known range. Historical records (1992 to 2003) of the species occur 19 km south-west of the Survey Area at Lake Logue and Lake Indoon (BirdLife Australia 2023). The most recent record in 2021 was recorded was recorded at Lake Indoon (20 km) (ALA 2023).



5.6 Significant Species

5.6.1 Carnaby's Black-Cockatoo

The Carnaby's Black-Cockatoo is listed as Endangered under the EPBC Act and BC Act. The species is present across the south-west of Western Australia, although is locally extinct in some areas of the central Wheatbelt (DCCEEW 2023c). It is estimated that between 11,000 and 60,000 birds comprise the total population (DCCEEW 2023c). The species relies on large hollow-producing eucalypt trees for nesting, large trees for roosting, and a range of habitats including banksia woodlands, Corymbia woodlands and kwongan heath for foraging (DAWE 2022b). Across most of its range, the Carnaby's Cockatoo is partially resident and partially migratory, though the population in proximity to the Survey Area is believed to be resident, with only localised movements around the Eneabba region (Johnstone and Johnstone 2024) (**Appendix D**). It is a slow-breeding and long-lived species that does not reach sexual maturity until approximately four years of age and may survive for up to 60 years (DCCEEW 2023c).

The desktop assessment identified records within the Survey Area, which was confirmed during the BBUSs and targeted fauna survey (Stantec 2025). Carnaby's Black-Cockatoo flights paths over the Survey Area are shown in **Figure 5-3**, within which each arrow denotes an individual or flock and the base of each arrow indicates the individual's or flock's location when observed. Insufficient data was captured to determine regular flight patterns across the Survey Area.

Carnaby's Black-Cockatoo have been recorded within and in the vicinity of the Survey Area on the following occasions:

- 150 individuals utilising the roost near FP6R on multiple evenings during the Q3 2025 BBUS;
- Two individuals observed from FP15 during the Q2 2025 BBUS;
- 80 individuals observed from FP16R during the Q2 2025 BBUS;
- Two individuals observed flying over the Additional Area during the Q4 2024 BBUS;
- An estimated total 105 individuals were observed within the Survey Area during the Q3 2024 BBUS;
- An estimated total 400 individuals were observed during the Q2 2024 BBUS. The largest flock observed during this period was of 380 individuals, and due to the flock being observed in similar locations close to dawn and dusk it is assumed that the majority of observations were of individuals from this group, with approximately 400 Carnaby's Black-Cockatoos utilising the Survey Area and surrounds during the Q2 2024 BBUS. Some of the more common flight paths observed for this flock were south to north close to First North Road, and east to west at the northern nature reserve R 12705;
- 22 individuals observed flying over the Survey Area during the Q1 2024 BBUS;
- Three individuals were observed 7.5 km south of the Survey Area in the White Gums Nature Reserve during the fauna site inspection (Stantec 2025); and
- Thirteen individuals were recorded in the Additional Area in 2012, during targeted fauna searches for the Carnaby's Black-Cockatoo by ENV Australia (2013).

Additional detail on roosting, breeding and foraging assessments is presented in the targeted fauna report (Stantec 2025). This species is unlikely to be subjected to impacts from rotor strike as it was not recorded flying within RSA height (**Section 5.8.1; Appendix D**). However, this species may be impacted by clearing of suitable habitat for the Proposal.





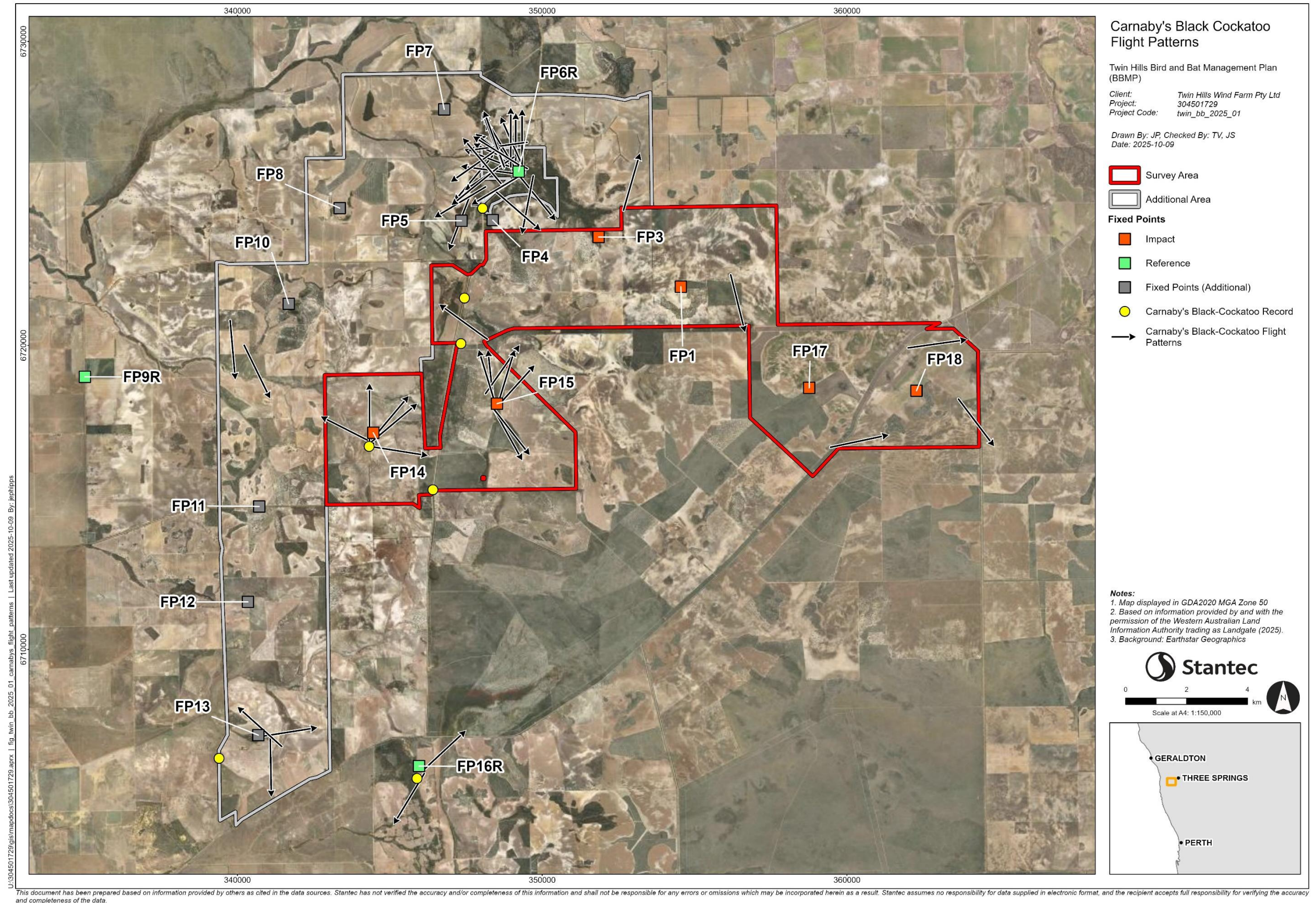


Figure 5-3: Carnaby's Black-Cockatoo observations and flight patterns observed during the Survey.

5.6.2 Peregrine Falcon

The Peregrine Falcon is listed as “other taxa in need of special protection” under the BC Act. The Peregrine Falcon is a powerful aerial hunter that inhabits most environments with suitable nest sites across Australia, with a preference for cliff faces (Menkhorst *et al.* 2019). Occurring across a range of habitats from woodlands to open grasslands and coastal cliffs, it hunts and feeds predominantly on other birds, but is also known to prey on rabbits and other moderate-sized mammals, bats and reptiles (DEE 2016). One Peregrine Falcon was observed within the Survey Area during the Q4 2024 BBUS, foraging within RSA height. The species was observed opportunistically near the north-eastern boundary of the Survey Area.

5.6.3 Malleefowl

The Malleefowl is listed as Vulnerable under the EPBC Act and BC Act. One Malleefowl mound was recorded within the Survey Area during the Q2 2024 BBUS (**Plate 5-2**). The mound was approximately 2.5 m x 1 m, with a flat profile and no evidence of recent use, and is therefore classified as a “long unused” mound (National Malleefowl Recovery Team 2020). Small pieces of eggshell and a thin layer of incubating material were present. Based on the age of the mound, the lack of other mounds/activity within the Survey Area (to be confirmed), and the activity of foxes and cats in the vicinity, it is confirmed that the species is no longer present within the Survey Area. If the species is confirmed present within the Survey Area, it will not be impacted by rotor strike due to its poor flight ability, however this species may be impacted by clearing of suitable habitat for the Proposal.



Plate 5-2: Long unused Malleefowl mound within the Survey Area.



5.7 Ecological Risk Model Findings

Risk index scores were calculated for the 97 bird species for which flight heights were recorded during the FP counts (**Figure 5-4**). According to the Impacts on Birds from Offshore Wind Farms in Australia (Reid *et al.* 2022), on which the ERM is based, the divisions between low-medium (2.30) and medium high risk (4.46) were based on the 25th and 75th percentiles of all possible risk scores. Therefore, the Carnaby's Black-Cockatoo and Australian Pelican would receive a medium risk score, and all other species would receive a low risk score. Risk indices may change following the expected release of ERM guidance for onshore wind farms. The 14 most at-risk species are identified on **Figure 5-4**, based on those species with a risk index above the arbitrary value of 1.50 or higher. These 14 species included three raptors, seven waterbirds, one shorebird and three other species of potential risk. In order of relative risk, these are Carnaby's Black-Cockatoo (risk index 3.32), Australian Pelican (*Pelecanus conspicillatus*) (2.64), Wedge-tailed Eagle (*Aquila audax*) (2.24), Peregrine Falcon (*Falco peregrinus*) (2.11), Little Pied Cormorant (*Microcarbo melanoleucos*) (1.90), Straw-necked Ibis (*Threskiornis spinicollis*) (1.90), Banded Lapwing (*Vanellus tricolor*) (1.83), Little Eagle (*Hieraaetus morphnoides*) (1.74), Red-tailed Black-Cockatoo (*Calyptorhynchus banksii esconditus*) (1.58), Little Black Cormorant (*Phalacrocorax sulcirostris*) (1.58), Western Corella (*Cacatua pastinator*) (1.54), Australasian Grebe (*Tachybaptus novaehollandiae*) (1.50), Eurasian Coot (*Fulica atra*) (1.50) and Pacific Black Duck (*Anas superciliosa*) (1.50).

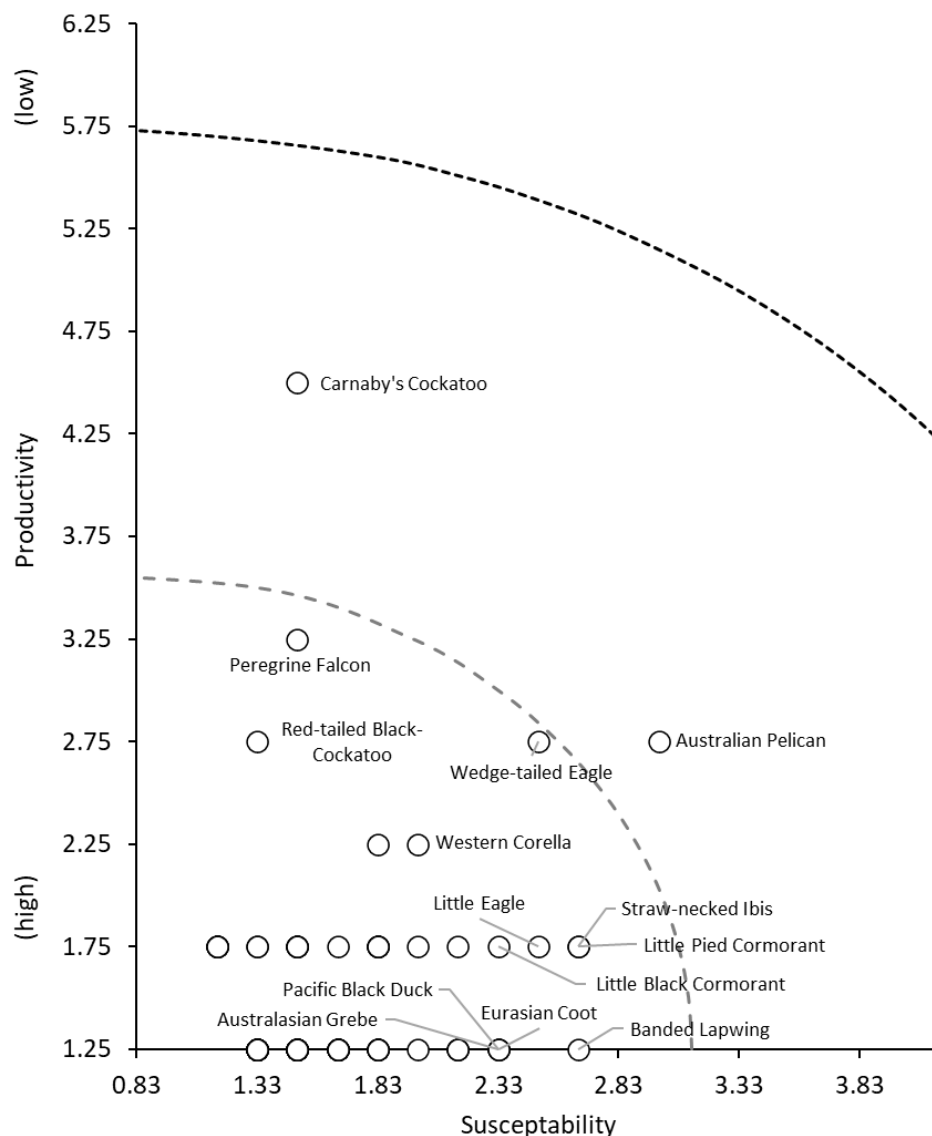


Figure 5-4: Risk indices for bird species sighted during the FP counts. Dashed lines indicate the lower quartile (grey) and middle half (black) of all possible risk index scores.



5.8 Impact Assessment

5.8.1 Bird Impact Assessment

Specific risks and discussion regarding the most at-risk bird species are presented in **Table 5-10**.

Table 5-10: Impact assessment of the 14 bird species with highest modelled risk index scores, and additional at-risk species/groups.

Common name (<i>Scientific name</i>)	Group	Reason for inclusion	Status		Productivity Score	Susceptibility Score	Overall Risk Index	Discussion
			EPBC Act	BC Act				
Carnaby's Black-Cockatoo (<i>Zanda latirostris</i>)	Other species of potential risk	High relative productivity risk score.	En	En	4.50	1.50	3.32	This species was the most frequently observed species during the Survey, with 5,661 observations, due to a large flock of up to 400 individuals being observed on multiple occasions during the Q2 2024 Survey. Despite being the species with the highest total observations, it was not observed flying at RSA height. The species' high relative productivity score is due to its endangered conservation status and its long average generation time of 11.28 years (Bird <i>et al.</i> 2020). According to Johnstone and Johnstone (2024) (Appendix D), Carnaby's Cockatoos generally fly at 5-15 m above the ground and there is a very low risk of rotor strike due to their preference for flying over uncleared bushland, their competent flight behaviour, and no known evidence of rotor strike on the species at operating wind farms. Johnstone and Johnstone (2024) have identified the local population as one that remains resident in the Eneabba region throughout the year. Clearing of breeding, roosting and foraging sites are likely to have the greatest impact to this population. The majority of observations were within nature reserve R 12705, which is bounded by but not included in the Survey Area, and where a roost site was also recorded. Buffers of at least 500m around known roost sites are recommended (Johnstone and Johnstone 2024).
Australian Pelican (<i>Pelecanus conspicillatus</i>)	Waterbird	High relative susceptibility and			2.75	3.00	2.64	One individual of this species was observed opportunistically on one occasion during Q4 2024 within the Additional Area. The species was observed flying within RSA height. Although the species is unlikely to regularly utilise the



Common name (<i>Scientific name</i>)	Group	Reason for inclusion	Status		Productivity Score	Susceptibility Score	Overall Risk Index	Discussion
			EPBC Act	BC Act				
		productivity risk scores.						Survey Area, it is likely to transit through the area occasionally, and may be at risk of rotor strike on the occasions.
Wedge-tailed Eagle (<i>Aquila audax</i>)	Raptor	High relative productivity and susceptibility risk scores.			2.75	2.50	2.24	80.53% (182) of the 226 observations of this species were within RSA height. The species is known to be at risk from rotor strike (Hull <i>et al.</i> 2013). Although it is not a listed species of significance, it is long-lived with a low fecundity, and an average generation time of 15.5 years (Bird <i>et al.</i> 2020). Therefore, impacts to a small number of individuals may have relatively high impacts on the local population. The soaring flight pattern and heavy body may make the species more susceptible to rotor strike (Tobias <i>et al.</i> 2022). The species perches on huge stick nests (Menkhorst <i>et al.</i> 2019), which have been identified within the Survey Area. Buffers around nests may reduce the risk of collision.
Peregrine Falcon (<i>Falco peregrinus</i>)	Raptor	High relative productivity risk score.		OS	3.25	1.50	2.11	The species was recorded opportunistically on one occasion within the Survey Area during the Q4 2024 BBUS. The species was observed foraging within RSA height. Nesting pairs and resident populations are likely to be at greater risk of rotor strike than nomadic individuals. Buffers around potential nesting habitats with tall trees may reduce the risk of collision.
Little Pied Cormorant (<i>Microcarbo melanoleucos</i>)	Waterbird	High relative susceptibility risk score.			1.75	2.67	1.90	27.27% (nine) of the 33 observations of this species were within RSA height. The high relative susceptibility is due to the species' poor aerial maneuverability (Tobias <i>et al.</i> 2022). Additionally, it has relatively long generation time of 6.84 years (Bird <i>et al.</i> 2020).
Straw-necked Ibis (<i>Threskiornis spinicollis</i>)	Waterbird	High relative susceptibility risk score.			1.75	2.67	1.90	This species was observed opportunistically on two occasions (122 observations) within the Survey Area. The flight height was only recorded on one occasion with 32 observations of this species within the RSA height. The high relative susceptibility is due to the species' poor aerial maneuverability (Tobias <i>et al.</i> 2022). Additionally, it has relatively long generation time of 8.82 years (Bird <i>et al.</i> 2020).



Common name (<i>Scientific name</i>)	Group	Reason for inclusion	Status		Productivity Score	Susceptibility Score	Overall Risk Index	Discussion
			EPBC Act	BC Act				
Banded Lapwing (<i>Vanellus tricolor</i>)	Shorebird	High relative susceptibility risk score.			1.25	2.67	1.83	68.86% (115) of the 167 observations of this species were within RSA height. The high relative susceptibility of the species is due to its habitat specialisation: relying on grasslands, chenopod shrublands and agricultural habitats for foraging and breeding (Garnett <i>et al.</i> 2015). Additionally, shorebirds are likely to move nocturnally and diurnally, and in mass in response to infrequent rainfall events across Western Australia (Halse <i>et al.</i> 2006). This may put these species at intermittent but high risk of rotor strike.
Little Eagle (<i>Hieraaetus morphnoides</i>)	Raptor	High relative productivity and susceptibility risk scores.			1.75	2.50	1.74	100% of the seven observations of this species were within RSA height. The species has a relatively long generation time of 8.04 years (Bird <i>et al.</i> 2020), making local populations susceptible to the loss of individuals. All four observations of the species were within the Additional Area, and its distribution within the Survey Area and therefore location- or habitat-specific risks are unclear.
Little Black Cormorant (<i>Phalacrocorax sulcirostris</i>)	Water Bird	High relative susceptibility risk score.			1.75	2.33	1.58	11.11% (one) of the nine observations of this species were within RSA height. The high relative susceptibility is due to the species' poor aerial maneuverability (Tobias <i>et al.</i> 2022). Additionally, it has a relatively long generation time of 5.48 years (Bird <i>et al.</i> 2020).
Red-tailed Black-Cockatoo (<i>Calyptorhynchus banksii esconditus</i>)	Other species of potential risk	High relative productivity risk score.			2.75	1.33	1.58	This species was not observed flying at RSA height. The species' high relative productivity score is due to its very long average generation time of 16.11 years (Bird <i>et al.</i> 2020). Clearing of breeding, roosting and foraging sites are likely to have the greatest impact to this species.
Western Corella (<i>Cacatua pastinator</i>)	Other species of potential risk	High relative productivity and susceptibility risk scores.			2.25	2.00	1.54	100% of the 200 observations of this species recorded within RSA height. The species' high relative productivity score is due to its very long generation time of 14.07 years (Bird <i>et al.</i> 2020). The majority of observations at RSA height were above small patches of River Red Gum Forest within the Additional Area, where there are many large tree hollows used by the species. Buffers around this habitat type may reduce risk of rotor strike.



Common name (Scientific name)	Group	Reason for inclusion	Status		Productivity Score	Susceptibility Score	Overall Risk Index	Discussion
			EPBC Act	BC Act				
Australasian Grebe (<i>Tachybaptus novaehollandiae</i>)	Water Bird	High relative susceptibility risk score.			1.25	2.33	1.50	This species was not observed flying at RSA height. The species' high relative susceptibility score is due to its poor aerial maneuverability (Tobias <i>et al.</i> 2022). Additionally, waterbirds are likely to move nocturnally and diurnally, and in mass in response to infrequent rainfall events across Western Australia. This may put these species at intermittent but high risk of rotor strike (Halse <i>et al.</i> 2006).
Eurasian Coot (<i>Fulica atra</i>)	Water Bird	High relative susceptibility risk score.			1.25	2.33	1.50	This species was not observed flying at RSA height. The species' high relative susceptibility score is due to its poor aerial maneuverability (Tobias <i>et al.</i> 2022). Additionally, waterbirds are likely to move nocturnally and diurnally, and in mass in response to infrequent rainfall events across Western Australia. This may put these species at intermittent but high risk of rotor strike (Halse <i>et al.</i> 2006).
Pacific Black Duck (<i>Anas superciliosa</i>)	Water Bird				1.25	2.33	1.50	7.41% (two) of the 27 observations of this species were within RSA height. The species' high relative susceptibility score is due to its poor aerial maneuverability (Tobias <i>et al.</i> 2022). Additionally, waterbirds are likely to move nocturnally and diurnally, and in mass in response to infrequent rainfall events across Western Australia. This may put these species at intermittent but high risk of rotor strike (Halse <i>et al.</i> 2006).
Grey Falcon (<i>Falco hypoleucos</i>)	Raptor	Not recorded during BBUSs, but a raptor of significance that may possibly.	VU	Vu				The species has not been recorded within the Survey Area, Additional Area or reference sites but is considered possible to occur. The species is threatened by land clearing and grazing which reduce the number and regeneration of trees used for nesting habitat (Garnett <i>et al.</i> 2011). The species is nomadic and it is unclear whether it is likely to be present or resident within the Survey Area. The sparse distribution of this species means management actions targeting potential habitat are unlikely to be effective.
Fork-tailed Swift (<i>Apus pacificus</i>)	Aerial Forager	Not recorded during BUSs, but an aerial forager of significance	IA	Mi				The species forages high above the canopy (Johnstone and Storr 1998) and is likely to fly within and above RSA height. It has not been recorded within the Survey Area, Additional Area or reference sites but as non-breeding visitor to Australia (Menkhorst <i>et al.</i> 2019) it is likely to occur intermittently.



Common name (<i>Scientific name</i>)	Group	Reason for inclusion	Status		Productivity Score	Susceptibility Score	Overall Risk Index	Discussion
			EPBC Act	BC Act				
		that is likely to occur						The species had been identified as having high likelihood of collision, but a low overall impact to the Australian population (Biosis Research 2006).
Other birds likely to fly at night	Multiple groups including waterbird, shorebird and nocturnal predator species	Not recorded during BBUSs, but may be at risk.						Although not likely to be observed during BUSs, many species, particularly waterbirds, shorebirds and nocturnal predators such as owls, are more active at night. These species may be recorded on acoustic recording units, although this is reliant on the species calling. The Barn Owl (<i>Tyto alba</i>) and Boobook (<i>Ninox boobook</i>) were observed multiple times when checking hollows for Black Cockatoos during the targeted fauna survey (Stantec 2025).



5.8.2 Bat Impact Assessment

All seven species recorded in the Survey Area are insectivorous. Insectivorous bat species show a strong relationship between ecology, particularly insect prey, and flight behaviour, morphology and echolocation patterns (Churchill 2008).

This interrelationship between ecology, morphology and behaviour also has potential relationships to risk from wind turbines. The bat species most at risk of collision tend to have long narrow wings, forage in open air and are migratory (Cryan and Barclay 2009). Research from North America has suggested that tree roosting species and those that disperse over greater distances are more prone to collision than other groups (Cryan and Barclay 2009; Thaxter *et al.* 2017). Tree roosting or migratory bats with high wing aspect ratios that forage in the open air at high altitude have been found to be more prone to fatalities at Wind Farms (Hull and Cawthen 2013). These risk factors are evident in the certain taxa, including the family Molossidae, which has been found to be especially vulnerable to wind farm collisions in studies from North America and Latin America (Agudelo *et al.* 2021; Thaxter *et al.* 2017).

Potential disturbance to bats caused by turbine-generated noise is poorly understood (Ellerbrok *et al.* 2022). This potential impact is not assessed within this report. Some evidence from Europe suggests that forest specialist bats may avoid turbines, but it is unclear whether this is caused by noise, habitat loss in proximity to turbines, or other factors (Ellerbrok *et al.* 2022).

A qualitative risk assessment of potential rotor strike was conducted in accordance with the *Guideline: Risk assessments* (DWER 2017) to assess the risks of the proposal to bats (**Table 5-14**). Each environmental risk identified has been provided a likelihood and consequence rating.

Likelihood ratings were determined based on a review of literature, with particular reference to flight heights, behaviour and evidence from existing wind turbine projects. Likelihood ratings are summarised in **Table 5-11**.

Table 5-11: Likelihood ratings for bats detected during BBUSs.

Likelihood rating	Criteria
Almost certain	The species is known to frequently fly at RSA height, as evidenced by its foraging behaviour, and evidence from existing wind farms.
Likely	The species is known to fly at RSA height, as evidenced by its foraging behaviour. Evidence from existing wind farms may be available.
Possible	The species may occasionally fly at RSA height, though this evidence is based only upon assumptions regarding its foraging behaviour.
Unlikely	The species is not expected to fly at RSA height, and there is no evidence of impacts from existing wind farms.
Rare	The species is not expected to fly at RSA height, despite it being present in the vicinity of existing wind farms.

Consequence ratings were determined based on the frequency of collisions or barotrauma impacts that are expected to the species, based on evidence from existing wind turbine projects; and based on the conservation listing of the species (all bats considered possible to occur within the Survey Area are not listed). Consequence ratings are summarised in **Table 5-12**.

Table 5-12: Consequence ratings for bats detected during BBUSs.

Consequence rating	Criteria
Slight	Low-level impact.
Minor	Mid-level Impact: Occasional injury or mortality of individuals with minimal affect on the viability of the population at a local scale
Moderate	Impacts from loss of individuals is expected to result in a population reduction at a local scale with the potential for a medium term reduction in the regional viability of the species for up to 5-10 years.



Major	High-level impact resulting from loss of individuals is expected to result in a population reduction with the potential to lead to a long term reduction in the state viability for a period of at least 10 years.
Severe	Greater than 25% of the local population is expected to be lost; or the species is conservation listed and individuals are expected to be lost.

Based on the likelihood and consequence, each species was assigned a risk rating of low, medium, high or severe as outline in **Table 5-13**.

Table 5-13: Risk rating system for rotor strike to bats.

Likelihood	Consequence				
	Slight	Minor	Moderate	Major	Severe
Almost certain	Medium	High	High	Extreme	Extreme
Likely	Low	Medium	High	High	Extreme
Possible	Low	Medium	Medium	High	Extreme
Unlikely	Low	Low	Medium	High	High
Rare	Low	Low	Low	Medium	High

The following assumptions were made when conducting the bat impact assessment:

- This impact assessment is based on inherent risk. Control or mitigation measures, such as curtailment, turbine placement and carcass search monitoring were not considered within the risk assessment, meaning that risk assigned is conservative in nature.
- Levels of risk of impact are theoretical in nature and have been assigned based on available information of the ecology of the species, foraging behaviour, flight heights and evidence from existing wind farms. However, there is a lack of scientific study into the impact of turbines on bats within the risk assessment. The risk assessment is therefore extremely conservative in light of the existing literature regarding the interactions between bats and wind turbines
- There is insufficient information available to definitively define specific bat species' tolerance to wind turbines and is based on current available literature.
- The results and conclusions of the risk assessment are limited to the available information at the time of writing.



Table 5-14: Qualitative impact assessment of all nine bat species recorded within the Survey Area.

Common name (<i>Scientific name</i>)	Status		Ecology and habitat	Flight behaviour	Foraging guild	Likelihood	Consequence	Inherent risk of rotor strike (before management)	Discussion
	EPBC Act	BC Act							
Molossidae									
White-striped Free-tailed Bat (<i>Austronomus australis</i>)			The species occupies a wide range of habitat types, including urban areas, forests, woodland, shrubland, grasslands and deserts. The species migrates southward in October, then returns north in March (Baker and Gynther 2023). In WA, individuals will migrate up to 1200 km between winter and summer (Bullen and McKenzie 2005). Within the Survey Area, the species was recorded in all habitats in all seasons.	The species possesses long, narrow wings adapted for high-altitude feeding. It flies in a fast, direct path, foraging for high flying insects. Can commute up to 50 km between roost and foraging areas (Baker and Gynther 2023). The species is fast-flying, capable of speeds of up to 61 km/h to intercept their prey 50 m or more above the ground. This foraging strategy is not suited to maneuverability (Churchill 2008).	Open space, aerial forager	Almost certain	Moderate	High	The species been regularly reported as the most frequent species impacted at windfarms in southeast Australia (Australian Ecological Research Services 2015; Bennett <i>et al.</i> 2022; Moloney <i>et al.</i> 2019; Smales 2015). Cape Nelson Wind farm in Victoria recorded the highest fatality rates with 90% of the carcasses belonging to the White-striped Free-tailed Bat. After the implementation of curtailment, the fatality rate decreased to one-third (Bennett <i>et al.</i> 2022). Cape Nelson Wind Farm has 11 turbines with an RSA height from 33.5 m to 126.5 m (Bennett <i>et al.</i> 2022).
Northern Free-tailed Bat (<i>Ozimops lumsdenae</i>)			The species occupies a range of mesic and semi-arid habitats across WA (Baker and Gynther 2023). In generally roosts in tree hollows but may also use roofs in urban areas. Within the Survey Area, the species was recorded in five of the eight habitats, in all seasons except summer.	The species has swift direct flight patterns and is not maneuverable (Baker and Gynther 2023). Its body is aerodynamic and ideal for open-space flying.	Open space, aerial forager	Likely	Moderate	High	The species belongs to the same family and foraging guild as the White-striped Free-tailed Bat, but as its range is limited to southern WA where there are few existing wind farms, there is little research on impacts. In the absence of such evidence and given its flight behaviour, it is assumed to be likely to be struck by rotors with a moderate consequence.
Vespertilionidae									
Gould’s Wattled Bat (<i>Chalinolobus gouldii</i>)			This ubiquitous bat is found in virtually all habitats throughout Australia from Alpine regions to tropical rainforests, eucalypt forests and woodlands, deserts, grasslands, agricultural land and urban areas (Churchill 2008). The species typically roosts in tree hollows and is found in most habitats except for treeless deserts (Menkhorst and Knight 2014). Within the Survey Area, the species was recorded in all habitats and in all seasons.	The species forages beside stands of vegetation in the open (McKenzie and Bullen 2009). It is known to travel up to 11 km from the roost to forage (Hull and Cawthen 2013) Flight pattern is direct and rapid but with limited maneuverability (Baker and Gynther 2023).	Open space, aerial forager	Almost certain	Moderate	High	The species has known recorded fatalities at Wind Farms in Australia. Bluff Point and Studland Bay Wind Farms in Tasmania recorded high fatality rates with 38 out of 54 (70%) recorded carcasses identified as Gould’s Wattled Bats (Hull and Cawthen 2012). The species had the second highest number of recorded bat mortalities (10%) in Moloney <i>et al.</i> (2019). The high fatality rates for this species may be due to its abundance, but it is nevertheless considered to be at high risk in the Survey Area, where it is widespread.
Chocolate Wattled Bat (<i>Chalinolobus morio</i>)			This species is common across southern Australian and inhabits a wide range of mesic habitats including forests, woodlands, shrublands and plains, and water courses in more arid regions (Churchill 2008). The species tends to be the last bat to enter winter hibernation and the first to emerge in spring (Churchill 2008).	The species forages in well-vegetated areas, generally below the canopy (Menkhorst and Knight 2014) but is also known to fly above the canopy (Baker and Gynther 2023).	Closed canopy forager; open space, aerial forager	Likely	Moderate	Medium	The species has known recorded wind farms in Australia. At Biala Wind Farm in New South Wales, the species was the second most frequently killed bat species, following the White-striped Free-tailed Bat but more frequently killed than Gould’s Wattled Bat (Nature Advisory 2024). At some other wind farms, the species has been struck by rotors but at low frequency (Nature Advisory 2021b).

Common name (<i>Scientific name</i>)	Status		Ecology and habitat	Flight behaviour	Foraging guild	Likelihood	Consequence	Inherent risk of rotor strike (before management)	Discussion
	EPBC Act	BC Act							
			Within the Survey Area, the species was recorded in five of the eight habitats and in all seasons.						
Inland Broad-nosed Bat (<i>Scotorepens balstoni</i>)			The species is common and broadly distributed throughout arid and semi-arid Australia, where it tends to forage over waterways, woodlands, shrublands and grasslands (Churchill 2008).	This species forages below the canopy but also at the edges of vegetation and into open space (Churchill 2008). It flies with moderate speeds of 12-21 km/h but with rapid, sudden movements (Churchill 2008).	Closed canopy forager; open space, aerial forager	Likely	Moderate	Medium	A review of existing literature has found no examples of wind farms where this species was recorded as a mortality. This may be due to the species being predominantly found in inland Australia where there are fewer existing wind developments. Based on its flight behaviour, the species is considered likely to fly at RSA height, with occasional loss of individuals expected.
Southern Forest Bat (<i>Vespadelus regulus</i>)			The species is distributed across forest and woodland in southern Australia (Churchill 2008). It tends to avoid fragmented or disturbed habitats (Churchill 2008). Within the Survey Area, the species was recorded in all habitats and is all seasons.	The species is highly maneuverable and with moderate speeds of 5-25 km/h (Churchill 2008). The species generally forages below canopy height, with acrobatic, agile movements (Churchill 2008).	Closed canopy forager	Possible	Moderate	Medium	Despite its flight behaviour, the species has been recorded with moderate numbers of fatalities (relative to other bat species) at wind farms in south-eastern Australia (Nature Advisory 2021b; 2024). Given the low apparent risk due to its flight behaviour, but records of rotor strike, the species is considered at medium risk.
Lesser Long-eared Bat (<i>Nyctophilus geoffroyi</i>)			The species usually occurs around water and riparian vegetation, particularly <i>Melaleuca</i> and <i>Pandanus</i> (Menkhorst and Knight 2014). It frequently roosts under exfoliating bark or in tree hollows. It has short broad wings and forages with a slow, manoeuvrable undulating flight. Prey is caught both aerial and gleaned from vegetation. Often flies close to the ground (Baker and Gynther 2023). Within the Survey Area, the species was recorded in six of the eight habitats (not in Minor Drainage Line or River Red Gum Forest) and in all seasons.	The species has short broad wings and forages with a slow, manoeuvrable undulating flight. Prey is caught both aerial and gleaned from vegetation. Often flies close to the ground (Baker and Gynther 2023). Flight is slow and highly manoeuvrable, flying close to the vegetation and into the understorey. In vegetation, they forage 6-10 m above the ground. In open areas they fly lower around shrubs and bushes. Flight speeds when foraging 4 km/h (slowest of all species examined). Communicating flight is 20 km/h (Churchill 2008).	Closed canopy forager	Unlikely	Moderate	Low	This species is considered at low risk due to its foraging behaviour. Closed canopy foragers tend to glean food from the surface of vegetation (Churchill 2008) and are not expected to forage far from the canopy, which is significantly lower than the RSA height proposed for the Project.



6. Potential Limitations and Constraints

The potential limitations and constraints in relation to the Survey are recognised in **Table 6-1**. Assumptions relating to the preliminary risk model are discussed in **Section 4.4.3**.

Table 6-1: Potential limitations and constraints of the Survey.

Potential Limitation	Constraint	Comments
Competency and experience of consultants	No	Joe Sollis was the Survey Lead for the Project, who is an experienced zoologist with over 8 years' experience and specific experience conducting bird and bat surveys for multiple wind farm projects. All supporting members of the Stantec survey team were experienced zoologists with experience in bird identification.
Scope	No	Available previous survey work undertaken within or in the vicinity of the Survey Area was reviewed. The BBUS assessed bird occurrence within and utilisation of the Survey Area using methods based on the Onshore Wind Farms: Interim guidance on bird and bat management (DAWE 2021) and a review of existing literature and best-practice approaches. Bird acoustic recordings were analysed by Nick Leseberg (Adaptive NRM) and Jasmin Pratt (Stantec) and bat echolocation recordings were analysed by Bob Bullen (Bat Call WA). The Ecological Risk Model (ERM) is based on the method described by Reid <i>et al.</i> (2022) for offshore wind farms, with minor amendments to include State- and Commonwealth-level conservation status.
Proportion of species identified	No	The inventory of 114 bird species recorded during the BBUSs and basic and targeted fauna survey (Stantec 2025) represents 49.57% of the total number of bird species that have been historically recorded within the desktop search extent (40 km buffer) (n = 230). The species accumulation curves suggest that further survey effort may yield between eight and 15 additional species.
Information sources	No	A desktop assessment was completed to generate a list of bird and bat species previously recorded within and in the vicinity of the Survey Area. The desktop assessment included results compiled from five database searches and seven terrestrial fauna surveys previously undertaken within or in the vicinity of the Survey Area.
Completeness and intensity	No	The BBUSs were undertaken based on the <i>Onshore Wind Farm Guidance: Best practice approaches when seeking approval under Australia's national environment law (Draft)</i> (DCCEEW 2024a), <i>Onshore Wind Farms: Interim guidance on bird and bat management</i> (DAWE 2021), and a review of existing literature and best-practice approaches for bird and bat surveys approaches (Jenkins <i>et al.</i> 2015; Scottish Natural Heritage 2017) and assessment of surveys undertaken for previous wind turbine assessments (Appendix D). The fixed point (FP) counts aimed to record all birds at each FP for a minimum of 2 ¼ hours over the duration of each survey. FP counts were undertaken during hours in which target bird species were likely to be active.



7. Conclusion

Twin Hills Wind Farm Pty Ltd, care of Wind Prospect Pty Ltd (Wind Prospect) commissioned Stantec Australia Pty Ltd (Stantec) to undertake bird and bat utilisation surveys (BBUSs; the Survey) of the Twin Hills Survey Area (the Survey Area) quarterly for two years. The Survey Area comprised a total of 9,993 ha within the Geraldton Sandplains bioregion. 12,769 ha of area additional to the Survey Area (hereafter, Additional Area') was surveyed during the Survey. The objective of the survey was to complete a desktop assessment and site investigation of the Survey Area to enhance knowledge of bird and bat utilisation of the Survey Area and inform a future Bird and Bat Management Plan to mitigate impacts to at-risk species.

In total, 19,980 observations were recorded during BBUS. Of these, 18,507 observations had associated flight height data (most of the remaining observations being heard bird calls), with 10.63% of these observations recorded within the rotor sweep area (RSA; 40 – 300 m) height. The Little Corella accounted 44.00% of all observations within RSA height, and the Tree Martin accounted for 19.00% of all observations within RSA height. A total of 113 bird species were recorded during the BBUS and basic and targeted fauna survey (Stantec 2025), with 27 species recorded within RSA height.

A total of seven bat species were recorded on bat echolocation units. The most frequently recorded species were the White-striped Free-tailed Bat (*Austronomus australis*) and Gould's Wattled Bat (*Chalinolobus gouldii*). 83.33% of all bat species identified during the desktop assessment were recorded during the BBUSs: not including the Little Red Flying-fox (*Pteropus scapulatus*). Two species were recorded that had not been previously identified during the desktop assessment: the Northern Free-tailed Bat (*Ozimops lumsdenae*) and Inland Broad-nosed Bat (*Scotorepens balstoni*). Bats identified during these surveys were present in all habitats within the Survey Area and during all seasons, although both habitat distribution and temporal distribution varies by species.

The desktop assessment identified a total of 31 significant species that were previously recorded and/or have the potential to occur within the Survey Area. Of those, two significant bird species were confirmed present within the Survey Area:

- Carnaby's Black-Cockatoo (*Zanda latirostris*; En, En):
 - Confirmed present during the BBUSs and targeted fauna survey (Stantec 2025). A total of 5,661 observations were recorded during the BBUSs, with no observations within RSA height. One roost was identified during the targeted fauna survey (Stantec 2025). According to R. Johnstone (pers. comm. 2024), this is likely to be a satellite roost for the population of Carnaby's Black-Cockatoos that is resident in the Eneabba region.
- Peregrine Falcon (*Falco peregrinus*; OS):
 - Observed opportunistically within the Survey Area during the Q4 2024 BBUS, foraging within RSA height.

In addition to these confirmed species, two species were considered likely to occur within the Survey Area based on the presence of suitable habitat and nearby recent records. Five species were classified as possible to occur, and 22 species were classified as unlikely to occur.

One long unused Malleefowl (*Leipoa ocellata*; Vu, Vu) mound was recorded within the Survey Area. Based on the age of the mound, the lack of other mounds/activity within the Survey Area, and the age/prevalence of records of Malleefowl in the vicinity of the Survey Area from the Desktop assessment, this species was assessed as possible to occur within the Survey Area.

A preliminary Ecological Risk Model (ERM) was developed, and risk scores calculated for the 97 bird species for which flight heights were recorded during the BBUSs. The 14 species with the highest risk scores, for which a qualitative impact assessment was also conducted, were comprised of three raptors, seven waterbirds, one shorebird and three other species of potential risk. Two of these species is a significant species: the Carnaby's Black-Cockatoo (En, En) and Peregrine Falcon (OS). According to Johnstone and Johnstone (2024) (**Appendix D**), Carnaby's Cockatoos generally fly at 5-15 m above the ground and there is a very low risk of rotor strike due to their preference for flying over uncleared bushland, their competent flight behaviour, and no known evidence of rotor strike on the species at operating wind farms. The Peregrine Falcon was recorded flying within RSA height.

A qualitative risk assessment (not including an ERM) was conducted for all bat species recorded within the Survey Area. Three of these species were determined to be at high risk, comprised of White-striped Free-tailed Bat (*Austronomus australis*), Northern Free-tailed Bat (*Ozimops lumsdenae*) and Gould's Wattled Bat (*Chalinolobus gouldii*). This risk rating



is primarily based on known foraging behaviour and associated morphology with the three high risk species being open space aerial foragers, and is also based on evidence of rotor strike at existing wind farms. Three species were considered at medium risk and one species was considered at low risk. No significant bat species were recorded or considered possible to occur within the Survey Area.



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Appendices

Appendix A Text Codes and Terms used to Describe Significant fauna

The Environmental Factor Guidelines for Terrestrial Fauna (reference) states that terrestrial fauna may be significant for a range of reasons, including: being identified as a threatened or priority species: species with restricted distribution: degree of historical impact from threatening processes and providing an important function required to maintain the ecological integrity of a significant ecosystem.

Those fauna detailed as threatened and priority as legislation protection under the EPBC Act and/or the BC Act, or being listed on the DBCA Priority Species List. The appendix presents a summary of the different rankings and listings used to describe conservation status. Some categories such as 'extinct', 'extinct in the wild' and 'conservation dependent' (EPBC Act) are represented here. As the table includes only the information needed to fully understand the codes presented in the preceding report. Refer to the relevant legislation for a full description of all codes in use, as well as their associated criteria.

Categories used un the EPBC Act		
Status	Code	Descriptions
Critically Endangered	Cr	Taxa considered to be facing an extremely high risk of extinction in the wild in the immediate future
Endangered	En	Taxa considered to be facing a very high risk extinction in the wild in the near future
Vulnerable	Vu	Taxa considered to be facing a high risk extinction in the wild in the medium-term future
Migratory	Mi	Species that migrate to, over and within Australia and its external territories

Conservation Codes used under the BC Act		
Status	Code	Description
Critically Endangered	Cr	Taxa rare or likely to become extinct, as critically endangered taxa
Endangered	En	Taxa rare or likely to become extinct, as endangered taxa
Vulnerable	Vu	Taxa rare or likely to become extinct, as vulnerable taxa
Presumed Extinct	Ex	Taxa presumed to be extinct
Migratory	Mia	Birds subject to international agreements relating to the protection of migratory birds
Conservation Dependent	Cd	Taxa of special conservation need, being species dependent on ongoing conservation intervention
Species Protection	Os	Taxa in need of special protection

Priority Fauna Under the BC act

Status	Code	Description
Priority 1: Poorly-known Species	P1	Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.
Priority 2: Poorly-known Species	P2	Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.
Priority 3: Poorly-known Species	P3	Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.
Priority 4: Rare, Near Threatened and other species in need of monitoring	P4	(a) Rare. Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands. (b) Near Threatened. Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent. (c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix B Species List

Symbol	Name	Citation
Database Searches		
A	Threatened and Priority Fauna	DBCA (2023b)
B	Protected Matters Search Tool	DCCEEW (2024b)
C	Atlas of Living Australia Occurrence Search	ALA (2023)
D	Birdlife Birdata	Birdlife Australia (2023)
E	NatureMap	DBCA (2023a)
Surveys		
F	Twin Hills Bird and Bat Utilisation Survey and Fauna Site Inspection	This report and Stantec (2025)
G	Twin Hills Preliminary Flora and Fauna Assessment	ENV Australia (2013)
H	One Tree Preliminary Flora and Fauna Assessment	ENV Australia (2013)
I	Arrowsmith North Project Fauna Assessment	Bamford (2022b)
J	Eneabba Mineral Sands Phase 3 Basic Fauna Survey and Black-Cockatoo Assessment	Western Wildlife (2021)
K	Ocean Hill Seismic Survey: Terrestrial Fauna and Black Cockatoo Habitat Assessment	Strategen (2021)
L	Arrowsmith Hydrogen Project Fauna Management Plan	Infinite Green Energy (2020)

Species	Common Name	Conservation Status		A	B	C	D	E	F	G	H	I	J	K	L
		BC Act	EPBC Act												
Aves															
Acanthizidae															
<i>Acanthiza apicalis</i>	Inland Thornbill						x		x						
<i>Acanthiza chrysorrhoa</i>	Yellow-rumped Thornbill						x		x	x	x		x	x	
<i>Acanthiza inornata</i>	Western Thornbill						x		x						
<i>Acanthiza uropygialis</i>	Chestnut-rumped Thornbill						x		x						
<i>Aphelocephala leucopsis</i>	Southern Whiteface		Vu		x	x	x								
<i>Calamanthus campestris</i>	Rufous Fieldwren					x	x		x			x	x	x	
<i>Calamanthus cauta</i>	Shy Heathwren					x	x					x			
<i>Gerygone fusca</i>	Western Gerygone					x	x		x					x	
<i>Pyrrholaemus brunneus</i>	Redthroat					x	x								
<i>Sericornis maculatus</i>	Spotted Scrubwren						x		x						
<i>Sericornis frontalis</i>	White-browed Scrubwren					x			x	x			x		
<i>Calamanthus montanellus</i>	Western Fieldwren					x									
<i>Smicrornis brevirostris</i>	Weebill					x	x		x	x	x			x	
Accipitridae															
<i>Accipiter cirrocephalus</i>	Collared Sparrowhawk						x		x						
<i>Accipiter fasciatus</i>	Brown Goshawk						x		x	x				x	
<i>Aquila audax</i>	Wedge-tailed Eagle						x		x	x	x			x	
<i>Circus approximans</i>	Swamp Harrier					x	x								
<i>Circus assimilis</i>	Spotted Harrier					x	x		x						
<i>Elanus scriptus</i>	Letter-winged Kite	P4				x									
<i>Haliaeetus leucogaster</i>	White-bellied Sea-eagle						x								
<i>Haliastur sphenurus</i>	Whistling Kite					x	x		x						

Species	Common Name	Conservation Status		A	B	C	D	E	F	G	H	I	J	K	L
		BC Act	EPBC Act												
<i>Hamirostra isura</i>	Square-tailed Kite					x	x		x						
<i>Hamirostra melanosternon</i>	Black-breasted Buzzard					x									
<i>Hieraaetus morphnoides</i>	Little Eagle						x		x						
<i>Milvus migrans</i>	Black Kite					x									
<i>Elanus axillaris</i>	Black-shouldered Kite					x	x		x	x	x			x	
Acrocephalidae															
<i>Acrocephalus australis</i>	Australian Reed Warbler						x		x	x					
Aegothelidae															
<i>Aegotheles cristatus</i>	Australian Owlet-nightjar						x		x						
Alcedinidae															
<i>Dacelo novaeguineae</i>	Laughing Kookaburra (naturalised)						x		x						x
<i>Todiramphus pyrrhopygius</i>	Red-backed Kingfisher						x								
<i>Todiramphus sanctus</i>	Sacred Kingfisher						x		x						
Anatidae															
<i>Anas castanea</i>	Chestnut Teal						x								
<i>Anas gracilis</i>	Grey Teal						x		x						
<i>Spatula rhynchotis</i>	Australasian Shoveler					x	x								
<i>Anas superciliosa</i>	Pacific Black Duck						x		x						
<i>Aythya australis</i>	Hardhead						x								
<i>Biziura lobata</i>	Musk Duck					x	x								
<i>Chenonetta jubata</i>	Australian Wood Duck					x	x		x	x					
<i>Cygnus atratus</i>	Black Swan						x								
<i>Dendrocygna eytoni</i>	Plumed Whistling Duck					x									
<i>Malacorhynchus membranaceus</i>	Pink-eared Duck					x	x								
<i>Oxyura australis</i>	Blue-billed Duck	P4		x		x	x	x							
<i>Tadorna tadornoides</i>	Australian Shelduck						x		x	x	x				
Anhingidae															
<i>Anhinga novaehollandiae</i>	Australasian Darter					x	x		x						
Apodidae															
<i>Apus pacificus</i>	Fork-tailed Swift	Mi	Mi	x	x		x	x							
Ardeidae															
<i>Bubulcus coromandus</i>	Eastern Cattle Egret	Mi				x									
<i>Ardea alba</i>	Great Egret					x	x								
<i>Egretta novaehollandiae</i>	White-faced Heron					x	x		x	x					
<i>Ardea pacifica</i>	White-necked Heron					x	x		x						
<i>Egretta sacra</i>	Eastern Reef Egret					x	x								
<i>Nycticorax caledonicus</i>	Rufous Night-heron					x	x								
<i>Ardea modesta</i>	Eastern Great Egret					x									
Artamidae															
<i>Artamus cinereus</i>	Black-faced Woodswallow						x		x	x	x		x	x	
<i>Artamus cyanopterus</i>	Dusky Woodswallow						x								
<i>Artamus personatus</i>	Masked Woodswallow						x		x						
<i>Artamus superciliosus</i>	White-browed Woodswallow								x						
<i>Cracticus nigrogularis</i>	Pied Butcherbird					x	x		x	x	x		x	x	

Species	Common Name	Conservation Status		A	B	C	D	E	F	G	H	I	J	K	L
		BC Act	EPBC Act												
<i>Gymnorhina tibicen</i>	Australian Magpie					x	x		x	x	x		x	x	
<i>Cracticus torquatus</i>	Grey Butcherbird					x	x		x					x	
<i>Strepera versicolor</i>	Grey Currawong						x								
Burhinidae															
<i>Burhinus grallarius</i>	Bush Stone Curlew								x						
Cacatuidae															
<i>Lophochroa leadbeateri</i>	Major Mitchell's Cockatoo					x	x								
<i>Cacatua pastinator</i>	Western Corella						x		x					x	
<i>Eolophus roseicapilla</i>	Galah					x	x		x	x	x		x	x	
<i>Cacatua sanguinea</i>	Little Corella						x		x					x	
<i>Calyptrorhynchus banksii escondidus</i>	Red-tailed Black-Cockatoo						x		x		x				
<i>Calyptrorhynchus banksii naso</i>	Forest Red-tailed Black-Cockatoo ³	Vu	Vu	x				x							
<i>Zanda baudinii</i>	Baudin's Black-Cockatoo	En	En			x									
<i>Zanda latirostris</i>	Carnaby's Black-Cockatoo	En	En	x	x	x	x	x	x	x	x	x	x	x	x
<i>Nymphicus hollandicus</i>	Cockatiel					x	x		x						
Campephagidae															
<i>Coracina maxima</i>	Ground Cuckoo-shrike						x		x						
<i>Coracina novaehollandiae</i>	Black-faced Cuckoo-shrike						x		x	x	x			x	
<i>Lalage tricolor</i>	White-winged Triller						x		x		x				
Casuariidae															
<i>Dromaius novaehollandiae</i>	Emu					x	x		x	x	x	x		x	
Charadriidae															
<i>Charadrius melanops</i>	Black-fronted Dotterel					x	x		x					x	
<i>Charadrius mongolus</i>	Lesser Sand Plover	En; Mi	En; Mi				x								
<i>Charadrius ruficapillus</i>	Red-capped Plover						x								
<i>Erythronyus cinctus</i>	Red-kneed Dotterel					x	x								
<i>Peltohyas australis</i>	Inland Dotterel						x								
<i>Pluvialis squatarola</i>	Grey Plover	Mi	Mi	x		x	x	x							
<i>Thinornis cucullatus</i>	Hooded Plover	P4		x		x	x	x							
<i>Vanellus tricolor</i>	Banded Lapwing						x		x		x				
Columbidae															
<i>Columba livia</i>	Rock Dove ¹						x					x			
<i>Geopelia cuneata</i>	Diamond Dove					x									
<i>Ocyphaps lophotes</i>	Crested Pigeon					x	x		x	x	x	x	x	x	
<i>Phaps chalcoptera</i>	Common Bronzewing						x		x	x		x	x	x	
<i>Streptopelia senegalensis</i>	Laughing Dove ¹					x	x		x			x			
Corvidae															
<i>Corvus bennetti</i>	Little Crow					x	x		x					x	
<i>Corvus coronoides</i>	Australian Raven					x	x		x	x	x		x		
<i>Corvus orru</i>	Torresian Crow					x	x								
Cuculidae															
<i>Cacomantis flabelliformis</i>	Fan-tailed Cuckoo						x		x				x		
<i>Heteroscenes pallidus</i>	Pallid Cuckoo					x	x		x		x				
<i>Chalcites basalıs</i>	Horsfield's Bronze-cuckoo					x	x		x		x			x	

Species	Common Name	Conservation Status		A	B	C	D	E	F	G	H	I	J	K	L
		BC Act	EPBC Act												
<i>Chalcites lucidus</i>	Shining Bronze-cuckoo					x	x		x						
<i>Chalcites osculans</i>	Black-eared Cuckoo					x	x								
Dicaeidae															
<i>Dicaeum hirundinaceum</i>	Mistletoebird						x		x	x	x			x	
Diomedeidae															
<i>Diomedea epomophora</i>	Royal Albatross ²	Vu; Mi	Mi		x										
<i>Diomedea exulans</i>	Wandering Albatross ²	Vu; Mi	Vu; Mi		x										
<i>Diomedea exulans amsterdamensis</i>	Amsterdam Albatross ²	Cr; Mi	En; Mi		x										
<i>Thalassarche carteri</i>	Indian Yellow-nosed Albatross ²	En; Mi	V; Mi		x										
<i>Thalassarche cauta</i>	Shy Albatross ²	Vu; MI	En; Mi		x										
<i>Thalassarche cauta steadi</i>	White-capped Albatross ²	Vu; Mi	Mi		x										
<i>Thalassarche impavida</i>	Campbell Albatross ²	Vu; Mi	Mi		x										
<i>Thalassarche melanophris</i>	Black-browed Albatross ²	En; Mi	Vu; Mi		x										
Estrildidae															
<i>Taeniopygia guttata</i>	Zebra Finch					x	x		x						
Falconidae															
<i>Falco berigora</i>	Brown Falcon						x		x		x			x	
<i>Falco cenchroides</i>	Australian Kestrel						x		x	x	x		x	x	
<i>Falco hypoleucos</i>	Grey Falcon	Vu	Vu		x		x								
<i>Falco longipennis</i>	Australian Hobby						x		x						
<i>Falco peregrinus</i>	Peregrine Falcon	S		x			x	x	x					x	
Haematopodidae															
<i>Haematopus fuliginosus</i>	Sooty Oystercatcher					x									
<i>Haematopus longirostris</i>	Pied Oystercatcher					x									
Hirundinidae															
<i>Cheramoeca leucosternus</i>	White-backed Swallow					x	x		x	x			x	x	
<i>Hirundo neoxena</i>	Welcome Swallow						x		x	x			x	x	
<i>Petrochelidon ariel</i>	Fairy Martin						x		x						
<i>Petrochelidon nigricans</i>	Tree Martin						x		x	x	x		x		
Laridae															
<i>Anous stolidus</i>	Common Noddy ²	Mi	Mi		x										
<i>Anous tenuirostris melanops</i>	Australian Lesser Noddy ²	En	Vu		x										
<i>Larus novaehollandiae</i>	Silver Gull					x	x								
<i>Larus pacificus</i>	Pacific Gull					x	x								
<i>Sternula albifrons</i>	Little Tern ²	Mi	Mi		x										
<i>Hydroprogne caspia</i>	Caspian Tern ²	Mi	Mi	x	x	x	x	x							
<i>Sterna dougallii</i>	Roseate Tern ²	Mi	Mi		x			x							
<i>Chlidonias hybrida</i>	Whiskered Tern						x								
<i>Sternula nereis nereis</i>	Fairy Tern ²	Vu	Vu		x	x	x								
<i>Thalasseus bergii</i>	Greater Crested Tern ²		Mi	x		x	x	x							
<i>Chlidonias leucopterus</i>	White-winged Black Tern ²		Mi			x									
<i>Gelochelidon nilotica</i>	Gull-billed Tern ²		Mi			x									
Locustellidae															
<i>Megalurus cruralis</i>	Brown Songlark						x		x						

Species	Common Name	Conservation Status		A	B	C	D	E	F	G	H	I	J	K	L
		BC Act	EPBC Act												
<i>Megalurus gramineus</i>	Little Grassbird					x									
<i>Megalurus mathewsi</i>	Rufous Songlark						x		x	x	x				
Maluridae															
<i>Malurus assimilis</i>	Purple-backed Fairywren						x		x					x	
<i>Malurus leucopterus</i>	White-winged Fairywren						x		x	x	x		x	x	
<i>Malurus pulcherrimus</i>	Blue-breasted Fairywren						x								
<i>Malurus splendens</i>	Splendid Fairywren						x		x				x	x	
<i>Stipiturus malachurus</i>	Southern Emuwren					x	x								
Megapodiidae															
<i>Leipoa ocellata</i>	Malleefowl	Vu	Vu	x	x	x	x	x							
Meliphagidae															
<i>Acanthagenys rufogularis</i>	Spiny-cheeked Honeyeater					x	x		x					x	
<i>Acanthorhynchus superciliosus</i>	Western Spinebill					x	x								
<i>Anthochaera carunculata</i>	Red Wattlebird						x		x					x	
<i>Anthochaera lunulata</i>	Western Little Wattlebird						x		x						
<i>Certhionyx variegatus</i>	Pied Honeyeater						x								
<i>Epthianura albifrons</i>	White-fronted Chat						x		x	x	x				
<i>Epthianura tricolor</i>	Crimson Chat						x		x						
<i>Gavicalis virescens</i>	Singing Honeyeater					x	x		x	x	x		x	x	
<i>Glyciphila melanops</i>	Tawny-crowned Honeyeater					x	x		x		x		x	x	
<i>Nesoptilotis leucotis</i>	White-eared Honeyeater					x								x	
<i>Lichmera indistincta</i>	Brown Honeyeater						x		x	x			x	x	
<i>Manorina flavigula</i>	Yellow-throated Miner						x		x	x					
<i>Melithreptus brevirostris</i>	Brown-headed Honeyeater						x		x						
<i>Phylidonyris nigra</i>	White-cheeked Honeyeater						x		x		x		x	x	
<i>Phylidonyris novaehollandiae</i>	New Holland Honeyeater						x		x					x	
<i>Ptilotula ornata</i>	Yellow-plumed Honeyeater					x	x							x	
<i>Purnella albifrons</i>	White-fronted Honeyeater					x	x		x						
<i>Sugomel niger</i>	Black Honeyeater						x								
<i>Ptilotula plumulus</i>	Grey-fronted Honeyeater					x									
<i>Sugomel nigrum</i>	Black Honeyeater					x									
Meropidae														x	
<i>Merops ornatus</i>	Rainbow Bee-eater						x		x			x			x
Monarchidae														x	
<i>Grallina cyanoleuca</i>	Magpie-lark					x	x		x	x	x		x		
Motacillidae														x	
<i>Anthus australis</i>	Australian Pipit						x		x	x	x		x		
<i>Motacilla cinerea</i>	Grey Wagtail	Mi	Mi		x										
Oceanitidae															
<i>Pelagodroma marina</i>	White-faced Storm Petrel ²					x									
Oreoicidae															
<i>Oreoica gutturalis</i>	Crested Bellbird					x	x								
Otidae															
<i>Ardeotis australis</i>	Australian Bustard					x	x								
Pachycephalidae														x	

Species	Common Name	Conservation Status		A	B	C	D	E	F	G	H	I	J	K	L
		BC Act	EPBC Act												
<i>Colluricincla harmonica</i>	Grey Shrike-thrush						x		x		x		x		
<i>Pachycephala pectoralis</i>	Western Whistler						x		x					x	
<i>Pachycephala rufiventris</i>	Rufous Whistler						x		x		x				
Pandionidae															
<i>Pandion haliaetus</i>	Osprey	Mi	Mi		x	x	x								
Pardalotidae															
<i>Pardalotus punctatus</i>	Spotted Pardalote						x		x					x	
<i>Pardalotus striatus</i>	Striated Pardalote						x		x				x		
Pelecanidae															
<i>Pelecanus conspicillatus</i>	Australian Pelican					x	x		x						
Petroicidae															
<i>Drymodes brunneopygia</i>	Southern Scrub-robin					x	x							x	
<i>Eopsaltria georgiana</i>	White-breasted Robin								x						
<i>Eopsaltria griseogularis</i>	Western Yellow Robin						x								
<i>Melanodryas cucullata</i>	Hooded Robin						x		x						
<i>Microeca fascinans</i>	Jacky Winter						x		x						
<i>Petroica boodang</i>	Scarlet Robin						x		x						
<i>Petroica goodenovii</i>	Red-capped Robin						x		x	x	x				
Phalacrocoracidae															
<i>Phalacrocorax carbo</i>	Great Cormorant						x								
<i>Microcarbo melanoleucos</i>	Little Pied Cormorant					x	x		x						
<i>Phalacrocorax sulcirostris</i>	Little Black Cormorant						x		x						
<i>Phalacrocorax varius</i>	Pied Cormorant						x								
Phasianidae														x	
<i>Coturnix pectoralis</i>	Stubble Quail						x		x		x	x			
Podargidae														x	
<i>Podargus strigoides</i>	Tawny Frogmouth					x	x								
Podicipedidae															
<i>Podiceps cristatus</i>	Great Crested Grebe					x	x								
<i>Poliiocephalus poliocephalus</i>	Hoary-headed Grebe					x	x							x	
<i>Tachybaptus novaehollandiae</i>	Australasian Grebe					x	x		x						
Pomatostomidae															
<i>Pomatostomus superciliosus</i>	White-browed Babbler						x								
Procellariidae															
<i>Macronectes giganteus</i>	Southern Giant Petrel ²	Mi	En; Mi		x	x									
<i>Macronectes halli</i>	Northern Giant Petrel ²	Mi	Vu; Mi		x										
<i>Pterodroma mollis</i>	Soft-plumaged Petrel ²		Vu		x										
<i>Ardenna carneipes</i>	Flesh-footed Shearwater ²	Vu; Mi	Mi		x	x									
<i>Ardenna pacifica</i>	Wedge-tailed Shearwater ²	Mi	Mi			x	x								
Psittaculidae															
<i>Melopsittacus undulatus</i>	Budgerigar					x	x								
<i>Neophema elegans</i>	Elegant Parrot						x						x		
<i>Parvipsitta porphyrocephala</i>	Purple-crowned Lorikeet					x									
<i>Pezoporus occidentalis</i>	Night Parrot ³	Cr	En		x										
<i>Pezopous flaviventris</i>	Western Ground Parrot ³	Cr	Cr	x				x							

Species	Common Name	Conservation Status		A	B	C	D	E	F	G	H	I	J	K	L
		BC Act	EPBC Act												
<i>Psephotellus varius</i>	Mulga Parrot						x							x	
<i>Barnardius zonarius</i>	Australian Ringneck					x	x		x	x			x		
<i>Polytelis anthopeplus</i>	Regent Parrot					x	x								
Rallidae															
<i>Fulica atra</i>	Eurasian Coot					x	x		x						
<i>Tribonyx ventralis</i>	Black-tailed Native-hen					x	x		x						
<i>Porzana fluminea</i>	Australian Spotted Crake								x						
Recurvirostridae															
<i>Cladorhynchus leucocephalus</i>	Banded Stilt					x	x								
<i>Himantopus himantopus</i>	Black-winged Stilt					x	x								
<i>Recurvirostra novaehollandiae</i>	Red-necked Avocet					x	x								
<i>Himantopus himantopus leucocephalus</i>	Pied Stilt					x									
Rhipiduridae														x	
<i>Rhipidura albiscapa</i>	Grey Fantail						x		x	x	x			x	
<i>Rhipidura leucophrys</i>	Willie Wagtail						x		x	x	x		x		
Rostratulidae															
<i>Rostratula australis</i>	Australian Painted Snipe	En; Mi	En		x										
Scolopacidae															
<i>Arenaria interpres</i>	Ruddy Turnstone	Mi	Mi	x		x	x	x							
<i>Calidris acuminata</i>	Sharp-tailed Sandpiper	Mi	Mi	x	x		x	x							x
<i>Calidris canutus</i>	Red Knot	Mi	En; Mi		x										
<i>Calidris ferruginea</i>	Curlew Sandpiper	Vu; Mi	Cr; Mi	x	x		x	x							
<i>Calidris melanotos</i>	Pectoral Sandpiper	Mi	Mi		x										
<i>Calidris ruficollis</i>	Red-necked Stint	Mi	Mi	x			x	x							
<i>Limosa lapponica</i>	Bar-tailed Godwit	Cr; Mi	Cr; Mi	x	x	x	x	x							
<i>Numenius madagascariensis</i>	Eastern Curlew	Vu; Mi	Cr; Mi		x										
<i>Numenius phaeopus</i>	Whimbrel	Mi	Mi	x			x	x							
<i>Tringa brevipes</i>	Grey-tailed Tattler	Mi; P4	Mi				x								
<i>Tringa glareola</i>	Wood Sandpiper	Mi	Mi	x				x							
<i>Actitis hypoleucos</i>	Common Sandpiper	Mi	Mi	x	x	x	x	x							
<i>Tringa nebularia</i>	Common Greenshank	Mi	Mi	x	x		x	x							
<i>Xenus cinereus</i>	Terek Sandpiper	Mi	Mi	x				x							
Strigidae															
<i>Ninox boobook</i>	Boobook Owl						x		x						
<i>Ninox connivens</i>	Barking Owl						x								
Threskiornithidae															
<i>Platalea flavipes</i>	Yellow-billed Spoonbill						x								
<i>Plegadis falcinellus</i>	Glossy Ibis	Mi	Mi	x		x	x	x							
<i>Threskiornis molucca</i>	Australian White Ibis					x	x								
<i>Threskiornis spinicollis</i>	Straw-necked Ibis					x	x		x	x					
Turnicidae														x	
<i>Turnix velox</i>	Little Button-quail						x		x						
Tytonidae															
<i>Tyto alba</i>	Barn Owl					x	x		x						

Species	Common Name	Conservation Status		A	B	C	D	E	F	G	H	I	J	K	L	
		BC Act	EPBC Act													
Zosteropidae																x
<i>Zosterops lateralis</i>	Silvereye					x	x		x	x	x					
Mammalia																
Megadermatidae																
<i>Macroderma gigas</i>	Ghost Bat ³	Vu	Vu		x	x										
Molossidae																
<i>Austronomus australis</i>	White-striped Free-tailed Bat					x			x							
<i>Ozimops lumsdenae</i>	Northern Free-tailed Bat								x							
Pteropodidae																
<i>Pteropus scapulatus</i>	Little Red Flying-fox					x										
Vespertilionidae																
<i>Chalinolobus gouldii</i>	Gould's Wattled Bat					x			x							
<i>Chalinolobus morio</i>	Chocolate Wattled Bat					x			x							
<i>Nyctophilus geoffroyi</i>	Lesser Long-eared Bat					x			x					x		
<i>Scotorepens balstoni</i>	Inland Broad-nosed Bat								x							
<i>Vespadelus regulus</i>	Southern Forest Bat					x			x							

¹ Introduced species, ² Species of significance excluded from the likelihood of occurrence due to being entirely marine species or Pelagic birds, ³ Species of significance excluded from likelihood of occurrence due to erroneous record or known to be locally extinct.

Appendix C Assessment of surveys undertaken for previous wind turbine projects

Summary table of examples of bird surveys, management plans and monitoring reports, with methods summarised.

Project	Year	Location	Project Area	Number of turbines	Method/s	Time per survey	Area surveyed per site	Number of sites	Seasonality	Within-season repeats
MacIntyre Wind Farm (Nature Advisory 2021c)	2021	Goondiwindi Region, QLD	300,000 ha*	169	Fixed-point counts	15 mins	200 m radius	12 (10 impact; 2 control) stratified by habitat type	2 visits in wet season, 2 visits in dry season	8 surveys per site (2 counts of each site in each of 4 periods of the day)
Karara Wind Farm Bird Utilisation Survey Nature Advisory (2021c)	2021	Cement Mills and Gore, QLD	6,400 ha*	17*	Fixed-point counts	15 mins	200 m radius	5	1 wet season and 1 dry season visit per year	8 surveys per site (2 counts of each site in each of 4 periods of the day)
Silverton Wind Farm: Bird and Bat Monitoring Biosis (2021)	2021	Far West, NSW	60,000 - 80,000 ha*	58	Fixed-point counts (separate points for general birds; and raptors) Incidental observations Targeted surveys for freckled ducks and wedge-tails Collision modelling with carcass and feather spot surveys	20 mins	Not mentioned	General birds: 29 (19 impact; 10 control) Raptors: 19 (11 impact; 8 control)	Spring 2018 - Summer 2019 Autumn 2019 -Summer 2020 Autumn 2020 Winter 2020 (to align with phased testing and operation of the wind farm)	1 per season within each monitoring period
Bango Wind Farm Nature Advisory (2021a)	2021	Southern Tablelands, NSW	800 - 1,200 ha*	46	Fixed-point counts Incidental observations	15 mins	200 m radius	10 (7 impact, 3 reference) Reference points >500 m away in “similar habitat”	Autumn 2019 - Summer 2020	8 (different times of day)
					Fixed point counts as per baseline Targeted surveys for superb parrots Carcass surveys	Fixed point counts as per baseline Carcass: day	Fixed point counts as per baseline Carcass searches within 60 m (inner zone) and 120 m (outer zone) of turbines	Fixed point counts as per baseline Carcass: each turbine	Each of 4 seasons in years 1 and 3	Fixed point counts as per baseline Carcass: every 2 months for 2 years following construction of each turbine
300 MW Wind and BESS Project (proposed survey methods) Stantec (2021)	2021	Missouri, US	-	-	Point-count survey - avian migration	10 mins (small birds) 60 mins (large birds) 4 hrs/day (starting 30 mins before sunrise)	100 m (small birds) 800 (large birds)	49	Two spring and two autumn migration seasons (over 2 years)	Once a month for 24 months
					Point-count survey - raptor migration	8 hrs	-	N/A		Four times per season
					Eagle nest survey	-	1 mile apart transects and targeted search	N/A	Survey between February and April, for 2 years	-
Asian Renewable Energy Hub Migratory Shorebirds	2018	Northwest WA Development envelope (inland study area)	360,000 ha*	Unknown	Area searches Opportunistic records Continuous Autonomous Recording Unit (ARU) deployment	30 mins	Unbounded	-	August/ September and March	None

Project	Year	Location	Project Area	Number of turbines	Method/s	Time per survey	Area surveyed per site	Number of sites	Seasonality	Within-season repeats
and Waterbirds Survey Biota (2018)		Eighty Mile Beach	~30 km along beach*	N/A	Shoreline transect count	2 hrs either side of high tide (when shorebirds gather)	Continuous, 5 km transects	N/A	October and March (when most birds present)	None
		Walyarta Wetland	Up to ~80 km in length	NA	Helicopter, boat and light aircraft surveys	-	NA	5 - 9 ARUs	After flooding (April - June)	None
Crookwell Wind Farms Brett Lane & Associates (2017b)	2017	Southern Tablelands, NSW	~2,000 ha*	~55*	Fixed-point counts	15 mins	200 m radius	10	February/March	8 (different time of day)
Kondinin Wind Farms – Fauna Assessment SW Environmental (2017)	2017	Wheatbelt, WA	3,237 - 4,740 ha*	~46*	Bird survey transects Targeted surveys	20 - 50 mins	180 - 600 m	4	Winter/Spring	-
Alberton Wind Farm Bird Surveys Brett Lane & Associates (2017a)	2016	South Gippsland, VIC	2,000 - 3,200 ha*	34*	Fixed-point counts Incidental observations	15 mins	200 m radius For species of concern widened to 500 m from observer	10 (8 impact, 2 reference) Impact points “near proposed turbine locations” Reference points >500 m away in similar habitat (“similar habitat” apparently relates to all impact points, as most are in grazing paddocks with scattered native vegetation)	Summer	8 (different times of day)
Oaklands Hill Wind Farm – Bird Utilisation Monitoring Australian Ecological Research Services (2013)	2013	Grampians Shire, VIC	2,320 ha	33*	Fixed-point counts	20 mins	Not mentioned	10	Each season (4) planned for 2 years	5 - 6 days per survey
Cape Bouvard, Clifton Beach - Bird and Bat Study ecologia (2012)	2012	Swan Coastal Plain, WA	1000 ha	Unknown	Fixed-point counts	20 mins	Not mentioned	26	Spring (November) Summer (January) Autumn (April) Winter (July)	3 times (different times of day)

*Indicative/estimated

Appendix D Report: Carnaby's Cockatoo
Calyptrorhynchus latirostris in the
Eneabba Region

Carnaby's Cockatoo *Calyptorhynchus latirostris* in the Eneabba Region



CARNABY'S COCKATOO *CALYPTORHYNCHUS LATIROSTRIS* IN THE ENEABBA REGION

R.E. & C. JOHNSTONE

SPECIES BACKGROUND INFORMATION

Carnaby's Cockatoo *Calyptorhynchus latirostris* (subgenus *Zanda*)

Carnaby's Cockatoo is listed as Schedule 1 (Endangered) under the Western Australian Wildlife Conservation Act, and the EPBC Act.

Distribution

Endemic to the south-west of Western Australia north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noogar (Moorine Rock), Lake Cronin, Hatters Hill, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Coodingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

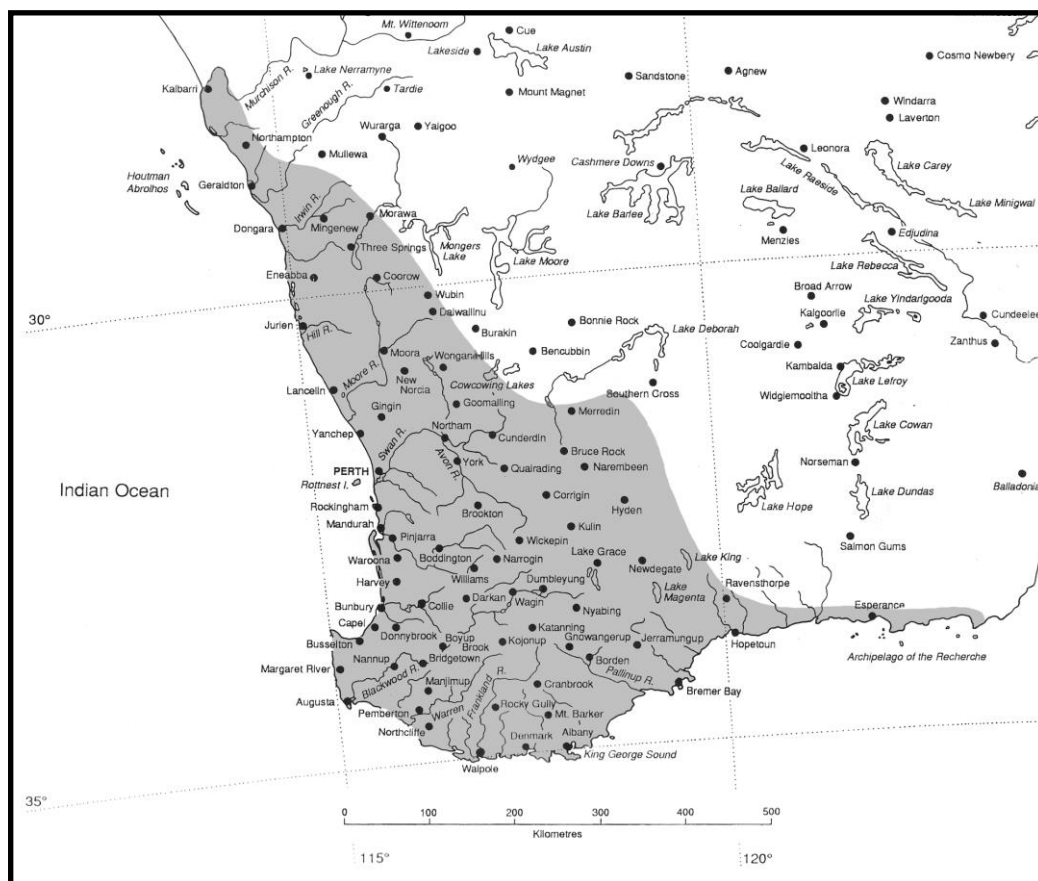


Figure 1. Distribution map of Carnaby's Cockatoo

Status

This species is a postnuptial nomad, tending to move west after breeding. For example; most birds breeding in Badgingarra, Dandaragan and Moora region tend to move west after breeding into higher rainfall areas especially the near-coastal *Banksia* scrubs e.g. at Wanagarren Nature Reserve, Nilgen Nature Reserve and Yanchep area, then many of these move further south on the Swan Coastal Plain to areas such as Neerabup, Gnangarra, Wanneroo, Burns Beach and including the Perth metropolitan area.

It is uncommon to common in the subhumid zone and wetter parts of the semiarid zone, scarce and patchily distributed in the drier parts of its range (north of Arrowsmith Lake and east of Marchagee, New Norcia, Toodyay, Tarin Rock and Lake Magenta) and scarce to moderately common in deep south-west (south of Margaret River, Nannup and Bridgetown and east of Albany).

Usually occur in pairs or small flocks, also large flocks (up to 10,000) in non-breeding season (late spring to mid-winter), especially at *Banksia* scrubs and pine plantations on the northern Swan Coastal Plain. Because of the large-scale post-war clearing of semiarid sandplains, this species has declined in much of the wheatbelt. There has been an apparent shift in its breeding range further west and south since the middle of last century with a more rapid increase in the past 10–40 years into the Jarrah-Marri forests of the Darling Scarp and the Tuart forests of the Swan Coastal Plain.

Preferred Habitat and Food

Generally, favours proteaceous scrubs and heaths and adjacent woodlands and forests, this species has also adapted to feeding on plantations of *Pinus* spp. which were introduced in the early 1930s. They have been observed feeding on a wide range of foods including seeding *Banksia*, *Dryandra*, *Corymbia*, *Eucalyptus*, *Hakea*, *Grevillea*, *Lambertia*, *Melaleuca*, *Pinus*, *Callitris*, *Jacaranda*, *Helianthus*, *Macadamia*, *Prunus*, *Liquidambar*, *Mesomelaena*, *Citrullus* and *Erodium*; also flower buds, flowers and nectar of *Banksia*, *Callistemon*, *Corymbia*, *Dryandra*, *Eucalyptus*, *Grevillea* and *Protea*, and insect larvae and insects from under bark and from wood of live or dead trees and shrubs. Also farmlands, especially with crops of Canola and weeds including storksbill.

Roost sites include stands of River Gums, Flat-topped Yates, exotic eucalypts and pines.

Breeding

Breeding is recorded from early July to mid-December. Mainly in semiarid and subhumid interior from the lower Murchison, Three Springs district south to the Stirling Range, west to Cockleshell Gully, Cataby, Regans Ford, Gingin, Yanchep, Serpentine, Mandurah, Lake Clifton, Bunbury, Nannup and Tone River and east to Manmanning, Kellerberrin, Woolundra, Lake Cronin, Hatters Hill and near Ravensthorpe (Storr–Johnstone Bird Data Bank). There has been an apparent shift in its breeding range further west and south since the middle of last century with a more rapid increase in the past thirty years in the Darling Range and Tuart forests of the Swan Coastal Plain.

Breeding Requirements

Carnaby's Cockatoo display strong pair bonds and mate for life. They nest in hollows of smooth-barked eucalypts especially Salmon Gum *Eucalyptus salmonophloia* and

Wandoo *Eucalyptus wandoo* but nests have also been found in other eucalypts including York Gum *Eucalyptus loxophleba*, Flooded Gum *Eucalyptus rudis*, Tuart *Eucalyptus gomphocephala* and the rough-barked Marri *Corymbia calophylla*. On the Swan Coastal Plain most nests are in Tuart.

In the central wheatbelt, Three Springs, Watheroo, Badgingarra and Dandaragan region, pairs begin to move back to their breeding sites in September-October (some as late as mid-November) and begin renovating or looking for a suitable nest hollow. Eggs are laid on a mat of wood chips at the bottom of a large hollow (mostly top entry hollows) ranging from a few centimetres to 5 m deep; clutch 1-2 (mostly two but only one young rarely two reared). Incubation lasts 29 days and only the female incubates and broods. The nestling is brooded by the female during which time both rely on the male for food. The female then leaves the nest each day at dawn, sometimes returning mid-morning (with the male) to feed the chick. After about 2-3 weeks she ceases to brood, and the chick is fed by one or both parents in the morning and late evening. Breeding success is largely dependent on suitable feeding habitat adjacent to the nest site to provide the necessary food for the survival of the chick.

Social Organisation, Flocking and Migration and Movements

Most breeding in the northern wheatbelt is completed by the end of January or early February and family groups begin to move west towards the coast and amalgamate into larger foraging flocks on the northern section of the Swan Coastal Plain. During the late summer and autumn-winter period (February, March, April and occasionally into May) large transit flocks forage in *Banksia* or *Kwongan* heaths and *Pinus* plantations on the Swan Coastal Plain, especially between Lancelin and Perth. During February, March, April and occasionally lingering into May-June, large transit flocks forage at major food sources including *Banksia* or *Kwongan* heaths and *Pinus* plantations in the Jurien Bay area and on the northern Swan Coastal Plain, the reverse movement of transient birds returning to their wheatbelt breeding quarters is evident in July, August and September.

However, there are some exceptions to this westward and southward yearly movement. For example, tracking data has shown post-breeding movement from Cataby to as far north as Dongara and the Chapman Valley (approximately 290 km) in late March-April. Additionally, a flock of 300–400 birds (including adult and juvenile) remain during the autumn-winter period in the Eneabba area – see Figure 3. These birds roost in tall river gums in and around the township and forage in both remnant native vegetation and adjacent farmlands.

Judging from the few banding recoveries and tail marked birds there is a strong movement of birds from the northern wheatbelt west and south onto the coastal plain. For example a female banded at a breeding site at Manmanning on 1 December 1971, was shot near Gingin on 27 February 1972 (a distance of 138 km WSW); a bird banded at Badgingarra on 15 November 1970 was hit by a car near Jurien Bay on 21 April 1973 (a distance 56 km WNW); and three tail-marked chicks from Cataby were recorded in the Perth region (Gnangarra pine plantation, at Wanneroo and at Cottesloe, a distance of approximately 160 km SSW from their fledging site).

The latter tail marking study provided valuable information on the migration pathway of birds from the central wheatbelt west and south onto the Swan Coastal Plain.

Of interest also was a female tagged and tracked from Cataby to Chapman Valley. On 2 March 2023 she was at Cataby, on 5 March 30 km north of Geraldton, and by 6 March 2023, had relocated 250 km north of Cataby to the Chapman Valley. A flock

of about 150–170 was estimated at the Chapman valley autumn roost on 26 April 2023 (Z. Kissane pers. comm). This northward movement is unusual for mid-west populations, with most birds in the past moving south-west onto the Swan Coastal Plain in autumn-winter.

Judging from recent surveys there is a proportion of populations in the mid-west that are becoming more sedentary, and remaining in or near their breeding area post breeding.



Figure 2. Female Carnaby's Cockatoo at a nest hollow

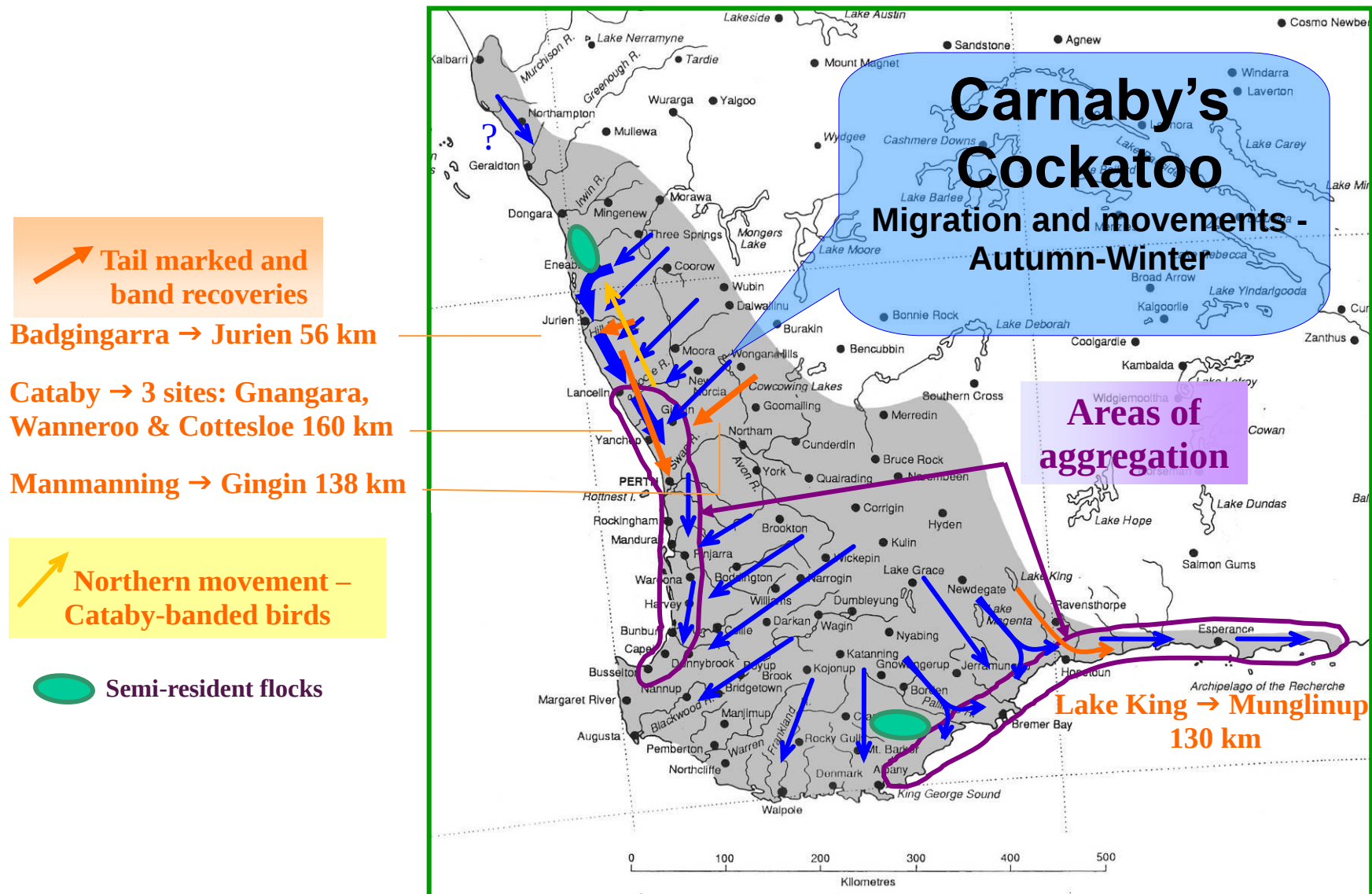


Figure 3. Migration and movements of Carnaby's Cockatoo

Significance of the Eneabba Region

There is no evidence of Carnaby's Cockatoo breeding or any suitable breeding habitat for this cockatoo has been found in the vicinity of Eneabba. The Carnaby's Cockatoo that occur in the area are non-breeding autumn-winter visitors probably from breeding sites well to the north-east and east of Eneabba i.e. Three Springs-Carnamah region and west in the Mt Peron-Lesueur region (Cockleshell Gully and Stockyard Gully). Virtually all the Carnaby's Cockatoos that breed in the northern and mid-western parts of the wheatbelt are post-nuptial migrants, tending to move west after breeding in January-February to the coast then south onto the Swan Coastal Plain. Judging from our data bank all birds from the Three Springs, Carnamah, Coorow, Badgingarra and Moora regions completely vacate their breeding sites by the end of February and aggregate into large flocks in the Kwongan heaths and pine plantations on the northern Swan Coastal Plain. Occasionally a flock of 60–100 birds remain in the Badgingarra National Park area into March-April. The reverse migration occurs in July-August (sometimes later) as birds return to their breeding sites. The exception to this movement is the large flock of about 300–400 that remain in the Eneabba region throughout the entire autumn-winter period – see Figure 3.

The Eneabba flock roosts in the township in tall river gums and leave the roost at dawn each day to forage in patches of native vegetation including remnant vegetation and mine site rehabilitation areas and in adjacent farmlands.

This flock has been observed foraging mainly in patches of remnant bushland on Eneabba Creek just north of Eneabba township, areas west of the Eneabba mine, areas around Lake Indoon and cleared farmlands to the east and west of the township. One of the main foods reported on farmlands were the seeds of the Afghan or Pie Melon *Citrullus lanatus* a summer growing annual native to Africa that is widespread in paddocks and along roadsides in the Eneabba area. The melon has a large spherical fruit (up to 15 cm across) that is produced in the autumn at a time when Carnaby's Cockatoos are arriving in the area. It has large seeds and Carnaby's Cockatoos were observed feeding on the seeds of recently broken green melons and old yellow and rotted melons. This cockatoo has not been recorded feeding on Pie Melons in any other part of its range.

Important roosting sites used since the mid1990s to 2024 (counts at roost made in 2006-2010) include the main Eneabba town roost in exotic River Gums and a satellite roost area on Woodada Road also in exotic River Gums. Important foraging sites are mainly in rehabilitated mining areas, native vegetation areas, in a small patch of burnt remnant woodland in the Eneabba township and *Banksia* woodlands west of Eneabba. Also noteworthy on a regional basis are reports of large numbers feeding in *Banksia* woodland in the Arrowsmith floodout 20 km north of Eneabba and the Lake Logue and Beekeepers Nature Reserve areas in July 2008. Also, more recently in July 2022 a flock of over 500 was photographed feeding in *Banksia* woodland near Jurien Bay, no doubt birds returning to mid-west breeding sites.

Observations for Eneabba Region from Storr-Johnstone Bird Data Bank

D. L. Serventy. August1954, recorded flocks roosting in river gums at Padbury Farm.

J. R. Ford. 27 March 1964, Cockleshell Gully (Wandoo-Marri) recorded.

- J. R. Ford. 28 March 1964, Arrowsmith Lake flock of 100-120 came in to drink in evening.
- J. R. Ford. 26 September 1965, flock of 10, 63 km NNW Badgingarra.
- J. R. Ford. 15 May 1979, Cockleshell Gully flock of ca.100.
- Storr. G.M. 27 March 1959, big flock 24 km WNW Badgingarra also 2 in Marri-banksia.
- G.M. Storr. 27 March 1959, big flock at Cockleshell Gully farm.
- G.M. Storr. 28 March 1959, flock of 25, 24 km NNE Jurien Bay.
- G.M. Storr. 22 October 1961, two birds 24 km east Jurien Bay and flock of 25 7 km SSE Badgingarra.
- G.M. Storr. 27 March 1964, two birds at Mt Lesueur.
- G.M. Storr. 28 March 1964, flock of 100 at Lake Arrowsmith came in at 5:30 pm.
- G. M. Storr. 20 January 1965, 24 km west Watheroo ca. 100 in *E. todtiana*, *B. prionotes*, *Macrozamia*, *Jacksonia*, *Calythrix*, *Acacia* etc.
- R. E. Johnstone. 4 October 1970, 2 birds flying north 120 km north of Gingin.
- R. E. Johnstone. 14 May 1973, small flock near Badgingarra townsite.
- Recovery Round up 1972. Adult female banded by D.A. Saunders at Manmanning on 1 December 1971, shot near Gingin on 27 February 1972, (138 km WSW).
- Recovery Round up 1973. Bird banded at Badgingarra on 15 November 1970, hit by car near Jurien Bay on 21 April 1973 (56 km WNW).
- J. Dell, and R.E. Johnstone. 1977. Cockleshell Gully Report. Moderately common in low forest of *E. Wandoo*, *E. accedens* and *E. calophylla* on dissected plateau. Flock of 11 observed in May 1974; between 22 and 29 October 1973 small flocks of up to 9 birds seen throughout hilly country including feeding in heath. On 29 October these small flocks began massing into a group of ca. 100.
- B. Haberley, 21 July 1982. Flock of ca. 160 seen in *Eucalyptus todtiana* and Xmas trees on the western boundary of Watheroo National Park.
- G. Carruthers, 6 January 2002. Flock of 6 over Eneabba flying south- west and later 2 birds in town.
- A. Meyer, 7 June 2006. Observed a large flock estimated at 1500 birds in Beekeepers Nature Reserve. Presumably the same mob estimated at 1000 + that were seen yesterday in same area. Presumably the same flock that have been seen in the *Banksia hookeriana* areas around the Eneabba townsite.
- B. Wynne pers. comm, 26 October 2006. On 8 October 2006 he located about five nests in gums 15 km SSE of Leeman near Stockyard Gully Caves.
- M. Mannion pers. comm. 22 January 2007. Observed about 100 birds roosting on eastern side of Eneabba town. They have been here for about a week, not as many as last year's flock that was in the order of 300 but this will probably increase as more return from breeding sites.
- M. Mannion, 25 April 2007. At 0:6:30 Eneabba flock moved from roost to north and north-east of town. In evening at 17:20 hrs, returning in two flocks from NE and N.

- M. Mannion, 26 April 2007. At 0:6:30 Eneabba flock moved north-west from town.
- M. Mannion, 17 May 2007. At 0:6:30- 0:700 Eneabba flock spent first hour in native vegetation to east of town, then flew east up the Three Springs Road to forage in farm paddocks.
- M. Mannion, 24 May 2007. At 0:6:30- 0:900. Eneabba flock tree-hopping along the Three Springs Road before stopping in farm paddocks to feed on Pie Melons.
- M. Mannion, 25 May 2007. Reports of flocks still in the Arrowsmith area along the highway (some killed by traffic). In Eneabba the flock is spending time in paddocks and have been seen eating Paddy Melons along the side of the Three Springs Road. They return to town most nights but have been absent on a couple of occasions. The larger roosting group has been splitting up into smaller groups most days with initial morning flights to north and east of town.
- M. Mannion, 20 June 2007. Observed flock returning to Eneabba roost from SSE at 1700 hrs.
- M. Mannion pers. comm. End of July 2007. Birds noted flying south in morning and returning from east at night, but no birds seen or heard since returning to Eneabba on 19 August. Between 31 July and 20 August, the large town flock had left the roost site.
- T. White, 14 February 2007. Flock of 7 feeding on pine cones on Campbell -White Road ; 2 feeding on pine cones on 9 March and 2 on 19 April.
- B. White, 26 August 2007. Observed a flock of 40-60 flying south over paddocks at Campbell -White Road, and has seen small groups feeding on pine cones at his homestead.
- M. Mannion, 29 August 2007. Cockatoos have moved their roosting area to trees around Lake Logue, so have not disappeared altogether.
- K. Conder pers. comm. 29 August 2007. Flock of 40-50 roosting in river gums at edge of farmland and Lake Logue Reserve on Woodada Road at 29 50 35.8 S, 115 10 54.5 E. Came into roost at 17:30 hrs.
- R.E. Johnstone & T. Kirkby, 30 August 2007. Woodada Road area, Lake Logue Reserve. Extensive evidence of feeding on *Banksia attenuata* (seeds and flowers), *B. prionotes*, *Dryandra sessilis* (flowers) and *Lambertia*. Also several birds calling to east and at 18:30 hrs 8 birds came into roost in river gums.
- R.E. Johnstone & T. Kirkby, 31 August 2007. Woodada Road area, Lake Logue Reserve. Several pairs and flock of 61 from line of river gums at dawn flew into banksia woodland then moved to SW into heath feeding and spreading out into native vegetation and by 0:700 well spread.
- M. Mannion, 1 September 2008. Group of birds feeding in mixed native vegetation and pasture east of Brand Highway, 55 km south of Eneabba.
- M. Mannion, 30 September 2008. Large flock roosting in pine trees on farm opposite Watto Nature Reserve.
- M. Mannion, 12 October 2008. Small flock roosting in pine trees on farm opposite Watto Nature Reserve.
- M. Mannion, 26 December 2008. Large flock roosting and flying around Eneabba townsite.

- M. Mannion, 19 January 2009. Flock of 100 flying across Brand Highway from tall pines on east of highway down Banovich Road in westerly direction at Warradarge . A few minutes later the same group observed in low heath north of Banovich road flying low along valley near powerline corridor in northerly direction. Birds stopped and foraged in farm paddocks near native vegetation.
- M. Mannion, 21 January 2009. Small group flying over mine administration building Eneabba.
- M. Mannion, 27 January 2009. Flock of 6 roosting in eucalypts near mine administration building, Eneabba. Flock of 10 feeding in heath with *E. tottiana* near Eneabba mine access rail crossing. Also small group in mature eucalypts on King Street Eneabba.
- M. Mannion, 29 January 2009. At 0700 hrs flock of 50 roosting in Eneabba town overnight at Banksia Village. They then flew low to south-east.
- M. Mannion, 30 January 2009. At 0600 hrs flock of about 100 flew into Eneabba from west (west roost) tree hopping through town from Banksia Village vthrough King Street. After short stay spread out in broad easterly direction. Splitting up into many smaller groups before rejoining into two groups, one going east along Three Springs Road the other south towards Eneabba mine concentrator.
- M. Mannion, 25 February 2009. At 05:45 hrs flock of 6 from Eneabba roost flying down Coolimba Road. A 18:50 hrs 10-12 birds flying south from Eneabba Golf Course and about 60 flying north towards town.
- M. Mannion, 3 March 2009. Eneabba, flock of 100 resting- roosting at mine administration area south of town , they return about midday stay until mid afternoon then around 8 pm fly north to town.
- M. Mannion, 17 March 2009. Eneabba roost flock breaking up into smaller groups , some flying east along Three Springs Road, others remain in town area.
- S. Plozza, 18 March 2009. Eneabba, large flock back in town but left flying east along Three Springs Road and returning by 18:00.
- M. Mannion, 23 April 2009. At 1600 hrs several small groups behind Eneabba town pool and 100 flying in from west.
- M. Mannion, 2 June 2009. Eneabba, Lake Logue flock of 200+feeding to west of Woodada Gas Road.
- M. Mannion, 3 June 2009. Large flock feeding in native vegetation just south of Eneabba Golf Course. Lots of smaller flocks flying in from south.
- R. E. Johnstone and T. Kirkby, June 2009 small flocks (up to 20) were observed near the Eneabba township. Also a flock of 50 birds was observed near the Arrowsmith floodout (50 km north of Eneabba).
- R. E. Johnstone and T. Kirkby, 22 June 2009 flocks of 150 and 70 were observed feeding on *Banksia* nectar and *Pinus* seeds near the Marchagee Track turn off.
- R. E. Johnstone and T. Kirkby, 22 June 2009 old evidence of feeding on *Dryandra sessilis* was found in the road verge at White Gums Reserve. Also at 1750 hr (just on dark) a flock of 130 were observed flying in towards Eneabba from the south to the town roost site.

- R. E. Johnstone and T. Kirkby, on 23 June 2009 a total of 388 birds left the Eneabba roost site just after sunrise at 0710 hr. This flock was followed for several hours as they foraged in *Banksia* woodland to the south and south-west of town. Birds were recorded feeding on *Banksia attenuata* and *Banksia leptophylla* var. *melletica* flowers for nectar and also taking seeds of *Dryandra sessilis* and *Eucalyptus todtiana*. The longest foraging distance from the roost that day for this flock was 5.5 km.
- M. Mannion, 1 August 2009. Eneabba, 17:00 hrs flock of 100 mooching around the Road Nature Reserve at intersection of Eneabba and Three Springs Road.
- M. Mannion, 4 August 2009. Eneabba, flock of 12 flying east along Three Springs Road at 17:00 hrs and not heading back to town roost.
- M. Mannion, 8 August 2009. Flock of 50 in scrub west of Lake Indoon (Caves access Road).
- M. Mannion, 11 August 2009. Eneabba, flock of 300 feeding and resting in scrub on farm property (Victoria Location 10895).
- M. Mannion, 14 August 2009. Eneabba, flock of about 80 in mine rehab block.
- R. E. Johnstone and T. Kirkby, on 17 August 2009 a flock of 32 was observed including some pairs in breeding display flights and giving the mating call, near the Eneabba mine administration building. Some from this flock were also noted tearing at the trunk just below the canopy of several garden palms and feeding on nectar from a red flowering eucalypt in the same gardens. Also old evidence was found of birds feeding on *Banksia attenuata* on the Leeman Road at 29. 51. 29.6 S, 115. 09. 28.1 E. At 1720 hr on the 17 August a flock of about 80 flew into Eneabba from the ESE and went to drink at roadside pools on King Street (31. 49. 06.0 S, 115. 16. 23.0 E), this group included adults making the mating call and some begging juveniles. At the same time and place another 20 birds flew in from the west and joined the main flock at the drinking site before heading to the main roost site. A total of 113 were recorded flying to the roost site at 1720 hr and many were giving the mating call.
- R. E. Johnstone and T. Kirkby, on 18 August 2009 at 0630 hr a flock of 73 left the Eneabba roost site (Darling Street at 29. 49. 22.6 S, 115. 16. 23.2 E) and flew, fast and direct to the south. At the same time a small group was heard heading west. At 0715 hr the flock of 73 was recorded feeding on *Dryandra sessilis* and seeds from *Banksia attenuata* near the Eneabba rubbish tip access road at 29. 50. 27.6 S, 115. 16. 39.2 E. At one stage this group flew up to meet a group of Red-tailed Black Cockatoos flying high towards the west. This mixed flock then flew north for a short distance before the Carnaby's Cockatoos returned.
- Another interesting observation is a flock of 30 and later 40 playing on thermals and moving north to join another flock when a Wedge-tailed Eagle was overhead. Recent evidence was also found of birds feeding on *Dryandra sessilis* and *Dryandra* spp. at 29. 54. 42 S, 115. 17. 09 E.
- A. Tinker, early September 2009 small flocks (up to 5) were recorded in the Arrowsmith floodout area.
- R. Woods, 22 September 2009 a flock of 200 – 300 was observed at the northern end of Logue Lake, bathing in a pool. Judging from the size of this flock we suspect

that it was the Eneabba flock and that most pairs had not yet returned to their breeding quarters.

- R.E. Johnstone and T. Kirkby, September 2009 pairs and small flocks were recorded flying into Wandoo woodland at 1700 hr at Dookanooka Nature Reserve at 29°36'00" S, 115°38'09" E. Also two nest trees were located in the Dookanooka Nature Reserve at 29. 35. 55 S, 115. 38. 28.1 E. Adjacent to this site were other patches of woodland that were potential breeding areas including areas of woodland at 29. 35. 21 S, 115. 41. 17 E and 29. 34. 35 S, 115. 41. 58 E on both sides of road.
- R.E. Johnstone, 25 September 2009 a breeding pair was observed (female flushed from hollow) at a hollow in a Wandoo at a creek crossing on the Green Head Road at 30. 04. 10.8 S, 115. 14. 35.7 E. A flock of 50 had been feeding for the past month in *Banksia* woodland near Jurien opposite the turn off to Drovers Cave Road (G. Briggs pers. comm). This is the westernmost breeding record for this region and judging from the habitat available there is probably a small breeding population in this patch of Wandoo.
- R. E. Johnstone, some sections of the Dandaragan – Moora and Dandaragan – Gingin Roads, road verges contain trees with suitable hollows, but no evidence of breeding has been reported. The Storr – Johnstone Bird Data Bank contains breeding records at 15 and 17 km south of Dandaragan on the Gingin Road.
- Storr–Johnstone Bird Data Bank and W. Kerkoff pers. comm. About 50 – 60 pairs of Carnaby's Cockatoos breed in and around Moora and in small reserves to the north and south of the township Breeding was recorded in roadside verges with tall Wandoo and Salmon Gums between Moora and Watheroo e.g. in verge at 30. 37. 08 S, 116. 00. 21.4 E and near Dallaroo East Road junction at 30. 29. 22.9 S, 116. 01. 47 E, at 30. 29. 22.1 S, 116. 01. 58.8 E and just south of Watheroo in Salmon Gum at 30. 20. 54.9 S, 116. 03. 41.3 E and at 30. 20. 09 S, 116. 03. 59 E (2 km south of Watheroo). Also two well chewed hollows were located in Salmon Gums just north of Marchagee at 29. 55. 23 S, 116. 02. 29 E.
- R. E. Johnstone and T. Kirkby. Small numbers are recorded breeding on the central section and western end of the Marchagee Track at Coomallo Creek and Herschell Range area (Johnstone and Kirkby 2008); and about 40 – 50 pairs breed in the Waddi Forest area west of Coorow (Storr – Johnstone Bird Data Bank). North of Coorow we located patches of York Gum and Salmon Gum woodland with potential breeding hollows at 29. 50. 51 S, 116. 00. 49 E and patches of Salmon Gum woodland at 29. 49. 12 S, 116. 00. 01 E and at Petah Creek crossing at 29. 46. 45 S, 115. 56. 03 E. There was also an extensive patch of Wandoo woodland with many large trees at 29. 28. 38.7 S, 115. 40. 12.4 E (on private property).
- S. Talbot pers. comm to REJ 2022. Large flock 300 + still roosting in Eneabba townsite.
- G. Dyer pers. comm to REJ October 2024. Large flock or flocks, observed around the Eneabba town and mine site for past 30 years. Flock of 150-200 observed near mine office area in June 2024.

Important foods in the Eneabba region

Major food in the Eneabba region includes *Banksia* spp. (especially *B. attenuata*, *B. hookeriana*, *B. leptophylla*, *B. kippistiana* and *B. sessilis*), *Hakea* spp. (especially *H. eneabba*, *H. spathulata*, *H. smilacifolia*, *H. polyanthema*, *H. psilorrhyncha*, *H. flabellifolia* and *H. costata*) and *Lambertia multiflora*. Also flower buds, flowers and nectar and insect larvae and insects from under bark and from wood of live or dead trees and shrubs. In farmland, Canola, Wild Radish *Raphanus raphanistrum*, Storksbill *Erodium botrys*, Pie Melon *Citrullus lanatus* and Lupins *Lupinus* are important foods.

Foraging Habitat

In the Eneabba region foraging mainly in patches of remnant bushland on Eneabba Creek just north of the Eneabba township; uncleared areas west of mine; areas around Lake Indoon and in cleared farmlands to east and west of township. Also important foraging in rehabilitated native vegetation areas throughout the mining area and large reserves north of Eneabba at Arrowsmith Floodout, Lake Logue and Beekeepers Nature Reserve.

General Observations of Habitat Usage and Potential Impacts of Wind Turbines

Carnaby's Cockatoo usually fly just above the ground in open areas, or just above the vegetation in heathlands or continuous tracts of vegetation. There are very few reports of birds flying at Turbine Rotor Sweep height. At Cataby, pairs and flocks flew between foraging sites and over cleared farmland at about 5-15 m and occasionally at 15-40 m and avoided the adjacent windfarm turbines and the power transmission towers.

On several occasions at Eneabba birds have been observed using thermals from large buildings, and on one occasion a flock was observed circling very high when pursued by pair of hunting Wedge-tailed Eagles. Also a literature record of White-tailed Black Cockatoos in acrobatics in hot air pillars formed by a fire in vent of huge hollow trunk of tree (D. Keast, WA Naturalist Vol 13, 8 p.205.).

At windfarms at Cataby, Walkaway, Emu Downs and Joanna Plains cockatoos appear to show a high avoidance of turbines and avoid or manoeuvre around them. Carnaby's Cockatoos also avoid power towers but will occasionally perch on power lines and there is a one record of a bird being killed by electrocution on power line in the Perth metro area.

P. Kirk pers. comm to R.E. Johnstone on 3 September 2021 and September 2024 monitored the Warradarge Windfarm daily for a period of two years and recorded a total of five bird deaths from turbine strikes (namely Australian Kestrel *Falco cenchroides*, Barn Owl *Tyto javanica*, Wedge-tailed Eagle *Aquila audax*, Australian Raven *Corvus coronoides* and Brown Songlark *Cincloramphus cruralis*).

Birds most at risk of turbine strikes would be those visiting remnant bushland adjacent to turbines to feed e. g. Carnaby's Cockatoos; migrant species flying at night and birds of prey and other species using the updrafts and thermals to gain height e.g. Wedge-tailed Eagles, Kestrel and corvids (Australian Raven and Little Crow) that also favour high vantage points to perch as lookouts.

Threats or Regional Impacts

The combination of extensive foraging habitat, permanent water for drinking sites and safe roosts enables this population to remain in the Eneabba area during the autumn –

winter period. The main threat to this flock would be the removal of the major roost sites. Intensive wildfire could also have a major impact on the availability of food in the region. To date, the breeding region of the Eneabba flock is as yet unknown and impacts at breeding sites within the broader region could affect this flock. Overall the clearing of important roost and foraging sites especially remnant bushland could have a significant impact on the local movements of this flock.

Major threats include the following:

- Loss or degradation of foraging habitat.
- Loss or degradation of roost sites.
- Change in fire regimes.
- Altered hydrology and water abstraction that may affect woodlands and drinking sites.
- Dieback *Phytophthora*.
- Competition for hollows at regional breeding sites (especially by European Honeybees and superabundant Galahs and Corellas).
- Vehicle strikes, none recorded so far for the Eneabba region but extensive losses in the Catby area on Brand Highway and on the northern Swan Coastal Plain on major roads.

CONCLUSION

Despite the Eneabba region (including the Project area) being a very fragmented landscape it is still environmentally suitable for Carnaby's Cockatoos, especially in relation to feeding habitat (i.e. food resources) drinking and roosting sites. This has no-doubt enabled the Eneabba flock to alter its traditional migration and movements westwards and southwards, and enabled them to remain closer to their breeding grounds in an environment that supports this in terms of foraging and roosting opportunity over the autumn-winter time. The establishment of a new wintering range could be important for the future conservation of this species in this area considering the rapid loss of foraging habitat in its traditional wintering zone (i.e. Swan Coastal Plain). Birds would be migrating south into an increasingly hostile environment.

For migrating birds the most important factor for their survival hinges primarily on food availability. Food availability is mainly controlled by the effects of climate on the habitat and superimposed on this is variability from year to year. Judging from our surveys over the past 20 years the Eneabba flock has evolved a pattern of timing that assures their arrival when sufficient food is available including both native and exotic foods.

Targeted surveys for breeding sites within the region have located important breeding sites in the following areas: Moora (within the township and in road verges to the north and south of town); between Moora and Watheroo (in roadside verges); Watheroo (just south of township); Marchagee (just north of township); Marchagee Track (central and western areas); Coorow (especially the Waddi Forest area) and just north of township; Dookanooka Nature Reserve; Green Head Road (at 30. 04. 10.8 S, 115. 14. 35.7 E); Dandaragan (near township); Dandaragan – Gingin Road (15 km & 17 km south of Dandaragan); Catby; Minyulo.

It would appear most likely that the region of origin of the 300 + birds that spend the autumn – winter in the Eneabba area come from these areas.

APPENDIX - STATEMENT COCKATOOS AND WINDFARMS

Risk of windfarm related mortality.

The principle threat to cockatoos from windfarms is from direct bird strikes by the turbines or by catching birds in the wind currents created by the turbines. Carnaby's Cockatoos generally fly at about 5-40 m above ground, rarely 40-200 m above the ground (i.e. about turbine height) in thermals or avoiding birds of prey. Overall, we believe that the probability of birds encountering and flying into turbines is very low for the following reasons.

1. There is a low rate at which Carnaby's Cockatoos appear to visit open farmland in the area. Generally small flocks (less than 50) occasionally flocks of several hundred are recorded as irregular visitors flying over cleared farmlands compared to very large aggregations (many hundreds) reported from uncleared bushland in the Eneabba and Badgingarra areas. This also applies to the operating windfarms in the Walkaway, Emu Downs, Joanna Plains and Cataby sites.
2. Birds would be most at risk flying to and from roosting, feeding and watering sites. Traditional and satellite roost sites are generally near water and should have a buffer zone of about 500 m from nearest turbine. Actual site utilization would be very low at the Eneabba site as this area is apparently mostly cleared and has little feeding, roosting, breeding and drinking habitat in close proximity to turbines. The Cataby wind farm is in similar habitat to that proposed at Eneabba site and at Cataby (which has a small breeding population of Carnaby's Cockatoo in adjacent remnant bushland) birds rarely flew across the wind turbine footprint, generally avoiding both turbines and transmission towers.
3. Although Carnaby's Cockatoos generally fly at about turbine height (5– 40 m.) above ground they are very competent flyers in poor light (dawn, dusk and twilight) and would be capable of avoiding wind turbines. Our data bank contains several records of small flocks flying through the canopy of eucalypt woodlands at dusk; flying into and through pine plantations at dusk and dawn; and small groups returning to nest hollows in eucalypt woodlands after dark.
4. The Storr-Johnstone Bird Data Bank contains no records of birds hitting power lines. There is however one record of a bird that died from electrocution after landing on a power pole and the Western Australian Museum receives about 10 road killed birds each year from the Perth area. Most road kills come from busy roads near pine plantations and from birds feeding in street trees or on road verges. Flocks of Carnaby's Cockatoos are regularly observed in Perth suburbs between late spring and mid-winter visiting pine groves and street trees and negotiating a maze of power lines and buildings.
5. Bird Impact Monitoring at existing windfarms has so far listed Australian Kestrel, Brown Songlark, Barn Owl, Wedge-tailed Eagle and Australian Raven.

R.E. Johnstone



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