

6. Fauna overview

This section presents the initial high-level characterisation of existing fauna and their habitats within the Macorna Wind Farm. Its primary objective was to identify the likelihood of occurrence for fauna species listed under the EPBC Act and/or the FFG Act, and to assess the likelihood of impacts on those species within the disturbance footprint.

This chapter also provides an overview of the detailed studies undertaken. These detailed studies are addressed in more depth in other chapters of this report. This includes:

- Birds (Section 7),
- Bats (Section 8),
- Brolga (Section 9),
- Migratory shorebirds (Section 10),
- Plains-wanderer (Section 11), and
- Growling Grass Frog (Section 12).

More comprehensive analyses of these species are presented in their relevant chapters.

6.1. Methodology

6.1.1. Sources of existing information

Database searches within the Project Area were undertaken on the 22nd of October 2025 to investigate which fauna species may be present. These searches used a 10 km radius around the proposed wind farm boundary (the 'search region'), a wider search region with a 20 km radius was used for the assessment of threatened communities (see details below). The following sources of information were reviewed in relation to the fauna overview assessment to collate existing information:

- Protected Matters Search Tool (DCCEEW 2026b);
- Victorian Biodiversity Atlas, VBA (DEECA 2026e);
- *NatureKit* (DEECA 2026a);
- Birddata database (BirdLife Australia 2025);
- Atlas of Living Australia, ALA (ALA 2026);
- eBird database (Cornell Lab of Ornithology 2026);
- BatMap (Australasian Bat Society 2026);
- Previous reports produced by Ecology & Heritage Partners (EHP) relating to fauna for Macorna Wind Farm
 - Preliminary Ecological and Cultural Heritage Assessment for the proposed Macorna Wind Farm: Macorna, Victoria, dated March 2024 (EHP 2024);
 - Brolga Roaming Surveys and Habitat Assessment: Macorna Wind Farm, Macorna, Victoria, dated January 2025 (EHP 2025b); and

- Migratory Shorebird Surveys for the proposed Macorna Wind Farm, Macorna, Victoria, dated March 2025 (EHP 2025c).

6.1.2. Desktop assessments

A list of the fauna species previously recorded in the search region was sourced from existing databases. Given that bat survey efforts vary greatly from region to region, with little to no survey effort in some areas, a 20 km search radius was used in BatMap to generate a bat species list. The potential for habitat across the site for these species was assessed using DEECA’s Habitat Distribution Model (HDM), Habitat Importance Model (HIM), and Brolga Breeding Habitat Suitability Model (BBHSM) (DEECA 2025i, 2026a) and through site visits that assessed suitable fauna habitat (see Sections 7 to 12).

The Protected Matters Search Tool (DCCEEW 2026b) was consulted to determine whether nationally listed species or communities potentially occurred in the search regions based on habitat modelling. The presence of listed bird communities was assessed through a desktop review of existing information and current survey efforts for birds and vegetation (see Sections 5 and 7). A 20-kilometre search radius was used for assessment of bird communities to account for the mobility of species, as per guidance documents (TSSC 2021). The presence of bird species and vegetation types was assessed against the published lists for the community to inform the potential presence of the communities.

A likelihood of occurrence analysis was performed on the species and communities with the potential to occur at MAWF (Appendix 6). The likelihood of occurrence analysis used the existing databases, as well as a desktop habitat assessment, to shortlist species with the potential to occur at MAWF. Species of concern are most often species listed under the EPBC Act and/or the FFG Act. Some species that are not listed, but are known to collide with wind turbines (e.g. raptors), are also included based on their likelihood of impact (DEECA 2024b; Symbolix 2020).

6.1.3. Field assessments

The results of the desktop assessment informed the field assessments. Field assessments began in 2024, with several currently ongoing/planned (Table 6-1). These assessments have been undertaken by EHP in 2024/2025 and Nature Advisory from October 2025. Detailed discussion of these surveys and their alignment with survey guidelines can be found in the relevant sections of this report (see Table 6-1 for the relevant sections of the report).

Table 6-1: Fauna surveys completed at the Macorna Wind Farm.

Survey Type	Consultancy	Dates
Brolga breeding surveys (See Section 9)	EHP	30 September – 4 October 2024
		25 – 31 July 2025
		25 – 28 August 2025
		15 – 19 September 2025
	Nature Advisory	27 – 30 October 2025
		18 – 21 November 2025

Survey Type	Consultancy	Dates
		21 – 24 July 2026
		<i>Scheduled:</i> Monthly August – December 2026
Brolga wetland assessments (See Section 9)	EHP	30 September – 4 October 2024
	Nature Advisory	23 – 26 February 2026
		7 – 10 July 2026
Migratory shorebird survey (See Section 10)	EHP	12 – 15 November 2024 (Summer 1)
		10 – 13 December 2024 (Summer 2)
		14 – 17 January 2025 (Summer 3)
	Nature Advisory	2 – 5 December 2025 (Summer 4)
		13 – 16 January 2026 (Summer 5)
		10 – 13 February 2026 (Summer 6)
		24 – 27 February 2026 (Summer 7)
Bird Utilisation Surveys (BUS) (See Section 7)	EHP	9 – 12 June 2026 (Winter 1)
		24 – 27 January 2025 (Summer 1)
		5 – 9 May 2025 (Autumn 1)
		30 June – 4 July 2025 (Winter 1)
	Nature Advisory	6 – 10 October 2025 (Spring 1)
		5 – 9 January 2026 (Summer 2)
Bat ultrasonic surveys (See Section 8)	Nature Advisory	4 – 8 May 2026 (Autumn 2)
		17 November – 9 December 2025
		6 January – 5 February 2026
		8 – 22 May 2026
Growling Grass Frog habitat (See Section 12)	Nature Advisory	29 July to late August (currently deployed)
		8 – 11 December 2025

6.2. Results

6.2.1. Fauna habitats

The following fauna habitats have been observed at the Project Area.

- Agricultural crops and pasture;
- Woodland habitat and scattered trees;
- Water bodies, including farm dams, swamps, wetlands, and creek lines (permanent and ephemeral);
- Native grassland; and
- Anthropogenic structures.

Descriptions of each habitat type and their presence within the Project Area are provided below. Some examples of these habitat features are shown in Plate 6-1 to Plate 6-8. Spatial location of the various habitats and DEECA-mapped waterbodies/watercourses is shown in Figure 5-1.

Agricultural crops and pasture

The majority of the Project Area comprised farmland for crops, with some pasture for livestock grazing (Plate 6-2). These areas provide habitat for generalist farmland birds and some grassland-dwelling species. Grasses in this habitat consisted of exotic, improved pasture. Cropped areas, being subject to ploughing, were generally of very low habitat quality as they were unlikely to retain rocks or underground refugia.

Crops and pasture were the most common forms of habitat in the region, but are unlikely to be of high importance to fauna due to being largely non-native, subject to farming, soil disturbance, and having low species diversity.

Woodland and scattered trees

Two main types of wooded fauna habitats identified in the Project Area were Riverine Chenopod Woodland and Lignum Swampy Woodland, with scattered trees present sporadically (Plate 6-8).

Riverine Chenopod and Lignum Swampy Woodland

Small patches of this woodland type (approximately <1 % of the Project Area) are scattered across the study area, consisting largely of remnant patches. They have an overstorey of River Red Gum and Black Box trees with an understorey of chenopod shrubs (Riverine Chenopod Woodland) or of lignum with scattered eucalyptus trees (Lignum Swamp Woodland). Typically, these patches were heavily infested by agricultural grasses, with some lower-quality areas exhibiting near-continuous weed infestations. Regardless, the presence of some mature trees with a sometimes intact and well-formed understorey likely provides habitat for bird nesting and foraging, with smaller birds taking advantage of the cover provided by the shrubbery. Reptiles, such as the Carpet Python, and mammals will also forage and take shelter in the denser vegetation provided in this habitat type.

Scattered trees

Scattered paddock trees, such as Black Box and River Red Gum, provide foraging habitat for birds and bats. Due to their typically old age, they offered hollow nesting opportunities for larger birds and structures on which raptors may nest. Smaller hollows in these trees may also provide shelter for tree-roosting microbats. Scattered trees were relatively isolated and therefore of limited value and accessibility to terrestrial and arboreal mammals and reptiles. Some of these trees provided

shade for livestock, while others remained isolated within cropland. Large, scattered trees may be of some importance in a landscape or regional context, due to their provision of nesting sites to large bird species (e.g. raptors) and their use as stepping-stone connections between distant wooded habitats.

Waterbodies, swamps and irrigation channels

Waterbodies in the Project Area included farm dams, swamps, lignum swamps, creeks, small river systems, wetlands, and man-made drainage channels, which were/are used for irrigation farming. The spatial location of the various DEECA-mapped waterbodies and water courses is shown in Figure 5-1.

Waterbodies

Waterbodies that are not connected (e.g. farm dams in paddocks) could serve as water sources for several species (e.g. bats and birds). While most farm dams in the Project Area are small, isolated, highly turbid, denuded of aquatic vegetation, and regularly accessed by stock and thus unlikely to provide high-quality habitat for waterbirds or frogs (Plate 6-2), some do provide sufficient features to qualify as moderately suitable habitat (Plate 6-7).

Waterways

Several waterways cross or border the Project Area, including:

- Calivil Creek;
- Loddon River;
- Nine Mile Creek;
- Pyramid Creek;
- Serpentine Creek; and
- A number of artificial drainage channels.

These systems are highly modified, but provide important riparian vegetation, water sources and habitat connections for the local fauna (Plate 6-1).

Swamps and wetlands

Several important wetlands exist in the wider region, with two bordering the Project Area: Hird and Johnson Swamp Wildlife Reserves.

Hird and Johnson Swamps are shallow freshwater wetland systems that support several ecological values, with both forming part of the Kerang Wetlands Ramsar site. Both wetlands are characterised by broad, shallow basins with an extensive distribution of emergent and aquatic vegetation. Fringing and surrounding vegetation includes River Red Gum (*Eucalyptus camaldulensis*), lignum (*Duma florulenta*), cumbungi (*Typha* spp.), rushes and areas of coarse woody debris, which collectively provide important habitat for waterbirds, fish and other aquatic fauna. Both swamps are known breeding wetlands for Brolga.

Hird Swamp is an important site for colonial breeding waterbirds, supporting significant breeding colonies of Straw-necked Ibis and Australian White Ibis (DSEWPac 2011). Hird Swamp also contains a high diversity and abundance of aquatic vegetation and up to eight recorded fish species (DSEWPac 2011). In the context of migratory shorebirds, the Hird and Johnsons Swamps show

much lower numbers compared to those observed at other higher quality wetlands to the north (see Section 10.3).

Both Hird and Johnson Swamps are actively managed through environmental water allocations designed to promote and maintain their ecological values, and as a result, are generally not dry for periods of five or more years (DSEWPac 2011).

Both Hird and Johnson Swamps are hydrologically disconnected from their natural water source, Pyramid Creek, as a result of stream modifications and the construction of levees in the 1960s (DSEWPac 2011). Current hydrological regimes are therefore largely managed, with water inputs regulated to support environmental values rather than natural flow processes. Both swamps can receive episodic floodwaters during large regional flood events, such as those that occurred in February 2011 and 2022, which play an important role in maintaining wetland condition and preventing further degradation of environmental values by sustaining ecological processes and productivity (DSEWPac 2011). This ongoing water management is a critical factor in maintaining adequate inundation to support Brolga breeding and sustain resources for Brolga and other waterbirds. Salinity within Hird Swamp typically ranges between approximately 2,600 and 3,100 EC (the lower end of what is considered brackish), while levels within Johnson Swamp are generally lower than those of Hird Swamp, ranging from approximately 400 to 1,500 EC (Lugg 1989).

Native grassland

Native grasslands within the Project Area included Plains Grassland and Chenopod Grassland (Plate 6-4 and Plate 6-5). They were generally dominated by Spider Grass and Rigid Panic, with some cover of various Wallaby grass species. Chenopod grassland had a higher concentration of chenopod shrubs, such as Berry Saltbush, Black Roly-poly, Ruby Saltbush, Wingless Bluebush and Hedge Saltbush. Shelter habitat through cracking clay soils was limited, but the site supported a relative abundance of rocks or coarse woody debris on non-managed land. Several patches of native grassland contained much bare ground (Plate 6-6), potentially providing habitat to species such as the Plains-wanderer. Small terrestrial vertebrates, including reptiles, small mammals and frogs, may occur in this fauna habitat, and so may a variety of bird species, including both generalists common in farmland and those specifically associated with grassland areas.

Anthropogenic structures

Farm dwellings, sheds, transmission towers, and fence posts offer some habitat by acting as shelter, nesting habitat, or perching opportunities for a range of species from birds (e.g. Black Falcon) to reptiles (e.g. Carpet Python and Bearded Dragon) and bats.

Disused structures are likely to be of value, as the lack of regular disturbance makes them more suitable for fauna. Being scattered across the landscape, this potential fauna habitat occupies a relatively low proportion of the Project Area and is poorly connected to similar areas both within and beyond the Project Area. The low quality of this fauna habitat makes it unlikely to be important in a landscape or regional context, with the exception of transmission towers, which provide valuable nesting habitat for large raptors (e.g. Black Falcon and Wedge-tailed Eagle), which are increasingly impacted by the loss of large nesting trees in the landscape.



Plate 6-1: Creek lines provide wetland and native vegetation habitats (Calivil Creek; Oct 2025).



Plate 6-2: Agricultural land dominates the site, with farm dams scattered throughout (Oct 2025).



Plate 6-3: Wetlands to the east of the site provide high-quality habitats (Hird Swamp, part of the Kerang Wetland Ramsar Site; Oct 2025).



Plate 6-4: Native grasslands and lignum swampland bordering Calivil Creek (Oct 2025).



Plate 6-5: Native grassland scattered throughout the site in small to moderate-sized patches (Dec 2025).



Plate 6-6: Native grasslands with much bare ground (Dec 2025).



Plate 6-7: The site contains many farm dams, most of low-quality habitat, though some retain features suitable for aquatic species such as frogs (Dec 2025).



Plate 6-8: Scattered trees and remnant woodland patches of vegetation are sparse throughout the site (Dec 2025).

6.2.2. Fauna species

Species recorded during field assessments

During field assessments, 119 fauna species were recorded within the Project Area. This included 105 bird species, at least 13 mammal species (2 introduced), and one reptile species. See Appendix 7 for a full list of species observed within the Project Area. Nine microbat species and one species complex (e.g., Long-eared Bat species complex, which consists of three species, Corben's Long-eared Bat, Gould's Long-eared Bat, and the Lesser Long-eared Bat).

Listed fauna species

Database searches returned records or distributions of 96 listed fauna species in the search region (Appendix 8). Assessment of the likelihood of these species occurring within the Project Area results in 55 species that are known, likely, or have the potential to occur within the Project Area (Table 6-2). Of these, 15 species were recorded within the search region during the field surveys (species in bold). A further 6 species were observed during field surveys in the wider 35 km shorebird search region.

The likelihood of occurrence of fauna species listed under the EPBC Act and FFG Act in the Project Area is addressed in detail in Appendix 8.

All species recorded in the VBA within the study area are shown in Figure 6-1. Note that not all of these species have been concluded as having the potential or likely to occur within the Project Area.

Table 6-2: Listed Fauna species that are likely or have the potential to occur within the Project Area, are known within the Project Area, or have been recorded within 10 km desktop search region or 35 km shorebird study area.

Species	Threatened species status		Likelihood of occurrence
	EPBC Act	FFG Act	
Birds			
Australasian Bittern	En	Cr	Known (recorded within 10 km search region)
Australasian Shoveler	-	Vu	Known (recorded within 10 km search region)
Australian Bustard	-	Cr	Potential
Australian Gull-billed Tern	-	En	Known (recorded within 10 km search region)
Australian Little Bittern	-	En	Potential
Australian Painted Snipe	En	Cr	Potential
Barking Owl	-	Cr	Potential
Black Falcon	-	Cr	Known (recorded within Project Area)
Blue-billed Duck	-	Vu	Likely
Blue-winged Parrot	Vu	-	Known (recorded within Project Area)
Brolga	-	En	Known (recorded within Project Area)
Brown Treecreeper	Vu	Vu	Known (recorded within Project Area)
Bush Stone-curlew	-	Cr	Potential
Caspian Tern	Mig.	Vu	Likely (recorded within 35 km shorebird study area)
Common Greenshank	En, Mig.	En	Likely (recorded within 35 km shorebird study area)
Common Sandpiper	Mig.	Vu	Likely
Curlew Sandpiper	Cr, Mig.	Cr	Likely (recorded within 35 km shorebird study area)
Diamond Dove	-	Vu	Potential
Diamond Firetail	Vu	Vu	Likely
Double-banded Plover	Mig.	-	Potential
Eastern Great Egret	-	Vu	Known (recorded within Project Area)
Fork-tailed Swift	Mig.	-	Potential

Species	Threatened species status		Likelihood of occurrence
	EPBC Act	FFG Act	
Freckled Duck	-	En	Likely
Glossy Ibis	Mig.	-	Likely
Grey-crowned Babbler	-	Vu	Likely
Hooded Robin	En	Vu	Likely
Latham's Snipe	Vu, Mig.	-	Likely
Little Eagle	-	Vu	Known (recorded within Project Area)
Little Egret	-	En	Likely
Long-toed Stint	Mig.	-	Potential
Magpie Goose	-	Vu	Known (recorded within Project Area)
Marsh Sandpiper	Mig.	En	Potential
Musk Duck	-	Vu	Known (recorded within 10 km search region)
Pectoral Sandpiper	Mig.	-	Potential
Plains-wanderer	Cr	Cr	Potential
Plumed Egret	-	Cr	Known (recorded within Project Area)
Red-necked Stint	Mig.	-	Likely (recorded within 35 km shorebird study area)
Sharp-tailed Sandpiper	Vu, Mig.	-	Likely (recorded within 35 km shorebird study area)
Southern Whiteface	Vu	-	Known (recorded within 10 km search region)
Square-tailed Kite	-	Vu	Likely
White-bellied Sea-Eagle	-	En	Known (recorded within 10 km search region)
White-throated Needletail	Vu, Mig.	Vu	Potential
White-winged Tern	Mig.	-	Potential
Wood Sandpiper	Mig.	En	Potential
Mammals			
Fat-tailed Dunnart	-	Vu	Potential
Corben's Long-eared Bat	Vu	En	Potential
Yellow-bellied Sheath-tail Bat	-	Vu	Potential

Species	Threatened species status		Likelihood of occurrence
	EPBC Act	FFG Act	
Fish			
Freshwater Catfish	-	En	Potential
Murray Cod	Vu	En	Potential
Murray Hardyhead	En	Cr	Potential
Murray-Darling Rainbowfish	-	En	Potential
Southern Purple-spotted Gudgeon	-	Cr	Potential
Frogs			
Growling Grass Frog	Vu	Vu	Potential
Reptiles			
Bearded Dragon	-	Vu	Known (recorded within Project Area)
Carpet Python	-	En	Potential

NOTES: Bolding indicates known to occur in the study area, through existing surveys by EHP or NA for the Project Area.

Potential impacts to the birds listed in Table 6-2 are provided in the bird utilisation section of this report (Section 7), though Brolgas (Section 9), migratory shorebirds (Section 10) and the Plains-wanderer (Section 11) are discussed in their own sections. Potential impacts to bats are addressed in Section 8, and that to the Growling Grass Frog in Section 12.

Potential impacts to species and species groups, such as aquatic species and reptiles that are not covered in separate chapters, are discussed below.

Fish species

No major creeks are impacted by the project (DCE 2026b), and none of the minorly impacted creeks, wetlands or waterbodies are considered to be potential habitat for any of the listed fish in Table 6-2. As such, impacts to these species are considered unlikely and will not be further assessed in this report.

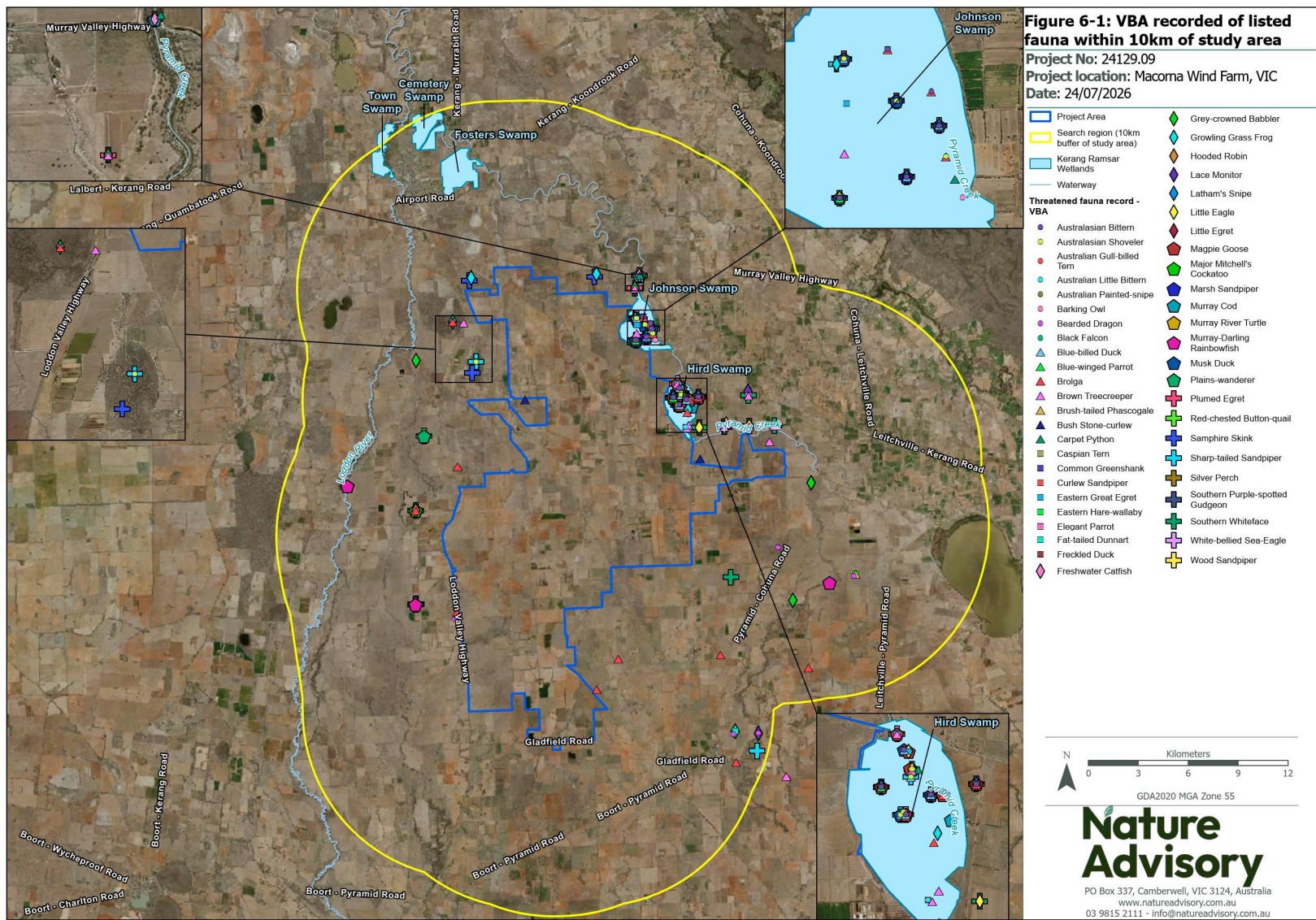
Reptiles

Eastern Bearded Dragon is listed as Vulnerable under the FFG Act and was recorded within the Project Area by EHP during roaming surveys in 2025. This species may be impacted through loss or degradation of habitat and direct loss of individuals as roadkill.

The species prefers dry woodland and forest areas but is known to inhabit a variety of habitats, including suburban gardens. Patches of remnant vegetation, including roadside areas, are likely important for the species, along with the larger tracts surrounding Johnson and Hird Swamp.

Traffic increases as a result of the project may slightly increase the probability of roadkill for reptiles, see the Amber report (Amber 2026) for further details. However, as woodland areas will be avoided by the project design, impacts to this species are considered unlikely.

Carpet Python *Morelia spilota* is listed as Endangered under the FFG Act and has the potential to occur within the project site in waterways (Loddon River, Pyramid Creek, Barr Creek, and the upper reaches of Serpentine Creek) and nearby swamps and wetlands (Tragowel Swamp Nature Conservation Reserve, and Hird, Johnson, and Two Mile Swamp Wildlife Reserves). The species depends on key structural habitat features such as hollow-bearing trees/logs and/or large rock outcrops with large rock crevices and thick litter/shrub cover (DSE 2003). Overall, habitat within the Project Area is present but relatively limited and fragmented compared to surrounding landscapes. Traffic increases as a result of the project may increase the probability of roadkill for reptiles, see the Amber report (Amber 2026) for further details. However, residual and cumulative impacts are expected to be low to negligible.



6.2.3. Listed bird communities

An assessment of the presence of listed ecological communities within the Project Area is presented in Section 5.4. This assessment identified three bird communities that may occur: the *Mallee Bird Community of the Murray Darling Depression Bioregion* (EPBC: endangered), the *Victorian Mallee Bird Community* (FFG: threatened), and the *Victorian Temperate Woodland Bird Community* (FFG: threatened).

The Victorian Temperate Woodland Bird Community was found to have the potential to occur within the search region, with a possibility of occurring within woodland habitats across the Project Area (Table 6-3). The *Mallee Bird Community of the Murray Darling Depression Bioregion* was found to not occur, whilst the *Victorian Mallee Bird Community* was found to be unlikely to occur. As a result, these two communities are not considered further in this assessment.

Table 6-3: Listed bird communities and their likelihood of occurrence in the study area

Community	Likelihood of occurrence
Mallee Bird Community of the Murray Darling Depression Bioregion (EPBC: Endangered)	The Mallee Bird Community (MBC) is an assemblage of 20 bird species that rely on mallee habitats. There are several key diagnostics to identify this community (TSSC 2021): ▪ Located within the geographic boundary: ▫ No, the Project Area is within the Riverina IBRA bioregion but not within the listed subregions (Murray Fans, Robinvale Plains or Murray Scroll Belt) ▪ Presence of native vegetation patches that are ≥ 5 ha and dominated by mallee vegetation: ▫ No mallee-specific EVCs are modelled to occur within the Project Area (DEECA 2026a), and none have been recorded during detailed vegetation surveys (see Section 5) ▪ Number of MBC species recorded within 20 km: ▫ 0 of the 8 mallee-specialist bird species, ▫ 9 of 12 mallee-dependent bird species Although many of the mallee-dependent bird species have been recorded within 20 km, this is likely a result of the proximity of the Murray Fans bioregion, where mallee habitats are known to exist. As the Project Area is not within the specified bioregions and there is no mallee vegetation modelled or known to occur within the Project Area, the community is considered not to occur within the MAWF. Does not occur.
Victorian Mallee Bird Community (FFG: threatened)	The Victorian Mallee Bird Community comprises 20 mallee-dependent bird species and subspecies, and an additional 23 that occur in such habitats but are not largely or totally restricted to mallee (SAC 2002):

Community	Likelihood of occurrence
	▪ The Project Area does not occur within the defined Mallee bioregion; ▪ No mallee-specific EVCs are modelled to occur within the Project Area (DEECA 2026a), and none have been recorded during detailed vegetation surveys (see Section 5); ▪ 8 of 20 mallee-dependent bird species recorded within 20 km; and ▪ 22 of 23 mallee-associated bird species recorded within 20 km Although many of the mallee-dependent and mallee-associated bird species have been recorded within 20 km, this is likely a result of the proximity of the Murray Fans bioregion, where mallee habitats are known to exist. As there is no mallee vegetation modelled or known to occur within the Project Area, the community is considered unlikely to be present within the MAWF. Unlikely to occur.
Victorian Temperate Woodland Bird Community (FFG: Threatened)	The Victorian Temperate Woodland Bird Community comprises 24 woodland-dependent species, which are characteristically and commonly found within box-ironbark, yellow box, cypress pine and other woodlands (SAC 2000). An additional 21 woodland-associated species are included within the community, but whose occurrence extends beyond woodlands (SAC 2000): ▪ The Project Area occurs within the general area defined by the community's listing; ▪ Two types of woodland EVCs are both modelled (DEECA 2026a), and known to occur within the Project Area (see Section 5); ▪ 19 of 24 woodland-dependent bird species recorded within 20 km; and ▪ 16 of 21 woodland-associated bird species recorded within 20 km. As a result, the community is considered to be potentially present, albeit restricted to woodland habitats, which are generally sparse across the Project Area (approximately <1% of the Project Area). Potential to occur.

NOTE: Communities highlighted in grey are known, likely, or have the potential to occur.

6.3. Conclusions and recommendations

6.3.1. Summary of findings

Field surveys and the analysis of existing data showed that there is a restricted range and abundance of fauna habitat present within the Project Area, with the majority comprised of farmland for crops and grazing. Some grazed paddocks comprise native grasslands, potentially providing habitat to species such as the Plains-wanderer and small terrestrial vertebrates, including reptiles, small mammals and a variety of bird species.

Small patches of woodland are scattered across the project site, providing refuge for fauna species, such as Carpet Python and Bearded Dragon and habitat for bird nesting and foraging. A small number of scattered trees are spread across the Project Area, providing foraging habitat for birds and bats.

Several waterways cross or border the Project Area, such as Calivil Creek and Loddon River, which provide important riparian vegetation, water sources and habitat connections for the local fauna. Several important wetlands exist in the wider region, with two bordering the Project Area: Hird and Johnson Swamp Wildlife Reserves, both being within the Kerang Wetlands Ramsar site.

Assessment of the likelihood of these species occurring within the Project Area found that 55 species listed under the EPBC Act and/or FFG Acts are known, likely, or have the potential to occur within the Project Area, 14 of which have been recorded during field surveys.

In addition, the FFG Act-listed *Victorian Temperate Woodland Bird Community* is considered to have the potential to occur. Likely in small patches owing to the lack of wooded areas within the Project Area.

6.3.2. Potential impact pathways

The impact pathways affecting fauna species can be broadly categorised into two groups: construction impacts and operational impacts.

Construction impacts

Construction impacts could include:

- *Habitat loss and fragmentation* from *clearance*, earthworks and physical disturbance. This includes construction and maintenance works during operation that involve earthworks, noise, and dust;
- *Road mortality* of individuals in fauna-vehicle collisions related to increased traffic during construction; and
- *Habitat degradation* from direct and indirect pathways, including introduction or spread of invasive species or pathogens, edge effects, barrier effects, surface hydrological changes, deposition of eroded sediments or contamination caused by accidental spills of hazardous materials.

Operational impacts

Operational impacts could include:

- *Collision mortality* of birds and bats with turbines, transmission lines, and/or other infrastructure; and

- *Road mortality* of individuals in fauna-vehicle collisions related to increased traffic from operational or maintenance vehicles.
- *Barrier effects* where birds and bats may be displaced as movement pathways are altered to avoid the wind farm

In addition to the above pathways, the following FFG Act-listed threatening processes have the potential to be exacerbated by the Project if there is any:

- Loss of hollow-bearing trees;
- Loss of coarse woody debris;
- Invasion of suitable habitats by environmental weeds; and
- Increase in sediment input into rivers and streams due to human activities.

6.3.3. Assessment of potential impacts

The key impact pathways for fauna (aside from birds and bats) associated with the Project relate primarily to habitat loss and fragmentation, habitat degradation, and direct mortality during construction and operation. Through an iterative design process, the Project has sought to avoid and minimise these pathways by excluding woodland habitat, reducing impacts to scattered and large trees, and substantially decreasing the overall extent of native vegetation removal from approximately 130 hectares to 45.523 hectares. In addition, micro-siting has avoided wetlands and minimised disturbance to waterways, with creek crossings limited to discrete, unavoidable locations. As a result, the primary pathway of habitat loss has been significantly reduced in scale and largely confined to modified or lower-value habitats within the broader agricultural landscape.

Given these design refinements, the significance of habitat loss and fragmentation for fauna is considered low. Most affected habitats are already fragmented and disturbed, and the Project avoids key habitat features that would otherwise support higher-value habitat and potential fauna assemblages. Similarly, potential impacts associated with habitat degradation are expected to be localised and temporary, arising mainly during construction activities, and will be managed through standard environmental controls and project-specific management plans.

The risk of direct fauna mortality, including vehicle strike and interaction with infrastructure, represents a residual impact pathway. However, with the implementation of mitigation measures (see Section 6.3.4), these risks are expected to be low and localised. Overall, due to the strong avoidance and minimisation approach embedded in the Project design, the residual impacts on fauna are not expected to be significant at a local or regional scale.

6.3.4. Recommended application of the mitigation hierarchy

This section provides recommendations for the application of the mitigation hierarchy to reduce the potential significance of key impact pathways. We note that some of these have been applied by the Proponent in the early stage of design, effectively reducing the impacts of the project. For a discussion on actions already taken and how that relates to impact assessment, see Section 14.2.2.

Rehabilitation

Where habitats or their connectivity are fragmented during construction (e.g. through unavoidable creek crossings), they should be subject to subsequent rehabilitation. Priority can be given to the restoration of patches that are, or can be made, sufficiently large or contain suitable habitat

features (e.g. hollow-bearing trees and coarse woody debris) to support breeding of those listed species that are present. Preference will be given to woodland habitat, which is generally sparse across the Project Area.

Reduce habitat degradation

Measures to reduce potential degradation of habitat should be included within a Construction Environmental Management Plan (CEMP). This plan should align with industry standards, best practices, and guidelines. Detailed recommendations are provided in Section 15.3.

Direct mortality (roadkill)

Road mortality associated with the development will be managed through a combination of controls featured in the Traffic Management Plan (TMP) (Amber 2026). The TMP should include measures to reduce the likelihood of roadkill for listed species, such as enforcing low vehicle speed limits at key periods and locations, such as in areas of suitable habitat for Bearded Dragon and Carpet Python during the warmer months (October to April), which can reduce mortality risks. Any road mortality of listed species (e.g. Bearded Dragon, Carpet Python, etc.) should be recorded to quantify potential impacts of increased traffic. The TMP will be finalised and provided to the regulator for approval prior to construction beginning.

6.3.5. Conclusions and further investigations

This assessment concludes that several listed fauna species and one bird community are likely to exist within the Project Area. As impacts to woodland habitat and wetlands are mostly avoided, impacts to species groups using these habitats are considered unlikely (see Section 13). This includes woodland birds, reptiles such as the Eastern Bearded Dragon and Carpet Python, as well as aquatic species.

Impact pathways for specific species or species groups are discussed in further detail in the relevant chapters: birds (Section 7), bats (Section 8), Brolga (Section 9), migratory shorebirds (Section 10), Plains-wanderer (Section 11), and Growling Grass Frog (Section 12). The proposed application of the mitigation hierarchy, residual risk to these species, as well as conclusions and any further investigations required for these species or fauna groups, is further discussed in these specific chapters.

Residual risks to other groups or species are expected to be appropriately managed through the implementation of recommended mitigation measures (see Section 6.3.4).

7. Bird utilisation surveys

This section presents the pre-construction baseline data on the utilisation of the proposed Project Area by birds. Bird Utilisation Surveys (BUS) were undertaken by EHP (2025, four seasons) and Nature Advisory (2026, two seasons). Further surveys are planned in 2026 to complete two years of seasonal surveys (eight total). The aim of the BUS is to assess the diversity, abundance, spatial distribution, activity, and flight characteristics of birds within the Project Area (DCCEE 2024a). This information will be used to identify species of concern, highlight potential impacts and inform recommendations for application of the mitigation hierarchy. Pre-construction BUS data also provides a baseline against which post-construction BUS data can be compared as part of a before–after control–impact (BACI) assessment.

A comprehensive analysis of the species and trends observed over the entire monitoring period to date is presented below. Some bird species are not suitably addressed using the BUS methodology and are thus addressed in targeted studies (e.g. Brolga, migratory shorebirds, and Plains-wanderer). The outcomes of these targeted studies are detailed in their relevant chapters.

7.1. Methodology

7.1.1. Fixed-point bird count

BUS were undertaken by both Ecology and Heritage Partners (EHP) and Nature Advisory (NA) using the fixed-point bird count method. This method involved an observer stationed at a pre-determined survey point for 20 minutes. During this period, a count of all bird species observed were recorded. A visual estimation of the height above ground is also made for all bird observations. For Species of Concern (listed threatened, migratory and raptor species), the minimum and maximum heights were also estimated and recorded by NA (but not EHP).

The height of birds that were heard only was estimated using cues such as knowledge of the species' usual behaviour, type of call (flight call, perched call, song, which usually indicates species-specific behaviour), and according to the canopy height and the woodland strata they were heard from. Flight heights for birds that were only heard are therefore likely less accurate than those for birds where the height can be visually estimated. Birds flying at or above the Rotor Swept Area (RSA) are rarely only heard, as they are generally flying at heights of >50 m, above the tree canopy and are readily visible. Therefore, inclusion of “heard-only” observations is unlikely to compromise data quality for collision impact assessments, as they mostly fall below RSA.

Comparison of EHP and NA methodology

The BUS methods implemented by EHP and NA are broadly comparable, with only minor methodological differences that do not materially affect the interpretation of bird utilisation across the study area. A comparison of the two survey methods can be found in Appendix 9. The most notable difference relates to the distribution of reference and impact survey points. A greater number of reference points were included in the EHP program; however, this primarily reflects subsequent project layout changes rather than a substantive methodological difference. The spatial coverage of these survey points still provides a representative assessment of bird utilisation across the broader landscape (Figure 7-1).

Survey effort between the two consultancies was largely aligned across seasons. The earliest EHP surveys included fewer replicate surveys per season, though an analysis of survey effort was undertaken to confirm that the sampling intensity was sufficient to detect the number of species

likely to be present in the study area. This analysis indicated that the survey effort was appropriate for characterising the avifauna community (see Section 7.2.1).

There are also some minor differences in observation protocols. EHP surveys applied a more restricted detection radius, which may result in fewer birds being recorded relative to the number present within the broader landscape. However, the subsequent NA surveys incorporated a broader detection approach, effectively compensating for this limitation and providing additional coverage that helps address any potential gaps in detection.

Differences also exist in the recording of flight height information for Species of Concern. EHP recorded only the initial flight height of these species, which limits the ability to determine whether a bird entered the RSA at any point during an observation. In contrast, NA recorded both the minimum and maximum flight heights observed, enabling a clearer determination of whether birds flew within the RSA at any point during the observation.

EHP also recorded listed species as point locations only and did not document flight paths. In contrast, NA recorded flight paths for species listed under the FFG Act, the EPBC Act, or as 'Species of Concern' (DEECA 2025h). This provides additional spatial information on bird movement through the study area, improving the ability to assess how sensitive species may move through the landscape and may assist with inclusion into a Collision Risk Model, if required.

Finally, EHP occasionally recorded "heard only" observations without associated distance estimates. These records are unlikely to influence the combined analysis of BUS results, as they do not contribute to flight height or spatial utilisation metrics that underpin the primary assessment of collision risk and bird movement through the landscape.

Table 7-1: Differences in BUS methodology between Nature Advisory and EHP.

Survey aspect	NA methodology	EHP methodology
Survey points	12 (10 impact, 2 reference)	12 (4 impact, 8 reference)
Minimum number of replicates per point	8	6 (Summer 2025) 8 (Autumn – Spring 2025)
Survey effort (minutes) per survey	20	20
Search radius	No limit, as far as observable using 10x binoculars	Small birds = 100 m Large birds = 400 m
Initial, minimum and maximum heights recorded for 'Species of Concern'	Yes, all three heights	No, initial heights only
Flight paths for 'Species of Concern'	Yes, collected for all FFG, EPBC-listed, and Species of Concern	None collected
Heard-only observations	Estimate height and distance	Estimate height only (no distance recorded)

7.1.2. Survey effort

A total of eight seasonal BUS surveys will be completed across two consecutive years, with Year 1 undertaken by EHP in 2025 and Year 2 undertaken by NA in 2026 (see Table 7-2 for details on survey effort).

For each seasonal BUS, a survey schedule was designed to ensure each point was surveyed at different times of day to avoid time-of-day bias in bird activity. Each survey included 12 points. Each point was surveyed twice within each time window (early morning, late morning, early afternoon, and late afternoon) per survey, resulting in eight replicates per point per season, with the exception of the summer 2025 BUS completed by EHP, which included six replicates. Table 7-3 provides an example of the survey schedule undertaken by Nature Advisory and indicates when each point was surveyed on each survey day.

Table 7-2: Total survey effort for bird utilisation surveys at Macorna Wind Farm. Those planned, but yet to be completed, are shown in grey font.

Survey Period (Consultancy)	Dates	Season	Sites (impact/reference)	Surveys (#)	Total survey time (hrs)
1 (EHP)	24 – 27 February 2025	Summer	12 (4/8)	72	24.0
2 (EHP)	5 – 9 May 2025	Autumn	12 (4/8)	96	32.0
3 (EHP)	30 June - 4 July 2025	Winter	12 (4/8)	94	31.3
4 (EHP)	6 – 10 October 2025	Spring	12 (4/8)	97	32.3
5 (NA)	5 – 8 January 2026	Summer	12 (10/2)	96	32
6 (NA)	4 – 8 May 2026	Autumn	12 (10/2)	96	32
7 (NA)	Late August 2026	Winter	12 (10/2)	-	-
8 (NA)	October 2026	Spring	12 (10/2)	-	-
TOTAL				549 surveys	182.9 hrs

Table 7-3: Example schedule of BUS surveys during a seasonal survey period, showing the range of times surveys were undertaken.

Time slot		Day 1		Day 2		Day 3		Day 4		Day 5	
		A	B	A	B	A	B	A	B	A	B
Early morning	7:30-8:00		R2	2			6	5		7	6
	8:00-8:30	1		5	2	1			3		
	8:30-9:00		R1				9	3		8	R2
	9:00-9:30	4		R1	7			9			10
	9:30-10:00				8	4	10				
Late morning	10:00-10:30	5	4	9	1	2	7	R1		5	
	10:30-11:00		3	10			8				3
	11:00-11:30	6			R1	10			R2	8	
	11:30-12:00	7	2					1			R2
	12:00-12:30			4	6		9				
Early afternoon	12:30-13:00		8	4	8		4	3	1	3	1
	13:00-13:30	9			9	10					
	13:30-14:00			6			2		5	6	
	14:00-14:30	R1	7	7	R1	R2		5	2		R2
	14:30-15:00						10				
Late afternoon	15:00-15:30		3		1				R2	4	
	15:30-16:00	8				1	R2				
	16:00-16:30		4	3			2	8			6
	16:30-17:00	7			6				R1	5	
	17:00-17:30					2		9			
	17:30-18:00			5							7
	18:00-18:30	9	10				R1			10	

Notes: Numbers refer to survey points and 'R' to reference sites; A and B refer to two individual surveyors.

7.1.3. Location of survey points

Surveys were undertaken at two types of survey points:

- *Impact points* – located at or within 300 m of proposed turbine locations, in similar habitat to that proposed for impact; and
- *Reference points* – located at least 500 m away from proposed turbine locations in a similar habitat to that found at impact sites.

Surveys completed by EHP included 12 survey points, comprising 4 impact points and 8 reference points (Figure 7-1). We note that the skew towards reference points was the result of changes to the early layout, moving turbines further away from the original EHP survey points. Surveys completed by NA consisted of 12 survey points: 10 impact points and 2 reference points (Figure 7-1). The habitat present at each BUS survey point is described in Table 7-4.

Table 7-4: Habitat descriptions of BUS survey points used by EHP and Nature Advisory.

Survey Point	Consultancy	Description of habitat
Impact sites		
EHP1	EHP	Native roadside grassland bordered by cropped land, with a drainage channel nearby containing sparse scattered eucalypt trees.
EHP7	EHP	Cropland at the edge of a large paddock, adjacent to a major drainage channel; no trees present in the immediate vicinity of the survey point.
EHP9	EHP	Cropland mosaic surrounded by cropped paddocks, with sparse roadside eucalypts to the east, a small farm dam, and grassland along the road reserve.
EHP11	EHP	Introduced pasture in the north-east corner of a large livestock paddock, with a small eucalypt woodland approximately 80 m to the east and a roadside eucalypt line commencing ~80 m to the north-west.
B1	NA	Roadside grassland with areas of introduced pasture; chenopod grassland extends into the northern paddock, with a southern paddock supporting grain or pasture crops. Drainage channels occur within 200 m.
B2	NA	Black Box and Lignum Swampy Woodland to the east, comprising mature, senescent, and dead trees with native Lignum and African Boxthorn (exotic weed) understorey, subject to periodic inundation. To the west, young sorghum/corn crops were seasonally flooded in summer 2026.
B3	NA	Cropland , semi-flooded during summer 2026, supporting ~1 m tall crops, with a vegetated farm dam nearby and chenopod grassland approximately 100 m to the west.
B4	NA	Native treed roadside adjoining grassy cropping paddocks , dry and harvested in summer 2026. A large water channel occurs approximately 120 m south of the point.
B5	NA	Irrigation cropping area , with crops to the south and no crops to the north. Additional irrigation flooding occurs further west.
B6	NA	Mixed agricultural landscape , comprising rain-fed grassy crops to the west and pasture to the east, adjacent to a small patch of planted native trees and shrubs. A large water channel occurs approximately 150 m south, and a Wedge-tailed Eagle nest is present on a transmission tower approximately 1 km to the south.
B7	NA	Lignum swamp (dry in summer 2026) to the south and dry rain-fed cropping land to the north, with roadside lignum swamp and chenopod grassland. Calivil Creek occurs approximately 300 m to the east.
B8	NA	Introduced pasture on both sides of the road, with scattered rows and patches of planted native trees. Nine Mile Creek occurs approximately 500 m to the east and south.

Survey Point	Consultancy	Description of habitat
B9	NA	Cropping land , with remnant Black Box trees along the roadside approximately 200 m to the north.
B10	NA	Introduced pasture to the north and extensive chenopod grassland to the south, with scattered roadside trees.
Reference sites		
EHP2	EHP	Roadside grassland and ephemeral drainage line, adjacent to a road between cropped paddocks to the north and south-east, with Johnson Swamp Wildlife Reserve immediately to the east. The drainage line is sparsely vegetated and grades into grassland toward the swamp. There is a Wedge-tailed eagle nest to the south.
EHP3	EHP	Roadside native vegetation adjoining a larger drainage channel, supporting dry grassland and scattered shrubs, and surrounded by cropped paddocks.
EHP4	EHP	Roadside native vegetation with scattered eucalypts, surrounded by cropped paddocks, with a strip of shrubby grassland to the west and a larger drainage channel approximately 250 m to the east.
EHP5	EHP	Cropland is situated approximately 100 m south of a larger drainage line. Sparse eucalypts line the north-south road approximately 50 m east of the survey point and occur along the northern bank of the drainage line.
EHP6	EHP	Cropland, adjacent to a eucalypt-lined road , with an ephemeral drainage line approximately 100 m to the east on the opposite side of the road.
EHP8	EHP	Cropland on the edge of a large paddock, adjacent to a road, with densely shrubby vegetation along Calivil Creek approximately 100 m to the north-east. Aside from creek-line shrubs, vegetation is limited to roadside grassland, with two small farm dams located approximately 130 m to the east on either side of the road. There is a Wedge-tailed eagle nest to the northeast.
EHP10	EHP	Cropland with nearby native roadside grassland . A line of eucalypts commences approximately 70 m from the survey point, and a farm dam occurs approximately 150 m to the south-east.
EHP12	EHP	Reserved shrubby grassland surrounded by cropped paddocks , with a mid-sized drainage channel within approximately 100 m of the site and a line of roadside eucalypts commencing approximately 100 m to the west. There is a Wedge-tailed eagle nest to the northwest.
R1	NA	Chenopod grassland to the east, adjoining a pasture or grazing crop to the west.
R2	NA	Roadside Lignum swamp and Chenopod grassland , with a dry grain crop to the east and a mosaic of dry cropping land and Lignum swamp to the west. A large drainage channel occurs approximately 700 m to the west.

7.1.4. Incidental observations

In addition to the observations during formalised fixed-point counts, incidental observations of birds of concern (listed threatened and migratory species and raptors) were made whilst travelling throughout the Project Area by both EHP and NA.

7.1.5. Data preparation and analysis

Survey suitability

To assess the suitability of the survey effort in detecting the majority of the species assemblage within the Project Area during each seasonal BUS, the number of species observed versus the number of individual surveys conducted was plotted as a species accumulation curve. A flattening of the plotted curve as the number of surveys conducted increases indicates that an increasingly higher proportion of the total species present during each BUS has been observed. All analyses were undertaken in the R statistical program (R Core Team 2026).

Flight heights

Recorded flight heights for all observations were assigned as below at, or above rotor swept area (RSA) height, as detailed below:

- **A** = Below RSA (< 60 m above ground)
- **B** = At RSA (60 – 252 m above ground)
- **C** = Above RSA (> 252 m above ground).

These categories were used as birds flying at RSA are considered to be at the greatest risk of collision, while those consistently flying below RSA are generally subject to lower risk. This categorical approach allows species-specific flight behaviour to be evaluated in a consistent and precautionary manner, while accounting for uncertainty in visual flight-height estimation under field conditions.

Preparation of EHP data

EHP undertook the first year of BUS surveys. Data from these surveys were provided to NA, who undertook data cleaning to ensure appropriate comparisons between EHP and NA data, and the full inclusion of EHP data into analyses. The following steps were taken:

- Excluded observations:
 - Where observations were made more than 20 mins after the start of the survey, they were removed ($n=65$). This standardises the 20 min survey effort and is in alignment with the 20 min survey timeframe as stated by EHP to be their method (Cogency *pers. comm.*).
- Included observations, with errors corrected:
 - When counts were recorded as zero or omitted from data, the counts were adjusted to 1 ($n=341$). This represents a conservative approach using the minimum number of observable birds.
 - Where the survey point was incorrectly recorded, these were reconciled with spatial data to the correct point ($n=10$).
 - Where species names were incorrectly labelled, they were corrected (e.g. Fairywren versus Fairy-wren). This made naming consistent and allowed comparisons between datasets.
- Included observations, with incomplete records:

- Where distance measurements were missing ($n=341$), the data were retained for inclusion. These data were retained as distance measurements are not central to the analyses presented here.
- Birds not identified to species level (e.g. Falcon spp., Martin spp., Miner spp., and Raven spp.) were not used to contribute towards the species tally, but were included in flight height analyses ($n=20$).

Following these steps, a total of 2,814 data points were retained for inclusion in this analysis. Of the data excluded from analysis, no observations were of listed threatened or migratory species.

7.1.6. Limitations

The layout of the Project has been adapted by the Proponent to avoid impacts to native vegetation, among other values. As a result, the earlier BUS survey points set by EHP have become reference points (i.e. >500 m from the nearest turbine). This means that the first year of BUS has an underrepresentation of surveys near impact sites (4 of 12). However, all sites are representative to habitat where turbines are now located. When NA assumed responsibility for ongoing BUS surveys in 2026, the location of survey points was changed to address this limitation. All points (except EHP9, which became B9), were moved to address the latest locations and habitat representation of impacted areas.

The summer 2026 BUS overlapped partly with a heatwave, where temperatures rose above 44°C at midday. This exceeded the maximum temperature for which field staff could safely undertake surveys. To compensate for the inability to survey during the hottest part of the afternoons, additional surveys were undertaken during the early morning. We do, however, note that the number of species observed by NA during this survey was the same as that recorded by EHP during summer 2025, suggesting that the survey effort was not poor. Regardless, future surveys will endeavour to complete additional afternoon surveys to account for the skewed time-of-day survey effort.

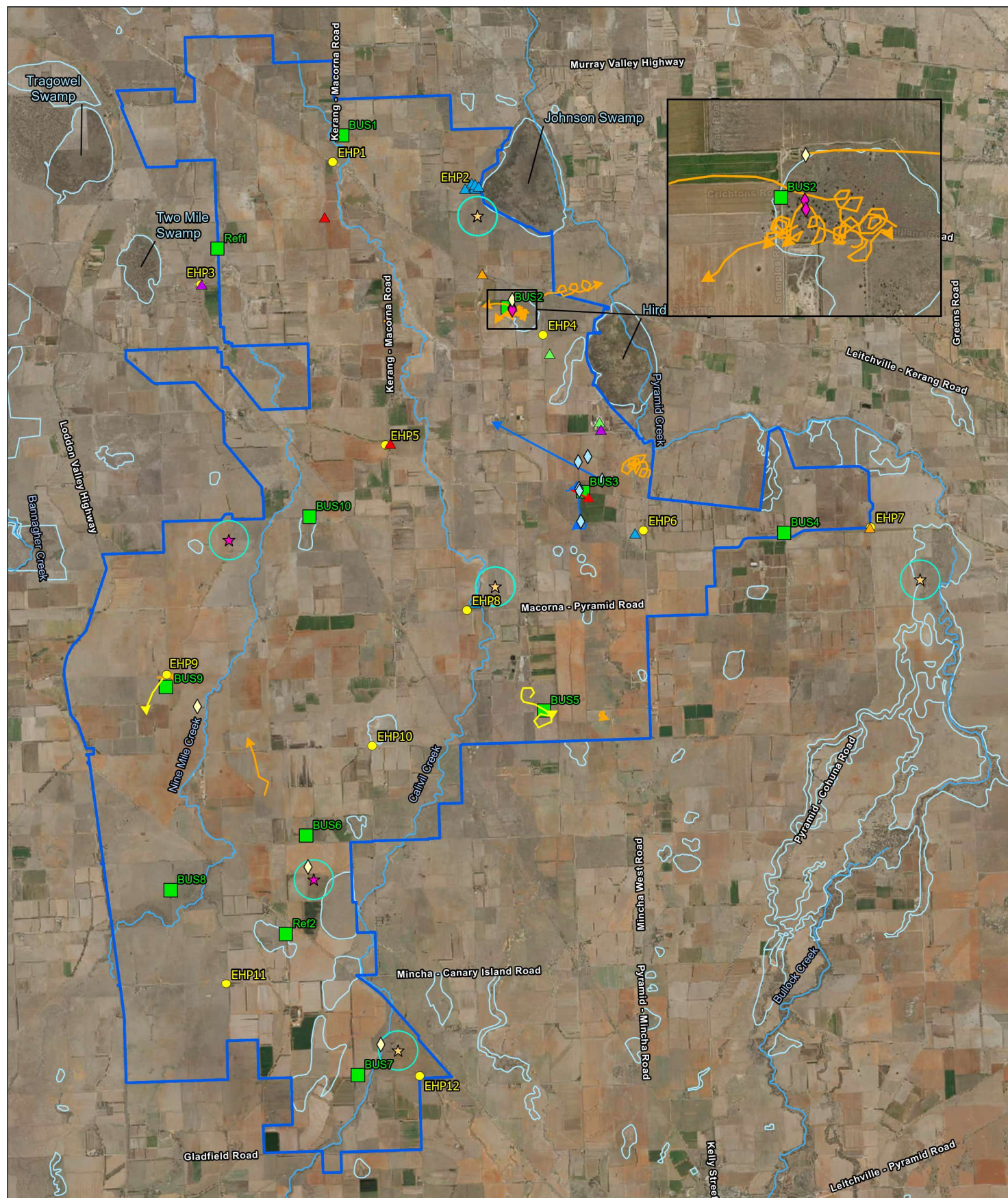


Figure 7-1. BUS survey sites at Macorna Wind Farm and listed species observed

Project No: 24129.09 **Project location:** Macorna Wind Farm, VIC **Date:** 24/07/2026

■ Project Area
 — Waterway
 ■ DEECA mapped wetland
 ■ WTE nest buffer - 500m
Nature Advisory Data
 ★ WTE nest location
 ■ BUS survey point

Listed species observed
Perched observation
 ◆ Brolga
 ◆ Brown Treecreeper (south-eastern)
 ◆ Wedge-tailed Eagle

Flight path species
 → Black Falcon
 → Brolga
 → Straw Necked Ibis
 → Wedge-tailed Eagle
EHP data
 ● BUS
 ★ WTE nest location

Listed species
 ▲ Black Falcon
 ▲ Blue-winged Parrot
 ▲ Intermediate Egret
 ▲ Little Eagle
 ▲ Magpie Goose



Kilometers
 0 2

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7.2. Results

To-date, six seasonal surveys have been undertaken, with two more BUS scheduled for winter and spring 2026. Results will be updated following completion of the second year of BUS.

7.2.1. Survey suitability

The suitability of the survey effort in detecting the majority of the species assemblage within the Project Area was assessed using a species accumulation analysis (Figure 7-2 and Figure 7-3). The data indicated that the number of species recorded generally levelled out between 60 and 75 surveys, depending on the season. This suggests that the number of survey replicates was generally adequate for detecting a large proportion of the bird assemblage present within the Project Area during each seasonal BUS. The stepped curve of summer 2025/26 surveys is likely the result of the heatwave at the time (see limitations in Section 7.1.6), with species counts rising in the early morning and slowing during other time periods when heat increased. Notably, however, the total species observed during the hot conditions of summer 2025/26 was the same as that observed during the summer 2024/25 surveys that did not have a heatwave (55 species for both).

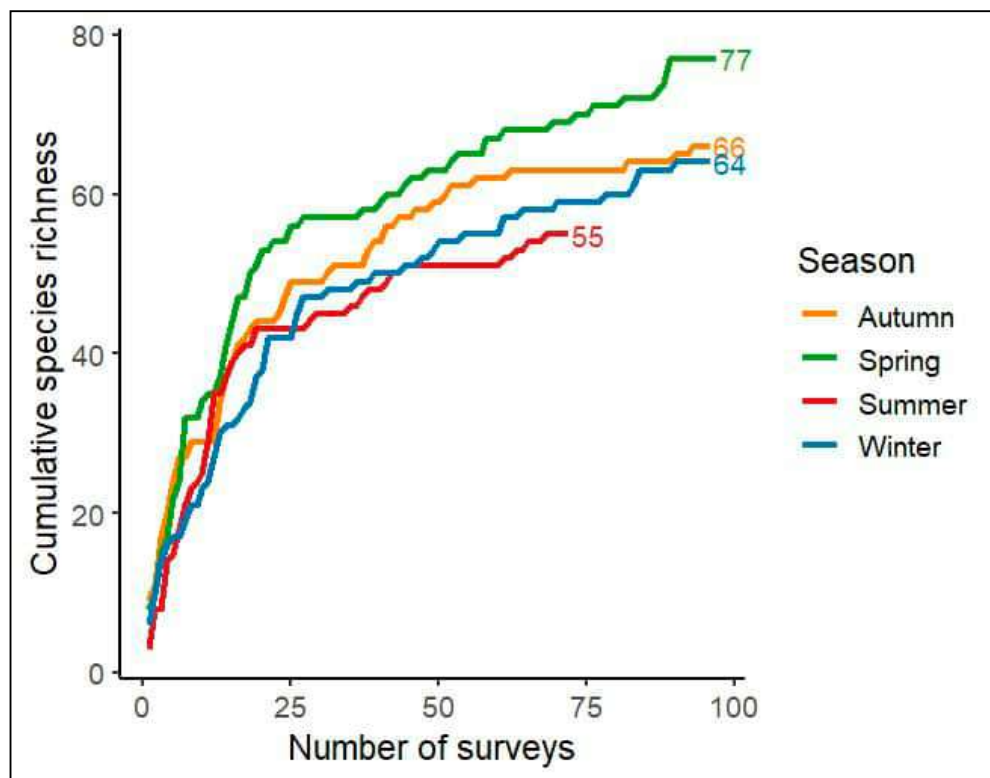


Figure 7-2: The species accumulation curves for the four seasons of BUS that were completed by EHP (2025).

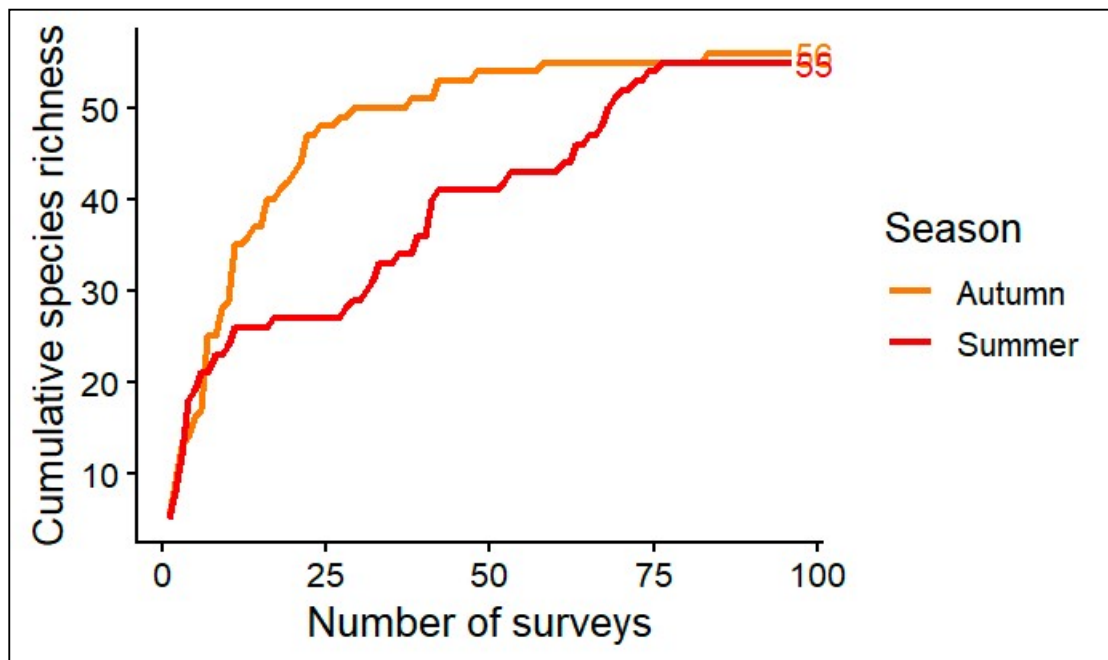


Figure 7-3: The species accumulation curve for the summer and autumn BUS that were completed by NA (2026).

7.2.2. Combined BUS results

The analysis in Appendix 9 determined that there were no material differences in the results stemming from the disparate survey methods of EHP and NA. Consequently, both consultancies' data were collated for further analysis.

Species composition

A total of 20,767 birds representing 105 bird species were recorded during BUS surveys (Appendix 10). This included 8,905 birds representing 78 species at impact points (42.9 % of all observed birds) and 11,862 birds representing 96 species at reference points (57.1 % of all observed birds). Species were predominantly grassland, woodland and wetland species.

After six BUS surveys, there has been approximately the same number of surveys performed at impact points as at reference points (see Section 7.1 for a discussion on how the layout changes resulted in an unbalanced design of EHP's surveys). For a list of all birds observed for each seasonal survey, see Appendix 10.

The following threatened species were observed (Figure 7-1):

- Black Falcon (FFG: Critically Endangered);
- Blue-winged Parrot (EPBC: Vulnerable);
- Brolga (FFG: Endangered)
- Brown Treecreeper (EPBC: Vulnerable; FFG: Vulnerable);
- Eastern Great Egret (FFG: Vulnerable);
- Intermediate Egret (FFG: Critically Endangered);

- Magpie Goose (FFG: Vulnerable); and
- Little Eagle (FFG: Vulnerable).

Some seasonal variations in species richness and abundance are evident, though not statistically testable due to the unbalanced number of surveys (at the present point, only summer and Autumn have had 2 surveys). At present, Spring has the highest diversity, and adjusting for survey effort, Autumn has the highest abundance of birds (Table 7-5).

Table 7-5: Seasonal abundance of species and birds during BUS at Project Area.

Season	Surveys	Species	Birds
Summer	166	69	6,140
Autumn	192	75	9,885
Winter	94	64	1,978
Spring	97	77	2,764
TOTAL	453	103	13,944

The most abundant birds recorded at MAWF are those that largely persist in farmland environments, and include two exotic species (Table 7-6). Collectively, these ten species accounted for almost two-thirds of all birds recorded during BUS surveys.

Table 7-6: Ten most abundant bird species recorded at BUS points, combined EHP and NA data.

Ranking	Species	Birds counted	Percentage of all birds observed
1	Little Raven	2,900	13.96 %
2	Straw-necked Ibis	2,615	12.59 %
3	Common Starling*	2,606	12.55 %
4	Australian Magpie	1,682	8.10 %
5	House Sparrow*	850	4.09 %
6	Galah	689	3.32 %
7	Grey Teal	577	2.78 %
8	Noisy Miner	572	2.75 %
9	Superb Fairy-wren	561	2.70 %
10	Red-rumped Parrot	550	2.65 %
TOTAL		8,705	65.5 %

NOTE: exotic species are denoted with an asterisk (*).

Flight heights

To date, 6.3 % of all birds observed during surveys were estimated to be flying at RSA height (Table 7-7). A larger proportion of birds flying at RSA were recorded at impact points (9.0 %) than at reference points (4.3 %).

Table 7-7: Summary of flight heights during BUS surveys at Project Area.

Flight Height Class	Impact survey points		Reference survey points		Combined	
	Individuals observed	Percentage of all birds at Impact points	Individuals recorded	Percentage of all birds at Reference points	Individuals observed	Percentage of all birds observed
A (below RSA, <60 m)	8,103	91.0 %	11,347	95.7 %	19,450	93.7%
B (at RSA, 60 – 252 m)	802	9.0 %	515	4.3 %	1,317	6.3 %
C (above RSA, >252 m)	-	0 %	-	0 %	-	0 %
TOTAL	8,905	100 %	11,862	100 %	20,767	100 %

To date, 19 bird species are represented among those recorded flying at collision risk height (Table 7-8).

The Straw-necked Ibis accounts for the majority of at-risk flights, with approximately a fifth of all observed flights for the species being at RSA. Straw-necked ibis were also commonly observed in flocks, with the average flock size being 40 and the maximum flock size 290. During BUS, 15 flocks of Straw-necked Ibis were observed flying at RSA height, ranging in size from 1 to 290 birds.

The Blue-winged Parrot was the only listed species observed at RSA during BUS surveys. This is represented by a single bird flying at 70 m height, recorded at EHP8 along Calivil Creek (Figure 7-1). No flight path or minimum/maximum heights were recorded by EHP to inform additional flight behaviour.

Four species of raptors were recorded at RSA height: Wedge-tailed Eagle, Whistling Kite, Nankeen Kestrel and Brown Goshawk. All of these species are known to regularly collide with turbines on wind farms (Nature Advisory unpublished mortality data; Smales 2006), but are not listed as threatened under the FFG or EPBC Acts, or as Species of Concern (DEECA 2025h). Some of these species, such as the Wedge-tailed Eagle, may be determined as culturally significant following discussions with Traditional Owners. If so, they will have to be considered for impacts according to guidance within the Handbook (DEECA 2025d).

Table 7-8: Species recorded during BUS to be flying at collision risk heights, 60 – 252 m.

Species	Flight Height Class (# of individuals observed)			Percentage of flights observed at RSA (single species)	Percentage of flights observed at RSA (all species combined)
	A	B	C		
Straw-necked Ibis	1,798	817	-	31.2 %	62.0 %
Little Raven	2,637	263	-	9.1 %	20.0 %
Australian Shelduck	193	91	-	32.0 %	6.9 %
Whistling Kite	218	29	-	11.7 %	2.2 %
Wedge-tailed Eagle	41	19	-	31.7 %	1.4 %
Welcome Swallow	403	14	-	3.4 %	1.1 %
Common Starling	2,592	14	-	0.5 %	1.1 %
White-browed Woodswallow	-	10	-	100.0 %	0.8 %
Australian Pelican	37	9	-	19.6 %	0.7 %
Galah	680	9	-	1.3 %	0.7 %
White-breasted Woodswallow	40	8	-	16.7 %	0.6 %
Black Kite	48	7	-	12.7 %	0.5 %
White-faced Heron	137	7	-	4.9 %	0.5 %
Little Pied Cormorant	26	5	-	16.1 %	0.4 %
Domestic Pigeon	248	4	-	1.6 %	0.3 %
Australian White Ibis	116	2	-	1.7 %	0.2 %
Nankeen Kestrel	126	2	-	1.6 %	0.2 %
Australian Raven	225	1	-	0.4 %	0.1 %
Blue-winged Parrot	55	1	-	1.8 %	0.1 %
Brown Falcon	60	1	-	1.6 %	0.1 %
Long-billed Corella	212	1	-	0.5 %	0.1 %
Brown Goshawk	3	1	-	25.0 %	0.1 %

Species	Flight Height Class (# of individuals observed)			Percentage of flights observed at RSA (single species)	Percentage of flights observed at RSA (all species combined)
	A	B	C		
Brown Songlark	33	1	-	2.9 %	0.1 %
Peregrine Falcon	-	1	-	100.0 %	0.1 %
TOTAL	9,928	1,317	0		

NOTE: Species highlighted in bold are those listed under the FFG and/or EPBC Acts.

Incidental Observations

To date, the following species have been recorded incidentally onsite that are listed under the FFG Act, EPBC Act, and/or identified as a 'Species of Concern' (DEECA 2025h):

- Australasian Bittern (EPBC Act: Endangered; FFG Act: Critically Endangered)
- Black Falcon (FFG Act: Critically Endangered)
- Blue-winged Parrot (EPBC Act: Vulnerable)
- Brolga (FFG Act: Endangered)
- Eastern Great Egret (FFG Act: Vulnerable)
- Plumed Egret (FFG Act: Critically Endangered)
- Little Eagle (FFG Act: Endangered)
- Magpie Goose (FFG Act: Endangered)
- Wedge-tailed Eagle (Species of Concern due to cultural significance)

All incidental observations were of birds below RSA height with the exception of the Wedge-tailed Eagle, which was regularly observed at RSA height (Table 7-8). These species are further discussed below in Section 7.2.3.

7.2.3. Species of Concern

Eight listed bird species were observed during surveys (Table 7-9). An Australasian Bittern was observed incidentally during an EHP Brolga survey, and a White-bellied Sea-eagle was observed incidentally during a migratory shorebird survey; both outside the Project Area. The Australian Painted Snipe, although not recorded during surveys, was included for discussion here in light of its cryptic nature, the potential to occur (Table 6-2), and directly asked about during regulator site assessment in February 2026. Please note, Brolga observations made during the Autumn 2026 BUS are discussed in the Section 9.

Non-listed raptors represent a high-risk group of species that are known to be susceptible to collision at wind farms and are therefore also considered Species of Concern (Nature Advisory unpublished mortality data; Smales 2006). In addition, the Wedge-tailed Eagle may be identified as culturally significant pending discussions with the Traditional Owners and may require consideration for impacts under the Handbook (DEECA 2025d) as a culturally significant species.

Waterbirds that are not listed as threatened or migratory under state or federal legislation are protected by the Kerang Wetlands Ramsar listing, as they contribute to the values listed in the wetlands' Ecological Character Description (ECD) (DSEWPaC 2011). The ECD lists both a high diversity and abundance of waterbird species and the fact that waterbird species use the wetlands to breed as criteria for the wetlands' listing. As such, non-listed waterbird species are also included as a Species of Concern, but assessed as a group.

Table 7-9: Listed bird species observed during BUS for each season.

Species	Status (FFG/EPBC)	Species of Concern	Summer	Autumn	Winter	Spring	Total
Australasian Bittern	(En/Cr)	Probable concern	-	-	-	(1)	1
Black Falcon	(Cr/ -)	Probable concern	1 (1)	1 (1)	1	-	5
Blue-winged Parrot	(- /Vu)	-	(2)	19	35	2	58
Brolga	(-/En)	Probable concern		12 (14)			26
Brown Treecreeper	(Vu/Vu)	Probable concern	3	-	-	-	3
Eastern Great Egret	(Vu/ -)	Precautionary concern	-	5	-	(1)	6
Little Eagle	(Vu/ -)	Probable concern	(2)	1	-	-	3
Magpie Goose	(Vu/ -)	Probable concern	-	-	-	2 (4)	6
Plumed Egret	(Cr/ -)	Probable concern	-	-	-	(2)	2
White-bellied Sea-eagle	(-/En)	Probable concern	-	-	-	(1)	1

NOTE: Numbers in brackets are incidental observations; 'Species of Concern' categories are from (DEECA 2025h).

Australasian Bittern (EPBC: Endangered, FFG: Critically Endangered)

A single Australasian Bittern was observed incidentally on the northern side of Hird Swamp (>2 km away from the nearest turbine) during an EHP Brolga survey on 15 September 2025. This observation adds to the 54 historical records within 10 km of the Project Area, which, given the cryptic and difficult-to-detect nature of the species, suggests they regularly inhabit suitable wetland habitat in the vicinity of the wind farm. Little suitable habitat is located within the Project Area, with the majority within the surrounding swamps and river systems. The entire population of Australasian Bittern is estimated at approximately 1,300 mature individuals (Herring et al. 2021), with the majority of the population found within the NSW

Riverina. The population around Macorna is expected to be sparse, owing to the rarity and low density of the species in general.

Data on Bittern flight heights is limited, with the most comprehensive study involving three Australasian Bitterns in New Zealand fitted with trackers that estimated their flight heights (Williams 2024). The study found that the two birds that inhabited areas of low topography (i.e. a lack of hills or mountains), similar to the Project Area, were never recorded above 50 m in height. This means all tracked flights by these two birds would be below the RSA of MAWF. The third bird was regularly recorded flying within the RSA of MAWF, but this bird was occupying mountainous terrain. Whilst this sample size is small and from another country, it provides some evidence that Bitterns do not regularly fly at the RSA height of MAWF in lowland areas.

Despite the often-sedentary behaviour of the Australasian Bittern, the species can sometimes travel long distances (Garnett and Baker 2020), with some movements being irruptive in response to wet years or exceptionally dry conditions (Kushland and Hancock 2005). There is limited empirical data on their flight heights during longer-distance movements, meaning that the potential risk of collision within their distribution range cannot be ruled out. However, given the expected low density of Australasian Bitterns and the 2 km turbine-free buffer around both Hird and Johnson Swamps, the probability of an individual encountering a turbine is low.

Australian Painted Snipe (EPBC: Endangered, FFG: Critically Endangered)

The Australian Painted Snipe was not seen during any formal surveys or incidentally to-date. The species was, however, present in the existing records at Hird Swamp Wildlife Reserve, 2 km away (observed six times between 2003–2005, up to 13 birds), and Yarrawalla Nature Conservation Reserve, ~7 km away (single bird in 2004) (Cornell Lab of Ornithology 2026). The species is found throughout mainland Australia, with an apparent stronghold in the Riverina region of Victoria and New South Wales (DCCEEW 2022; Higgins and Davies 1996). The species has the potential to occur within the Project Area, albeit in small numbers.

The species is cryptic and primarily inhabits the emergent grasses of shallow terrestrial freshwater wetlands, including temporary and permanent lakes, swamps and claypans (DCCEEW 2022; Higgins and Davies 1996). They also use inundated or waterlogged grassland or saltmarsh, dams, rice crops, sewage farms and bore drains. Typical sites include those with emergent tussocks of grass, sedges, rushes or reeds, or samphire; often with scattered clumps of Lignum, *Muehlenbeckia* or Canegrass or sometimes tea-tree (*Melaleuca*) (DCCEEW 2022; Higgins and Davies 1996).

Little is known of the species' movements, with it generally being described as nomadic with local rainfall and conditions, though there is evidence of some migration behaviour with birds flying up to several hundred kilometres to regularly visited areas (DCCEEW 2022). Critical habitat for the species includes any wetland habitat where it is known or likely to occur, including periodically available habitats (DCCEEW 2022). Within the surrounding region of the Project Area, this is likely to equate to the larger wetlands, particularly those of higher quality and frequency of inundation.

There is limited empirical data on their flight heights for the Australian Painted Snipe, meaning that the potential risk of collision within their distribution range cannot be ruled out. However, given the expected low density of the species and the 2 km turbine-free buffer around both the highest quality habitats at Hird and Johnson Swamps, the probability of an individual encountering the development footprint is low. Other ephemeral wetlands and creeks within the Project Area are largely avoided due to Brolga and Growling Grass Frog buffers (see Figure 9-5 and Figure 12-4). However, a level of residual risk is expected, albeit low.

Black Falcon (FFG: Critically Endangered)

Black Falcons were observed on five occasions: once during winter 2025 (1 individual), once incidentally during summer 2025 (1 individual), once during summer 2026 (1 individual) and twice during autumn 2026 (two observations of a single individual, once during BUS and once incidentally). All observations of Black Falcons were made in the central and western areas of the Project Area, within approximately 10 km of the Macorna township, with multiple observations near survey point B05 (Figure 7-1).

Black Falcon has not been observed flying at RSA height at the Project Area. However, they are known to regularly fly at turbine height elsewhere, and have been recorded as collision-mortality at wind farms in both Victoria and NSW (Symbolix 2020; Nature Advisory unpublished mortality data; Debus 2014; DEECA 2025h).

The species is expected to occur regularly in the region at low density, with individual birds or pairs attracted by the abundance of small and medium-sized birds as prey, potential nest trees, and waterways and wetlands (Debus 2019; Debus et al. 2017, 2025). Given the species' large territories and home ranges (Debus et al. 2017), it may not be recorded frequently within the Project Area despite regular use of the broader area. Suitable breeding habitat may also occur locally in large trees or on anthropogenic infrastructure (e.g. transmission towers) (Debus et al. 2017).

Black Falcons are known to be attracted to some farm operations that present hunting opportunities by making prey more visible, such as stubble burning and tractor/harvester activities during ploughing or harvesting (Debus 2022). Preventing or reducing the regularity of these activities in the vicinity of active turbines or curtailing turbines that are near these activities may reduce the risk of Black Falcon turbine collisions.

Collision risk may also be elevated if nesting occurs or during land management activities that attract Black Falcon near to turbines. A 300 m turbine-free buffer around any Black Falcon nests may further reduce risk, as well as curtailment of turbines in the vicinity of future nest sites detected once the wind farm becomes operational (Regan et al. 2025). Surveys to identify nesting activity within the Project Area are planned to be undertaken during the 2026 breeding season.

Given Black Falcons have been observed in low densities at the Project Area along with adoption of adaptive management strategies (Section 7.3.4), residual low impacts are predicted. Mitigation measures for this species are further discussed in Section 7.3.4.

Blue-winged Parrot (EPBC: Vulnerable)

Blue-winged Parrots were observed 12 times during formal surveys (56 birds) and once incidentally (2 birds; Figure 7-1). The species was observed in all seasons (when including incidental observations), though the majority of records were from winter (35 birds) and autumn (19 birds) when the average flock size was 6 (range: 2 to 14). Few birds were seen in spring (2 birds), and a single incidental record in summer (2 birds). The Blue-winged Parrot was largely seen near Johnson Swamp Wildlife Reserve at EHP2 survey point (55 of 58 birds), with a single record occurring around Calivil Creek (EHP8) and near an irrigation channel derived from Pyramid Creek (EHP6).

Observations for this species suggest that it preferentially utilises major waterbodies in the area, consistent with what is known about the species' biology (Higgins 1999; DCCEEW 2023b). The current layout has shifted away from Johnson Swamp Wildlife Reserve, giving the area a buffer of several kilometres. This is likely to result in fewer observations of the Blue-winged Parrot at impact sites and an overall avoidance of potential impacts. It is unlikely that the species will use the areas of impact to a

significant degree, with their use of the site more concentrated at wetlands and watercourses, which are generally avoided within the layout design.

Only a single observation was of a bird at RSA (70 m high). This observation was made by EHP along Calivil Creek in the south of the Project Area (Figure 7-1). From prior work by NA across Victoria and Tasmania, this species is known to regularly fly up to 60 m with occasional higher flights (NA unpublished data). It is known to have collided with turbines at other wind farms (Nature Advisory unpublished mortality data). As turbines have been placed to avoid proximity to wetland habitat, especially with a 2 km buffer to Johnsons Swamp where most observations were made, it is less likely that a collision may occur. However, a low level of residual risk is expected. The remaining BUS surveys and analyses will provide further evidence for this conclusion of impact assessment and the utilisation of the study area by the species.

Brown Treecreeper (Southeastern) (EPBC: Vulnerable)

Brown Treecreeper was recorded twice (3 individuals) in a remnant patch of Black Box and Lignum Swampy Woodland (B2; Figure 7-1). These observations occurred only during the summer 2026 surveys, likely due to EHP survey points not being located near suitable woodland patches (see habitat descriptions for survey points in Section 7.1.3).

This species is not known to fly at heights where collision risk exist, rather, it is more likely to be impacted by habitat loss, fragmentation, and degradation (DCCEEW 2023c; Cooper and Walters 2002a). Habitat features important for this species include the presence of mature trees with nesting hollows, coarse woody debris (logs and fallen trees), and a relatively open mid-story (DCCEEW 2023c). It is expected that the species is likely to remain largely in this patch, due to its suitability for the species and general isolation from other connected habitats. There is no expected impact on this patch of habitat from the proposed layout, and only minor removal of woodlands (~0.5 ha), so impacts are likely to be low.

Eastern Great Egret (FFG: Vulnerable)

The Eastern Great Egret was observed six times within the Project Area, EHP7 (3 observations), EHP5 (1), EHP4 (1), and incidentally along Calivil Creek to the south (1) (Figure 7-1). Each observation was of only a single bird. The species is expected to occur along watercourses, wetlands, and dams.

All observations were below RSA, with five of the six being of birds ≤ 6 m high and one at 25 m. Impacts to this species are expected to be low as the project avoids the large wetlands and watercourses that this species is restricted to. The remaining BUS surveys and analyses will provide further evidence for this conclusion of impact assessment.

Plumed Egret (FFG: Critically Endangered)

The Plumed Egret was observed twice within the Project Area, both single birds and incidentally, along drainage and dams near Hird Swamp (Figure 7-1). The species is expected to occur along watercourses, wetlands, and dams.

All observations were of birds on the ground. Impacts are expected to be low based on the current understanding of the use of the Project Area, being largely restricted to suitable habitat, and the avoidance of large wetlands and watercourses by the proposed layout. The remaining BUS surveys and analyses will provide further evidence for this conclusion of impact assessment.

Little Eagle (FFG: Vulnerable)

The Little Eagle was observed on three occasions, once during winter 2025 surveys (1 individual bird), and twice incidentally during summer 2025 (single birds; Figure 7-1). It is expected that the species will

continue to be observed, albeit infrequently. The species prefers a mixture of open and wooded areas, such as heavily treed farmland (Marchant and Higgins 1993). There are quite limited treed areas in the vicinity of the Project Area, which likely explains why they have not often been observed.

All observations were of birds flying below RSA, however, the species is known to fly at collision risk heights (Smales 2006; DEECA 2025h). Impacts are likely to be low based on the current understanding of the limited use of the Project Area by the species. If breeding in the area, risks will be higher in the vicinity of nests. The remaining BUS surveys may clarify the utilisation of the site by the Little Eagle, and the planned nest searches will address the presence of any nesting.

Magpie Goose (FFG: Vulnerable)

Magpie Geese were observed twice, once near Two Mile Swamp Wildlife Reserve during spring 2025 (2 individual birds at EHP3; Figure 7-1) and once incidentally near Hird Swamp Wildlife Reserve in spring 2025 (4 birds). The species is expected to occur seasonally in the area, at times in high numbers – an observation on eBird of 500 individuals was recorded in Johnson's Swamp in 2023 (Cornell Lab of Ornithology 2026).

Although both observations of Magpie Geese recorded during the surveys involved birds flying below the rotor swept area (RSA), the species is known to regularly fly at collision-risk height and often in large flocks (DEECA 2025h). Consequently, the potential collision risk is more likely to be influenced by the frequency and direction of flights through the Project Area than by flight height alone.

The movement patterns of Magpie Geese are closely associated with the availability of food and water resources (Marchant and Higgins 1990). Around the Project, these resources are strongly influenced by water management, with water levels in Johnson and Hird Swamps being artificially regulated. As the largest wetlands in the vicinity, these swamps are expected to retain water and provide foraging habitat for longer than the smaller wetlands and drainage lines within the Project Area. When conditions deteriorate, geese are therefore expected to move between these swamps and other substantial wetlands located predominantly to the northwest and east of the Project. This pattern is likely to be most pronounced for larger flocks, which require extensive open-water habitat, although smaller flocks may also utilise smaller local waterbodies.

The likelihood of regular flights through the Project Area is further reduced by the commitment to maintain a 2 km turbine-free buffer around Johnson and Hird Swamps. This buffer preserves largely unobstructed flight corridors between these key wetlands and the larger wetland complexes to the northwest and east, reducing the need for birds to traverse the turbine array during routine movements. Given this, the likelihood of collisions for the Magpie Goose is considered low.

White-bellied Sea-eagle (FFG: Endangered)

One White-bellied Sea-eagle was observed incidentally during the Spring 2024 migratory shorebird survey at Johnson Swamp, which is within >2 km from the nearest turbine. When inland, White-bellied Sea-eagle prefer large open wetlands with deep water, such as swamps, lakes, reservoirs and billabongs (Marchant and Higgins 1993). This habitat is absent from the project footprint, with the nearest examples being Hird and Johnson Swamps when they have adequate water. There are approximately 80 records of White-bellied Sea Eagles on eBird at these two swamps since 2002, indicating they regularly utilise those wetlands. The species is also regularly sighted in the larger wetlands of the Kerang Lakes Ramsar system to the northwest.

Sea-eagles, like most raptors, are known to fly at RSA height and are therefore at higher risk of turbine collision. However, Sea-eagles were not observed during BUS, nor incidentally in any other survey, nor are

there any historical records within the Project Area. Therefore, the potential risk of turbine collisions is likely low, most likely restricted to Sea-eagles moving through the Project Area when travelling between major wetland habitats. Therefore, whilst a risk remains, the limited scenarios under which a collision would occur means the collision risk for this species is expected to remain low.

Raptor species

Raptors are known to be a functional group that is generally prone to collision risk due to their relatively low manoeuvrability and flight behaviour, such as soaring at height (Lumsden et al. 2019; Smales 2006). Some species may be considered culturally significant and would therefore require inclusion in impact mitigation measures as per the Handbook (DEECA 2025d). Outcomes of discussions with Traditional Owners are pending at present. The following raptor species were observed during BUS surveys:

- Australian Hobby
- Black Kite
- Black-shouldered Kite
- Brown Falcon
- Brown Goshawk
- Nankeen Kestrel
- Swamp Harrier
- Wedge-tailed Eagle
- Whistling Kite

These species were either observed flying at RSA (e.g., Wedge-tailed Eagle and Whistling Kite; Table 7-8) or are known as collision mortalities at other wind farms (Smales 2006; Nature Advisory unpublished mortality data). Several of these species are likely to experience a level of collision risk at MAWF, particularly if nesting in the area, such as the Wedge-tailed Eagle. The Project Area contains an abundance of prey items for these raptor species, and all species are expected to regularly occur onsite. Table 7-8).

Impacts on these species are likely to be higher around nests (Smales 2006; Nature Advisory unpublished mortality data). Six Wedge-tailed Eagle nests were observed incidentally during BUS surveys (Figure 7-1). It is expected that a 300 m buffer around nests of Wedge-tailed Eagle, Little Eagle and Black Falcon will reduce the risk of collisions, however, a residual risk will likely remain for these species. The remaining BUS surveys and analyses will provide further evidence to support the assessment of collision and disturbance risks.

Some of these species, such as the Wedge-tailed Eagle, may be determined as culturally significant following discussions with Traditional Owners. In accordance with the Handbook (DEECA 2025d), consideration should be given to estimating impact rates for culturally significant species during operations. Where impacts occur, Traditional Owner consultation should inform impact assessment, monitoring, and adaptive management.

Non-listed waterbirds associated with the Kerang Wetlands Ramsar listing

The high number of observations of some of the waterbird species that contribute to the ecological character of the Kerang Wetlands Ramsar site (DSEWPaC 2011) flying at RSA height suggests that there is an elevated risk of impact. The non-listed waterbirds of the Ramsar wetland are recognised as they

maintain the biodiversity of the biogeographic region, are supported during critical life stages in their life cycles, such as breeding or moulting and use the wetlands as a refuge during drought cycles, and because they contribute to the abundance of waterbirds using the wetlands (>20,000) (DSEWPac 2011). Based on historical mortality data, neither species seems likely to be impacted in large numbers by the proposed wind farm, though some impacts may occur. It is therefore unlikely that the proposed wind farm will impact non-listed waterbirds to the extent that the values of the Ramsar wetland will be critically affected.

Six species of non-listed waterbirds were observed flying at RSA height within the Project area, with Straw-necked Ibis (87.8 % of non-listed waterbird flights at RSA) and Australian Shelduck (9.8 %) making up the 97.6 % of these observations (Table 7-10). Straw-necked Ibis were by far the most commonly observed bird flying at RSA during BUS to date.

Whilst Straw-necked Ibis and Australian Shelduck are waterbirds that favour wetlands, both are known to utilise agricultural habitat regularly. These species can roost or forage on farmland, particularly irrigated or wet/flooded paddocks (Marchant and Higgins 1990, 1993). Both species have robust populations, with the Shelduck thought to be increasing, whilst Straw-necked Ibis numbers can fluctuate dramatically in response to good breeding conditions (Cornell Lab of Ornithology 2026). They regularly occurred in the Project Area and flew regularly at RSA height (Table 7-10), so they are at an elevated risk of collision. However, both species are common at many wind farm sites across Victoria, yet there are only two recorded collisions for Shelducks and six for Straw-necked Ibis in Nature Advisory's extensive mortality database of 22 wind farms where the company performs operational monitoring, going back to 2005 (Nature Advisory unpublished mortality data). This may suggest that these species are generally avoidant of turbine blades, and have a relatively low collision risk.

Table 7-10: Observations of non-listed waterbirds that were recorded flying at RSA height during BUS.

Species	Flights below RSA	Flights at RSA	All observations				Total
			Autumn	Winter	Spring	Summer	
Straw-necked Ibis	1,798	817	909	-	386	1,320	2,615
Australian Shelduck	193	91	230	20	5	29	284
Australian Pelican	37	9	13	27	1	5	46
White-faced Heron	137	7	55	10	24	55	144
Little Pied Cormorant	26	5	7	5	9	10	31
Australian White Ibis	116	2	44	18	22	34	118
TOTAL	2,307	931	1,258	80	447	1,453	3,238

7.3. Conclusions

7.3.1. Summary of findings

Eight listed species were recorded during the BUS and a further two were recorded incidentally during other survey types:

- Australasian Bittern (EPBC Act: Endangered; FFG Act: Critically Endangered)

- Black Falcon (FFG Act: Critically Endangered)
- Blue-winged Parrot (EPBC Act: Vulnerable)
- Brolga (FFG Act: Endangered)
- Brown Treecreeper (EPBC Act: Vulnerable)
- Eastern Great Egret (FFG Act: Vulnerable)
- Little Eagle (FFG Act: Endangered)
- Magpie Goose (FFG Act: Endangered)
- Plumed Egret (FFG Act: Critically Endangered)
- White-bellied Sea-Eagle (FFG Act: Endangered)

Species that are largely restricted to woodlands and are not known to regularly fly at RSA height nor be impacted by turbine collisions (e.g. Brown Treecreepers) are expected to be at lower risk, as suitable habitat within the Project Area is limited and can generally be avoided or minimised through design measures. In contrast, higher-flying species (e.g. Raptors and Blue-winged Parrot) that utilise the broader landscape are considered to have a comparatively higher potential risk.

Listed waterbirds, such as Magpie Goose, Australasian Bittern, and Brolga, may traverse the area, moving between the larger wetlands in the landscape and occasionally utilising smaller wetlands within the Project Area, with collision risk for these species likely being lower than for raptors but higher than for woodland species. Non-listed waterbird species associated with the Kerang Wetlands Ramsar site (DSEWPaC 2011) were regularly observed flying at RSA height (particularly Straw-necked Ibis and Australian Shelduck) and are therefore at elevated risk of collision, but due to their abundance and possible avoidance behaviour, are unlikely to be impacted to the extent that it influences the values of the Ramsar wetland.

Understanding of species utilisation of the site, including seasonal patterns of habitat use and movement, will be further refined upon completion of the full survey program.

7.3.2. Potential impact pathways

The impact pathways affecting bird species can be broadly categorised into two groups: construction impacts and operational impacts.

Construction impacts

The utilisation of the Project Area by birds may be impacted by construction through:

- Reduction of habitat through *loss or degradation*,
- *Fragmentation* of habitat, and
- *Disturbance* of nesting birds from construction activities.

This may occur for woodland species as their habitat across the site is largely isolated and/or poorly connected, present mostly as narrow corridors along the roadside. These corridors represent most of the remnant native vegetation in the landscape outside wildlife reserves. It is assumed that most patches of wooded vegetation provide some level of potential breeding habitat for woodland-dependent species. The turbine locations and associated infrastructure have been carefully located to avoid and minimise impacts on woodland habitat so that reduction and fragmentation of habitat are minimal and unlikely to significantly impact threatened woodland species.

Disturbance through noise, dust and the presence of people and machinery has the potential to lead to abandonment of nests and breeding attempts (Goodship and Furness 2022). Such an impact is expected to be confined both spatially and temporally around breeding sites and in the breeding season and can be avoided through appropriate mitigation measures such as buffers around Wedge-tailed Eagle and Black Falcon nests (see 7.2.3).

Operational impacts

The utilisation of the Project Area by birds may be impacted by the operation of wind farms through:

- *Direct mortality* from collision with turbines, transmission lines, and other infrastructure; and
- *Barrier effects* from birds diverting around turbines.

Direct mortality is a higher risk for species and species groups known to fly at RSA height. This would include most raptor species and species moving in large flocks at-height (e.g., Straw-necked Ibis). Overhead powerlines are also a well-documented risk for collision mortality, with the degree of risk influenced by the location and extent of lines and the various species' manoeuvrability, physiological sensory systems, and local flight behaviour (Bernardino et al. 2018; Jenkins et al. 2010; Van Harten et al. 2026).

Barrier effects are unlikely to be significant for waterbird or migratory shorebird species. Detailed discussions on the implications of barrier effects are discussed in detail in Section 10.

In addition to the above pathways, the following FFG Act-listed threatening processes have the potential to occur and can be managed to avoid and minimise impacts during micro-siting and construction, such as:

- Loss of hollow-bearing trees;
- Loss of coarse woody debris;
- Invasion of suitable habitats by environmental weeds; and
- Increase in sediment input into rivers and streams due to human activities.

7.3.3. Assessment of potential impacts

The primary potential impact pathway for birds is likely to be through collision mortality and habitat removal/fragmentation.

Layout amendments have been undertaken to avoid almost all woodland areas and minimise the removal of scattered trees and large trees in patches of native vegetation, with the removal of native vegetation having been significantly reduced from initially over 130 ha to 45,523 ha. Wetland habitat has been buffered and will only be impacted through unavoidable creek crossings for access tracks. In particular, turbines have been sited away from key wetlands, including Hird and Johnson Swamps, to avoid and minimise collision risk, direct habitat impacts, and potential fragmentation of movement and connectivity between these wetland systems. Turbine placement also avoids locations between waterways, thereby reducing the likelihood of intersecting common flight paths. The remaining risk of habitat degradation and roadkill can be managed through appropriate management plans and mitigation measures.

To reduce collisions, the project has adopted a minimum RSA clearance of 60 m, which is expected to reduce the likelihood of bird interactions with turbine blades by placing the rotor swept zone above the typical flight height of many species. In addition, the total number of turbines has been reduced from 133

to 114 as part of the iterative design process. This reduction decreases the overall footprint and density of turbines, thereby lowering the potential for collision risk and cumulative impacts to avifauna.

Seven Wedge-tailed Eagle nests have been recorded within the Project Area, with more nests of eagles and other raptors likely present. It is expected that a 300 m buffer around nests of Wedge-tailed Eagle, Little Eagle and Black Falcon will reduce the risk of collisions, however, a residual risk will likely remain for these species. The remaining BUS surveys and analyses will provide further evidence to support the assessment of collision and disturbance risks. Nest searches are required around proposed turbine locations to identify raptor nests and inform the application of buffers and final micro-siting adjustments to minimise disturbance and collision risk. Where new nests are identified during or post-construction, additional management measures (e.g. temporary daytime curtailment) may be implemented as required.

7.3.4. Recommended application of mitigation hierarchy

This section outlines the key impact pathways and provides recommendations for the application of the mitigation hierarchy to reduce the potential significance of these impacts. We note that many of these have been applied by the Proponent in the early stage of design, effectively reducing the impacts of the project. For a discussion on actions already taken and how that relates to impact assessment, see Section 14.2.2.

Habitat loss and fragmentation

Avoidance of habitat loss and fragmentation has been prioritised through the careful micro-siting of all project infrastructure. Infrastructure, where practicable, should be located to avoid areas mapped as native vegetation, with particular emphasis on woodland habitats that occur as small and often isolated patches within the broader landscape. These patches may provide disproportionately important ecological functions, including foraging, shelter, and breeding habitat for a range of fauna species. The currently proposed layout includes the removal of 5 trees (see Section 5.2.2 and Appendix 2). The suitability of these trees as fauna habitat is yet to be assessed. Micro-siting should also seek to avoid the removal of scattered trees, particularly hollow-bearing trees, which represent critical habitat resources.

In addition, infrastructure placement and associated construction activities should be designed to minimise the fragmentation of intact and connected habitat patches, particularly where fragmentation may create barriers to movement for threatened or otherwise sensitive species known or likely to occur in the area. The extent to which fragmentation may represent a functional barrier will depend on the ecological requirements, movement behaviour, and home-range characteristics of individual species, and should therefore be considered in a species-specific context where relevant. Brown Treecreeper habitat, for example, is generally considered to be fragmented if the distance between habitats is longer than 100 m (Cooper and Walters 2002b).

Where impacts to native vegetation or habitat connectivity cannot be fully avoided, restoration and rehabilitation measures should be implemented to mitigate the effects of habitat loss and fragmentation. Rehabilitation should aim to restore structural and functional connectivity across the landscape by re-establishing vegetation cover and habitat features in disturbed areas following construction. Priority should be given to restoring habitat patches that are, or can be made, sufficiently large to support ecological function, or that contain key habitat attributes such as hollow-bearing trees, coarse woody debris, and structurally complex vegetation. Restoration in these areas can enhance habitat quality and improve connectivity between remnant patches, thereby supporting the movement, foraging, and breeding requirements of listed species present within the study area. Where feasible, restoration works should also aim to strengthen existing habitat linkages and reduce edge effects associated with

infrastructure development, thereby contributing to the long-term persistence of habitat values within the project landscape.

Habitat degradation

Measures to minimise the degradation of habitat during construction should be incorporated into the project's Construction Environmental Management Plan (CEMP). The CEMP should outline clear procedures and controls to manage activities. These measures should aim to protect adjacent native vegetation and habitat features that are retained within and surrounding the development footprint, and to ensure that construction activities do not result in unintended disturbance beyond approved impact areas. Further detail on applicable standards, guidelines, and management requirements is provided in Section 14.

Direct mortality

Avoidance measures should be implemented to minimise the risk of direct mortality to birds associated with project infrastructure. In particular, transmission infrastructure should be placed underground where feasible to avoid collision and electrocution risks associated with overhead powerlines. Where overhead lines are required, they should be located away from key habitat features or likely flight paths (e.g. waterbodies, streams, woodland). Where transmission lines cannot practicably be placed underground, overhead lines should incorporate bird diverters or line markers to improve visibility and reduce collision risk, consistent with relevant industry guidance (EGA Energy Grid Alliance 2022).

Turbine dimensions, particularly lower blade clearance, can influence collision risk for different bird species by altering the degree of overlap between the rotor-swept area and typical flight heights. Increasing the minimum blade clearance above ground may reduce collision risk for species that predominantly undertake low-altitude flights, such as Blue-winged Parrots and Australasian Bitterns. Observations from other wind farms generally show that Blue-winged Parrots, for example, regularly fly up to 60 m (NA unpublished observations). Raising turbine blades above this height would be expected to work towards minimising collision risk. As such, turbine height represents a potential design mitigation that should be considered alongside turbine siting, micro-siting and operational mitigation measures.

Avoidance has, and will continue, to be applied through the strategic siting of turbines and associated infrastructure to reduce overlap with areas of high fauna activity, including key movement corridors, breeding habitat, nest sites, high-use foraging areas, and landscape features that concentrate bird movements, such as wetlands, waterways and habitat edges. For example, a 2 km turbine-free buffer has been implemented around Hird and Johnson Swamps, in recognition of their status as Ramsar wetlands and in order to protect the high ecological value they harbour. A 300 m turbine-free buffer will be placed around active Wedge-tailed Eagle and Black Falcon nests located prior to construction.

Where impacts cannot be fully avoided, a range of minimisation measures should be implemented through turbine design, siting, and operational management. Collision mortality risk can be reduced through careful selection of turbine hub heights and blade lengths to minimise overlap with typical flight heights of sensitive species (Smales 2006; Symbolix 2020). For this project, a minimum RSA height of 60 m has been adopted to reduce interaction with species that predominantly fly at lower altitudes. Additional minimisation can be achieved through the application of species-specific buffers around known nesting locations. Recommended buffers include a 300 m setback from Wedge-tailed Eagle nests, Black Falcon nests, and Little Eagle. The Wedge-tailed Eagle is not listed, however, buffers around their nests are recommended as the species is known to experience a high risk of collision and, pending discussions with Traditional Owners, is likely to be identified as culturally significant and thus require mitigation under the Handbook (DEECA 2025d).

Further measures should be implemented in consultation with landholders to minimise activities that may attract Black Falcon, Little Eagle, and other raptors or increase their prey availability near turbines. Where practicable, agricultural activities such as tractor operation or burning should be limited to calm conditions when turbines are not operating. Where this is not possible, daytime curtailment of selected turbines within approximately 1 km of active paddocks may be considered, subject to refinement through further data collection, as these activities may flush prey and attract raptors such as Black Falcon. Additional measures should include the removal of roadkill within the Project Area to avoid attracting scavenging raptors, avoiding the feeding of stock with grain underneath or within 250 m of turbines, and avoiding livestock birthing activities within the same buffer distance. Management of prey availability should also be considered, including the removal (e.g. ripping) of rabbit warrens where appropriate and investigation of measures to minimise grain spillage that could attract prey species.

Land use

Several land use practices are known to attract raptors and can therefore increase collision risk should they occur near operational turbines (Debus 2022). Stubble burning and tractor operations can attract Black Falcons that use the disturbance to farmland to hunt fleeing prey animals, whilst carcasses from roadkill or turbine collisions may attract Wedge-tailed Eagles or other scavenging raptors (Debus 2014). Preventing stubble burning and tractor operations near turbines, or ensuring they occur on windless days when turbines are not turning, is expected to reduce collision risk, whilst carcass removal can reduce collision risk for Wedge-tailed Eagles. Implementation of these measures is expected to reduce the risk to raptor species.

Nesting disturbance

Avoidance should be prioritised to minimise disturbance to nesting listed species. Where practicable, wind turbines and associated infrastructure should not be located within 300 m of identified Black Falcon, Wedge-tailed Eagle, and other listed raptor nest sites. These buffers are intended to reduce the likelihood that construction or operational activities will disturb breeding birds or disrupt nesting behaviour. Early identification of active or potential nesting sites during pre-construction surveys should inform the final micro-siting of infrastructure to ensure that these buffers can be applied wherever feasible.

Where construction activities must occur in proximity to known nest sites, disturbance should be minimised through the careful timing of works. In particular, construction activities should be scheduled to occur outside the breeding season of the species in question wherever possible. Where works cannot be scheduled outside the breeding period, additional management measures may be required, such as pre-construction nest monitoring, the establishment of temporary exclusion zones, or modification of construction activities to reduce disturbance levels. These measures should be implemented in consultation with relevant regulators and informed by ecological advice to ensure that disturbance to breeding birds is minimised.

Bat and Avifauna Management (BAM) Plan

Residual risks to birds and bats should be managed through the preparation and implementation of a Bat and Avifauna Management Plan (BAM Plan). The BAM Plan should be informed by site-specific bird utilisation data and developed in consultation with the relevant regulator in accordance with current Victorian guidance (DEECA 2025b). Through measures such as operational carcass monitoring and targeted surveys, the BAM Plan aims to:

- Minimise the impacts from the MAWF on threatened fauna listed under the Commonwealth EPBC Act and the Victorian FFG Act;

- Improve the understanding of turbine collision risk to listed fauna that occurs on-site;
- Improve the understanding of how listed fauna use the site changes in response to wind farm construction and operation;
- Monitor and assess the possible reasons for turbine collisions in a timely manner;
- Establish clear triggers for management response, supported by a structured adaptive management framework which includes general and species-specific management strategies;
- Ensure the adaptive management framework is implemented in accordance with relevant approval and permit conditions, with corrective measures escalated in line with the mitigation hierarchy; and
- Where applicable, the development and implementation of tangible, on-ground management actions to promote long-term collision risk reduction on listed threatened and migratory bird and bat species.

7.3.5. Conclusions and further investigations

The results of BUS to-date indicate that there are unlikely to be significant impacts to listed species and species of concern, provided the recommended mitigation measures are implemented. We note that the Proponent has already undertaken several design changes to reduce the impact of bird species, including avoidance of habitat and micro-siting of turbines (see Section 15). Any residual risks on listed bird species following their implementation are expected to be low.

Cumulative risk remains difficult to quantify for many bird species due to limitations in available data, particularly for highly mobile taxa (e.g. Little Eagle, Blue-winged Parrot, Black Falcon, and Magpie Goose). Species that range widely across the landscape may interact with multiple developments and land uses over large spatial scales and extended timeframes. Cumulative impacts have been considered in the context of other wind energy developments in the region. Given the level of avoidance achieved, the absence of key habitat features within the Project Area, and the application of standard mitigation measures across the sector, the Project is not expected to make a material contribution to cumulative biodiversity impacts. Potential cumulative effects may not be fully captured by project-scale assessments alone. While the proposed development represents a small and localised contribution to potential residual impacts, the cumulative effects of similar developments across the broader landscape cannot be entirely discounted for species with large home ranges and/or high mobility.

Two further BUS surveys are planned to be undertaken (winter and spring 2026). As these studies provide additional information to inform the utilisation of the site and potential impacts, they will be incorporated into this report to inform recommendations on mitigation.

Other studies, such as nest searches for Black Falcon and Wedge-tailed Eagle, are recommended to inform areas of higher collision risks and to apply nest buffers.

The inclusion of culturally sensitive species should be undertaken as per the guidance of the Handbook (DEECA 2025d) and is pending the outcome of meetings between the Proponent and the Traditional Owners.

8. Bat studies

This section presents the pre-construction baseline data on the utilisation of the proposed Project Area by bats. Bat surveys were undertaken by Nature Advisory (2025 – ongoing). These studies were undertaken as per the guidance provided within *The Handbook for the development of renewable energy in Victoria* (DEECA 2025d), and its associated *Appendix 3: Species Specific Guidance for Onshore Wind Energy Facilities – Bat Species of Concern* (DEECA 2025a). An analysis of the species and foraging guilds observed over the monitoring period is presented below.

8.1. Methods

8.1.1. Echolocating insectivorous bat surveys

Bat detector surveys were undertaken to determine the microbat species that utilise the study area, particularly the listed threatened species. Best-practice survey techniques were deployed to detect which bat species occur across the study area. Ultrasonic detectors that passively detect and record echolocation calls emitted by free-flying insectivorous bat species were deployed to identify, through expert opinion, the species occurring at the proposed site.

Although ultrasonic detectors are the recommended technique to detect most insectivorous bats (DEECA 2025a), there are limitations to acoustic surveys and the interpretation of their data, as outlined in Appendix 11.

Survey effort

Three seasonal bat detector surveys have been undertaken during spring 2025, summer 2026 and autumn 2026. A further five seasonal surveys are planned for 2026–2027, comprising two full years of eight seasonal surveys (Table 8-1). These further surveys will be used to validate the preliminary conclusions in this report or reassess the risk, where required.

Deployment of ultrasonic bat detectors occurred for several weeks at a time at 15 survey sites during each season. Once all eight seasonal surveys are complete, it will provide a representative sample of the species utilising the MAWF site across a year, including the time when the seasonally migratory Yellow-bellied Sheath-tail Bat is likely to be present. No surveys at height are planned for MAWF, as it will be assumed that all bat species recorded at ground level have the potential to fly at rotor swept area (RSA) heights unless their biology indicates otherwise.

Table 8-1: Echolocating insectivorous bat survey effort at the Project Area.

Survey Period	Sites (#)	Total detector nights
Spring and summer 2025 17 November – 11 December 2025	15	279
Summer 2026 6 January – 5 February 2026	15	210
Autumn 2026 8 May – 22 May 2026	15	210
Winter 2026 Scheduled for late July 2026	15	Pending
TOTAL		699 nights

Location of survey sites

The bat detectors were deployed within a range of habitats across the study area (Figure 8-1). Table 8-2 presents the habitat descriptions for each of the survey sites and the proximity of the site to treed habitats and permanent waterbodies. Due to access issues, two sites in summer 2026 were placed in different locations from the other seasons. Sites 11 and 14 were not surveyed in summer 2026, and substituted with sites 16 and 17. All other surveys were undertaken at Sites 1–15.

Due to changes in landholder participation, Sites 13 and 14 are no longer located within the Project Area (Figure 8-1) and will be excluded from surveys from winter 2026 onwards. To maintain representative sampling across the Project Area, two new survey sites will be established in areas containing comparable habitats.

Table 8-2: Description of the sites used for the bat detector survey at Macorna Wind Farm.

Site	Habitat/landscape description
1	Small patch of open, grassy planted young Eucalyptus and Melaleuca. Next to open grassland and crops, with an unvegetated dam is located 500 m to the south-east in a cleared paddock.
2	Small patch of <i>Allocasuarina</i> tree line in roadside vegetation, next to a full water channel. Approximately 450 m from an unvegetated section of Nine Mile Creek, and no other treed areas in close proximity. Open grassland paddock to the north and south.
3	Next to a small dam with water, along a roadside tree line next to cleared cropping land.
4	Small patch of Eucalyptus trees with Boxthorn understorey, and grassland surrounding. No connection to other treed habitat, adjacent paddocks are cleared farmland. Next to a dry

Site	Habitat/landscape description
	channel, and no other waterbodies were observed nearby. Approximately 500 m from an untreed section of Nine Mile Creek.
5	Roadside vegetation, including <i>Melaleuca</i> , <i>Eucalyptus</i> and <i>Allocasuarina</i> , next to cleared paddocks. Four small dams are located within 30 - 300 m.
6	Scattered <i>Eucalyptus</i> trees and Boxthorn within grassland paddocks, surrounded by mostly cleared landscape. No water in sight.
7	Patch of trees next to a cleared grazing paddock. Located on an <i>Acacia</i> tree with tangled lignum as understorey and next to Cavil Creek.
8	Small patch of <i>Eucalyptus</i> trees with sparse tall shrubby understorey. Lignum present, indicating potential intermittent flooding. No water nearby, but located 200 m from Johnson Swamp Wildlife Reserve.
9	In a patch of remnant scattered woodland along a channel that is holding some water. The woodland patch is open, with dominant understorey as grassland and glasswort. A large dam is located 50 m directly south.
10	Open paddock, no water in sight. A few scattered <i>Eucalyptus</i> spp. Placed in the grassland next to Hird Swamp Wildlife Reserve.
11	Recorder placed on planted <i>Eucalyptus</i> trees with some sparse shrubs. Next to a drain low in water, and 1 km east of Cavil Creek.
12	Roadside treed vegetation next to grassland and hay crops. Connected to other roadside tree lines, scattered paddock trees and a more extensive treed area around a farmhouse to the west.
13	Roadside trees. Surrounding landscape is cropped but contains bordering tree rows. There is no water nearby. Due to be excluded from Winter 2026 onwards due to changes in landholder participation.
14	Next to the Macorna Channel and Pyramid Creek intersection, in a patch of scattered <i>Eucalyptus</i> trees. Grassland and shrubs are present nearby, and scattered trees are throughout the landscape. Flannery Nature Conservation Reserve is located 750 m to the south. Due to be excluded from Winter 2026 onwards due to changes in landholder participation.
15	Recorder placed on <i>Allocasuarina</i> tree. No water nearby and near a paddock with sheep grazing.
16	Only surveyed in summer 2026. Located in open farmland in the north of the study area, with a low-lying area directly north which looks like it may hold water during wet periods. Pyramid Creek is located approximately 800 m to the north.
17	Only surveyed in summer 2026. Located along Calivil Creek in the centre of the study area. This portion of the creek is vegetated with shrubs and is surrounded by open farmland. A dam is located off the creek approximately 200 m to the west.

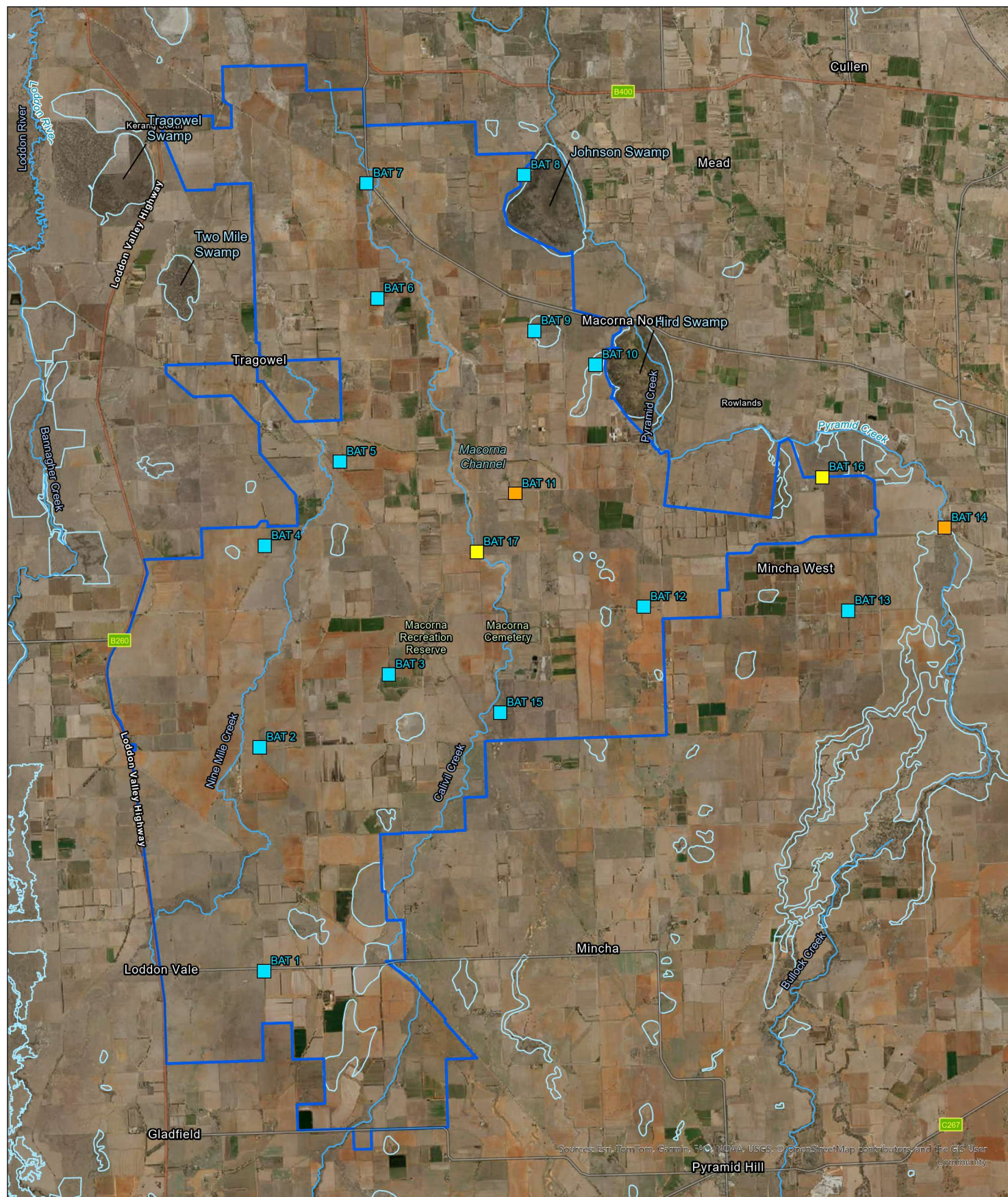


Figure 8-1. Location of bat survey points at Macorna Wind Farm

Project No: 24129.09 **Project location:** Macorna Wind Farm, VIC **Date:** 27/07/2026

- Project Area
- Waterway
- DEECA mapped wetland

- Bat survey points**
- Used during all survey periods
 - Used for Spring 2025 and Autumn 2026 surveys
 - Used for Summer 2025/26 surveys only



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Echolocation call identification

An initial desktop search was performed to assess which species were likely to be present within 50 km of the project using the online resource BatMap (Australasian Bat Society 2026).

Initially, calls were filtered through Kaleidoscope Lite (Wildlife Acoustics, Maynard, USA) to remove files that do not contain bat calls and those with less than 4 bat pulses (noise files). Microbat call sequences were subsequently analysed using Anabat Insight (Version 2.1.7-0-ge456fe0 – 2.19-0-g94a3eff; Titley-Scientific, Brendale, QLD). Initially, the call sequences were roughly sorted and labelled using a custom decision tree. These call sequences were then manually checked to confirm the presence (or absence) of each candidate species.

Call identification was assigned using a combination of published keys and online resources, including, but not limited to, the following: (Armstrong et al. 2021; Pennay et al. 2004; Reinhold et al. 2001; Sue Churchill 2008; Thompson et al. 2024). In some cases, the published literature and/or other call analysts were consulted to gain further information on distinguishing call parameters and identification.

Three levels of confidence, modified from Mills et al. (1996), were used to assign species identification, including:

- *Definite* – Very high confidence in the identification of the species producing the call sequence.
- *Probable* – High confidence in the call identification, although the call characteristics are similar to those of another microbat species.
- *Possible* – Little confidence in the call identification, as it can be difficult to distinguish between at least two microbat species with similar call characteristics. Species in this group are typically grouped together in a species complex. Example calls of threatened species identified (i.e., the *Nyctophilus* spp. complex) are presented in Appendix 12.

Lastly, calls were coarsely grouped into foraging guilds, which are defined by a bat's echolocation call frequency (kHz), wing loading, and wing aspect ratio (Adams et al. 2009; Sue Churchill 2008; Fullard et al. 1991; Lo Cascio et al. 2022; Pennay et al. 2004; Rhodes 2002). In this case, foraging guilds have been assigned to broad categories based upon the characteristic frequency (Fc) (kHz) of the echolocation calls. These categories are:

- *Open-space foraging* – includes those bats whose calls have an Fc range of between 10 and 28 kHz
- *Edge-space foraging* – includes those bats whose calls have an Fc range of between 28 kHz and 48 kHz
- *Cluttered space foraging* - includes those bats whose calls have an Fc greater than 48 kHz.

Foraging guilds are used to explain a species' utilisation of the environment and are an effective way of grouping bats when assessing risk in relation to wind farm projects. The foraging guild data provided in this report should be used to inform potential high-risk sites, and if further monitoring is required, rather than as a proxy for full species activity. This foraging guild data is not manually verified and likely still contains noise and a proportion of incorrect species foraging guild allocations.

Assumptions and limitations

There are limitations to undertaking bat detector surveys; a detailed explanation of the limitations of using bat detectors and bat call analysis to study echolocating insectivorous bats is outlined in

Appendix 11. A summary of the limitations and efforts to counteract these limitations is provided below. These are inherent methodological limitations of acoustic bat surveys, and the survey design, multiple detector locations, seasonal sampling and operational BAM Plan address these limitations to the extent possible.

Detecting capabilities – bat detectors are only capable of detecting echolocation calls that arrive at the microphone above a critical sound pressure level and at a sufficiently high signal-to-noise ratio. This means that, for an echolocation call to be recorded by a bat detector, it must be louder than the background or ambient noise. Furthermore, the call data collected is from only a portion of the entire three-dimensional airspace in which the turbines will operate. This limitation will be taken into consideration when assessing the impacts on bats and in the consideration of appropriate avoidance and mitigation measures.

Zone of detection – echolocation calls produced by bats attenuate (reduce in amplitude) as they travel through air, with higher frequency calls attenuating faster than lower frequency calls. This limitation will be taken into consideration when assessing the impacts on bats and in the consideration of appropriate avoidance and mitigation measures.

Survey variation - There are variables when collecting field data, including variation in the way the detectors are installed, environmental/seasonal conditions, methodology, survey purposes, and personnel collecting the data. Nature Advisory aim to keep equipment and survey methodology consistent across survey periods. Due to issues with the GPS during the summer 2026 surveys, two detector sites were placed at the incorrect locations. Therefore, sites 11 and 14 were not surveyed in summer 2026, and sites 16 and 17 were added for this survey only. This does not materially compromise spatial or seasonal representativeness of the survey dataset. Detector sites will remain consistent with the spring 2025 survey locations for the remainder of the surveys, and sites 16 and 17 will not be surveyed again.

Bat activity levels across weather conditions – bat activity levels within and between nights may vary in response to weather variables such as air temperature, relative humidity, barometric pressure, wind speed, direction and gusts, and rain. The Handbook (DEECA 2025a) states that these variables should be considered during bat assessments and therefore will be considered when more seasonal surveys have been completed.

Relative activity vs abundance – passively collected echolocation call data cannot be used to quantify the numbers of bats present in a given area. Therefore, it is not possible to determine population numbers (abundance), but rather only a measure of relative activity (e.g., calls per night per site). A measure of relevant activity will be reported once more seasonal surveys have been undertaken, and weather data is provided to understand fluctuations in activity.

Overlap in species-specific call characteristics – calls produced by one bat species may at times closely resemble those of other species. The considerable variability in calls produced by free-flying echolocating bats often makes it difficult, or sometimes impossible, to assign species-level identifications to passively recorded calls. Therefore, all calls that cannot be reliably identified to species level are placed into a call complex.

The echolocation calls produced by long-eared bats (*Nyctophilus* spp.) cannot be distinguished to species level and, hence, are grouped as a long-eared bat complex (Pennay et al. 2004). The species of this complex that have the potential to occur at the Macorna Wind Farm site include the Corben's Long-eared Bat (*N. Corbeni*) (EPBC Act: Vulnerable; FFG Act: Endangered), and the unlisted Lesser Long-eared Bat (*N. geoffroyi*) and Gould's Long-eared Bat (*N. gouldi*).

8.2. Results

This summary includes the results of the spring 2025, summer 2026 and autumn 2026 surveys, which are all the surveys conducted to-date. A detailed outline of the results for each season is presented in Appendix 24.

To date, a total of 181,120 bat calls have been recorded across the 17 sites surveyed (Table 8-4), with nine species and two multi-species complexes were identified (Table 8-3 and Table 8-4).

8.2.1. Foraging guilds

The highest activity across the study area was recorded by the edge-space foraging bats (121,877 calls), which consists of Gould's Wattled Bat (*Chalinolobus gouldii*), Inland Broad-nosed Bat (*Scotorepens balstoni*) and Large Forest Bat (*Vespadelus darlingtonia*; Table 8-3). These species tend to forage along the edges of treed habitat but do also venture into more cleared areas, which makes them susceptible to turbine strikes. Gould's Wattled Bat, in particular, is the second-most frequently observed bat species found to collide with turbines (Moloney et al. 2019; Nature Advisory 2024) in eastern Australia.

The open-space foraging group, consisting of the White-striped Free-tailed Bat (*Austronomus australis*), Eastern Free-tailed Bat (*Ozimops ridei*) and South-eastern Free-tailed Bat (*O. planiceps*), recorded 44,411 across the site (Table 8.4). Free-tailed bats, in particular the White-striped Free-tailed Bat, are highly susceptible to turbine strikes due to their higher flight heights (Moloney et al. 2019; Nature Advisory 2024).

The clutter-adapted species, including the Long-eared Bat complex, Chocolate Wattled Bat (*c. morio*), Southern Forest Bat (*V. regulus*) and Little Forest Bat (*Vespadelus vulturnus*), recorded 14,832 calls. These species tend to forage close to or within the tree canopy and, therefore, are less susceptible to turbine strikes. However, collisions of clutter-adapted species have been reported in south-east Australia (Moloney et al. 2019; Nature Advisory 2024). Sites 2, 7, 10 and 14/13 recorded a higher number calls from these species (Appendix 24).

Table 8-3: Microbat species recorded during the bat detector surveys at the MAWF site.

Common name	Scientific name	Foraging guild	Recorded	Conservation status	Timing	Site(s)
White-striped Free-tailed Bat	<i>Austronomus australis</i>	Open-space	Definitely	-	All seasons	All sites
Gould's Wattled Bat	<i>Chalinolobus gouldii</i>	Edge-space	Definitely	-	All seasons	All sites
Chocolate Wattled Bat	<i>Chalinolobus morio</i>	Clutter-space	Definitely	-	All seasons	All sites excl. 13, 16, and 17
South-eastern Free-tailed Bat	<i>Ozimops planiceps</i>	Open-space	Definitely	-	All seasons	All sites
Eastern Free-tailed Bat	<i>Ozimops ridei</i>	Open-space	Definitely	-	All seasons	All sites
Inland Broad-nosed Bat	<i>Scotorepens balstoni</i>	Edge-space	Definitely	-	All seasons	All sites

Common name	Scientific name	Foraging guild	Recorded	Conservation status	Timing	Site(s)
Large Forest Bat	<i>Vespadelus darlingtoni</i>	Edge-space	Definitely	-	All seasons	All sites excl. 2, 4, and 17
Southern Forest Bat	<i>Vespadelus regulus</i>	Clutter-space	Definitely	-	All seasons	All sites excl. 16 and, 17
Little Forest Bat	<i>Vespadelus vulturnus</i>	Clutter-space	Definitely	-	All seasons	All sites excl. 17
Species complex						
Long-eared bat spp. complex: Corben's Long-eared Bat , Gould's Long-eared Bat and Lesser Long-eared Bat	<i>Nyctophilus</i> spp. <i>N. corbeni</i> , <i>N. gouldi</i> , <i>N. geoffroyi</i>	Clutter-space	Possible	EPBC: Vulnerable; FFG Act: Endangered	All seasons	All sites
Forest Bat spp.	<i>Vespadelus</i> spp. complex	Clutter-space	Possible	-	Spring 2025	Sites 1 & 2 only

NOTES: Rows shaded with bold text are listed species under the EPBC Act or Vic FFG Act.

8.2.2. Species of Concern

Two species listed as threatened under the Commonwealth EPBC Act and/or the Victorian FFG Act have the potential to occur in the study area:

- Corben's (South-eastern) Long-eared Bat, *Nyctophilus corbeni*, and
- Yellow-bellied Sheathtail Bat, *Saccolaimus flaviventris*.

These species are listed as Species of Concern in the Handbook (DEECA 2025d). Both species were considered to potentially occur in the study area during the initial risk assessment (Nature Advisory 2025).

Corben's Long-eared Bat

Corben's Long-eared Bat is listed as 'vulnerable' under the EPBC Act and 'endangered' under the FFG Act.

This species cannot reliably be detected by ultrasonic methods, and so is addressed by the presence/absence of any Long-eared Bat species. Hence, calls recorded in the study area that are attributed to the long-eared bat complex group could be produced by Corben's Long-eared Bat, Gould's Long-eared Bat *N. gouldi* or the Lesser Long-eared Bat *N. geoffroyi*. There were 2,034 recorded calls of the Long-eared Bat complex in the study area across all sites. Site 15 recorded the highest number of calls for the complex (17.7 %; Table 8-4). This was then followed by sites 1, 5, 7, 9, and 13, which all recorded over 200 Long-eared Bat calls.

The number of calls assigned to the Long-eared Bat complex varied across surveys. The least number of Long-eared Bat complex call sequences was recorded in Summer 2025-2026, and the highest in Autumn 2026 (Table 8-4 and Appendix 24).

Corben's Long-eared Bat is a clutter-adapted species, preferring to forage within and around patches of vegetation in the landscape (DoE 2013). In Victoria, this species inhabits dry woodland and shrubland communities in semi-arid regions (Menkhorst 1996). There is a lack of remnant semi-arid woodland and habitat corridors present in the study area. However, it is close to the species modelled distribution and therefore could occur in a low density. Distribution mapping shows the species' range within 8 km to the south-east and 10 km to the north-east of the study area. However, GPS tracking of the species has shown they generally cross cleared land when it is in close proximity (less than 600 m, but up to 2.3 km) of large forest blocks (Gonsalves et al. 2024). Due to the nature of the cleared landscape within and around the study area, with habitat only present as interconnected rows of remnant trees and plantings, and the lack of large forest blocks, the study area may support some of the species, but is unlikely to support an important population, which is defined as populations within areas reserved for protection (DCCEE 2025).

Small numbers of Lesser Long-eared Bat and Gould's Long-eared Bat have collided with operating wind turbines with minimum RSA heights of 20-40 metres in south-east (Nature Advisory unpublished mortality data). However, there have been no reported collisions of Corben's Long-eared Bat with turbines to Nature Advisory's knowledge, but it is listed as a Species of Concern for Victorian wind farms (DEECA 2025a). While the species is generally considered a lower flyer (Baker and Gynther 2023) and therefore unlikely to fly regularly at RSA heights, some flights at RSA height may occur.

The use of harp trapping was considered to target Corben's Long-eared Bat, as this species cannot be reliably distinguished from other Long-eared Bats using acoustic call data alone. However, acoustic monitoring has recorded Long-eared Bat complex calls across most survey locations, indicating that if Corben's Long-eared Bat is present, it is unlikely to be confined to a specific area suitable for targeted trapping. Furthermore, the fragmented patches of suitable habitat do not provide a suitable trapping habitat due to the lack of bat flyways, which could make it difficult to trap this species.

In addition, trapping for this species is known to be challenging, and failure to capture individuals does not necessarily indicate absence from the study area (DEWHA 2010). Accordingly, a precautionary approach is recommended, whereby the species is assumed to be present and appropriate mitigation measures, such as habitat buffers from turbines, are incorporated into project design.

Yellow-bellied Sheathtail Bat

The Yellow-bellied Sheathtail Bat (YBSB) is listed as 'Vulnerable' under the FFG Act.

YBSB has not been recorded during the surveys completed to date. There is no information on the population size of YBSB in Victoria, but the species could be a rare visitor to southern Australia, predominantly in late summer and autumn (NSW Office of Environment and Heritage 2021; Hall and Richards 2023). Therefore, this species may be recorded in the study area during the subsequent planned surveys.

The YBSB is a large (mean body weight = 44 g), open-space adapted species that flies high and fast above the canopy, but has been observed flying lower over open spaces and at the forest edge

(S Churchill 2008). The species has been recorded colliding with wind turbines further north in its range in NSW, where it is assumed to be more abundant and indicates that it is vulnerable to turbine collision. Nature Advisory is not aware of any YBSB carcasses recorded during mortality monitoring at operational wind farms in Victoria (Nature Advisory unpublished mortality data). However, it is listed as a Species of Concern for Victorian wind farms (DEECA 2025a). Typically, in Victoria and NSW, acoustic recordings indicate low levels of activity and are of a few calls (1–5) recorded on one or two nights at different locations across a site.

Future surveys and analyses will clarify the utilisation of the Project Area by this species and provide information to inform a significant impact assessment for this species.

Table 8-3: Number of calls per bat foraging guild at each survey site at MAWF.

Foraging guild	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	TOTAL *
Spring 2025																		
Clutter-space	142	305	299	80	437	824	1,461	1,094	332	880	126	390	2,117	718	46	N/A*	N/A*	9,251
Edge-space	1,855	2,977	1,575	4,170	2,180	2,252	2,248	2,413	2,837	3,767	727	4,681	1,624	3,573	1,186	N/A*	N/A*	38,065
Open-space	830	1,420	460	2,125	552	261	1,472	835	478	972	123	1,178	77	859	339	N/A*	N/A*	11,981
TOTAL	2,827	4,702	2,334	6,375	3,169	3,337	5,181	4,342	3,647	5,619	976	6,249	3,818	5,150	1,571	N/A*	N/A*	59,297
Summer 2025/2026																		
Clutter-space	82	2382	90	12	298	223	194	154	764	782	N/A*	117	46	N/A*	93	81	22	5,340
Edge-space	1,074	3,306	1,462	2,043	2,893	3,093	3,189	3,803	11,976	11,319	N/A*	2,658	1,482	N/A*	2,005	3,077	1,352	54,732
Open-space	243	776	663	442	550	317	371	605	1978	1571	N/A*	949	427	N/A*	1337	1175	296	11,700
TOTAL	1,399	6,464	2,215	2,497	3,741	3,633	3,754	4,562	14,718	13,672	N/A*	3,724	1,955	N/A*	3,435	4,333	1,670	71,772
Autumn 2026																		
Clutter-space	5	2	1	1	183	12	1	2	25	3	1	1	1	2	1	N/A*	N/A*	241
Edge-space	1154	1635	1175	4812	2425	3907	984	1253	4604	1269	969	783	752	946	2412	N/A*	N/A*	29,080
Open-space	1574	837	2430	2962	1768	1594	133	892	3020	1211	917	888	229	1271	1004	N/A*	N/A*	20,730
TOTAL	2733	2474	3606	7775	4376	5513	1118	2147	7649	2483	1887	1672	982	2219	3417	N/A*	N/A*	50,051
TOTAL ALL SEASONS	6,959	13,640	8,155	16,647	11,286	12,483	10,053	11,051	26,014	21,774	2863	11645	6755	7369	8423	4333	1670	181,120

NOTE: * Sites 16 and 17 were only used during Summer 2025/26, where access issues prevented surveying at Sites 11 and 14.

Table 8-4: Number of long-eared bat calls at each survey site at MAWF.

Season	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Site 7	Site 8	Site 9	Site 10	Site 11	Site 12	Site 13	Site 14	Site 15	Site 16	Site 17	Total
Spring 2025	181	0	13	7	16	14	9	38	18	36	14	37	27	39	31	-	-	480
Summer 2026	18	4	25	2	14	9	6	17	76	6	-	21	8	-	29	27	2	264
Autumn 2026	59	19	54	39	243	27	196	24	145	50	69	15	16	34	300	-	-	1,290
TOTAL	258	23	92	48	273	50	211	79	239	92	83	73	51	73	360	27	2	2,034

8.3. Conclusions

8.3.1. Summary of findings

Two listed bat species have the potential to occur in the study area. Neither has been definitively detected during surveys to-date, however, Long-eared Bats (*Nyctophilus* spp.) were detected during the surveys. This complex cannot be distinguished to species level and, hence, may include the Corben's Long-eared Bat (EPBC Act: Vulnerable; FFG Act: Endangered), and the unlisted Lesser Long-eared Bat and Gould's Long-eared Bat. Yellow-bellied Sheath-tail Bat have not been detected during surveys to date. Only three seasons have been completed to date, with subsequent surveys likely to provide a more robust view of the species likely to be onsite, namely the potential for YBSB to occur in the Project Area.

8.3.2. Potential impact pathways

The impact pathways affecting bat species can be broadly categorised into two groups: construction impacts and operational impacts.

Construction impacts

Construction impacts include:

- **Habitat loss and fragmentation** through clearance or displacement, including foraging and roosting habitat (e.g., hollow-bearing trees) and commuting corridors;
- **Disturbance to roosting and maternity sites**, such as removal of hollow-bearing trees and man-made structures used as roosts.

Operational impacts

Operational impacts include:

- **Displacement and barrier effects**, where bats may be displaced as movement pathways are altered to avoid the wind farm;
- **Mortality resulting from collision** with turbines and transmission lines; and
- **Barotrauma** from operating wind turbines.

In addition to the above pathways, consideration of the above impacts in the context of similar nearby renewable energy facilities must be considered (i.e., cumulative impacts).

8.3.3. Assessment of potential impacts

This impact assessment is based on the results of the spring 2025, summer 2026 and autumn 2026 surveys and will be updated dependent on the results of subsequent seasonal surveys.

Construction impacts

Construction will result in the loss of an insignificant amount of vegetation used by bats in the context of the broader landscape. The loss of native vegetation is unlikely to have a material effect on the availability of foraging habitat for bat populations, however, any removal of hollow-bearing trees will result in loss of habitat for hollow-roosting bat species, including Corben's Long-eared Bat and Yellow-bellied Sheath-tailed Bat, which are both hollow-roosting species. Currently, 5 scattered trees are impacted by the project (they will be assessed for hollows during the next site survey), and further design refinement may seek to avoid these trees during detailed design.

Disturbance effects from a wind farm may result in changes in the behaviour and/or reproductive success of bat species. Effects of construction and operational noise, traffic and artificial light and hydrological impacts on natural vegetation, wetlands and waterways, and roost locations (both inside and outside the MAWF area) have been considered.

Most construction stage activity will occur during daylight hours and will be temporary and intermittent (estimated to last for short periods at any work site within the longer project construction period). Nighttime security lighting should only be used at the terminal station and at temporary construction compounds. Any impacts of lighting or noise during construction will be temporary, and lighting can be baffled and placed away from high-quality bat habitat, including woodland areas, waterbodies and waterways, and tree rows.

Once construction is complete, there will be a lower level of vehicle traffic and human activity associated with operating the completed wind farm. During operation, turbines generally only require aviation warning lighting when within proximity to airfields. This consists of red flashing lights, which are not known to attract bats, and there is no known international literature to suggest that this kind of lighting is of any concern at onshore wind farms.

Operational impacts

The primary cause of bat mortality at wind farms is collision with operational turbine blades. Barotrauma has also been suggested as a direct impact pathway (Baerwald et al. 2008), but this remains somewhat controversial due to difficulties in diagnosing the specific cause of death for bat carcasses discovered at wind farms (Rollins et al. 2012). To avoid confusion, it seems reasonable to assume that, for bat carcasses found beneath operating wind turbines, mortality was most likely the result of direct interaction with rotating turbine blades.

Microbats are known to collide with operating turbines throughout eastern Australia (Nature Advisory 2024; Moloney et al. 2019; Symbolix 2020). The impact to species' populations due to wind farm mortalities remains unclear, but the nature of the impact of wind farms on bats is anticipated to be long-term or permanent without avoidance and mitigation measures applied (DEECA 2025d). Non-threatened bat species recorded at MAWF that are most susceptible to collisions due to their behaviour of flying regularly at RSA height are (Nature Advisory unpublished mortality data):

- White-striped Free-tailed Bat (most frequently recorded bat mortality),
- Gould's Wattled Bat (second-most frequently recorded bat mortality),
- Eastern Free-tailed Bat, and
- South-eastern Free-tailed Bat.

To reduce collisions, a number of design changes have been incorporated. The design has avoided the removal of woodland habitat which may be used by the listed Corben's Long-eared Bat species. The project has also adopted a minimum RSA clearance of 60 m, which is expected to reduce the likelihood of bat interactions with turbine blades by placing the rotor swept zone above the typical flight height of many bat species. However, it is noted that the success of this measure is still uncertain for bats, and is likely to be species-specific (DEECA 2025a). In addition, the total number of turbines has been reduced from 140 to 114 as part of the design refinement process. This reduction decreases the overall footprint and density of turbines, thereby lowering the potential for collision risk and cumulative impacts to bats.

8.3.4. Recommended application of mitigation hierarchy

The recommended application of the mitigation hierarchy for bats at the Project Area is given below, categorised by avoidance, minimisation and restoration measures.

Avoidance

Layout amendments have been undertaken to avoid all woodland areas and minimise the removal of scattered trees and large trees in patches of native vegetation (outlined further in Section 13.2). Other avoidance and minimisation measures already incorporated into the project design, such as 2 km buffers to Hird and Johnson Swamp, 100m buffers to major creek lines and 30m buffer to minor waterways, will result in benefits to bats as well.

Micrositing of all infrastructure during detailed design will further avoid direct disturbance to potential bat habitat, if possible, with a focus on avoiding any loss of hollow-bearing trees.

Minimisation of disturbance during construction

Where construction is to happen in close proximity to confirmed known threatened species roosts (i.e., hollow-bearing trees), consideration should be given to timing construction activities outside of the breeding season for that species.

Minimisation of direct mortality (collision) & Barotrauma during operation

The project has minimised the risk of direct mortality and barotrauma during operation through careful **turbine placement** that avoids the airspace that overlaps with the flight paths of most bat species, a **minimum rotor swept area** (RSA) of 60 m above ground level has been adopted. This RSA height could be sufficient to avoid most flights of Corben's Long-eared Bat. However, the degree to which turbines attract bats into the RSA is still unknown, and therefore raising the minimum RSA height may not remove collision risk completely. Due to the higher flight heights of the Yellow-bellied Sheathtail Bat, raising the minimum RSA height is unlikely to reduce collision risk to this species.

Residual risks will be addressed through the development of a **Bat and Avifauna Management Plan** (BAM Plan), including trigger responses should carcasses exceed expected low mortality events of threatened bat species be found, including recommendations of turbine curtailment. For threatened species, a trigger event can be as low as one individual mortality. This plan will be informed by local information on bat utilisation and agreed to in consultation with the regulator. The contents of BAM Plans are outlined in the Handbook (DEECA 2025b). Mitigation measures to be considered in the BAM Plan in response to impacts on threatened bat species include potential adaptive measures such as:

Nighttime **turbine cut-in speeds** (i.e., low windspeed curtailment) can be altered to reduce direct collision impacts on bats. Low windspeed curtailment involves raising the windspeed at which turbines begin to produce energy (the 'cut-in speed'), which is effective because insectivorous bats are more active during lower wind conditions (DEECA 2025a).

Nighttime **blade feathering** can be used as a measure to minimise the collision risk of bats (DEECA 2025a). Turbine blades can still rotate below the cut-in speed when electricity is not being generated. 'Feathering' is the act of preventing the turbine blades from free-spinning below the cut-in speed, which is achieved by locking turbine blades or angling the blades to be parallel to the wind (Barré et al. 2023). In some cases, the blades may still move a minimal amount (e.g. 1–2

rotations/minute). This reduces the risk of bats colliding with spinning turbine blades (Whitby et al. 2024), without impacting facility output.

Emerging technologies, such as ultrasonic bat deterrents, can be trialled for efficacy in reducing mortalities of Australian bats at wind farms. Ultrasonic bat deterrents aim to deter bats from the airspace of the rotor swept area, to decrease the chances of colliding with rotating blades. These systems generate ultrasonic sound within the frequency range used by bats that is designed to mask returning echoes from the bat's echolocation signal, forcing them to leave the airspace (Arnett et al. 2013). The success of ultrasonic bat deterrents in Australia is unknown. Therefore, trailing deterrents alongside other mitigation measures is recommended until their full effects are understood (DEECA 2025a).

Restoration of habitat

Where habitats, or their connectivity, are fragmented during construction, they should be subject to subsequent rehabilitation. Priority can be given to the restoration or improvement of woodland patches that are, or can be made, sufficiently large or contain suitable habitat features (e.g. hollow-bearing trees and coarse woody debris) to support breeding of those bat species that are present.

8.3.5. Conclusions and further investigations

The conclusions presented here are informed by three seasonal surveys. This provides some information on utilisation but represents the early stages of the studies. As such, the findings should be considered preliminary, with the ongoing studies likely to address any uncertainties in the available information. An additional five studies are proposed that will provide further data to refine the understanding of bat activity and risk in the Project Area. These studies are planned to be undertaken in consecutive seasons across the rest of 2026 and into 2027. This will complete a two-year study period, which complies with the Commonwealth Onshore Guidance (DCCEEW 2024a) and will provide a robust assessment that accounts for the strong seasonal climatic variability of the study area, characterised by hot, dry summers and cool, wet winters, which can substantially influence bat activity patterns (DEWHA 2010; Erickson and West 2002). As future studies provide additional information to inform the utilisation of the site and potential impacts, they will be incorporated into this report to inform recommendations on mitigation and conclusions on impacts.

This assessment preliminarily concludes that, with implementation of the recommended mitigation hierarchy, as also outlined in the guidance documents (DEECA 2025a), the Project is unlikely to result in significant impacts to bat species. The mitigation measures incorporated into project design, such as a 2 km buffer to Hird and Johnson Swamp, 100 m buffers to major creek lines, 30 m buffer to artificial waterways, avoidance of woodland removal and operational management, are expected to substantially reduce potential impact pathways, including collision risk and habitat disturbance.

Notwithstanding this, some residual risk to bats may remain. The extent to which such residual impacts may contribute to cumulative effects at a broader landscape scale is difficult to quantify, particularly given the mobility of bat species and the potential for interaction with multiple developments across their range. This residual risk will be addressed in a BAM Plan, which will follow guidance documents for the adaptive management of residual risk (DEECA 2025a).

9. Brolga studies

This section presents the pre-construction baseline data on the utilisation of the proposed Project Area by Brolga. Brolga surveys were undertaken by Ecology and Heritage Partners (2024-2025) and Nature Advisory (2025 – ongoing). The initial 2024 EHP study was undertaken under the guidance of the *Interim Guidelines* (DSE 2012), which was superseded in 2025 by *The Handbook for the development of renewable energy in Victoria* (DEECA 2025d) and its *Appendix 2: Species specific guidance for onshore wind energy facilities - Victorian Brolga* (DEECA 2025c) (hereafter referred to as the Handbook). Subsequently, from 2025, studies were undertaken as per the guidance provided within the Handbook. As the Project is to be referred under the EE Act within 12 months after the Handbook commenced, the transitional provisions of Section 4.6 of the Handbook apply, and this project will be assessed according to the Handbook. An impact assessment for Brolga following the Handbook is presented below.

9.1. Background information

9.1.1. Description

The Brolga belong to the family Gruidae (cranes), of which two species occur in Australia (Marchant and Higgins 1993). Brolgas are very similar to other cranes in their general ecology and physiology, being large-bodied, long-legged and long-lived. Adult Brolgas typically stand between 1-1.4 m tall, have a wingspan of over 2 m, and a weight range of 4–8 kg (Plate 9-2).

The Brolga breeds in shallow freshwater wetlands, with reproductive activity closely linked to rainfall and wetland inundation (Veltheim and Sundar 2019; Marchant and Higgins 1993). Nests are constructed as large, circular mounds composed of emergent aquatic vegetation such as sedges, rushes and cumbungi, together with grasses and other available plant material (Plate 9-1). The nest mound is typically 1–1.5 metres in diameter and raised approximately 20–50 centimetres above the water surface, positioned within shallow inundation to reduce access by terrestrial predators. Clutches usually comprise two eggs, although often only one chick successfully fledges.

Breeding pairs can form long-term bonds and, if one of the pair dies, the remaining individual may take several seasons to find another mate (Marchant and Higgins 1993). Brolga pairs will aggressively defend their breeding territory (Arnol et al. 1984) and have been observed destroying nests that other Brolgas have attempted to build within it.

The annual cycle is divided into two main periods.

- *Breeding season* (July–December), during which territorial pairs nest in shallow freshwater wetlands that are often ephemeral and only hold water reliably in winter and spring; and
- *Flocking season* (December–June), when Brolga disperse from their breeding wetlands, which are drying up, to larger wetlands that are more permanent. Here, they form flocks that roost at the wetland and forage in adjacent terrestrial and wetland habitats (DSE 2012; Sheldon 2005). Brolgas often form large flocks (occasionally as many as 200 birds) but are typically seen in smaller groups (10–20) (Veltheim and Sundar 2019; Marchant and Higgins 1993).

Between the breeding and flocking seasons, Brolga move between their breeding and flocking sites during two migration periods that are roughly consistent with December and June/July, although variations due to rainfall can be expected. In some areas, resident pairs can also remain year-round (Veltheim et al. 2022).



Plate 9-1: Brolga pair on a nest (not at MAWF).



Plate 9-2: Brolga foraging (not at MAWF).

9.1.2. Habitat

In Victoria, Brolga occur in a variety of habitats and utilise different habitats in the breeding season compared with the non-breeding season (Arnol et al. 1984). In the breeding season, territorial pairs nest in shallow freshwater wetlands that are often ephemeral, holding water reliably only in winter and spring (Herring 2005). During the non-breeding season, Brolga congregate together at larger, often permanent waterbodies where they roost, drink and forage and venture out across the landscape to forage in terrestrial habitats (Arnol JD, White DM and Hastings I 1984; Johnsgaard 1983).

Brolga rely on hydrologically and ecologically functional wetlands for nesting, food resources and night-time roosting sites (Johnsgaard 1983). In the breeding season (July-December), this species nests in shallow freshwater marshes less than 50 cm deep and with emergent vegetation and freshwater meadows less than 30 cm deep dominated by annual herbs, rushes, or tussock grass (Marchant and Higgins 1993). Emergent vegetation at these functional wetlands plays a crucial role in providing Brolga habitat, as it is used as nesting material (Myers 2001; Du Guesclin 2003), food resources (tubers, aquatic animals) (Herring 2018), provides shelter for prey (vertebrates and invertebrates) (Herring 2005), and cover from predators for young chicks (Herring M 2018; Johnsgaard 1983).

A Brolga family will spend most of its time in the Brolga Breeding Wetland foraging during the breeding season, and will move to other functional wetlands nearby to forage and/or roost as the chicks develop and food resources are depleted in the original Brolga Breeding Wetland. Brolga also forage in pasture and, to a lesser degree, during the breeding season, cereal and canola crops in the vicinity of the Brolga Breeding Wetland and night-time roost. Brolga roost at a wetland during the night and move about during the day within, around and between them to forage (Veltheim, I 2018).

A *Brolga Breeding Wetland* is defined by the Handbook as the perimeter of the surrounding wetland of the nest of a Brolga breeding pair (DEECA 2025c). These are wetlands with previous verified records of Brolga breeding attempts in the last 20 years.

A study by Veltheim et al. at nine breeding sites in Victoria tracked 11 pre-fledged Brolga chicks using GPS transmitters (Veltheim et al. 2019). The researchers found that pre-fledged Brolgas

moved an average of 442 m between night roosts and daytime foraging areas, with maximum movements reaching 1.9 km. Nesting wetlands may be used as night roosts once chicks leave the nest, but Brolgas also use other nearby wetlands as night roosts or for foraging that were not the original nest site. During nest building the pair mostly moves together but will take turns incubating once eggs are laid. Once chicks hatch, the family tends to walk together, though adults may occasionally fly when defending their breeding territory. Breeding home-range areas varied substantially among individuals, from 70 ha to 523 ha, encompassing night roosts, day roosts and foraging habitat. Because of this considerable variability, the core area may extend up to 1.6 km from the night roost, while the full home-range radius can reach up to 2 km in some cases, based on the most extreme records from the collected data. Based on these findings, the authors recommended a conservative 1.6 km turbine-free buffer to encompass most nesting and night-roost wetlands, and a broader 2 km buffer to include wider foraging habitat and movement corridors necessary for successful fledging. These recommendations formed the basis from which the guidance outlined within the Handbook was developed (DEECA 2025c).

Brolgas in Veltheim et al.'s study used an average of 2.82 wetlands (range 1–7), with most utilised wetlands being less than 15 ha (Veltheim et al. 2019). The average size of night-roost wetlands was 7.62 ha (range 0.60–40.74 ha), and the average size of all wetlands used was 8.38 ha. Wetlands between 1 and 10 ha were the most frequently used. Five known nesting wetlands averaged 13.2 ha, although sizes varied widely (2.96–40.74 ha), suggesting that wetland characteristics may be more influential than size alone in determining nesting suitability. It should be noted that both confirmed breeding wetlands near the MAWF, Hird and Johnson Swamps are > 400 ha in size. Within their home ranges, Brolgas also relied heavily on cropping and grazing paddocks for foraging, whilst avoiding buildings (e.g., farmhouses and sheds) and watercourses such as creeks and rivers. Activity near buildings may cause disturbance and lead to avoidance, while watercourses can act as movement barriers or pose drowning risks for chicks.

The key threat to Brolga habitat is the drainage and alteration of the hydrology of wetlands (Du Guesclin 2003). Wetlands that have been permanently drained, partially drained, hold water only for brief periods during the breeding season, and small, unvegetated farm dams have little habitat value for Brolga, as they do not provide the physical and biotic resources the Brolga requires.

9.1.3. Distribution

The Australian Brolga population numbers in the tens of thousands, giving it a secure conservation status. However, most of the population occurs in northern Australia (Marchant and Higgins 1993) and constitutes a genetically distinctive Brolga population from the population found in Victoria (Miller 2016). In Victoria, its range has contracted since European settlement due to wetland drainage and habitat loss related to agriculture, and predation of eggs and young by the introduced Red Fox (*Vulpes vulpes*). Its former range included north-eastern Victoria, Gippsland and the formerly extensive wetlands of the Melbourne region. Currently, Brolgas are found in south-western Victoria and parts of the Murray River Basin (Du Guesclin 2003).

The distribution of Brolga within Victoria varies seasonally. Although Brolga movements are not fully understood, limited tracking indicates that some individuals are resident, whilst others undertake seasonal movements of up to 111 km between breeding and flocking sites (Veltheim et al. 2022; ARI 2026). Long-distance movements may take place in very dry years, and populations may move from dry inland wetlands to wetlands associated with the Murray River (Marchant and Higgins 1993), whereas in very wet seasons, birds may remain at breeding sites year-round.

Three key breeding areas have been identified in northern Victoria (Herring 2018): the Yarrawonga–Katamatite–Benalla–Rutherglen region, the Corop region, and the Echuca–Dingee–Kerang region. Birds in northern Victoria appear to flock locally (Herring 2018), with a flocking stronghold identified in the Dingee–Corop area, approximately 43 km south-east of the MAWF (DEECA 2025c).

Most of the Victorian Brolga population is largely concentrated in the south-western portion of the State with over 850 Brolga counted in south-western Victoria in 2025, whilst a smaller roughly estimated population of less than 100 individuals (less than 10 % of the State population) in northern Victoria (SWIFFT 2025). These populations are spatially differentiated as shown in Figure 9-1. The lower numbers in northern Victoria are likely a result of drier climatic conditions and reduced availability of suitable freshwater habitats.

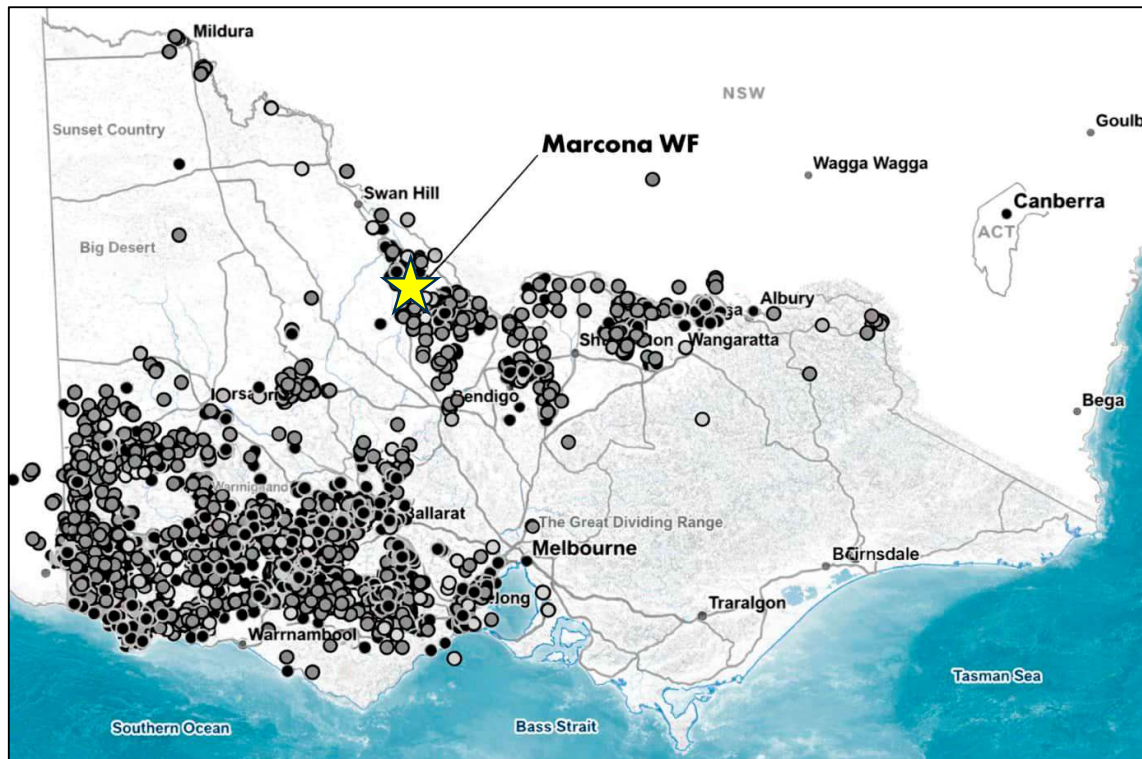


Figure 9-1: Brolga records in Victoria (DEECA 2026e).

9.1.4. Threats

Key threats to the species outlined in the Action Statement *Flora and Fauna Guarantee Act 1988* No. 119 (Du Guesclin 2003) and the Handbook (DEECA 2025c) are summarised below.

- Threats to breeding sites:
 - Drainage and alteration to the hydrology of wetlands;
 - Altered flood regime;
 - Modification of vegetation structure and species composition, water quality or soil structure at Breeding Wetlands and terrestrial foraging areas;

- Widespread use of herbicides and pesticides, especially near breeding sites;
 - Disturbance by hunting activities where young birds are still in the Breeding Wetland;
 - Introduced predators, feeding on eggs and chicks;
 - Wildlife and burning programs, which remove nest material;
 - Grazing by stock degrading wetlands;
 - Subdivision and fencing large private landholdings as chicks can caught in fences;
 - Climate change impacts, primarily through reduced water levels and decreased duration of filling;
 - Erection of structures such as overhead powerlines that can cause collisions; and
 - Use of wetlands for irrigation and/or re-use systems.
- Threats to flocking sites:
 - Disturbance by hunters during the duck season and deposition of lead shots in wetlands;
 - Loss of habitat due to changes in vegetation, for example, changes in agricultural practices;
 - Catchment degradation resulting in changes in water quality, including increased salinity, siltation or flooding;
 - Poisoning of agricultural pests, e.g., locus; and
 - Erection of structures such as overhead powerlines.
 - Threats to migration
 - Collision with wind turbines and other infrastructure.

Threats resulting from wind farms

Turbine collision is noted as a low but potential risk by DEECA (DEECA 2025c). Although turbine collision is not considered a major overall threat, a single fatality in approximately 20 years of onshore wind operation in Victoria has been reported as the potential result of a turbine strike, at Dundonnell Wind Farm (Biosis 2023).

Other wind farm-specific threats include disturbance. Disturbance effects are thought to arise primarily from human presence and activity rather than from the physical presence of turbines or other structures. This is supported by observations of Brolgas nesting as close as ~100 m from operating turbines (Wood 2017, 2014), while avoiding areas with frequent human activity, such as buildings, which are likely associated with human presence (Veltheim et al. 2019). Direct habitat loss is generally avoided at Victorian wind farms, as both current and previous guidelines require turbine layouts to exclude known breeding and flocking wetlands.

9.1.5. Legislative protection

Victoria: Listed as Endangered under the FFG Act.

Commonwealth: None.

9.2. Methodology

The methodology applied in this assessment followed the Handbook, specifically Appendix 2 (DEECA 2025c). Consultation with DEECA has occurred on the 18th of February 2026, regarding the application of the Handbook for MAWF and interpretation of methods.

9.2.1. Sources of existing information

Database searches were undertaken for the Project Area and a 5 km buffer (the 'study area') on 18 December 2025 (the 'assessment area'). The following sources of information were reviewed to collate existing information about Brolga at MAWF:

- Brolga Tracker (ARI 2026);
- *NatureKit* (DEECA 2026a);
- eBird database (Cornell Lab of Ornithology 2026);
- Atlas of Living Australia, ALA (ALA 2026);
- Birddata database (BirdLife Australia 2025);
- Victorian Biodiversity Atlas, VBA (DEECA 2026e);
- Brolga Flocking Areas (DEECA 2025c);
- Victorian Wetland Inventory, VWI (DEECA 2026b);
- Brolga breeding habitat suitability model, BBHSM (DEECA 2025i);
- Previous Brolga reports from MAWF:
 - *Brolga Roaming Surveys and Habitat Assessment: Macorna Wind Farm, Macorna, Victoria*. Report by Ecology and Heritage Partners (EHP), prepared for Atmos Renewables, January 2025 (EHP 2025b).
- Hydrological reports:
 - *Hydrology and Stormwater Constraints Investigation, Macorna Wind Farm*. Report by Dalton Consulting Engineers, prepared for Atmos Renewables, January 2026 (DCE 2026b).
 - *Calivil Creek Wetlands Investigation, Macorna Wind Farm*. Report by Dalton Consulting Engineers, prepared for Atmos Renewables, February 2026 (DCE 2026c).
 - *Additional Wetlands Investigations, Macorna Wind Farm*. Report by Dalton Consulting Engineers, prepared for Atmos Renewables, February 2026 (DCE 2026a).

9.2.2. Community consultation

Consultation with landowners and local environmental groups is a key aspect in identifying areas lacking historical records in biological databases, providing due diligence in identifying potential unmapped Brolga breeding and flocking sites (DEECA 2025c).

An initial consultation by EHP in 2024 invited host landowners within the Project Area to complete a questionnaire, covering 25 landholdings (EHP 2025b). A follow-up consultation by Nature Advisory from December 2025 to February 2026 supplemented this assessment with further landholder engagement Figure 9-2 and contacting local environmental groups (Echuca Bendigo Birdlife Group, North Central CMA, Murray Mallee Landcare Group, Gunbower Landcare Group). Incidental community observations were also recorded opportunistically during field Brolga breeding and wetland surveys in 2025 and 2026.

Landholders and local groups were contacted by mailed questionnaires (EHP in 2024) or by phone/email (Nature Advisory in 2025/26) to provide further Brolga records, information on habitat, and broader details on historical and current land use and other biodiversity values (Table 9-1). The questionnaire used by EHP can be found in Appendix 13 and that used by Nature Advisory in Appendix 14.

Community drop-in sessions were also arranged by Atmos on 18 and 19 November 2025 in Kerang and Pyramid Hill. An ornithologist from Nature Advisory attended the Pyramid Hill session on 19 November 2025 to engage with the local community regarding Brolga and other ecological values.

The quality of the community consultation data is likely to vary due to landholder interest and length of residency; however, the data obtained has added information to the overall picture of Brolga activity and, importantly, provided evidence on Brolga activity from a much longer period than the period of the current project-specific field investigations. A range of additional methods, including review of existing resources, field surveys and wetland assessments, were used to assess Brolga activity at properties.

Table 9-1: Summary of community consultations at Macorna Wind Farm regarding Brolga.

	Number of consultations
Landholders contacted by EHP	25
Landholder contacted by Nature Advisory	18
Community drop-in session	2
Local environmental groups contacted by Nature Advisory	4

9.2.3. Flocking assessments

The MAWF was assessed for flocking areas by investigation of the mapped (DEECA 2025c) and unmapped wetlands. Unmapped flocking areas were assessed via desktop within a 5 km radius of the Project Area, and determined to be flocking sites if they met all three of the following criteria (DEECA 2025c):

- Two or more records of 10 or more Brolga;
- Records from two or more consecutive Brolga flocking seasons (December to June); and
- Records from more than one month.

Verification of the desktop review of flocking potential will be addressed through field surveys during the 2026/27 flocking season.

9.2.4. Wetland assessments

The current assessment uses guidance from the Handbook (DEECA 2025c), where wetlands within 5 km of the Project Area were assessed, including those captured by the Brolga Breeding Habitat Suitability Model (BBHSM) and the Victorian Wetland Inventory (VWI). In addition, any unmapped wetlands not captured by either BBHSM or VWI were also assessed if encountered during field surveys or by hydrological studies.

Field assessments

Initial wetland field assessments

The initial wetland assessments were conducted by EHP (EHP 2025b) between 30 September and 4 October 2024, addressing 64 wetlands throughout the study area (see list of wetlands that were field assessed in Appendix 15). Wetlands were categorised by EHP into three main habitat categories, as described below:

- **High** – Habitat components listed below are *usually* present:
 - Shallow freshwater marsh or shallow freshwater meadow less than 0.5 m deep;
 - Wetlands with large areas of aquatic and emergent vegetation (e.g., annual herbs, rushes, *Juncus* spp., or tussock grasses *Poa* spp.);
 - Little or no signs of changed water regimens (e.g., drained wetlands); and
 - Little or no signs of disturbance (e.g., cultivation, native vegetation removal, grazing).
- **Moderate** – Some fauna habitat components are *often* missing, although wetlands still provide some characteristics to provide nesting opportunities:
 - Water body likely to hold water throughout the breeding season (July-December) (i.e., permanent, or largely permanent);
 - Water body with some aquatic and emergent vegetation (e.g., annual herbs, rushes, *Carex* or *Juncus* spp., or tussock grasses *Poa* spp.);
 - Some changes to the water regime may have occurred (drainage lines); and
 - Wetlands show some signs of disturbance (such as limited access to stock, cultivation, and feral predators).
- **Low** – Many habitat elements have been lost. Wetland habitats that are:
 - Likely to be ephemeral or drained (only holds water for a limited time of the year);
 - Little or no aquatic or emergent vegetation;
 - Changed water regime, little water present; and
 - Showing signs of disturbance (such as heavily grazed by stock, cultivated, or feral predators).

Given that the EHP wetland assessment was largely undertaken under the (now superseded) *Interim Brolga Guidelines* (DSE 2012), and using criteria developed by EHP for the interim guidelines, the data gathered does not directly conform to the criteria required in an assessment under the Handbook (DEECA 2025c). There are some limitations of this, particularly around

assessment in the middle of the breeding season in a drier year (see a discussion on the limitations in Section 9.2.7).

To adapt the EHP data into the Handbook and the current assessment, it was inferred from that wetlands in EHP's High/Moderate categories are likely to provide some level of emergent vegetation, while those categorised as Low are unlikely to provide sufficient material for nest building (i.e., Criteria 9.3, Table 9 of the Handbook). This interpretation was applied across the wetlands unless it was superseded by observations made by Nature Advisory that were undertaken in accordance with the Handbook's criteria (see below). EHP's wetland assessments were not relied on alone to determine if wetlands provided suitable or unsuitable habitat for Brolga.

Further wetland field assessment

Nature Advisory commenced further wetland assessments from the 23rd to 26th of February 2026 and 7th to 10th of July 2026, addressing 33 and 59 wetlands, respectively, within proximity of turbines (Appendix 16). These assessments addressed the functional wetland boundaries determined by Dalton Consulting Engineers (DCE 2026a, 2026b, 2026c).

The NA assessments were based on the Handbook's criteria within Tables 9, 10 and 11 (DEECA 2025c), specifically addressing:

- **Criteria 9.3** – *Wetland with sufficient emergent vegetation, within and surrounding wetland, to allow for nest building.*
- **Criterion 10.3/11.4** – *The wetland is covered by a hardened, man-made surface (e.g. a road) and is therefore no longer capable of holding water or functioning as a wetland.*
- **Criterion 10.4/11.5** – *A modelled wetland has been incorrectly identified as a wetland, and the mapped area is not capable of functioning as a wetland.*
- **Criterion 10.5/11.4** – *The wetland has been permanently drained.*
- **Criterion 11.3** – *Permanent saline swamps, temporary saline swamps, saline marshes and meadows, estuaries, high country peatlands and intertidal flats and farm dams that do not have a known breeding record.*

February 2026 surveys

Wetland surveys were undertaken in February 2026 to provide timely ecological information to inform ongoing design refinement. Although this timing fell outside the optimal survey period for Brolga wetland assessment objectives, the surveys were undertaken to provide immediate input into the design process and inform a level of avoidance early in the design process.

The February assessment was completed in late summer, when wetlands are at their driest. At the time of assessment, no wetlands held water, and each had limited quantities of emergent vegetation due to the dry conditions. As such, a conservative approach was adopted. Wetlands were only deemed unsuitable if it was clear that they would not be suitable at any time of year, due to dense growth of *Lignum* or complete scalping for agriculture.

In this context, emergent vegetation was determined as:

- *Potential* – likely to support emergent vegetation suitable for Brolga breeding when inundated, or contained space for such vegetation to colonise; and

- *Unsuitable* – Brolga breeding, by way of being densely dominated by tall shrubby vegetation such as *Lignum*, or having been completely cleared/ploughed.

July 2026 Surveys

The July 2026 wetland assessment was undertaken to provide a more robust characterisation of wetland condition in accordance with current assessment guidance, and to address the limitations of the February assessment. July assessments were completed following a period of sustained high rainfall, when wetlands were near peak inundation, providing favourable conditions for evaluating hydrological extent, wetland characteristics, and their suitability as potential Brolga breeding habitat. Data collected on these assessments followed that required to an assessment under the Handbook's Appendix 2 (DEECA 2025c).

The findings were used to refine the assessment of wetland values and to prioritise wetlands for targeted breeding surveys. Wetland conditions and evidence of breeding activity will continue to be monitored throughout the monthly breeding surveys undertaken between July and December 2026 to capture temporal variation in inundation and habitat suitability over the breeding season.

Hydrological wetland assessments

Hydrological analyses were undertaken by DCE (DCE 2026c, 2026b, 2026a). The results of these assessments are included within this Brolga wetland assessment.

Wetlands assessed by DCE included those mapped under the VWI and BBHSM datasets, as well as additional unmapped areas identified during the assessment (DCE 2026d). An initial filtering process excluded wetlands smaller than 0.1 ha, saline waterbodies, farm dams, and wetlands that are no longer present (i.e., topographically incorrect mapping). The remaining wetlands were evaluated to determine whether they achieved at least 120 days of inundation during any period within the past 10 breeding seasons. DCE undertook hydrological modelling using continuous simulation modelling in the Model for Urban Stormwater Improvement Conceptualisation (MUSIC) software, incorporating actual rainfall and evaporation data alongside wetland and catchment characteristics. For managed waterways, DCE supplemented their modelling with a review of managed water flows to confirm likely inundation durations.

Wetland boundaries were investigated by DCE using aerial imagery and terrain analysis (DCE 2026a). DCE conducted a digital terrain model analysis within 300 m of wetlands of interest using Global Mapper software to identify areas likely to hold water to depths greater than 0.2 m, thereby indicating areas more likely to retain water for at least 120 days during the breeding season.

A final assessment by DCE (2026) refined the extent of wetlands that were considered to hold water for at least 120 days during the Brolga breeding season. Agricultural areas that would not hold water during typical conditions to a depth greater than 0.2 m were excluded from the extent of a wetland, for example, areas of cropping delineated by fields modified to have berms constructed to direct water for flood irrigation.

9.2.5. Breeding surveys

After an early roaming survey by EHP in Sep/Oct 2024, breeding surveys were conducted initially by EHP at the start of the 2025 breeding season (July to September), with Nature Advisory concluding the season from October (Table 9-2). A second year of surveys is currently being undertaken by Nature Advisory through July to December 2026, prioritising all breeding wetlands and those potential breeding wetlands that may be within range of impacts from MAWF. Following

the conclusion of the 2026 surveys, breeding would have been assessed across two breeding seasons in line with the guidelines (DEECA 2025c).

These breeding surveys were designed to capture wetlands identified as potentially suitable habitat, as determined from early surveys (EHP 2025b), modelled wetland habitat (DEECA 2026b, 2025i), and subsequent wetland assessments by NA in February and July 2026. Breeding surveys targeted wetlands that could provide suitable nesting habitat, subject to these holding water during the survey periods.

EHP surveys

EHP undertook surveys in 2024 at 105 wetland sites within 10 km of the Project Area, as per the superseded Interim Guidelines (DSE 2012). To align with the Handbook 5 km study area (DEECA 2025d, 2025c) and maintain consistency with 2025 surveys, results are presented only for wetlands within 5 km of the Project Area (hereafter, “the assessment area”). This covers 81 individual wetland sites visited over the survey period (Appendix 16).

Surveys were undertaken by vehicle or foot using binoculars, with visibility/survivability noted as limited at several sites where vantage points were not available (EHP 2025b).

Nature Advisory surveys

Monthly roaming surveys were continued by Nature Advisory during the 2025 Brolga breeding season in October and November 2025, visiting 100 wetland sites (Table 9-2; Appendix 16). A survey was not undertaken in December 2025, despite it also falling within the breeding season, because most suitable wetlands were dry in November 2025 (45 of 75). Furthermore, other ecological surveys undertaken at MAWF in December 2025 found the conditions had deteriorated further, near all wetlands dry. Further, the Brolga that were observed once in September 2025 had not reappeared in the subsequent three months. For a full list of wetlands surveyed by Nature Advisory, see Appendix 16.

Wetlands were accessed by vehicle or foot when good vantage points were available. When no vantage points were available, a drone was used to allow good visibility of the wetlands on public land or with the agreement of landowners.

The presence and activity of Brolgas at each visited wetland was checked using high-powered optics (binoculars and/or telescopes) and drone cameras. Brolgas were also searched for incidentally while in transit between wetlands by vehicle and on foot.

Table 9-2: Survey dates and effort of Brolga breeding surveys conducted/planned for Macorna WF. Those in grey font are planned.

Survey Number (Consultancy)	Dates	Wetlands visited (#)
2024 breeding season (10km buffer as per Interim Guidance)		
1 (EHP)	30 Sep – 4 Oct 2024	105
2025 breeding season (5 km buffer as per Handbook)		
2 (EHP)	25 – 31 July 2025	76

Survey Number (Consultancy)	Dates	Wetlands visited (#)
3 (EHP)	25 – 28 August 2025	65
4 (EHP)	15 – 19 September 2025	77
5 (NA)	24 – 30 October 2025	93
6 (NA)	17 – 24 November 2025	76
2026 breeding season		
7 (NA)	21 – 24 July 2026	70
8 -12 (NA)	<i>Scheduled: Monthly from August to December 2026</i>	-

9.2.6. Wetland buffers

All BBHSM/VWI/unmapped wetlands within 5 km of the proposed site boundary (the assessment area) were assessed for their suitability for Brolga breeding. The application of buffers to Breeding and potential breeding wetlands followed the process outlined in the Handbook (DEECA 2025c), summarised as:

- **Breeding Wetland** (900 m buffer + 90 m blade length) – the nest of a Brolga breeding pair and the perimeter of the surrounding wetland, including wetlands with verified Brolga breeding records from the past 20 years. These wetlands are BBHSM that did not meet the exclusion criteria of Table 10 in the Handbook (DEECA 2025c), and additional wetlands that met the criteria as breeding wetlands. Each Breeding Wetland buffer includes:
 - A 900 m (600 m foraging buffer plus 300m disturbance buffer) buffer around the breeding wetland, applied from the boundary of the wetland,
 - A buffer must also be applied to all other Brolga breeding wetlands or potential breeding wetlands within 2 km of the subject Brolga breeding wetland,
 - A movement corridor between each breeding wetland and other breeding/potential breeding wetland within 2 km, with these movement corridors linked in straight lines between the widest extent of the wetland,
 - Areas between wetlands must be buffered to protect movement corridors, and
 - An additional 90 m turbine-free buffer (equivalent to blade length) to account for the swept area of blades.
- **Potential breeding wetland buffer** (300 m + 90 m blade length) – wetlands that provide suitable habitat but have no records of breeding within the last 20 years. These wetlands are those BBHSM wetlands that did not meet the exclusion criteria of Table 11 in *The Handbook*, and those additional wetlands that met the criteria of Table 9 (DEECA 2025c). Around each isolated potential breeding wetland, there was:
 - A 300 m disturbance buffer; and

- An additional 90 m buffer (equivalent to blade length) to account for the swept area of blades.
- **Wetlands not requiring buffering** – wetlands that were not found to provide suitable habitat were not provided with buffers. These are any wetlands that either failed the inclusion criteria of Table 9 or met the exclusion criteria of both Tables 10 and 11 in the Handbook (DEECA 2025c).

Determination of boundaries for buffered wetlands

As a default, the extent of a wetland was based on the wetland boundaries mapped in the BBHSM/VWI. In some situations, the BBHSM/VWI modelled wetland perimeters did not match the hydrological data (DCE 2026a, 2026c). In these situations, and as per guidance in the Handbook (DEECA 2025c), the following has been used to update the true boundaries of the wetlands from which to buffer:

- Hydrological analysis (DCE 2026a, 2026c, 2026d), which includes:
 - Recorded rainfall and evaporation data over a ten-year period;
 - Satellite imagery assessment;
 - High-resolution topography mapping (LiDAR); and
 - Hydraulic and water balance modelling in MUSIC software.
- Hydrological analysis (DCE 2026c) that defined the extent of potential breeding wetlands based on the ability of wetlands to pond water during typical conditions based on agricultural usage of the land (see Section 9.2.4).
- Site surveys will be undertaken during the period when wetlands are at their greatest extent during breeding season (i.e., early breeding season, July/August) to refine wetland boundaries through on-ground information – planned for 2026.

9.2.7. Limitations

Many of the wetlands within the assessment area were drying towards the end of the 2025 breeding season, with 45 of 76 surveyed in November 2025 found to be dry. Other ecological surveys undertaken by Nature Advisory (see Section 10), found the conditions had deteriorated further with most wetland drying over the subsequent month. Rainfall in the region was below-average and temperature above-average during both the 2024 and 2025 periods (BOM 2026). As a result, both survey periods were considered to reflect below-average conditions for Brolga breeding and wetland conditions. This limitation may be overcome by subsequent monitoring year in 2026, where environmental conditions are ideally more favourable.

Field assessment of wetland habitat was undertaken by EHP over five days in September/October 2024 and covered the middle of the breeding season only. These surveys were undertaken during dry conditions, and the conditions at the time may have resulted in little water and emergent vegetation. The results of that survey are considered to represent the habitat available during drier breeding seasons. However, breeding surveys undertaken in July 2025 were undertaken at a time of good rainfall and therefore were likely to capture results when there is more water in the landscape. An additional wetland habitat field assessment is planned in July 2026 to assess conditions during the start of the breeding season in accordance with the Handbook.

The wetland assessment by Nature Advisory in February 2026 were undertaken at the request of the client to progress the survey program and inform immediate layout concerns. The assessment

was conducted in summer when wetlands were relatively dry. As such, emergent vegetation that may be present during breeding would not have been detectable at the time of survey. Furthermore, the wetlands were not holding any water at the time of assessment. To address this limitation, a conservative approach was conducted for the assessment, and wetlands were only deemed unsuitable for Brolga breeding if it was clear they would be unsuitable year-round. All these wetlands were subsequently surveyed in July 2026 to ensure survey guidelines were met (DEECA 2025c).

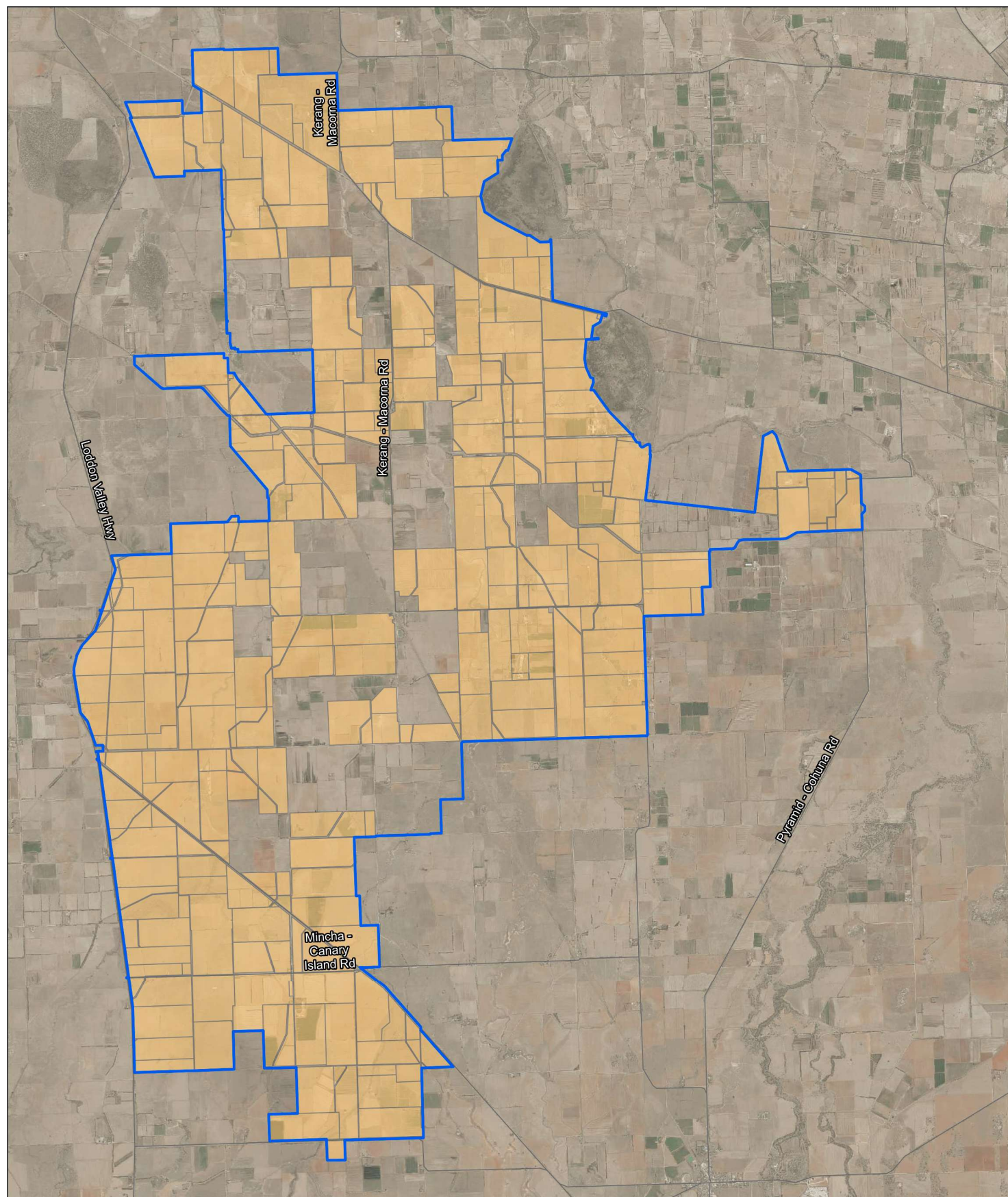


Figure 9-2: Landholders contacted by Nature Advisory between December 2025 and January 2026

Project No: 24129.09 **Project location:** Macoma Wind Farm, VIC **Date:** 13/04/2026

- Project Area
- Road
- Properties of landholders interviewed



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9.3. Results

9.3.1. Community consultation

Community consultation regarding any Brolga sightings has been undertaken within the Project Area as part of the due diligence assessment for this project. Of the 25 landholders contacted by EHP in 2024 (EHP 2025b) seven provided responses. In 2025–26, Nature Advisory contacted 18 landholders (17 responded) and 4 environmental groups (3 responded; Figure 9-2).

Across this consultation, the following relevant information was reported:

- Three observations of Brolga foraging (up to one pair) between 2023–2024 up to approximately 2.7 km west of Hird Swamp, foraging on paddocks;
- A pair observed 6km east of Hird Swamp near Flannery Rd in 2024/2025;
- A pair of Brolga sighted on property, 100m west of Hird Swamp in December 2025;
- Regular recent sightings of Brolga flying across from Hird Swamp and Johnson Swamp;
- Breeding events at both Hird and Johnson Swamp over the last 10 years;
- Regular sightings of 2 Brolga at a wetland west of the Project Area near Lodden Valley Highway;
- One Brolga observed near Campbells Rd southwest of Macorna in 2025;
- One Brolga seen 5 years ago south of the Project Area near Herdmans Road;
- Sighting at Kow Swamp over 10 years ago; and
- Pair regularly breeding at Bannagher Creek (Wetland 326) over the last 30 years, with the most recent being 2 years ago (2024).

Most of the landholders contacted have not seen Brolgas on their property in the last 5 to 30 years. No landholders recorded Brolga breeding activity or nests except isolated sightings of Brolga at and near Hird and Johnson Swamp, and no landholders recorded Brolga flocking activity.

9.3.2. Flocking area investigation

The Project Area is not within 5 km of any DEECA-identified flocking area (DEECA 2025c). The mapped Dingee-Corop flocking site is more than 43 km southeast of the Project Area.

Database searches were undertaken to check for any unmapped Brolga flocking areas and six records of 10 or more Brolga were identified within the assessment area (Table 9-3, Appendix 18). These records were associated with three locations, Hird Swamp (one record), the Pyramid Saltworks in proximity to Calivil Creek (three to four records) and Calivil Creek near Gladfield Road (one record; Figure 9-4).

Hird Swamp Wildlife Reserve – this site is near the boundary of the Project Area, with approximately 2.0 km to the nearest turbine. It likely represents a one-off flocking site, with a single observation of 11 Brolga in 2018.

- A single record of 11 Brolga was recorded at Hird Swamp, on 9/5/2018 (VBA Obs. ID:1796146). Other records from the flocking season show that birds are largely present in pairs (2002-2007, 2017/18, and 2020/21), though at times three (15/2/2018) or four birds (25/1/2007).

- No flocking events of Brolga were observed during seven migratory shorebird surveys at Hird Swamp between November 2024 and January 2025 and December 2025 and February 2026.
- **Hird Swamp does not conform to the criteria as a flocking area** (DEECA 2025c) as only a single record of 10 or more Brolga was reported at this site.

Calivil Creek (near Pyramid Hill Salt Works) – this site is near the edge of the assessment area, with approximately 7.7 km to the nearest turbine. The following observations were made:

- Three records of ≥ 10 birds in the 1994 (17 birds), 1997 (35 birds) and 1998 (41 birds) flocking seasons. While Brolga were observed over at least 3 months in 1994, 2 months in 1997, the numbers of birds present was largely unreported.
- There are no recent records of large numbers of Brolga at this site, with observations in 2016 and 2017 reporting only 2 birds during the flocking season.
- The previous EHP assessment (EHP 2025b) reported 20 Brolga at the **Pyramid Hill Salt Works** in the 2004 flocking season, attributed to an Arthur Rylah Institute investigation. Although no primary source was provided, this observation may correspond to the records from the databases, which loosely match the same area.
- **Calivil Creek near the Pyramid Hill Salt Works does not qualify as a flocking area**, according to the guidance within the Handbook (DEECA 2025c), as no flocking was observed over more than one month within a flocking season.

Calivil Creek (near Gladfield road) – this record is near the boundary of the Project Area, and is approximately 2.3 km to the nearest turbine. No information regarding the spatial accuracy or precise location of this record is provided in the source dataset (Atlas of Living Australia (ALA)). Based on a review of comparable records from the same location and observer across the ALA, eBird, and VBA, it is likely that this record relates to a location further south along Calivil Creek, closer to the Pyramid Hill Salt Works. Several other records appearing near Gladfield Road in ALA and eBird match the same observer/date/count of VBA records attributed to Calivil Creek near the Pyramid Hill Salt Works. Notably, VBA records are provided with a stated spatial accuracy of 100 m for these other records, suggesting that ALA and eBird records may represent a generalised locality rather than a precise coordinate. In the absence of definitive spatial metadata confirming the exact location of this record, it has been retained at the mapped location near Gladfield Road for the purposes of this assessment. However, it is acknowledged that the true observation locality is likely to be further south along Calivil Creek.

- A single record of 12 Brolga was recorded near Gladfield Road on Calivil Creek, dated as 4/3/2012 (ALA Obs ID: 4ea9180f-080d-48f4-8035-ea2ca0ee1ef3). No accuracy or comments on the specific location of this record is provided in the record. It is likely that this record is from further south in Calivil Creek, towards the Pyramid Hill Salt Works. Other observations listed from this location in eBird can be attributed to the Pyramid Hill Salt Works to the south, either from comments within the checklists or the record appearing in the more spatially accurate VBA database.
- Brolga were recorded over consecutive flocking seasons in 1997 to 1998, 2005 to 2006, and 2016 to 2017, but not with numbers ≥ 10 birds. The exact location of these records was either not able to be determined or was attributed to an area further south near the Salt Works.

- **Calivil Creek near Gladfield Road does not conform to the criteria as a flocking site** (DEECA 2025c), as only one record of 12 Brolga was recorded at this site in 2012. It is also likely that the records reported from this location can be attributed to a site further south near the Pyramid Hill Salt Works.

According to the definitions of flocking sites (Section 9.2.3) in the Handbook (DEECA 2025c), none of the above sites qualify as a flocking area. Field surveys are planned for the summer 2026/27 flocking season to provide a robust assessment of the potential for flocking sites to occur within 5 km of the MAWF.

Table 9-3: Historical records containing 10 or more Brolga during the flocking season.

Wetland (BBHSM/VWI)	Count	Date	Accuracy	Source	Distance from closest turbine (approx.)	Conclusion
Hird Swamp	11	9/5/2018	1000*	VBA, ALA	2 km	Not a flocking site
Calivil Creek (near Gladfield Rd)	12	4/3/2012	-	ALA	2.3 km	Not a flocking site
Calivil Creek (near Pyramid Hill Salt works)	41	26/03/1998	-	eBird	7.6 km	Not a flocking site
	32	28/03/1997	-	eBird		
	17	20/3/1994	100	VBA, eBird, ALA		
Pyramid Salt Works	20	2004	-	ARI (in EHP 2025)	7.3 km	Not a flocking site

NOTE: asterisk denotes records recorded as sensitive, with accuracy generalised for the record.

9.3.3. Breeding records

Existing breeding records

Information from databases showed 12 breeding records between 1966 and 2025 within the assessment area (Table 9-4), associated with seven wetlands, with one along a creek line (not a wetland) and another potentially associated with several wetlands. Five breeding records are from within the past 20 years (Table 9-4; see all existing records in Appendix 18). Figure 9-4 shows the location of historical breeding records.

All breeding records occurred outside the Project Area, with the exception of a single record from 1984 (Figure 9-4). This record has an accuracy buffer of 900 m and, with application of the Handbook's low-moderate spatial accuracy methodology, could not be reliably associated with any existing wetland. As such, this record can be discounted.

Breeding records within the past 20 years comprise two records from 2018, located at Hird Swamp Wildlife Reserve, where Birdlife identified nests with eggs and two records at Johnson Swamp Wildlife Reserve, one from 2019 and another of young out of a nest from 2005. Both wetlands have multiple recent non-breeding records, including entries from databases, and an active nesting event at Hird Swamp observed during the 2025 roaming surveys (see below).

Table 9-4. Historical records of breeding Brolga and associated wetlands within the assessment area, records within the past 20 years, are highlighted in grey.

Source	Survey Date(s)	Accuracy (m)	Associated wetland ID(s)
eBird/ALA	5/07/2025	Unreported	Hird Swamp (Wetland 724)
VBA	24/08/2019	5	Johnson Swamp (Wetland 153)
VBA	4/02/2018*	1000	Hird Swamp (Wetland 724)
VBA	22/11/2005	1000	Johnson Swamp (Wetland 153)
VBA	13/01/2005*	1000	Wetland 542
eBird	28/11/2004	Unreported	Calivil Creek (not associated with wetland)
VBA	26/11/2001	100	Calivil Creek (likely associated with Hunt Swamp, Wetland 920)
VBA/ALA	1984	900	Discounted
VBA/ALA	1984	900	Wetland 894
VBA/ALA	1984	900	Several possible (Wetlands 99/1114-1117)
VBA/ALA	1984	900	Hunt Swamp (Wetland 920)
VBA/ALA	17/10/1966	100	Wetland 193

NOTES: Some records listed as 'breeding' are outside of the breeding season, as denoted with asterisks (*).

Brolga breeding surveys

During roaming surveys conducted by EHP in Sep/Oct 2024, no Brolgas were detected within the 5 km assessment area, although an incidental observation of one individual was made at Kow Swamp, approximately 7.5 km east of the Project Area on the 30th of September 2024.

In 2025, evidence of Brolga breeding was recorded by EHP at Hird Swamp, where a pair was observed nesting on four occasions between 15 and 19 September 2025. No eggs or chicks were