Hexham Wind Farm

Chapter 8

Biodiversity and habitat

WIND PROSPECT

8.1 Overview

This chapter describes the biodiversity values within and surrounding the project site, focusing on terrestrial vegetation, flora and fauna. It provides an assessment of the potential impacts of the construction and operation of the project on these values, and measures that are proposed to avoid and minimise these impacts.

Biodiversity refers to the variety of ecosystems, communities, and flora and fauna populations within a defined area

This chapter is based on the findings of the ***Flora and Fauna Assessment*** (provided in Appendix D) prepared by Nature Advisory.

Characterisation and assessment of bat species (including the Southern Bent-wing Bat, Grey-headed Flying-fox and Yellow-bellied Sheath-tailed Bat) and the Brolga have been presented separately in Chapter 9 – ***Bats*** and Chapter 10 – ***Brolga***, respectively.

Most of the project site has been highly modified by past and ongoing agricultural practices, with land cleared of original native vegetation to facilitate grazing and cropping. As such, native vegetation is largely restricted to roadsides, waterways and wetland areas. Many of these areas are also highly modified, and some contain a high abundance of invasive species.

Extensive vegetation, flora and fauna surveys have been conducted for the project over more than a decade. These surveys have included concentrated efforts to characterise the presence of threatened ecological communities and flora, and the use of the site by threatened fauna and protected migratory birds.

Vegetation assessments identified 87.3 hectares of native vegetation in patches within the project site, transport route and roadside upgrade investigations areas, consisting of nine Ecological Vegetation Classes (EVCs). Two ecological communities, all listed as Critically Endangered under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), were also recorded during vegetation surveys. These are:

- Grassy Eucalypt Woodland of the Victorian Volcanic Plain
- Natural Temperate Grassland of the Victorian Volcanic Plains.

In addition, two communities listed under the *Flora and Fauna Guarantee Act 1988* (FFG Act) were also recorded:

- Western (Basalt) Plains Grassland Community
- Western Basalt Plains (River Red Gum) Grassy Woodland.

Spiny Rice-flower (*Pimelea spinescens* subsp. *Spinescens*), listed as Critically Endangered under the EPBC Act and FFG Act, and Purple Blown-grass (*Lachnagrostis semibarbata var. filifolia*), listed as Endangered under the FFG Act, were recorded during targeted flora surveys. Additionally, a single *Dianella* individual was observed, however this could not be identified to the species level due to a lack of flowering material. This individual could be a Matted Flax Lily (*Dianella amoena*), listed as Endangered under the EPBC Act and Critically Endangered under the FFG Act, or Glaucous Flax-lily (*Dianella longifolia var. grandis*), listed as Critically Endangered under the FFG Act. No other flora species listed as threatened were recorded within the investigation areas, and all other flora species listed as threatened are now considered unlikely to occur within the investigation areas based on the targeted flora survey results.

Significant survey effort has been undertaken to identify the threatened fauna species known or likely to be present within the investigation areas. This includes:

- migratory bird species including the Common Greenshank (*Tringa nebularia*), Common Sandpiper (*Actitis hypoleucos*), Double-banded Plover (*Charadrius bicinctus*), Latham's Snipe (*Gallinago hardwickii*), Red-necked Stint (*Calidris ruficollis*) and Sharp-tailed Sandpiper (*Calidris acuminata*)
- other birds including Australasian Shoveler (*Spatula rhynchotis*), Black Falcon (*Falco subniger*), Blue-billed Duck (*Oxyura australis*), Blue-winged Parrot (*Neophema chrysostoma*), Eastern Great Egret (*Ardea alba modesta*), Little Eagle (*Hieraaetus morphnoides*), and Musk Duck (*Biziura lobata*)
- frogs, reptiles and invertebrates including the Growling Grass Frog (*Litoria raniformis*), Tussock Skink (Pseudemoia pagenstecheri) and Hairy Burrowing Crayfish (*Engaeus sericatus*).

The Wedge-tailed Eagle (*Aquila audax*) is not listed under the EPBC Act or FFG Act, however, it is also known to breed within the project site and has been assessed as a species of potential concern due to its cultural significance, ecological function and susceptibility to collisions. The Spotted Harrier (*Circus assimilis*), listed as a species of interest by Lumsden et al. (2019) was also recorded within the project site.

Construction of the project has the potential to impact biodiversity through vegetation loss resulting in direct and indirect habitat loss, the degradation of habitat and vegetation, potential collision with construction activities and traffic, and other indirect disturbances. Through the application of design mitigations, the area of native vegetation to be impacted has been reduced, with the following removal proposed:

- Four large and two small scattered trees, required for all transport options.
- For the Geelong Transport Route option, a total of 7.895 hectares of native vegetation including four large trees in patches
- For the Portland Transport Route option, a total of 8.080 hectares of native vegetation including nine large trees in patches proposed
- For the Combined Transport Route option (where approval is sought for both options), a total of 8.190 hectares of native vegetation including nine large trees in patches.

Losses of native vegetation and large trees would be offset according to the Guidelines for the removal, destruction or lopping of native vegetation (DELWP, 2017c).

While this vegetation removal has the potential to directly impact a range of flora and fauna species, following the application of general and species-specific management measures including habitat buffers, seasonal scheduling of specific construction activities, protection zones, and the establishment of nest boxes where breeding locations cannot be avoided, these impacts were assessed to be very low to moderate (depending on the species).

Indirect impact pathways, such as the spread of weeds and pathogens and degradation of surrounding land, would be managed through the incorporation of biodiversity and biosecurity management measures within the Construction Environmental Management Plan [EMM BH01], including decontamination bays and protection zones. Management measures have also been proposed for works on or near waterways, to avoid impacts to fauna and habitat, so far as is reasonably practicable [EMM SW04].

During operation, wind turbines blades present a collision risk to some bird species depending on their flying behaviour and some species may be reluctant to fly through the project site. A range of management measures have been proposed in Attachment V - ***Bat and Avifauna Management Plan*** [EMM BA01], which is being exhibited alongside this EES, to minimise impacts to bat and bird species during project operation. With the implementation of this plan, residual risks of collision to bird species are assessed as very low to moderate (depending on the species).

8.2 EES objectives and key issues

The EES scoping requirements specify the evaluation objective and key issues, outlined in Table 8.1, relevant to terrestrial and aquatic biodiversity that have guided this assessment.

Table 8.1 EES evaluation objective and key issues

Evaluation objective	
Biodiversity and habitat: *To avoid, and where avoidance is not possible, minimise potential adverse effects on biodiversity values within and near the site including native vegetation, listed threatened species and ecological communities, and habitat for these species. Where relevant, offset requirements are to be addressed consistent with state and Commonwealth policies.*	
Key issues	• Direct loss or degradation of native vegetation and associated listed ecological communities, including those listed as threatened under the EPBC Act and/or the FFG Act. • Direct loss or degradation of habitat for migratory or threatened flora and fauna listed under the EPBC Act and/or the FFG Act. • Disturbance and/or degradation of adjacent or nearby habitat that may support listed threatened or migratory species or other protected flora, fauna or ecological communities • Disturbance and increased mortality risk to flora and fauna species listed under the EPBC Act and/or FFG Act. • Indirect habitat loss or degradation resulting from other effects, such as edge effects, surface hydrological changes, groundwater drawdown, noise, vibration, light or the introduction of weeds/ pathogens. • Disruption to the movement of fauna between areas of habitat across the broader landscape, including between roosting, breeding and potential foraging sites for the Southern Bent-wing Bat and Grey-headed Flying-fox. • The availability of suitable offsets for the loss of native vegetation and habitat for listed threatened species under the EPBC Act and/or FFG Act. • Potential collision risk for protected bird and bat species with project infrastructure, including with wind turbine blades. • Potential impacts on groundwater dependent ecosystems. • Potential cumulative effects on relevant listed threatened and migratory species and communities of flora and/or fauna, in particular, but not limited to, Brolga, Southern Bent-wing Bat, Grey-headed Flying-fox, White-throated Needletail and Black Falcon from the project in combination with the construction and operations of other energy facilities. • Potential for the project to have significant impact on wetland systems, including, but not limited to, Seasonal Herbaceous Wetlands (EPBC Act listed community), and the ability for wetland systems to support habitat for flora species listed under the FFG Act and EPBC Act.

8.3 Legislation, policy and guidelines

Legislation, policies and guidelines relevant to the biodiversity assessment are summarised in Table 8.2.

Table 8.2 Relevant legislation, policies and guidelines

Legislation, policy and guidelines	Description	Relevance to project
Commonwealth		
Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act)	The EPBC Act provides a framework for the protection and management of defined matters of national environmental significance (MNES). Under the EPBC Act there are nine MNES, which include: • nationally threatened species and threatened ecological communities • migratory species.	The project was referred to the Commonwealth Department of the Environment and Energy (now the Department of Climate Change, Energy, the Environment and Water) under the EPBC Act in March 2022. The Commonwealth Minister for the Environment determined the project to be a 'controlled action', in part due to the potential for impacts to: • listed threatened species and communities (sections 18 and 18A). It was determined the project would be assessed under the bilateral agreement with Victoria. Under this agreement, the Victorian Minister for Planning's assessment of the environmental effects of the project (i.e., based on this EES) would be provided to the Commonwealth Minister for the Environment to inform the approval decision in relation to the EPBC Act. Further information on the EPBC Act assessment process is outlined in Chapter 3 – ***Legislation and policy framework***.
State		
Flora and Fauna Guarantee Act 1988 (FFG Act)	The FFG Act provides a framework for biodiversity conservation in Victoria. This Act provides for the listing of threatened species, communities of flora and fauna and potentially threatening processes. A number of non-threatened flora species are also protected under the FFG Act.	All species listed on the FFG Act have been assessed with respect to potential impacts of the project. Any removal of threatened flora species or communities (or protected flora) listed under the FFG Act from public land requires a permit under the Act, obtained from the Department of Energy, Environment and Climate Action (DEECA).
Catchment and Land Protection Act 1994	The *Catchment and Land Protection Act 1994* defines requirements to avoid land degradation, conserve soil, protect waste resources, and to eradicate and prevent the establishment and spread of noxious weeds and pest animals. This Act integrates management and protection of catchments through catchment management authorities.	The proponent is responsible for the control of weeds and pest fauna species during the life of the project to minimise their spread and impact on biodiversity values.

Legislation, policy and guidelines	Description	Relevance to project
Planning and Environment Act 1987	The purpose of the *Planning and Environment Act 1987* is to establish a framework for planning the use, development and protection of land in Victoria. This Act sets out the process for obtaining permits under schemes, settling disputes, enforcing compliance with planning schemes and permits, and other administrative procedures.	The Moyne Planning Scheme is relevant to the project and is administered by Moyne Shire Council.
	Planning Policy Framework and Municipal Strategic Statement	The following clauses of the Planning Policy Framework and Municipal Strategic Statement contained within the Moyne Planning Scheme are relevant to biodiversity for the project: • 12.01-1S Protection of biodiversity objective is *"to protect and enhance Victoria's biodiversity."* • 12.01-2S Native vegetation management objective is *"to ensure that there is no net loss to biodiversity as a result of the removal, destruction or lopping of native vegetation."* • 12.03 River and riparian corridors, waterways, lakes, wetlands and billabongs objective is *"to protect and enhance waterway systems including river and riparian corridors, waterways, lakes, wetlands and billabongs."*
Guidelines for the removal, destruction or lopping of native vegetation (the Guidelines) (DELWP, 2017c)	The Guidelines outline Victoria's policy in relation to the assessment and compensation for native vegetation removal. Applications to remove native vegetation are categorised as of three assessment pathways: • Basic: limited impacts on biodiversity. • Intermediate: could impact on large trees, endangered Ecological Vegetation Classes (EVCs) and sensitive wetlands and coastal areas. • Detailed: could impact on large trees, endangered EVCs, sensitive wetlands and coastal areas, and could significantly impact on habitat for rare or threatened species. The assessment pathway for an application to remove native vegetation reflects the potential impact on biodiversity and is determined by the location category and the extent of native vegetation proposed for removal.	The project is to be assessed under the 'detailed' assessment pathway. In accordance with the Guidelines, all applications to remove native vegetation must provide an avoid and minimise statement which details any efforts to avoid the removal of and minimise the impacts on biodiversity and other values of native vegetation, and how these efforts focused on areas of native vegetation that have the most value. Offsets would be required to compensate for the proposed removal of native vegetation under the Guidelines. All offsets would be secured before the removal of native vegetation.

Legislation, policy and guidelines	Description	Relevance to project
Other guidelines		
Significant Impact Guidelines 1.1 – MNES, EPBC Act (Significant Impact Guidelines) (DoE, 2013)	The Significant Impact Guidelines help determine whether a referral to DCCEEW under the EPBC Act is required.	Potential impacts to MNES from the project were considered in accordance with the Significant Impact Guidelines.
Policy statements / Nationally threatened species guidelines	Policy statements and species guidelines relevant to the project include: • National Recovery Plan for the Southern Bent-wing Bat *Miniopterus orianae bassani* (DELWP, 2020a) • National Recovery Plan for the Grey-headed Flying-fox Pteropus poliocephalus *(DAWE, 2021)* • EPBC Act Policy Statement 3.21 - Industry guidelines for avoiding, assessing and mitigating impacts on EPBC Act listed migratory shorebird species (DoEE, 2017). • Significant impact guidelines for the critically endangered spiny rice-flower (*Pimelea spinescens* subsp. *spinescens*) (DEWHA, 2023) • Significant impact guidelines for the vulnerable growling grass frog (*Litoria raniformis*) (DEWHA, 2009) • Referral guidelines for the vulnerable striped legless lizard, *Delma impar* (DSEWPaC, 2011a) • Referral guideline for management actions in Grey-headed and Spectacled flying-fox camps (DoE, 2015b)	These statements and guidelines were considered as part of the significant impact assessment process for relevant threatened species.
Wind Farms and Birds - Interim Standards for Risk Assessment (interim standards) (AusWEA, 2005)	The interim standards include protocols for assessing bird usage (before and after installation of a wind farm) and mortality due to collision with wind turbines and towers. The interim standards recommend investigations at three levels: level one (initial risk assessment), level two (level of risk is considered low or can be reduced through mitigation), level three (if there is a remaining residual risk).	Bird utilisation surveys for the project were conducted in accordance with the requirements for a 'Level Two' bird risk assessment outlined in these standards.

Legislation, policy and guidelines	Description	Relevance to project
Planning Guidelines for Development of Wind Energy Facilities (DTP, 2023a)	The Planning Guidelines for Development of Wind Energy Facilities provide a framework for the planning, assessment, and development of wind energy facilities in Victoria. They include requirements for environmental assessments, community consultation, visual and landscape impact assessments, and biodiversity considerations, particularly in relation to native vegetation and fauna.	These guidelines require that impacts of wind farms on EPBC Act and FFG Act listed species be assessed.
Best Practice Guidelines for wind farms in Australia (Clean Energy Council, 2018b)	The Best Practice Guidelines for wind farms in Australia outline best practice measures for wind farm proponents, owners and operators for the approvals pathway and stakeholder identification, site planning and site operations phases of a project. This includes detailed assessment approach for site-specific investigations to enable assessment of the impacts of the project.	These guidelines were considered in the development of the flora and fauna impact assessment for the project.
Onshore Wind Farm Guidance - Best practice approaches when seeking approval under Australia's national environmental law - Draft (DCCEEW, 2024a)	This guidance outlines best practice for planning and assessing onshore wind farm projects under the EPBC Act. It provides advice on survey requirements and management plans for nationally threatened bird and bat species.	Attachment V - ***Bat and Avifauna Management Plan*** has been prepared in accordance with the Onshore Wind Farm Guidance (DCCEEW, 2024a).

8.4 Investigation area

Within the project site, the investigation area included the locations of proposed project infrastructure, with the following buffers applied:

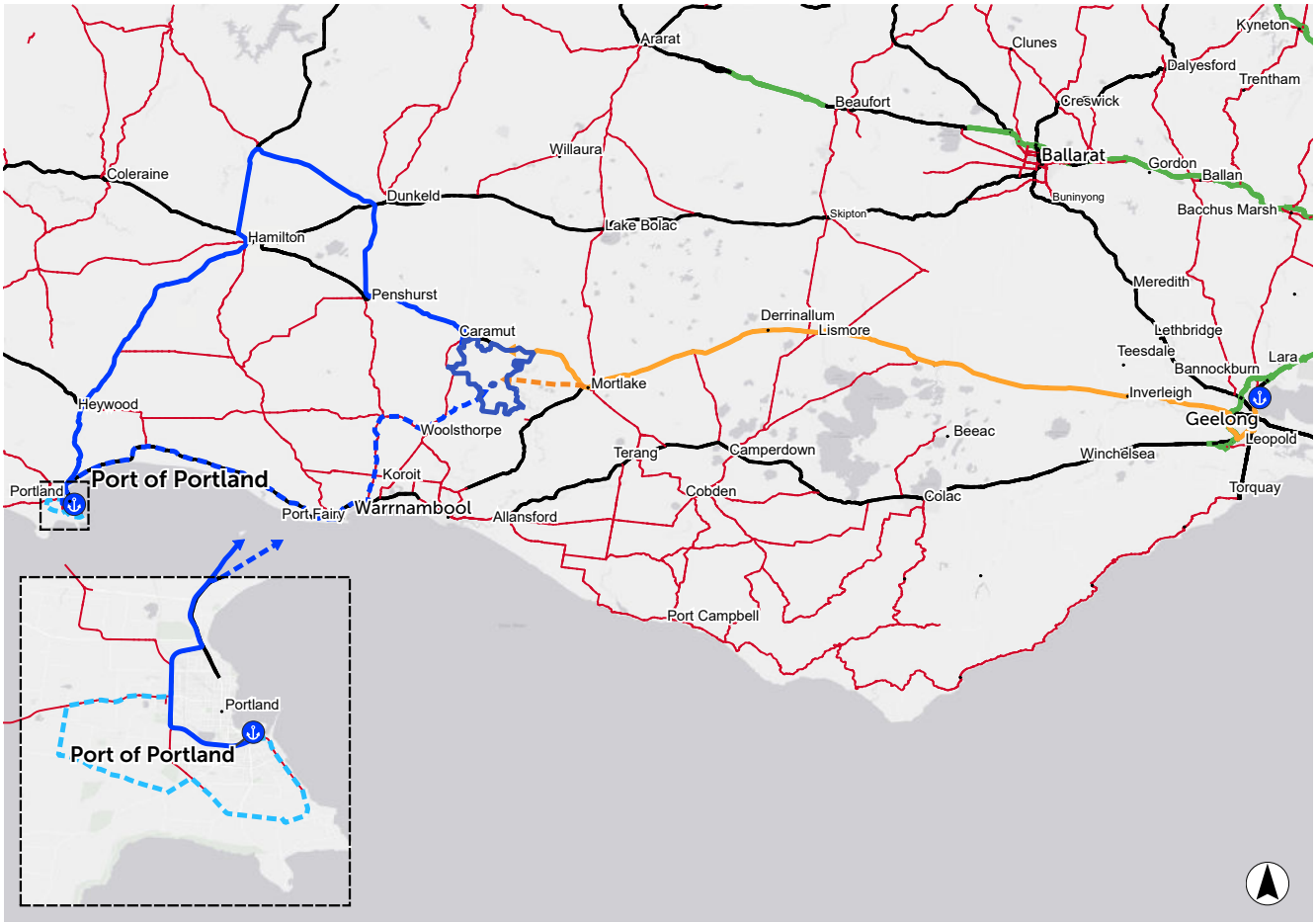
- 25 metres each side of the centreline of vehicle tracks
- 15 meters each side of the centreline of cable trenches
- 100 metres from the centre point of turbines.

Ecological surveys were undertaken progressively as the project design was developed so the survey areas included both current and previously proposed project infrastructure.

Database searches of existing flora and fauna species records and potential occurrence of EPBC Act matters included the project site plus a buffer area of at least 10 kilometres from the project site boundary and swept path intersections. This is referred to as the investigation region.

Flora and vegetation assessments were also undertaken along potential turbine blade transport routes, including swept path intersections, connecting to the project site from Geelong and from Portland, as well as a combined option. Multiple transport routes have been assessed to support the selection of a preferred construction transport strategy. Assessed areas along these routes are external to the investigation area and referred to as the transport route investigation area and roadside upgrade investigation area. An overview of the project site and the location of transport route options is shown in Figure 8.1.

Swept path intersections refer to the area that vehicles transporting turbine blades occupies or "sweeps" as it turns through an intersection. Some locations along the turbine blade transport routes may require road widening and/or vegetation trimming to accommodate swept paths.



Legend

- Site Boundary
- Port Location

Road Network

- Freeway
- Highway
- Arterial Roads

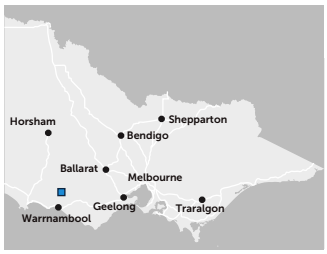
Port of Geelong:

- Primary OD Route
- Secondary OD Route

Port of Portland:

- Primary OD Route
- Secondary OD Route
- Alternative Port Access

0 25 50 km



Data: State of Victoria (DECCA/Land Use Victoria), Commonwealth of Australia, Wind Prospect, and specialist studies/reports. Data is indicative only; accuracy and completeness are not guaranteed. © State of Victoria and other data providers

Figure 8.1 Overview of the project site and proposed transport routes

8.5 Method

The presence of biodiversity and habitat across the project site and surrounding areas, including threatened species and ecological communities, listed migratory species and native vegetation, was characterised through a combination of desktop information and field-based surveys. These investigations are described in the following sections.

8.5.1 Desktop review

Desktop reviews were undertaken to develop an initial understanding of the native vegetation, threatened ecological communities, and listed flora and fauna species likely to occur within the investigation area. This included the following resources:

- **EVC benchmarks for the Victorian Volcanic Plain bioregion** (DSE, 2004a) to assess the quality, condition, and conservation significance of EVCs within the bioregion.
- **DEECA NatureKit** to determine pre-1975 (pre-European settlement) vegetation distributions
- **Victorian Biodiversity Atlas to** identify previous flora and fauna species records
- **Commonwealth Protected Matters Search Tool** to identify MNES with the potential to occur based primarily on their distribution and habitat modelling (discussed further in Chapter 27 - ***Matters of National Environmental Significance)***
- **eBird Database** to assess the most up-to-date bird species records available at the time
- **Groundwater Dependent Ecosystems Atlas** to identify ecosystems within the investigation area that may rely on groundwater, including wetlands, rivers, and groundwater-dependent vegetation
- **Australian Groundwater-Dependent Ecosystems Toolbox Part 1: Assessment Framework to** guide the identification and assessment of groundwater-dependent ecosystems
- Previous ecological and hydrological assessments completed in the investigation area and in the region.

A precautionary approach was adopted in determining the likelihood of occurrence for flora listed under the EPBC Act and/or FFG Act. That is, where insufficient evidence was available on the potential occurrence of a listed species, it is assumed it could be present in an area of suitable habitat.

8.5.2 Vegetation and flora assessment

Several vegetation and flora surveys have been undertaken within the project site and surrounds, beginning with initial assessments by EHP in 2011 and continuing with surveys conducted by Nature Advisory from 2018 onwards. A summary of these surveys is provided in Table 8.3.

Vegetation surveys were completed initially by vehicle, with areas supporting native vegetation inspected in more detail on foot. All observed flora species were recorded, with any significant species mapped, the overall condition of vegetation and habitats noted, and habitat hectare assessments completed. During native vegetation surveys, sites found to support native vegetation or with potential to support listed matters were mapped through a combination of aerial photograph interpretation and ground-truthing using a hand-held GPS. The quality of mapped habitat zones within the investigation areas was assessed in accordance with Native Vegetation: sustaining a living landscape, Vegetation Quality Assessment Manual – Guidelines for applying the Habitat Hectare scoring method (DSE, 2004b) to determine the biodiversity value of the site and subsequent offset requirements.

A list of threatened flora species with the potential to occur within the project site was developed through a desktop review of existing data sources. This desktop review informed the design of targeted flora surveys, which were conducted during appropriate seasonal survey periods (see Table 8.3). These targeted surveys involved systematic visual searches by qualified botanists along transects spaced no more than five metres apart. Where threatened flora species were identified, their locations were recorded using handheld GPS units, and specimens requiring further identification were collected for laboratory analysis.

Table 8.3 Summary of vegetation and flora surveys

Survey effort	Species targeted or objectives
7–10 June 2011 2–4 November 2011 7–9 November 2011 5–9 December 2011	Targeted flora surveys and Net Gain Assessment undertaken by EHP.
13–28 November 2018 8–11 November 2021	Native vegetation assessments of the investigation area initially by vehicle, with areas supporting native vegetation inspected in more detail on foot to confirm their extent and assess their potential to support listed matters.
28–30 November 2018 10–11 January 2019 22–25 November 2021	Targeted surveys for spring and summer-flowering threatened ecological communities and listed flora species in areas of suitable habitat that may require removal (i.e. within the construction disturbance area of operational footprint) to confirm their presence. This included the following EVCs: • Plains Grassy Wetland (EVC 125) • Plains Grassy Woodland (EVC 55_61 and 55_63) • Heavier-soils Plains Grassland (EVC 132_61).
4–18 June 2023	Updated native vegetation assessments of the investigation area.
4–6 June 2025	Native vegetation assessments undertaken at 23 locations along the Portland and Geelong Transport Routes options (see Chapter 25 - ***Traffic and transport***) to identify areas that support native vegetation or with potential to support listed matters.
17–18 June 2025	Native vegetation assessments undertaken at four locations along roadsides proposed to be upgraded as part of the project (See Chapter 25 - ***Traffic and transport***) to identify areas that support native vegetation or with potential to support listed matters.
8–10 July 2025	Targeted surveys for the Spiny Rice-flower in areas of suitable habitat that may require removal (i.e. within the construction disturbance area or operational footprint) to confirm their presence.
27–29 October 2025	Targeted surveys for listed spring-flowering orchids in areas of suitable habitat, comprising Heavier-soils Plains Grassland (EVC 132_61) and areas of Plains Grassy Woodland (EVC 55_61 and EVC 55_63) supporting a native ground layer.
1–5 December 2025	Targeted surveys for listed early summer-flowering species in areas of suitable habitat, comprising all areas of Plains Grassy Wetland (EVC 125) and Heavier-soils Plains Grassland (EVC 132_61), and areas of Plains Grassy Woodland (EVC 55_61 and EVC 55_63) supporting a native ground layer. This also included targeted surveys for potential occurrences of Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lower Plain ecological community, following a period of sufficient rainfall to enable assessment under the typical pattern of seasonal wetting and drying, required by wetland flora typical of this community (Threatened Species Scientific Committee, 2012).

8.5.3 Fauna assessment

Numerous fauna assessments have been conducted within and around the project site. Initial surveys were undertaken by EHP between 2011 and 2012, with subsequent assessments carried out by Nature Advisory from 2018 onwards.

A summary of the effort and methods used to characterise fauna within the project site is provided in Table 8.4. In addition to general fauna surveys, targeted assessments were undertaken to investigate the presence of, and potential habitat for, threatened fauna species identified through a desktop review of existing data sources as having potential to occur within the investigation area. Targeted assessment for bat species (including the Southern Bent-wing Bat, Grey-headed Flying-fox and Yellow-bellied Sheath-tailed Bat) and Brolga have been presented separately in Chapter 9 – ***Bats*** and Chapter 10 – ***Brolga***, respectively.

Table 8.4 Summary of fauna studies and methods

Survey effort	Species targeted or objectives	Survey method
28 November–2 December 2011 20–22 February 2012 29 October–2 November 2018 4–8 March 2019 18–25 August 2024 25–29 November 2024 24–27 February 2025 7–10 April 2025	Bird community	Fixed-point bird surveys were the primary method to collect bird utilisation data. These surveys involve an observer stationed at a survey point for15 minutes (2018-19 surveys) or 20 minutes (2024-25 surveys). During this period, all birds (species and abundance) were recorded, and flight height was documented. Incidental observations of threatened bird species and raptors were also recorded while moving across the site. Previous studies undertaken by EHP in 2011 and 2012 followed a different survey method to the Nature Advisory surveys. This method was consistent with the requirements of Wind Farms and Birds – Interim Standards for Risk Assessment issued by the Australian Wind Energy Association (AusWEA, 2005).
18–20 December 2018 9–11 January 2019 30–31 January 2019 26–28 February 2019 27–29 March 2019	Migratory shorebirds (targeted surveys and habitat assessment)	Wetlands were visited during spring and summer and assessed for their suitability to provide foraging habitat for migratory shorebirds. Searches were carried out using binoculars and telescope. All listed migratory birds encountered were identified and the number of individuals was counted. Surveys were completed in accordance with EPBC Act survey guidelines for migratory species (DoE, 2015a).
5–9 December 2022 6–10 February 2023 22–25 March 2023	White-throated Needletail	Targeted surveys were conducted to determine the presence or absence of the White-throated Needletail within the investigation area and surrounds. A fixed-point count method was used, which required an observer to be stationed at a survey point for 45 minutes. During this period, all White-throated Needletails observed were recorded. If observed, the number of individuals, approximate height when first sighted, flight height range, and direction of flight were documented.
20–23 June 2023	Wedge-tailed Eagle (targeted nest survey)	A targeted survey for Wedge-tailed Eagle nests was conducted identify any that may be impacted by the project. Searches involved active inspection of large trees and forested areas within the investigation area, including a one-kilometre buffer. The coordinates, approximate size, and signs of activity were recorded for each identified nest. Incidental observations of Wedge-tailed Eagles were also recorded whilst traversing the investigation area.

Survey effort	Species targeted or objectives	Survey method
28 November – 2 December 2011 20–22 February 2012 27–29 October 2025	Striped Legless Lizard and Fat-tailed Dunnart (habitat assessment)	No targeted surveys were undertaken based on early advice from the Department of the Environment and Primary Industries (now the Department of Energy, Environment and Climate Action (DEECA)) to assume presence of Striped Legless Lizard and Fat-tailed Dunnart within suitable habitat. Following this approach, patches of Plains Grassland (EVC) and Plains Grassy Woodland (EVC) were assessed to identify areas of suitable habitat for both species, which have very similar habitat requirements, within the project site investigation area. This assessment considered the size and connectivity of mapped native vegetation patches. This assessment was updated to reflect more recent native vegetation assessments undertaken by Nature Advisory, which included confirmation of potential habitat by an ecologist.
21–24 November 2011 13–28 November 2018 Further surveys were undertaken during Brolga habitat surveys (See Chapter 10 – ***Brolga***)	Growling Grass Frog (habitat assessment)	Wetlands and aquatic habitats within and near the project site were assessed for their suitability to support Growling Grass Frog during spring and summer. This considered the presence and quality of key habitat components such as water permanence, aquatic and fringing vegetation, shelter availability, connectivity with other suitable habitats and signs of disturbance. Growling Grass Frog calls were also opportunistically recorded while undertaking surveys.
16 December 2011 19 December 2011 6 January 2012	Golden Sun Moth	Targeted Golden Sun Moth surveys were conducted to determine the presence or absence of this species and their habitat within the investigation area and surrounds.
21–24 November 2011	Fish	Native freshwater fish surveys were undertaken using fyke nets, dip netting, and collapsible bait traps. The techniques used at each survey site were selected dependent on the depth, habitat type and water quality conditions present. Electrofishing was not used due to high water salinity at all survey sites.

Limitations of fauna surveys

Several surveys informing the ***Flora and Fauna Assessment*** (Appendix D) are more than five years old. However, these surveys remain relevant as they reflected typical climate conditions, and regional waterways and habitats have not changed significantly. To ensure accuracy, a precautionary approach was applied, assuming species presence in all potential habitats and updating vegetation data with 2025 observations. As such, the age of earlier surveys is not considered a major limitation in evaluating environmental impacts.

Potential threatened fauna habitats along the transport route were not formally surveyed, but native vegetation patches were assessed and a precautionary approach was applied through which all areas qualifying as potential habitat were assume to support relevant species. In October 2025, an ecologist ground-truthed these areas and confirmed that they could provide suitable habitat. Therefore, the approach taken is considered to be appropriate and not a major limitation.

Although future surveys are planned, the bird utilisation surveys carried out by Nature Advisory to date, supplemented by the late-Spring to Summer surveys carried out by EHP in 2011 and 2012, provide an adequate basis to assess risks to birds posed by the project at this point in time.

Fauna surveys were undertaken when weather conditions were conducive to observations, however it acknowledged that there are limitations for human based surveys (such as those undertaken for the White-throated Needletail) which may have impacted results.

8.5.4 Groundwater Dependent Ecosystem assessment

The likelihood of occurrence of Groundwater Dependent Ecosystems was assessed by Nature Advisory based on desktop reviews of mapping prepared by the Bureau of Meteorology and Victorian Government (as discussed in Section 8.4.2), and by considering the following questions:

- Does a stream/river continue to flow all year, or a floodplain waterhole remain wet all year in dry periods?
- Does the volume of flow in a stream/river increase downstream in the absence of inflow from a tributary?
- Is groundwater discharged to the surface for significant periods of time each year at critical times during the lifetime of the dominant vegetation type?
- Is groundwater or the capillary fringe above the water table present within the rooting depth of any vegetation?
- Is the level of water in a wetland/swamp maintained during extended dry periods?

No field-based surveys were undertaken to confirm the presence of Groundwater Dependent Ecosystems. As such, a precautionary approach was adopted in determining the likelihood of occurrence, and it was assumed that Groundwater Dependent Ecosystems may be present where there was a positive answer to one or more of the above questions.

However, native vegetation assessments (see Section 8.4.3) have been used to accurately describe the presence of potential terrestrial Groundwater Dependent Ecosystems within the investigation area.

8.6 Existing conditions

The project site is located within a rural landscape dominated by agriculture, including dryland cropping and sheep and cattle grazing, with scattered residences. Extensive historical clearing for farming has left patches of native vegetation largely confined to roadside reserves, watercourses and isolated patches within private properties. These remnant patches of native vegetation include grasslands, wetlands, and woodlands. However, some of these areas contain a high abundance of invasive species and canopy cover is limited in woodland areas. Some windbreaks planted along paddock edges contain also native species, which may provide a food and shelter to threatened species.

As the project site has been highly modified, supporting livestock grazing for over 150 years, habitat available to support native fauna is limited. Fertiliser application, pasture improvement, and cropping have further modified the landscape. The highest quality native vegetation occurs along the wide road reserve of Hexham-Ballangeich Road, where grassland and woodland species persist.

The landscape is gently undulating,supporting several permanent watercourses as well as seasonal surface water bodies. The most major of these is Mustons Creek in the northern portion of the project site, which flows into the Hopkins River to the east, and Drysdale Creek in the south, and continues to the coast near Warrnambool. Numerous tributaries (many unnamed) of Mustons Creek and Drysdale Creek occur within the project site. Supported wetland and riparian environments provide important habitat for migratory and other listed species across the project site.

There are no National or State Parks within proximity of the project site. However, reserves supporting native flora and fauna species are present. These include:

- Cobra Killuc Wildlife Reserve, approximately eight kilometres north of the project site
- Mortlake Common Flora Reserve, approximately 12 kilometres east of the project site
- Woolsthorpe Nature Conservation Reserve, approximately 16 kilometres south-west of the project site.

8.6.1 Native vegetation

Ecological Vegetation Classes

Vegetation refers to plant communities (made up of multiple flora species) that occur within a defined area and interact to form ecosystems such as forests, grasslands, and woodlands.

In Victoria, patches of native vegetation are classified into Ecological Vegetation Classes (EVC) based on the combination of plant species, structure, and ecological characteristics. Each EVC is bioregion-specific and is assigned a conservation status based on its extent and condition within that bioregion.

Condition Scores for native vegetation patches are assigned in accordance with the habitat hectares scoring method detailed in Vegetation Quality Assessment Manual (DSE, 2004b), which involves comparison against a mature and apparently long-undisturbed benchmark.

Approximately 90 mapped habitat zones (or patches of native vegetation), covering an area of approximately 55.3 hectares, were identified within the project site investigation area as detailed in Table 8.5. Detailed maps showing the extent of native vegetation proposed to be impacted are show in Figure 2-1 through Figure 2-57 of Appendix D – ***Flora and Fauna Assessment***. This area includes seven EVCs and 1.59 hectares of DEECA-mapped wetlands, which are treated as native vegetation in accordance with the Guidelines, and cover less than 3% of the total area of mapped native vegetation within the project site.

External to the project site, an additional 59 mapped habitat zones were identified within the transport route investigation area, and 131 mapped habitat zones were identified within the road upgrades investigation area. Together, these cover an additional area of approximately 87.3 hectares.

Across all investigation areas the quality of mapped habitat zones varied greatly, with average condition scores ranging between four and 56. However, most mapped habitat zones were assessed as being of low quality, with an average condition score of 21 out of 100. Only 7% of native vegetation patches were assessed as having a condition score greater than or equal to 40 out of 100. This variation in quality was due to differences in the level of historic disturbance and modification, with high quality areas located along roadsides and farming tracks, in remnant patches within grazing lands, native woodland windbreak areas and in wetland areas of riparian vegetation or swamps/marches where agricultural practices are limited and disturbance does not occur as frequently. The highest quality native vegetation was found along the wide road reserve of Hexham-Ballangeich Road.

Large trees were identified within mapped habitat zones in all investigation areas, which contribute to the structural and ecological integrity of the native vegetation patch and may provide important habitat values. These include:

- 10 large trees within native vegetation patches in the project site investigation area
- 13 large trees within native vegetation patches in the transport route investigation area
- One large tree within a native vegetation patch in the road upgrade investigation area.

Table 8.5 **Extent and type of EVC present within investigation areas**

Ecological Vegetation Class	Area (Hectares)
EVC present within the project site investigation area	
Plains Grassy Woodland (EVC 55_61) (Endangered)	9.317
Heavier-soils Plains Grassland (EVC 132_61) (Endangered)	4.926
Plains Grassy Wetland (EVC 125) (Endangered)	35.369
Higher-rainfall Plains Grassy Woodland (EVC 55_63) (Endangered)	1.795
Creekline Grassy Woodland (EVC 68) (Endangered)	0.755
Aquatic Herbland (EVC 653) (Endangered)	0.278
Plains Sedy Wetland (EVC 647) (Endangered)	0.423

Ecological Vegetation Class	Area (Hectares)
Mapped Wetlands	1.590
Total	**55.302**
EVC present within the transport route investigation area	
Heavier-soils Plains Grassland (EVC 132_61) (Endangered)	10.641
Plains Grassy Woodland (EVC 55_61) (Endangered)	8.837
Creekline Grassy Woodland (EVC 68) (Endangered)	0.028
Plains Grassy Wetland (EVC 125) (Endangered)	0.008
Total	**19.514**
EVC present within the road upgrade investigation area	
Heavier-soils Plains Grassland (EVC 132_61) (Endangered)	19.317
Plains Grassy Woodland (EVC 55_61) (Endangered)	17.419
Plains Grassy Wetland (EVC 125) (Endangered)	0.052
Creekline Grassy Woodland (EVC 68) (Endangered)	0.028
Total	**36.816**

Scattered trees

Scattered trees refer to native canopy trees that do not form part of a native vegetation patch (i.e., are not located within mapped habitat areas). There were 31 scattered trees mapped in the project site investigation area, which would have once formed canopy vegetation within Plains Grassy Woodland (EVC 55_61) and High-rainfall Plains Grassy Woodland (EVC 55_63) native vegetation patches.

These include:

- 13 large River Red-gum trees
- 16 small River Red-gum trees.

No scattered trees were recorded within the transport route investigation area or road upgrade investigation area.

Individual trees are described as **large** or **small** based on their diameter at breast height, compared to the benchmark for that species within the bioregional EVC.

Threatened ecological communities

Desktop reviews identified the following five threatened ecological communities, listed under the EPBC Act, that have the potential to occur within the investigation area:

- Grassy Eucalypt Woodland of the Victorian Volcanic Plain (Critically Endangered)
- Natural Temperate Grassland of the Victorian Volcanic Plain (Critically Endangered)
- Seasonal Herbaceous Wetlands (Freshwater) of the Temperate Lowland Plains (Critically Endangered)
- Grey Box (*Eucalyptus microcarpa*) Grassy Woodlands and Derived Native Grasslands of South-eastern Australia (Endangered)
- White Box-Yellow Box-Blakely's Red Gum Grassy Woodland and Derived Native Grassland (Critically Endangered)

Based on vegetation and flora assessments and a review of published descriptions and condition thresholds, two of these ecological communities were confirmed to occur within the project site investigation area, transport route investigation area and road upgrade investigation area: Grassy Eucalypt Woodland of the Victorian Volcanic Plain (Figure 8.2), Natural Temperate Grassland of the Victorian Volcanic Plain (Figure 8.3).

In addition, the Western (Basalt) Plains Grassland Community (also shown in Figure 8.3) and Western Basalt Plain (River Red-gum) Grassy Woodland (shown in Figure 8.4), listed under the FFG Act, were also recorded. These occurrence of these communities is detailed in Table 8.6. No other threatened ecological communities were recorded or assessed as having the potential to occur during field-based surveys.

Figure 8.2
Grassy Eucalypt Woodland of the Victorian Volcanic Plain in Habitat Zone DA3 on Hexham-Ballangeich Road
(Source: Nature Advisory)

Figure 8.3
Natural Temperate Grassland of the Victorian Volcanic Plain and Western (Basalt) Plains Grassland Community in Habitat Zone 41 on Woolsthorpe-Hexham Road
(Source: Nature Advisory)

Figure 8.4
Western Basalt Plain (River Red-gum) Grassy Woodland, in Habitat Zone 1K on Dunkeld-Cavendish Road
(Source: Nature Advisory)

Table 8.6 Extent and type of threatened ecological communities within investigation areas

Community	Project site investigation area	Transport route investigation area	Road upgrade investigation area	Total area (hectares)*
EPBC Act listed communities				
• Grassy Eucalypt Woodland of the Victorian Volcanic Plain (Critically Endangered)	• **5.113 hectares** recorded occur along Hexham-Ballangeich Road.	• **5.559 hectares** recorded throughout this investigation area.	• **11.138 hectares** recorded throughout this investigation area.	11.318
• Natural Temperate Grassland of the Victorian Volcanic Plain (Critically Endangered)	• **3.288 hectares** recorded along Woolsthorpe-Hexham Road, Cooramook Lane and Hamilton Highway.	• **9.279 hectares** recorded throughout this investigation area.	• **17.878 hectares** recorded throughout this investigation area.	20.596
FFG Act listed communities				
• Western (Basalt) Plains Grassland Community	• **9.135 hectares** recorded throughout this investigation area.	• **16.331 hectares** recorded throughout this investigation area.	• **29.658 hectares** recorded throughout this investigation area.	33.093
• Western Basalt Plain (River Red-gum) Grassy Woodland	• **0.024 hectares** recorded throughout this investigation area, along Mustons Creek.	• **0.235 hectares** recorded throughout this investigation area.	• Not recorded within this investigation area during field-based surveys.	0.259

* Note that the total area includes overlap between investigation areas

8.6.2 Flora

Desktop reviews of the Victorian Biodiversity Atlas records and the MNES Protected Matters Search Tool indicated that within the investigation region there were records of, or potential suitable habitat for, 31 flora species listed under the EPBC Act and 99 listed under the FFG Act (including 26 listed under both Acts). The likelihood of occurrence of each species within the project site investigation area was assessed, with species considered 'likely to occur' where they have a very high chance of being in the area based on numerous records in the search region and the presence of suitable habitat. In total, two listed flora species were identified as being likely to occur within the project site investigation area, as detailed in Table 8.7.

Flora field assessments and targeted surveys identified 148 flora species within the project site investigation area. Of these, 93 (63%) were indigenous and 55 (37%) were introduced or non-indigenous native. Of these, two species (1%) are listed as threatened:

- **Spiny Rice-flower** (*Pimelea spinescens* subsp. *Spinescens*) (Figure 8.6), listed as Critically Endangered under the EPBC Act and FFG Act, recorded incidentally during native vegetation surveys in June 2025 and confirmed through targeted surveys in July 2025.
- **Purple Blown-grass** (*Lachnagrostis semibarbata* subsp. *filifolia*) (Figure 8.7), listed as Endangered under the FFG Act, recorded during targeted surveys in November 2021.

Additionally, the October 2025 surveys identified a single *Dianella* individual, though this could not be identified to species level due to a lack of flowering material. This individual has the potential to be a Matted Flax Lily (*Dianella amoena*), listed as Endangered under the EPBC Act and Critically Endangered under the FFG Act, or Glaucous Flax-lily (*Dianella longifolia var. grandis*), listed as Critically Endangered under the FFG Act. The individual was re-examined in December 2025 to confirm the species, however, floristic characteristics were still unsuitable for accurate identification. Regardless of the species identification, this individual record falls outside the construction disturbance area and operational footprint and will not be impacted.

Targeted surveys for listed flora species at an appropriate time of year have been undertaken in all areas of suitable habitat within the project site proposed to be impacted, and no other listed species were recorded in any of the investigation areas. Based on the findings of targeted flora surveys, all other listed flora are considered unlikely to occur within the investigation areas.

Table 8.7 Listed species likely or known to occur within the investigation areas

Name	EPBC Act status	FFG Act status	Suitable habitat	Summary of records
Purple Blown-grass (*Lachnagrostis semibarbata* var. *filifolia)*	–	Endangered	Grows in partially saline depressions in grasslands, and occasionally woodlands. Suitable habitat is present along drainage lines. Potential to occur within EVCs 125, 641 and 821.	**Known to occur.** 27 individuals recorded across all investigation areas during targeted surveys in November 2021.
Spiny Rice-flower (*Pamela spinescens* subsp. *spinescens)*	Critically Endangered	Critically Endangered	Found in grassland, open shrubland and occasionally woodlands on soils derived from basalt. Primarily occurs on flat land. Potential to occur within in EVC 132_61.	**Known to occur.** 158 individuals recorded in Hamilton Highway Road reserve (north of the project site) during targeted surveys in July 2025. This location is included in all investigation areas.

Figure 8.6
Spiny Rice-flower recorded within the investigation area
(Source: Nature Advisory)

Figure 8.7
Purple Blown Grass
(Source: Plants of South Australia, n.d.)

A further 14 species were assessed as having the potential to occur within surveyed portions of the investigation areas due to the presence of suitable habitat, but recent records are scarce. These are:

- **Casteron Watter** (*Acacia exudans),* listed as Critical under the FFG Act
- **Half-bearded Spear-grass** (*Austrostipa hemipogon*), listed as Vulnerable under the FFG Act
- **Swamp Flax-lily** (*Dianella callicarpa*), listed as Critically Endangered under the FFG Act
- **Glaucous Flax-lily** (*Dianella longifolia* var. *grandis*), listed as Critically Endangered under the FFG Act
- **Golden Cowslips** (*Diuris behrii*), listed as Endangered under the FFG Act
- **Western Purple Diuris** (*Diuris daltonii*), listed as Critically Endangered under the FFG Act
- **Clumping Golden Moths** (*Diuris gregaria*), listed as Critically Endangered under the FFG Act
- **Austral Crane's-bill** (*Geranium solanderi* var. *solanderi s.s.*), listed as Endangered under the FFG Act
- **Pale-flower Crane's-bill** (*Geranium* sp. *3*), listed as Endangered under the FFG Act
- **Purple Blown-grass** (*Lachnagrostis semibarbata* var. *filifolia*), listed as Endangered under the FFG Act
- **Western Gaping Leek-orchid** (*Prasophyllum* sp. aff. *correctum* (Mortlake)), listed as Critically Endangered under the FFG Act
- **Clumping Leek-orchid** (*Prasophyllum* sp. aff. *occidentale E*), listed as Critically Endangered under the FFG Act
- **Fragrant Leek-orchid** (*Prasophyllum suaveolens*), listed as Endangered under the EPBC Act and Critically Endangered under the FFG Act
- **Brackish Plains Buttercup** (*Ranunculus diminutus*), listed as Endangered under the FFG Act.

In addition, 11 species were identified as having potential to occur in unsurveyed areas only:

- **Cut-leaf Burr-daisy** (*Calotis anthemoides*), listed as Critically Endangered under the FFG Act
- **Curly Sedge** (*Carex tasmanica*), listed as Endangered under the FFG Act
- **Small Milkwort** (*Comesperma polygaloides*), listed as Critically Endangered under the FFG Act
- **Pale Swamp Everlasting** (*Coronidium gunnianum*), listed as Critically Endangered under the FFG Act
- **Matted Flax-lily** (*Dianella amoena*), listed as Endangered under the EPBC Act and Critically Endangered under the FFG Act
- **Trailing Hop-bush** (*Dodonaea procumbens*), listed as Vulnerable under the EPBC Act
- **Adamson's Blown-grass** (*Lachnagrostis adamsonii*), listed as Endangered under the EPBC Act and the FFG Act
- **White Sunray** (*Leucochrysum albicans subsp. tricolor*), listed as Endangered under the EPBC Act and the FFG Act
- **Plains Yam-daisy** (*Microseris scapigera* s.s.), listed as Critically Endangered under the FFG Act
- **Hairy Tails** (*Ptilotus erubescens*), listed as Critically Endangered under the FFG Act
- **Basalt Sun-orchid** (*Thelymitra gregaria*), listed as Critically Endangered under the FFG Act.

Five declared noxious weed species listed under the *Catchment and Land Protection Act 1994* were recorded within the project site investigation area. These are Spear Thistle (*Cirsium vulgare*), African Box-thorn (Lycium *ferocissimum*), Sweet Briar (*Rosa rubiginosa*), Blackberry (*Rubus fruticosus*), and Willow (*Salix* ssp.).

8.6.3 Fauna

Fauna habitats

The project site investigation area supports limited fauna habitat due to historic clearing and modification, predominantly supporting agriculture. This habitat includes:

- **Modified native grasslands**, varying greatly in habitat quality with moderate to high quality patches typically found in areas with limited disturbance. These may provide habitat and foraging opportunities.
- **Modified woodland**, occurring in scattered patches particularly along roadsides, riparian zones, and within agricultural land. These typically consist of open canopies with trees around 20 metres tall and understoreys that have been heavily modified for agricultural use. Despite limited connectivity, they provide important habitat in an otherwise cleared landscape.
- **Scattered trees**, primarily River Red-gums (*Eucalyptus camaldulensis*), are dispersed across the project site investigation area. While they offer limited habitat and foraging opportunities due to their isolation, these many contain hollows that are essential habitat for a range of fauna species.
- **Planted vegetation**, primarily in the form of linear shelter belts or windbreaks bordering paddocks. These plantings include a mix of native and non-native species. While they generally lack structural complexity, these can still provide some shelter and foraging opportunities.
- **Rivers, creeks and drainage lines**, including both major waterways such as the Hopkins River to the east of the project site, Mustons Creek and Salt Creek, as well as smaller, highly modified drainage lines. These features vary in permanence, with some holding water year-round and others being ephemeral. Despite limited and modified riparian vegetation, they may offer essential habitat for aquatic species, waterbirds, and microbats.
- **Swamps and marshes**, which are of moderate value to fauna where they remain intact. Although often lacking in diversity, these support various fauna species. These areas are typically characterised by sedges and rushes and are seasonally inundated, though they are often grazed when accessible.
- **Artificial waterbodies**, such as farm dams scattered across private properties. These are primarily used for stock watering and are often degraded by frequent use and lack of vegetation. However, some may support limited fringing vegetation and provide occasional resources for birds and microbats.
- **Exotic pasture and crops**, which dominate the landscape and are of low ecological value. These areas are heavily grazed or cultivated for cereal crops and provide minimal shelter or habitat for native fauna.

Fauna

Desktop reviews of the Victorian Biodiversity Atlas records and the MNES Protected Matters Search Tool indicated that within the investigation region there were records of, or potential suitable habitat for, 64 fauna species listed as threatened or migratory under the EPBC Act and / or the FFG Act. As with listed flora, the

likelihood of occurrence of each species within the project site investigation area was assessed, with species considered 'likely to occur' where they have a very high chance of being in the area based on numerous records in the search region and the presence of suitable habitat. In total, 16 listed fauna species were identified as being likely to occur within the project site investigation area, including 13 bird species and one reptile, amphibian and invertebrate. This excludes Brolga and bat species, which are discussed separately in Chapter 10 – ***Brolga*** and Chapter 9 – ***Bats***, respectively.

An additional 11 listed fauna species were identified as having the potential to occur within the project site investigation area due to the presence of suitable habitat, but recent records are scarce. This includes birds, mammals, reptiles, amphibians, and invertebrates. The species known, likely, or with potential to occur within the investigation areas are discussed by type (taxonomic group) in the following sections.

The project site was also assessed for its potential to support the Victorian Temperate Woodland Bird Community, which is listed under the FFG Act. However, the project site was determined to be unlikely to support the community due to its location, distance to remnant woodlands, limited observations of benchmarking species, and lack of suitable habitat. The project site is relatively devoid of remnant woody vegetation, with applicable canopy vegetation restricted to roadside vegetation, riparian corridors, and some grazing paddocks. However, the size and shape of these remnant patches make them unsuitable for maintaining the community. Where riparian woodland dominated by characteristic species to support this community is present, adjacent to the eastern boundary of the project site along Hopkins River, previous agricultural activities have substantially modified the understory vegetation. As such, this habitat is also unlikely to support the community.

Threatened communities

Under Victoria's FFG Act, a threatened community is an entire ecological community (including groups of plants, animals, and their habitats) that is at risk of extinction or severe decline.

The Victorian Temperate Woodland Bird Community is defined as *"a group of bird species characteristically and commonly found within box-ironbark, yellow box, cypress pine...(and other) woodlands"* and includes *"a large number of unique species which are totally or largely restricted to the temperate woodland habitat"* (Scientific Advisory Committee, 2000). This community of birds is distinct, with the community evolving in response to specific characteristics of their woodland habitat, such as year-round availability of food.

Birds

Bird utilisation studies undertaken by Nature Advisory between 2018 and 2025 recorded 125 species within and around the project site, including species observed incidentally over the same period. The most abundantly species recorded all studies were common, not listed under the EPBC Act of FFG Act. These are shown in Table 8.8. In all studies undertaken by Nature Advisory, the five most common species accounted for over 50% of all birds recorded. Earlier studies undertaken by EHP in 2011 and 2012 observed a similar dominant species, indicating that little change has occurred in bird species structure in the last decade.

The abundance and diversity (number of species recorded) of bird species was generally similar across the project site. However, survey locations surrounded by planted or scattered trees such tended to display higher abundance compared with locations within open grazing paddocks lacking trees. Relative abundance tended to be the highest during winter, with 4,140 individuals recorded.

Table 8.8. **Most abundant bird species recorded in bird utilisation studies**

2018/2019 study	2024/2025 study
Lorikeet sp.	Little Raven
Raven sp.	Australian Magpie
Common Starling	Common Starling
Australian Magpie	Eurasian Skylark
Red-rumped Parrot	Raven sp.

As shown in Figure 8.8, most birds were recorded flying at an altitude below which the turbine rotors will sweep (referred to as the minimum Rotor Swept Area), which is 40 metres. In 2018-19, 94.4% of birds flew below this level, and would not be at risk of collision with wind turbines. In 2024-25, this reduced to 87.5% of birds, reflecting the large flocks of Straw-necked Ibis that were observed flying within the Rotor Swept Area in Winter 2024.

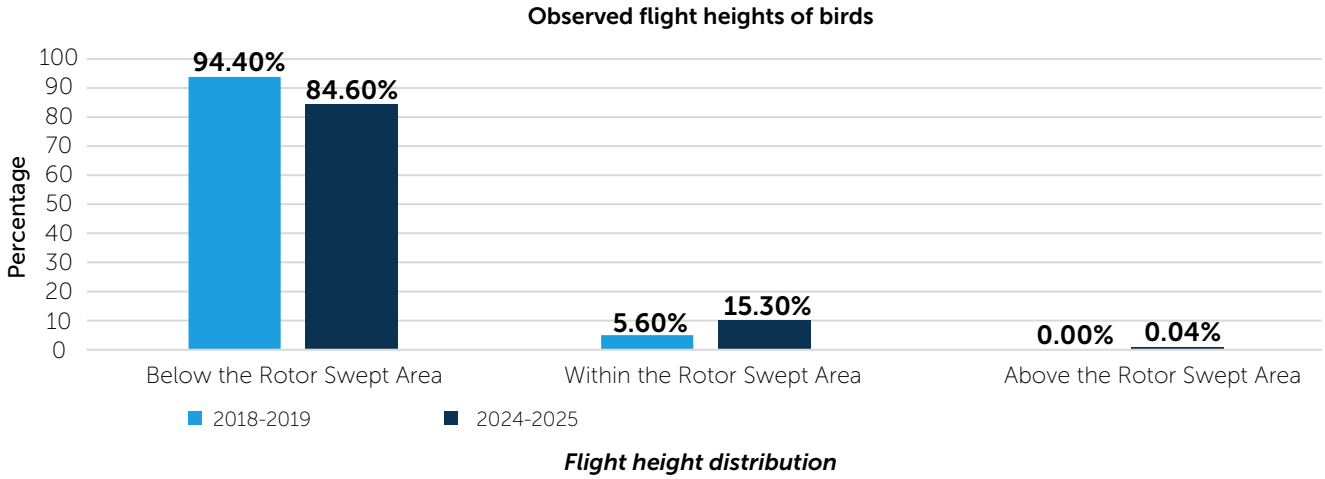
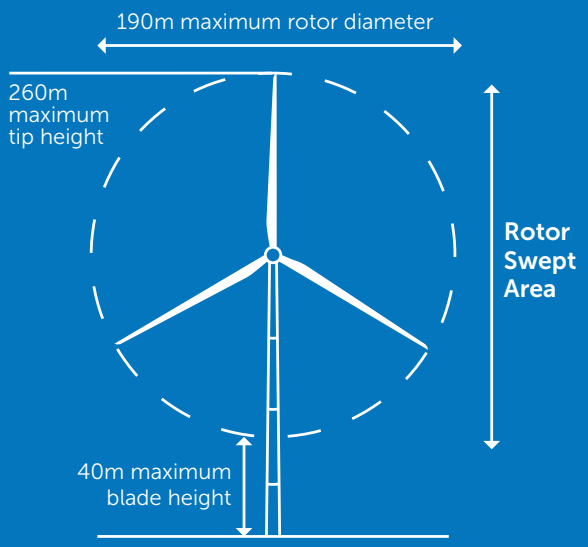


Figure 8.8 Bird flight heights recorded during utilisation surveys

Rotor Swept Area

This is the circular area a wind turbine's blades cover as they rotate. For the project, the following is relevant:

- Below the Rotor Swept Area: less than 40 metres above the ground
- At the Rotor Swept Area level: between 40 and 260 metres above the ground
- Above the Rotor Swept Area: greater than 260 metres above the ground.



The occurrence of several threatened bird species within the project site was confirmed through bird utilisation surveys and incidental observations between 2018 and 2025. Additional listed species were recorded opportunistically during wetland habitat assessments undertaken to assess the location and extent of suitable habitat for migratory bird species listed under the EPBC Act, and targeted species surveys undertaken for the Wedge-tailed Eagle and White-throated Needletail.

The listed species known or likely to occur within the project site investigation area are shown in Table 8.9, including a description of their habitat requirements and recorded observations.

Table 8.9 Listed bird species likely or known to occur in the project site investigation area

Name	EPBC act status	FFG act status	Preferred habitat	Summary of records
Migratory species				
Common Greenshank (*Tringa nebularia*)	Migratory species	Endangered	Coastal and inland wetlands, especially muddy margins or rocky shores.	**Likely to occur** Indicated in the Victorian Biodiversity Atlas to occur within or near the project site investigation area.
Common Sandpiper (*Actitis hypoleucos*)	Migratory species	Vulnerable	Coastal and inland wetlands, especially muddy margins or rocky shores.	**Known to occur** Recorded once incidentally during bat surveys in the Summer-Autumn 2020 survey period.
Double-banded Plover (*Charadrius bicinctus*)	Migratory species	–	Coastal and inland wetlands, especially muddy margins or rocky shores.	**Known to occur** One pair recorded in the central section of Wetland No. 29405 in February 2019 wetland habitat surveys.
Latham's Snipe (*Gallinago hardwickii*)	Vulnerable; Migratory species	–	Prefers open freshwater wetlands with dense cover nearby, including rivers, creeks, bogs, swamps, and waterholes.	**Known to occur** One pair recorded at Mustons Creek, hiding among vegetation, in January 2019 wetland habitat surveys.
Red-necked Stint (*Calidris ruficollis*)	Migratory species	–	Shallow fresh to saline wetlands, often with open fringing mudflats and low emergent vegetation.	**Known to occur** Recorded incidentally during Brolga surveys. Eight birds previously recorded by EHP (2014).
Sharp-tailed Sandpiper (*Calidris acuminata*)	Vulnerable; Migratory species	–	Shallow fresh to saline wetlands, often with open fringing mudflats and low emergent vegetation.	**Known to occur** A small group (seven to eight birds) recorded on a large wetland within the project site in December 2018 wetland habitat surveys.
Non-migratory species				
Australasian Shoveler (*Spatula rhynchotis*)	–	Vulnerable	Large and deep permanent water bodies, billabongs, floodwaters, swamps, and farm dams with aquatic flora.	**Known to occur** Recorded incidentally during bird utilisation surveys.
Black Falcon (*Falco subniger*)	–	Critically Endangered	Woodlands, open country, and wetlands; prefers open plains with low vegetation.	**Known to occur** Recorded once incidentally in the Summer 2025 survey period. Previously recorded by EHP (2014).
Blue-billed Duck (*Oxyura australis*)	–	Vulnerable	Deep, permanent, well-vegetated terrestrial wetlands.	**Known to occur** Recorded incidentally during bird utilisation surveys.

Name	EPBC act status	FFG act status	Preferred habitat	Summary of records
Blue-winged Parrot (*Neophema chrysostoma*)	Vulnerable	–	Grasslands, grassy woodlands, and forests in coastal to inland habitats. The project site is within a known breeding area. However, breeding is unlikely due to limited mature woodlands and absence of seasonal records.	**Known to occur** Several flocks recorded in the Winter 2024 survey period foraging on grasses and weeds growing on sides of farm tracks, in paddocks and near revegetation windbreaks.
Eastern Great Egret (*Ardea alba modesta*)	–	Vulnerable	Variety of wetlands including permanent lakes, swamps, and floodplains with aquatic vegetation.	**Known to occur** Recorded once in both the Spring 2018 and Autumn 2025 bird utilisation surveys, below the Rotor Swept Area.
Little Eagle (*Hieraaetus morphnoides*)	–	Vulnerable	Over wooded and forested lands and open country of Aust. Range extending into arid zone. Most abundant in open forest and woodland	**Known to occur** Recorded once in both the Spring 2018 and Autumn 2025 bird utilisation surveys, within the Rotor Swept Area.
Musk Duck (*Biziura lobata*)	–	Vulnerable	Deep, stable, well-vegetated terrestrial wetlands, estuarine habitats, and sheltered inland waters.	**Known to occur** Recorded 20 times in the Autumn 2025 bird utilisation survey, below the Rotor Swept Area. However, flight heights are unknown as this species moves nocturnally.
Wedge-tailed Eagle (*Aquila audax*)	–	-	Primarily nests in mature ecalypt forest. In Victoria, nests are commonly at the top of large trees located in gullies or on moderate slopes, with an average height of 12.6 metres. However, in semi-arid areas nests can occur in trees as low as a few metres tall.	**Known to occur** Six confirmed nests and three potential nests were recorded during the June 2023 survey. All nests were inactive; however three pairs of Wedge-tailed Eagles were recorded flying near three sites suggesting that they may be used in the breeding season.

The Little Eagle (listed as Vulnerable under the FFG Act) was the only listed bird species observed within the Rotor Swept Area during bird utilisation surveys. However, due to a lack of woodland vegetation within the project site, this species is expected to only occur in very low abundance when foraging or traveling.

Nature Advisory determined that there is very little suitable habitat within the project site investigation area for most species of migratory shorebird due to the ephemeral nature of most waterbodies and the lack of muddy shorelines. Latham's Snipe (listed as Vulnerable and Migratory under the EPBC Act) is an exception, as its specific habitat requirements can be provided along Mustons Creek and some of the muddy margins of the large lake (unnamed) central to the project site and large dams. However, recorded observations did not indicate a significant population was present.

Non-threatened species considered in this assessment

The **Wedge-tailed Eagle** (*Aquila audax*) is not listed as threatened under the EPBC Act or the FFG Act. However, it is considered a species of concern for this project due to its cultural significance, role as an apex predator, and its susceptibility to collisions with operation wind farms across Victoria. Between 2023 and 2025, ten confirmed and three potential Wedge-tailed Eagle nests were recorded within a one-kilometre buffer of the wind farm boundary. The location of these nests is shown in Figure 5.9. Six incidental observations of Wedge-tailed Eagle were also recorded in the 2023 survey period, with flight heights ranging from 10 to 60 metres. As such, this species is **known to occur**.

Similarly, the **Spotted Harrier** (*Circus assimilis*) is not listed as threatened under the EPBC Act or the FFG Act. This species was identified as a 'species of interest' for wind farm collisions in Lumsden et al. (2019). It has been recorded on one occasion in the northern portion of the project site, and as such is **known to occur**. However, this singular observation suggests a relatively low occurrence compared to the survey effort, and to other locations where it is recorded frequently in surveys.

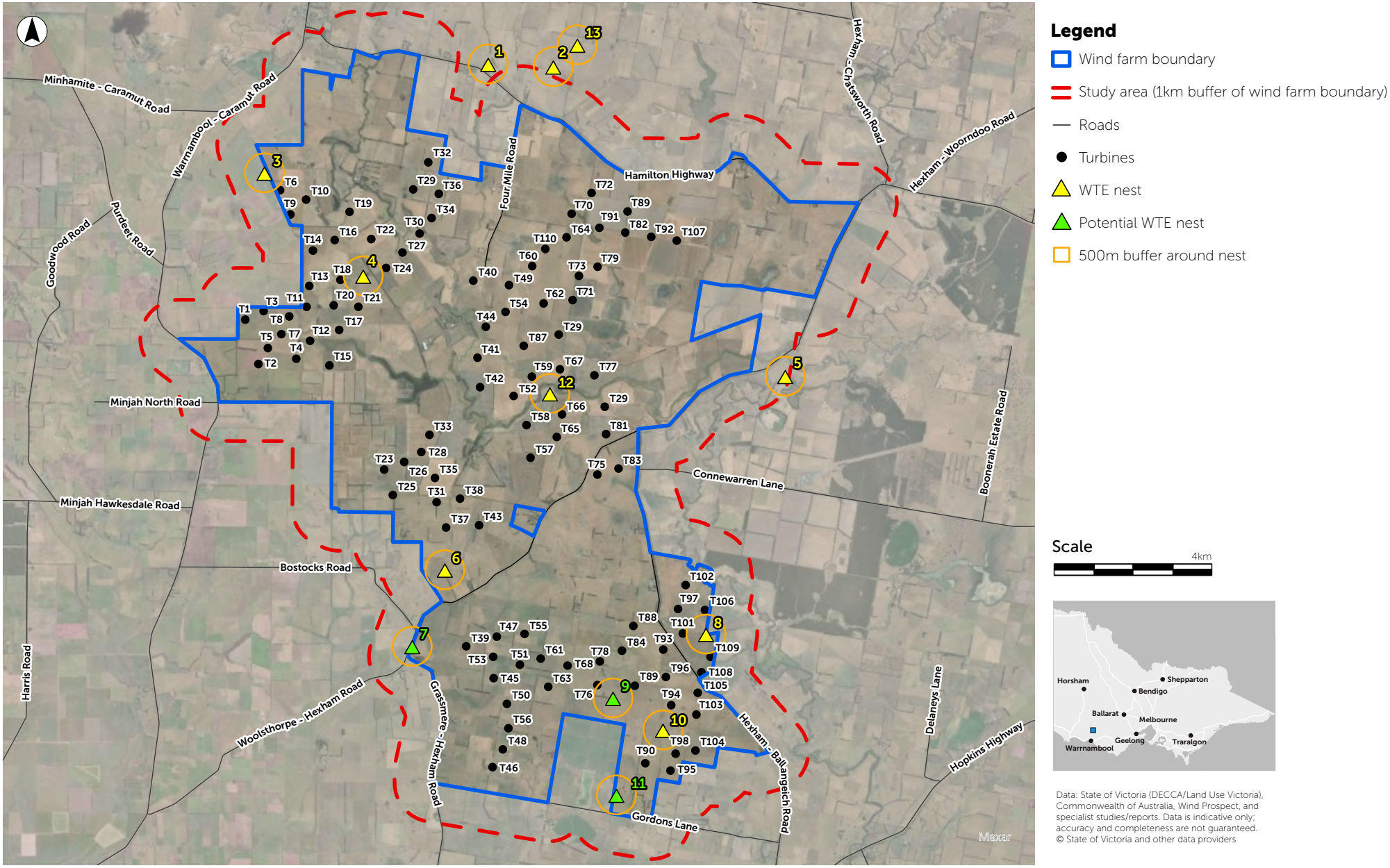


Figure 8.9. Wedge-tailed Eagle nest locations

Other bird species identified as having potential to occur within the project site include:

- **Australian Gull-billed Tern** (*Gelochelidon macrotarsa*), listed as Endangered under the FFG Act.
- **Curlew Sandpiper** (*Calidris ferruginea*), listed as Critically Endangered under the EPBC Act and Critically Endangered under the FFG Act.
- **Fork-tailed Swift** (*Apus pacificus*), listed under international migratory agreements (CAMBA, ROKAMBA, JAMBA).
- **Freckled Duck** (*Stictonetta naevosa*), listed as Endangered under the FFG Act.
- **Marsh Sandpiper** (*Tringa stagnatilis*), migratory species under the EPBC Act and listed as Endangered under the FFG Act.
- **White-throated Needletail** (*Hirundapus caudacutus*), listed as Vulnerable and migratory under the EPBC Act and Vulnerable under the FFG Act.

Targeted surveys were undertaken for the White-throated Needletail (listed as Vulnerable under the EPBC Act and FFG), however none were recorded. Combined with the absence of records during on-site surveys conducted to date, this suggests that this species is unlikely to use the area in or around the project site frequently or in large numbers.

Amphibians

Only one listed amphibian species, the Growling Grass Frog (*Litoria raniformis*), is known or likely to occur within the project site investigation area. A description of their habitat requirements and recorded observations is provided in Table 8.10.

Table 8.10 **Listed amphibian species likely or known to occur in the project site investigation area**

Name	EPBC Act Status	FFG Act Status	Preferred Habitat	Summary of records
Growling Grass Frog (*Litoria raniformis*)	Vulnerable	Vulnerable	Permanent, still or slow flowing water with fringing and emergent vegetation in streams, swamps, lagoons or artificial wetlands.	**Known to occur** Calls recorded at three habitat locations along Mustons Creek, where year-round usage is assumed.

Targeted Growling Grass Frog habitat assessments were undertaken in November 2011 and November 2018 due to the presence of a range of suitable habitat in a range of waterbodies and tributaries within the project site investigation area. These considered 12 potential habitat areas (shown in Figure 8.10) of which:

- Three had a 'High' habitat quality to support the Growling Grass Frog.
- Five had a 'Medium-High' habitat quality to support the Growling Grass Frog.
- Two had a 'Medium' habitat quality to support the Growling Grass Frog.

Growling Grass Frog calls were recorded at three separate sections of Mustons Creek, which connects to the Hopkins River to the east of the project site and therefore forms a large, contiguous network of habitat. Several smaller tributaries of Mustons Creek within the project site may also provide habitat during the wet season and contribute to the wetland habitat network. In addition, a large lake (wetland 29405) and associated dams may contribute to habitat, but most dams lack suitable habitat, are impacted by livestock trampling and are of low value for this species.

The Growling Grass Frog also has potential to occur within a dam at the intersection of Hexham-Ballangeich Road and Connewarren Lane along the transport route investigation area. Records of the species occur nearby, and the dam could contribute to the species distribution within the local area.

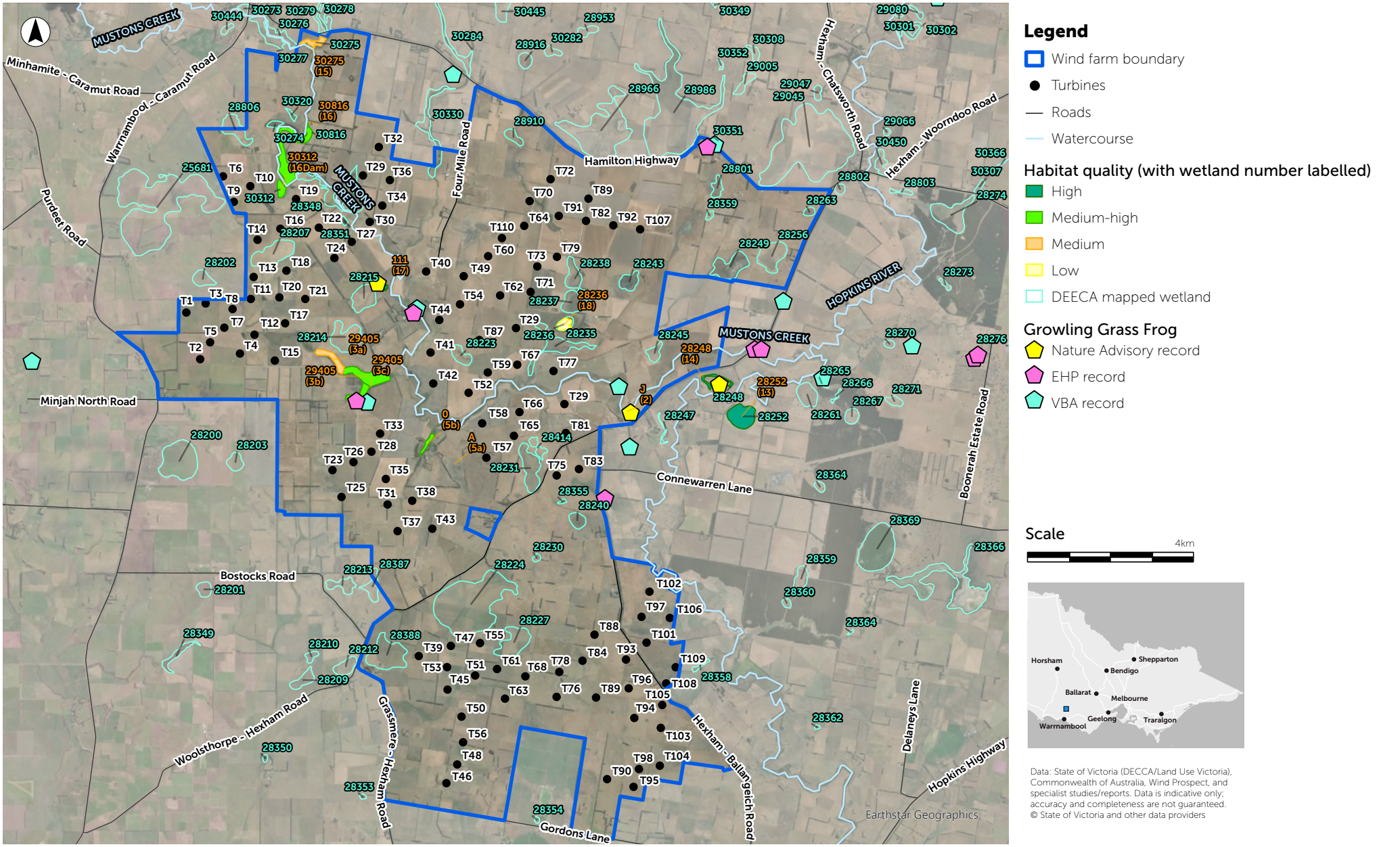


Figure 8.10. Growling Grass Frog habitat quality

Mammals

No listed mammal species are known or likely to occur within the project site. However, the Fat-tailed Dunnart (*Sminthopsis crassicaudata*) was assessed as having potential to occur due to the presence of suitable habitat. The Fat-tailed Dunnart is listed as Vulnerable under the FFG Act, and prefers native grassland habitat, especially around rocks, rough pasture and recently harvested paddocks.

Targeted habitat assessments for the Fat-tailed Dunnart, undertaken by EHP in 2011 and 2012, did not record the species. However, some suitable habitat was observed.

The Fat-tailed Dunnart has potential to occur at multiple locations along the roadside upgrades and transport route investigation areas. It is assumed that this species occurrence may also extend beyond the defined native vegetation 'patches', which require a minimum of 25% native vegetation cover to be defined.

Reptiles

One listed reptile species, the Tussock Skink (*Pseudemoia pagenstecheri*), is known or likely to occur within the project site investigation area. A description of their habitat requirements and recorded observations is provided in Table 8.11.

Table 8.11 **Listed reptile species likely or known to occur in the project site investigation area**

Name	EPBC Act Status	FFG Act Status	Preferred Habitat	Summary of records
Tussock Skink (*Pseudemoia pagenstecheri*)	-	Endangered	Tussock Grasslands with few or no trees.	**Known to occur** Recorded incidentally during bird utilisation surveys in 2024.

The Striped Legless Lizard (*Eulamprus tympanum marnieae)*, listed as Vulnerable under the EPBC Act and Endangered under the FFG Act, was assessed as having potential to occur due to the presence of some suitable habitat, particularly in road reserves.

Both of these reptile species prefer grassland habitats (typically with an absence of trees) and can shelter in grass tussocks. In particular, the Striped Legless Lizard is known to occur in some areas dominated by introduced species, including areas used for grazing and pasture which are common within the project site. However, most habitat sites in Victoria feature cracking clay soils with some surface rocks. Targeted habitat assessments for the Striped Legless Lizard, undertaken by EHP in 2011 and 2012, did not record the species.

Both the Tussock Skink and Striped Legless Lizard have the potential to occur at multiple locations along the roadside upgrades and transport route investigation areas. It is assumed that both of these species occurrence may also extend beyond the defined native vegetation 'patches', which require a minimum of 25% native vegetation cover to be defined.

Invertebrates

One listed reptile species, the Hairy Burrowing Crayfish (*Engaeus sericatus*), is known or likely to occur within the project site investigation area. A description of their habitat requirements and recorded observations is provided in Table 8.12.

Table 8.12 **Listed reptile species likely or known to occur in the project site investigation area**

Name	EPBC Act Status	FFG Act Status	Preferred Habitat	Summary of records
Hairy Burrowing Crayfish (*Engaeus sericatus*)	-	Vulnerable	Spend most of their time underground near creeks, typically identified by freshy excavated soil at burrow entrances.	**Known to occur** Suitable habitat is present and Victorian Biodiversity Atlas records exist.

There is little information available regarding this cryptic species, however its habitat preferences are associated with waterways and wetland habitat. It can be identified by mud chimney structures around margins of aquatic habitats and can be found some distance from water itself in flood plains and wet areas.

Targeted surveys were undertaken by EHP in 2011 and 2012 to determine the presence of Golden Sun Moth (*Synemon plana*), listed as 'Critically Endangered' under the EPBC Act and Vulnerable under the FFG Act. Given the time elapsed since the surveys and using a precautionary approach, it is considered that the species has potential to occur in any patches of native vegetation with a native grassy understorey (Plains Grassland and Plains Grassy Woodland) within the project site investigation area. The Golden Sun Moth also has the potential to occur at multiple locations along the roadside upgrades and transport route investigation areas.

8.6.4 Groundwater Dependent Ecosystems

Several potential aquatic and terrestrial GDEs occur within the project site investigation area, located along Mustons Creek, Tea-tree Creek, Drysdale Creek, Black Swamp, and several unnamed wetlands.

Confirmation of the presence of GDEs typically requires monitoring over several years, which was not considered practical. As such, the presence of all potential GDE within the project site investigation has been assumed. This includes a range of types of both aquatic and terrestrial GDEs, detailed in Table 8.13.

Surface water features within and downstream of the investigation area are described in detail in Chapter 12 – ***Surface water***.

Groundwater dependent ecosystems (GDEs) rely on groundwater to sustain ecological processes and biodiversity.

Terrestrial GDEs include vegetation and habitats that access groundwater via roots, while **aquatic GDEs** are surface water systems like wetlands, springs, and rivers that are fed or maintained by groundwater inputs.

Table 8.13 Groundwater Dependent Ecosystems assumed present within the project site investigation area

Type	Description	Presence
Aquifer and cave ecosystems (Type 1)	Underground cave and groundwater stores (aquifers) provide unique habitats for organisms such as stygofauna. Stygofauna live in groundwater for their entire life cycle and require stable, dark conditions.	Aquifer groundwater samples taken at the western project site boundary indicated the seasonal presence of Stygofauna, suggesting that Type 1 GDEs are likely to be present within the project site investigation area, but that populations exhibit season variation. However, the extent of these GDEs is unknown. No cave systems have been identified.
Ecosystems dependent on the surface expression of groundwater (Type 2)	Springs, wetlands, and rivers that are fed by groundwater support aquatic plants and animals. These ecosystems rely on groundwater to keep water flowing and support surrounding vegetation, especially during low rainfall periods.	Nine types of native vegetation patches (EVCs) were recorded throughout the project site investigation area that are considered to be Type 2 GDEs, including wetlands, grasslands, marsh, and woodlands. However, as the water level of all watercourses and other wet depressions fluctuates seasonally according to changes in rainfall, groundwater is understood to not be the primary water source supporting this native vegetation.
Ecosystems dependent on subsurface presence of groundwater (Type 3)	Plants in these ecosystems use deep roots to access groundwater below the surface. This helps them survive in dry climates or during droughts, even when there's no visible water.	Three types of native vegetation patches (EVCs) were recorded throughout the project site investigation area that are considered to be Type 3 GDEs, including woodlands and grasslands. The primary source of water for supported native vegetation is understood to be rainwater. However, vegetation may benefit from access to groundwater over summer and during periods of drought.

8.7 Impact assessment

8.7.1 Impact pathways

Development of the project has the potential to impact terrestrial and aquatic biodiversity values during construction and operation. These impact pathways are summarised in Table 8.14.

While disturbance will primarily occur during construction, a small amount of disturbance is also expected during project decommissioning. As wind farms are constructed progressively, construction activities at any one location would be temporary (over several weeks), with the exception of the on-site quarry and construction site compounds which would be operational for the entirety of the two-year construction period.

Table 8.14 **Potential construction and operation impact pathways relevant to biodiversity values**

Impact	Pathway description	Relevant biodiversity value(s)
Construction		
Vegetation loss, and direct and indirect habitat loss	Direct vegetation and habitat loss may result from earthworks and physical disturbance, including: • vegetation and habitat removal (including hollow-bearing trees and wetland habitat), which may result in direct mortality to individual plants and/or habitat fragmentation for fauna species (where previously contiguous areas of habitat are separated into smaller patches) • excavation and trenching • earthworks such as stockpiling or cut-and-fill material movements required to construct project infrastructure. The shape, size and duration of physical disturbance (i.e., temporary or permanent) influences the degree to which native vegetation and listed flora species may be impacted. Habitat loss may also result through indirect impacts to wetlands and adjacent habitats that support fauna species.	Native vegetation Threatened ecological communities Threatened flora Threatened birds Migratory shorebirds and waterbirds Mammals: Fat-tailed Dunnart Frogs: Growling Grass Frog Invertebrates: Golden Sun Moth and Hairy Burrowing Crayfish Reptiles: Striped Legless Lizard and Tussock Skink
Habitat and vegetation degradation (direct and indirect)	Habitat and vegetation degradation may result from: • spread of invasive species or pathogens transported by construction plant and equipment • edge and barrier effects • changes to surface water hydrology (drainage patterns and flow pathways) and runoff from construction areas into adjacent habitat • changes to groundwater recharge and flow, such as from the introduction of less permeable surface and physical barriers (wind turbine foundations and access tracks) • groundwater drawdown (dewatering) from operation of the on-site quarry and construction of turbine foundations where shallow groundwater is intercepted, affecting groundwater availability for groundwater dependent ecosystems • deposition of eroded sediments into watercourses, reducing water quality and impacting riparian habitats • contamination from accidental spills of hazardous materials.	Native vegetation Threatened ecological communities Threatened flora Groundwater Dependent Ecosystems

Impact	Pathway description	Relevant biodiversity value(s)
Collision with construction activities and traffic	• Direct mortality or injury of fauna due to collision with construction traffic and/or construction activities	Mammals: Fat-tailed Dunnart Frogs: Growling Grass Frog Invertebrates: Hairy Burrowing Crayfish Reptiles: Striped Legless Lizard and Tussock Skink
Indirect disturbance to fauna	• Increased vehicle movements, human activity and noise during construction, deterring mobile fauna species from using these areas. • Disturbance and behavioural changes due to increased light and noise, including from on-site quarry blasting.	Threatened fauna Migratory birds Migratory shorebirds and waterbirds Wedge-tailed Eagles
Operation		
Collision with wind turbine blades	• Direct mortality or injury of birds and bats due to collision with operating turbines. Some birds and bats are particularly sensitive to collision with turbines based on their flight behaviour, for example, high flying species or those that are less manoeuvrable.	Threatened birds Migratory shorebirds and waterbirds Migratory birds

8.7.2 Design mitigation

The project has applied the mitigation hierarchy whereby the approach has been to firstly avoid potential impacts if possible and practical, then to minimise the severity of the impact, followed by the application of targeted mitigation and management measures.

Adoption of the mitigation hierarchy has included:

- Avoid: measures taken to avoid impacts from the outset using spatial placement of infrastructure away from ecological values (including native vegetation), or scheduling works to avoid impacts. Avoidance measures have focused on those on areas that are important to terrestrial and aquatic biodiversity, particularly those areas that support rare or threatened species.
- Minimise: measures taken to reduce the duration, intensity and/or extent of impacts that cannot be completely avoided, as far as is practically possible. For example, limiting the number of watercourse crossings for access tracks to the minimal number needed to connect sectors of the project.
- Offset: measures taken to compensate for any residual, adverse impacts that cannot be avoided, minimised and/or rehabilitated or restored, in order to achieve no net loss or preferably a net gain of biodiversity. The project would offset any clearance of native vegetation.

From the earliest point in the project design, ecological considerations have been built into the project geographic information system (GIS) as constraints. These constraints have been progressively refined as ecological field studies have been conducted and an improved understanding of the site has been achieved. The purpose of incorporating these constraints and buffers into the planning process was to ensure that potential impacts could be either avoided or minimised at the outset.

Other specific design measures that have been developed in response to key environmental features of the site relating to native vegetation, ephemeral wetlands, watercourses, and habitat features of threatened fauna.

Measures incorporated through the project design process to avoid and/or minimise impacts to native vegetation, threatened ecological communities and listed flora species are discussed below. Where practicable, the project commits to further avoidance and minimisation efforts during the detailed design process.

Wetlands, watercourses and riparian zone buffers

A 100-metre buffer was applied around all wetlands mapped in the Victorian Wetland Inventory and watercourses (including Mustons Creek, Drysdale Creek and smaller drainage lines) and a 30-metre buffer around ephemeral drainage lines to exclude primary wind farm infrastructure (other than ancillary infrastructure). This area was selected as a means of:

- Limiting physical disturbance to wetlands, watercourses and their banks, and drainage lines.
- Limiting surface water runoff and sedimentation to wetlands, watercourses and drainage lines from construction work areas.

Watercourses and riparian zones are known to be important habitats for biodiversity, both aquatic and terrestrial. Watercourses and drains were defined using the VicMap Hydro data, which contains line features delineating hydrological features including channels, rivers and streams. Watercourse crossings for access tracks and electrical cables are needed to connect wind turbines and associated infrastructure and to provide access to infrastructure within the project site. As such, there are instances where the watercourse buffers are crossed by access tracks and electrical cables. Watercourse crossings were minimised through:

- Siting of access tracks and cable routes.
- Design of permanent surface structures to maintain existing overland flow paths and not cause increased upstream flood levels.
- Design of waterway crossings to accommodate a one in 10 Average Recurrence Interval design criteria (i.e., 10% chance of a rainfall event of a certain magnitude is expected to occur or be exceeded in any given year).

Other key design measures for watercourse crossings are detailed in Chapter 12 - ***Surface water***.

Native vegetation and habitat avoidance

Native vegetation

Re-alignment and micro-siting of project infrastructure was undertaken during the design development, resulting in:

- Most native vegetation within the project construction disturbance area being avoided.
- A reduction in the amount of Grassy Eucalypt Woodland of the Victorian Volcanic Plain and Natural Temperate Grassland of the Victorian Volcanic Plain within the project construction disturbance area.
- Avoidance of impacts to Purple Blown-grass, with all but one individual avoided by the Geelong Transport Route option and all but five individuals avoided by the Portland Transport Route option.
- A reduction in impacts to Natural Temperate Grasslands of the Victorian Volcanic Plain and Grassy Eucalypt Woodland of the Victorian Volcanic Plain threatened ecological communities along Hexham -Ballangeich Road due to the removal of two site access locations with associated road upgrades that removed areas of these ecological communities. This avoided approximately three kilometres of roadside impacts.

Local road upgrades originally proposed for Immigrants Lane, Gordon Lane and Ross Lane were also removed from the final design, which avoided and minimised impacts to native vegetation in these areas.

As a result of design modifications along the transport routes and at locations of proposed road upgrades, only small areas of roadside habitats are anticipated to be impacted. These impacted areas are located immediately adjacent to roadsides and therefore are generally more disturbed and degraded in comparison to retained vegetation. If the Geelong Transport Route option is selected as the preferred over-dimensional route it would avoid impacts to 0.166 hectares of native vegetation and five large trees in patches (see Section 8.6.5 Native vegetation), as well as 0.005 hectares of Natural Temperate Grassland of the Victorian Volcanic Plain, 0.063 hectares of Western (Basalt) Plains Grassland Community and 0.007 hectares of Western Basalt Plain (River Red-gum) Grassy Woodland (see Section 8.6.5 Threatened ecological communities).

Areas of proposed native vegetation clearance and areas of avoided native vegetation clearance within the investigation areas are show in Figure 2-1 through Figure 2-57 of Appendix D – ***Flora and Fauna Assessment***. The process to avoid clearance of native vegetation throughout the design process is further described in Chapter 5 – ***Project alternatives and design development***.

Bat habitat

Based on the results of bat recording for the project and consideration of findings from other investigations (Appendix C2 – ***Bat Assessment***), a 269-metre buffer was applied from the base of the turbine to the nearest habitat edge. To reduce the area of Southern Bent-wing Bat habitat within 269 metres of proposed turbines, 33 turbines were micro-sited, resulting in all turbines where the 269-metre buffer originally overlapped with permanent creek habitat being relocated. Design measures to avoid and minimise impacts to bats are further discussed in Chapter 9 – ***Bats***.

Brolga habitat

To minimise the impact of the project on the Victorian Brolga population, turbine-free buffers were established around wetlands used for Brolga breeding i.e. those used for nesting or egg incubation. The buffer was then extended to include other suitable wetlands within 2,000 metres of the breeding wetland that may be used for foraging and night roosting, as well the non-wetland areas located between these wetlands. A further 300-metre buffer was applied to this area to limit disturbance from human activity. Design measures to avoid and minimise impacts to Brolga are further discussed in Chapter 10 – ***Brolga***.

Wedge-tailed Eagle habitat

Wedge-tailed Eagle are highly vulnerable to disturbance during sensitive phases of the breeding cycle (Olsen 2005, Rowe et al., 2018), and new human activity can lead to desertion of their nests. As such, 500-metre turbine and overhead transmission line exclusion buffer was applied around all known and potential Wedge-tailed Eagle nests as recommended by the New South Wales Department of Planning, Industry, and Environment (NSW DPIE, 2018). This reflects the vulnerability of Wedge-tailed Eagle fledglings to any threats near the nest during their first flights and aims to ensure existing nests remain active (Energy Grid Alliance, 2021).

One proposed turbine (T108) was located within 300 metres of a Wedge-tailed Eagle nest; however, this turbine was relocated approximately 600 metres from the nest during the design process. With this relocation, no turbines are located within 500 metres of any known Wedge-tailed Eagle nest (Figure 8.9).

Migratory shorebirds

Wetlands across the project site were assessed to determine their habitat quality for supporting migratory shorebirds listed under the EPBC Act. To avoid and minimise potential impacts to these species, wind turbines have been sited away from moderate to high-quality wetland habitats, as far as reasonably practicable. In most cases, turbines are located at least 700 metres from the edge of wetland areas.

Additionally, turbines have been positioned at least 100 metres from all major waterways, which may provide habitat for migratory shorebirds including Latham's Snipe.

Minimum turbine blade height

A minimum tip height of 40 metres has been adopted for the project (i.e., all wind turbine blades would be at least 40 metres from ground level). This limit was selected to minimise potential collision risk with birds and bats. This was informed by flight behaviour data gathered by Nature Advisory during 15 years of bird and bat surveys in south-west Victoria, showing decreasing bird and bat strikes with increasing turbine blade height.

On-site quarry

The proposed temporary on-site quarry has been designed as a 'zero discharge' site, with all surface water and groundwater to be managed within the quarry site using retention basins, either infiltrating or evaporating stored water.

8.7.3 Environmental management measures

Where possible, design measures have been included to avoid potential impacts to biodiversity. To further minimise potential impacts, management controls would be carried out during construction and operation of the project. Committed management measures are outlined in Table 8.15.

Table 8.15 Biodiversity management measures

Biodiversity impact	Project phase	Management measures	Number
Vegetation loss, and direct and indirect habitat loss Habitat and vegetation degradation (direct and indirect) Collision with construction activities and traffic Indirect disturbance to fauna	Construction	**Construction Environmental Management Plan – Biodiversity and biosecurity management** 1. Prior to the commencement of construction, develop and implement biodiversity and biosecurity management measures. These measures will be documented in the Construction Environmental Management Plan (EMM01), and include: a. showing the native vegetation to be removed and retained (including Vegetation Protection Zones, in accordance with EMM BH02) on all site plans b. designating entry and exit points from each property within the project site c. requiring biosecurity signage, with clear instructions and contact details, at all project site entry points d. requiring a site induction for all employees and visitors, including specific requirements in relation to: i. Native vegetation ii. Threatened ecological communities iii. Listed flora species, including Purple Blown Grass (*Lachnagrostis semibarbata* var. *filifolia*) iv. Listed fauna species known, likely, or with the potential to occur within the project site. e. requiring habitat restoration once impacts cease, in areas not required to support operation of the project f. establishing decontamination bays at all project site entries and between properties, where necessary, to prevent the spread of weeds across the project site g. measures to ensure any materials imported to the project site are free from biosecurity risks, including record keeping of all materials h. measures to avoid, minimise, and mitigate potential impacts on listed species i. measures to minimise the disturbance of banks, channels and nearby vegetation where essential wind farm infrastructure (e.g. access roads, or transport route swept paths) crosses a creek line or wetland identified as potential habitat of a listed aquatic fauna species. These works will preferably be undertaken during periods when the creek line or wetland is dry and if feasible, restored or enhanced to at least its pre-construction condition.	BH01

Biodiversity impact	Project phase	Management measures	Number
Vegetation loss, and direct and indirect habitat loss Habitat and vegetation degradation (direct and indirect) Collision with construction activities and traffic Indirect disturbance to fauna	Construction	**Construction Environmental Management Plan - Vegetation and tree protection zones** 1. Prior to the commencement of construction, establish appropriate vegetation / tree protection zones around areas of native vegetation and scattered native trees to be retained, where these occur within 20 metres of works. These zones will be established with marked using temporary fencing or bunting, and appropriated signposted as 'no-go' zones. 2. The location of vegetation / tree protection zones will be documented within the Construction Environmental Management Plan (EMM01) 3. All construction personnel will be appropriately briefed prior to works, and no construction personnel, machinery or equipment will be placed inside vegetation / tree protection zones, as defined in the Construction Environmental Management Plan (EMM01). 4. Machinery, earthworks, laydown areas and stockpiles will be located in areas that do not support native vegetation.	BH02
	Construction	**Construction Environmental Management Plan – Salvage and relocation / translocation** 1. Prior to the commencement of construction activities within identified habitat areas proposed for removal, an ecologist or qualified fauna spotter-catcher will be engaged to undertaken habitat suitability surveys. These will inform the need to further targeted species surveys and any salvage/translocation to the nearest retained habitat. 2. A qualified wildlife handler will be engaged for any tree removal to search for any birds or mammals within hollows and relocate these or delay works until animals have safely finished breeding and left the habitat. 3. If Golden Sun Moth are confirmed to be present, further avoid and minimise measures will be explored and included in the Construction Environmental Management Plan where practicable.	BH03

Biodiversity impact	Project phase	Management measures	Number

	Construction	**Construction Environmental Management Plan – Offsets**
		
		1. Prior to the commencement of construction, offsets will be secured to compensate for unavoidable impacts to:
		  a. Native vegetation
		  b. Natural Temperate Grassland of the Victorian Volcanic Plain
		  c. Grassy Eucalypt Woodland of the Victorian Volcanic Plain
		  d. Habitat for Striped Legless Lizard (*Delma impar*)
		2. Offsets for unavoidable impacts to native vegetation under the Guidelines for the removal, destruction or lopping of native vegetation (Department of Environment, Land, Water and Planning, 2017c) will be sourced through the Native Vegetation Credit Register (NVCR). These offsets must meet the required general habitat units, strategic biodiversity value (SBV) thresholds, and large tree protection criteria.
		3. Offsets for unavoidable impacts to protected matters under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) will be secured (if not already secured) via conservation covenants or s69 Landowner Agreements, ensuring long-term protection and management.
		4. An Offset Management Plan will be developed and submitted to the Department of Climate Change, Energy, the Environment and Water (DCCEEW) for approval prior to the unavoidable impacts to protected matters under the EPBC Act. At a minimum, this will:
		  a. demonstrate compliance with the EPBC Act Environmental Offsets Policy (Department of Sustainability, Environment, Water, Population and Communities, 2012)
		  b. identify threats to offset values and outline management actions, including:
		  i. timing and frequency of actions
		  ii. responsible parties
		  iii. performance standards
		  c. include environmental objectives for each protected matter
		  d. provide access provisions for scientific research and monitoring
		  e. include a table mapping EPBC approval conditions
		  f. present a commitments table with references to responsible parties and actions
		  g. define monitoring protocols, including:
		  i. specific, measurable, attainable, relevant, time-based indicators
		  ii. thresholds for action
		  iii. adaptive management responses.
		  h. outline reporting and review mechanisms, including documentation standards
		  i. detail risk management strategies, including contingency measures for unforeseen adverse effects
		  j. include a long-term funding mechanism to support ongoing management.
			BH04

Biodiversity impact	Project phase	Management measures	Number
	Construction	**Wedge-tailed Eagle** 1. During construction, the following measures will be implemented to manage impacts to Wedge-tailed Eagle (*Neophema chrysostoma*): a. monitoring surveys of known and incidentally recorded nests will be undertaken prior to and early during the breeding season to determine whether nests are active b. where possible, construction activities will be modified to reduce or avoid disturbance within 500 metres of active nests until any chicks have fledged.	BH05
	Construction Operation	**Blue-winged Parrot** 1. During construction, the following measures will be implemented to manage impacts to Blue-winged Parrot (*Neophema chrysostoma*): a. pre-clearance surveys of potential mature treed habitat to be removed during the breeding season (spring and summer) to identify active breeding locations b. avoidance of identified breeding sites until chicks have fledged c. installation of compensatory nest boxes where potential breeding habitat (hollow bearing trees) is removed d. monitoring of nest box usage to assess effectiveness. 2. Nest box design will be developed in consultation with the BirdLife Bass Coast BWP Project.	BH06
	Construction	**Gang-gang Cockatoo** 1. During construction, the following measures will be implemented to manage impacts to Gang-gang Cockatoo (*Callocephalon fimbriatum*): a. minimisation of tree and woody understorey removal in Cavendish swept path site b. revegetation of removed trees and woody understorey following the completion of construction activities in the area.	BH07
	Construction	**Growling Grass Frog** 1. During construction, the following measures will be implemented to manage impacts to Growling Grass Frog (*Litoria raniformis*): a. scheduling the timing of creek crossing construction and underground cabling near Growling Grass Frog habitat in the summer months when the species is mostly in the water, active, and outside their wintering harbours, enabling them to move away from machinery.	BH08
	Construction	**Hairy Burrowing Crayfish** 1. During construction, the following measures will be implemented to manage impacts to Hairy Burrowing Crayfish (*Engaeus sericatus*): a. scheduling earthworks, creek crossings, and vegetation removal in areas of suitable habitat for Hairy Burrowing Crayfish during drier months when the species retreats closer to permanent water bodies.	BH09

Biodiversity impact	Project phase	Management measures	Number
	Construction	**Striped Legless Lizard and Tussock Skink** 1. During construction, the following measures will be implemented to manage impacts to Striped Legless Lizard (*Delma impar*) and Tussock Skink (*Pseudemoia pagenstecheri*): a. prior to the removal of roadside grassland habitat, modifying the grassland (e.g., through slashing, relocation of surface rocks and debris, and placement of tiles outside these areas) to facilitate dispersal of these species. b. scheduling road upgrade works requiring grassland removal in warmer months, when these species are more active. This will enable them to move out of construction areas, and reduce the risk of direct mortality and disturbance.	BH10
	Construction	**Black Falcon** 1. During construction, the following measures will be implemented to manage impacts to Black Falcon (*Falco subniger*): a. avoidance of identified breeding sites until chicks have fledged through the implementation of a 200-metre buffer.	BH11
	Pre-construction	**Detailed drainage design** 1. Prior to the commencement of construction, develop the detailed drainage design in consultation with Glenelg Hopkins Catchment Management Authority to minimise impacts to surface waters and supported ecosystems, considering best practice design guidelines. 2. Design measures will include, but not be limited to: a. permanent surface structures designed to maintain existing overland flow paths and not cause increased upstream flood levels b. culverts installed parallel to the alignment of the banks of the waterway c. the use of a reduced-width construction right of way at watercourse crossings and aim to avoid any standing water d. micro-siting crossings of Mustons Creek to avoid deeper pools where practicable to prevent potential effects on Growling Grass Frog e. integrating culverts into access track design to allow for the diversion of flow paths below the roads.	SW01
	Construction	**Water Management Plan - Minimise impacts to groundwater discharge, recharge and flow** 1. Include construction activities and temporary works that may impact on groundwater discharge, surface permeability and groundwater flow would be included within the Water Management Plan. 2. Measures to minimise groundwater discharge, recharge and flow related impacts relating to these activities and works will include, but not be limited to: a. revegetation of disturbed areas b. backfilling cabling trenches using excavated material where possible, or material of a similar permeability where this is not possible c. micro-siting turbine foundation excavations and trenches to avoid unmapped springs and watercourses.	GW04-1

Biodiversity impact	Project phase	Management measures	Number
	Construction	**Construction Environmental Management Plan - Creek crossings** 1. Where essential wind farm infrastructure (e.g., access tracks and electrical cables) crosses a creek, measures for avoiding and minimising impacts will be documented in the Construction Environmental Management Plan (EMM01) prior to the commencement of construction, including: a. preferentially scheduling works during drier months of the year and lowest flow of the waterway where watercourse trenching is required b. avoiding undertaking of works when high rainfall events are expected c. maintaining adequate flow rates and water levels in waterway to be crossed (as determined in consultation with the relevant authorities) to minimise impacts on aquatic ecosystem and environmental values d. restoration of temporarily disturbed waterways and vegetation (removing any obstructions to waterway flow) as soon as practicable following the open cut trenching works to at least its pre-construction condition e. design measures to minimise future erosion in areas where trenching occurred (e.g., use of riprap made of stones to stabilise the waterway, geofabric to prevent erosion and scour until establishment of vegetation).	SW03

Biodiversity impact	Project phase	Management measures	Number
	Construction Operation	**Sediment, Erosion and Water Quality Management Plan** 1. Prior to the commencement of construction, develop and implement a Sediment, Erosion and Water Quality Management Plan as a sub-plan to the Construction Environmental Management Plan (EMM01) in consultation with Glenelg Hopkins Catchment Management Authority in accordance with EPA Publication 1834.2: Civil construction, building and demolition guide. 2. Erosion and sediment control measures within the construction site will adopt a treatment train approach and include: a. monitoring surface water quality upstream and downstream of the works area during detailed planning, construction and operation phases to confirm control effectiveness and protection of environmental values b. phasing ground-disturbing works to periods of lower rainfall, where possible c. minimising vegetation clearance, particularly along drainage lines, waterways and steep slopes d. reinstating vegetation in accordance with EMM LS02 e. maintaining watercourse and wetland buffers (except at watercourse crossings) and implementing management controls for works near waterways in accordance with EPA Publication 1894: Managing soil disturbance f. installing primary, secondary and tertiary sediment control measures based on site-specific hazards, consistent with Publication 1893: Erosion, sediment and dust: treatment train g. designating areas for stockpiles prior to construction, ensuring stockpiles and batters have slopes no greater than 2:1 (horizontal/vertical) h. implementing stockpile management controls consistent with EPA Publication 1895: Managing stockpiles and establishing vegetation or grass on stockpiles to be left for longer periods i. stabilising exposed soils and applying soil disturbance controls in accordance with EPA Publication 1894: Managing soil disturbance j. installing sediment fencing to protect riparian zones where works occur within 30 metres of waterways k. installing sediment treatment controls (including around stockpiles) to adequately capture sediment loads l. restricting vehicle movements to designated roads and access areas m. directing stormwater through constructed lined channels or sediment basins to reduce runoff velocity n. developing contingency measures for works within waterways or floodplains, including controls to be implemented when storm events are forecast.	SW04

Biodiversity impact	Project phase	Management measures	Number
Collision with wind turbine blades	Operation	**Bat and Avifauna Management Plan** 3. Attachment V - Bat and Avifauna Management Plan has been prepared for the project in accordance with the following guidelines and will be implemented prior to the commencement of operation to minimise impacts to bat and avifauna species: a. Onshore Wind Farm Guidance – interim guidance on bird and bat management (Department of Agriculture, Water and the Environment, 2022) b. Onshore Wind Farm Guidance: Best practice approaches when seeking approval under Australia's national environment law (Department of Climate Change, Energy, the Environment and Water, 2024a). 4. Attachment V - Bat and Avifauna Management Plan outlines monitoring protocols and responsibilities, impact triggers for listed and non-listed bird and bat species, and operational procedures following occurrence of impact triggers including reporting requirements. Adaptive management measures to reduce impacts will be considered as part of the Bat and Avifauna Management Plan. 5. Attachment V - Bat and Avifauna Management Plan outlines committed financial compensatory measures that would be implemented in response to a significant impact (above the relevant defined impact threshold) to species listed under the *Environment Protection and Biodiversity Conservation Act 1999* during project operation. 6. Attachment V - Bat and Avifauna Management Plan include species-specific management strategies for the following species of concern to focus management efforts and improve mitigation effectiveness in response to impact triggers: a. Blue-winged Parrot (*Neophema chrysostoma*) b. White-throated Needletail (*Hirundapus caudacutus*) c. Fork-tailed Swift (*Apus pacificus*) d. Brolga (*Grus rubicunda*) e. Black Falcon (*Falco subniger*) f. Wedge-tailed Eagle (*Aquila audax*) g. Grey-headed Flying-fox (*Pteropus poliocephalus*) h. Southern Bent-wing Bat (*Miniopterus orianae bassanii*) i. Yellow-bellied Sheath-tailed Bat (*Saccolaimus flaviventris*) 7. Key measures of Attachment V - Bat and Avifauna Management Plan are outlined in EMM BA01-1 through BA01-7. 8. Attachment V - Bat and Avifauna Management Plan will be a sub-plan to the Operations Environmental Management Plan (EMM09).	BA01

Biodiversity impact	Project phase	Management measures	Number
	Operation	**Bat and Avifauna Management Plan - Curtailment strategies** 1. As detailed in Attachment V - Bat and Avifauna Management Plan,the minimum required wind speed for night-time operation of moderate and higher-risk turbines (i.e., the night-time low windspeed cut-in) will be increased to 4.5 m/s during periods when Southern Bent-wing Bat are most actively moving across the landscape to reduce the risk of collision between wind turbines and the Southern Bent-wing Bat (*Miniopterus orianae bassanii*). 2. Curtailment conditions for each turbine will be outlined in Attachment V - Bat and Avifauna Management Plan (BA01), and updated as required in response to monitoring undertaken as part of Attachment V - Bat and Avifauna Management Plan. This includes temporary daytime curtailment of turbine(s) within a 300-metre buffer of active Black Falcon (*Falcon subniger*) and Wedge-Tailed Eagle (*Aquila audax*) nests identified during operation. 3. The Department of Energy, Environment and Climate Action will be consulted regarding specific parameters for each turbine to confirm adequacy and acceptability of these measures.	BA01-1
	Operation	**Bat and Avifauna Management Plan – Black Falcon** 4. As detailed in Attachment V - Bat and Avifauna Management Plan (BA01), the wind farm operator will liaise with relevant landowners to minimise certain farming activities that may attract Black Falcon (*Falcon subniger*), such as tractor activity in cropped paddocks and stubble burns, close to turbines and establish communication procedures.	BA01-7

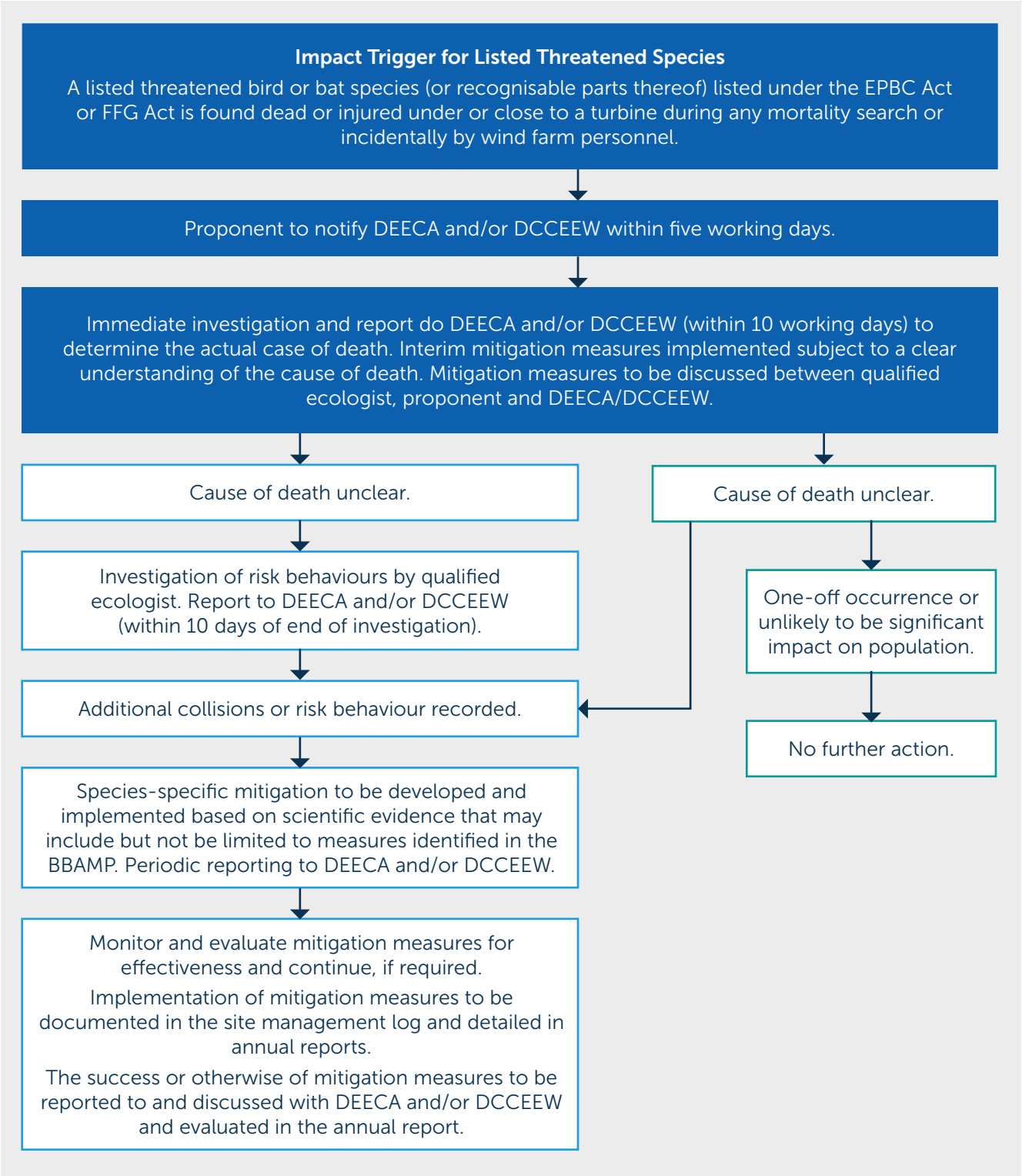


Figure 8.13 **Proposed decision making framework for identifying and mitigating impacts on threatened bird and bat species within the bird and bat adaptive management plan**

8.7.4 Offsets

Native vegetation unable to be retained during the design and construction phases would be offset in accordance with the Guidelines (DELWP, 2017c). The amount of native vegetation required to be offset for the project is presented in Table 8.16 and discussed in detail in Appendix D – ***Flora and Fauna Assessment***.

Table 8.16 Project offset requirements

Aspect	Offset requirement
Wind farm site, Geelong Transport Route option and local road upgrades	
General offset amount	2.8860 general habitat units
Vicinity	Glenelg Hopkins Catchment Management Authority boundary or the Moyne Shire Council municipal district
Minimum strategic biodiversity value	0.3494
Large trees to be offset	8
Wind farm site, Portland Transport Route option and local road upgrades	
General offset amount	2.8830 general habitat units (Moyne Shire) 0.1000 general habitat units (Southern Grampians Shire)
Vicinity	Glenelg Hopkins Catchment Management Authority boundary, the Moyne Shire Council municipal district or the Southern Grampians Shire Council municipal district
Minimum strategic biodiversity value	0.3470 (Moyne Shire) 0.4170 (Southern Grampians Shire)
Large trees to be offset	13
Wind farm site, Combined Transport Route option and local road upgrades	
General offset amount	2.9110 general habitat units (Moyne Shire) 0.1000 general habitat units (Southern Grampians Shire)
Vicinity	Glenelg Hopkins CMA boundary, the Moyne Shire municipal district or Southern Grampians Shire municipal district.
Minimum strategic biodiversity value	0.3490 (Moyne Shire) 0.4170 (Southern Grampians Shire)
Large trees to be offset	13

The following MNES may be significantly impacted by the project and would therefore require offsets under the EPBC Act:

- Natural Temperate Grassland of the Victorian Volcanic Plain
- Grassy Eucalypt Woodland of the Victorian Volcanic Plain
- Spiny Rice-flower
- Striped Legless Lizard.

Direct offsets are discussed in Chapter 27 – ***Matters of National Environmental Significance*** and will be secured in accordance with the Environment Protection and Biodiversity Conservation Act 1999 Environmental Offsets Policy (DSEWPaC, 2012), with a conservation covenant registered on title under the Victorian *Conservation Trust Act 1972* or a Section 69 Landowner Agreement. An Offset Management Plan will be prepared for each site to the satisfaction of DCCEEW, Trust for Nature / DEECA and the landowner. Each Offset Management Plan detail how the offset will be secured, managed and monitored to meet the defined environmental outcomes. All offsets must be secured prior to the removal of native vegetation.

8.7.5 Residual impacts

After the development of design measures and management controls, an assessment of residual effects was completed describing the likely changes to vegetation, ecological communities, and populations of flora and fauna brought about by the construction, operation and eventual decommissioning of the project, and rating the significance of these effects.

Impacts were rated using the criteria outlined in Table 8.17.

Table 8.17 Impact criteria for biodiversity impacts

Rating	Criteria
Very high	The effects on ecological values extend beyond the investigation areas across its entire range. Major loss or alteration to ecological value and/or loss of a significant proportion of the known population or range of the value with the viability of the biological value reduced.
High	The effects on ecological values extend beyond the investigation areas within the region. Loss or alteration to ecological value and/or loss of a proportion of the known population or range of the value with the viability of the biological value reduced. The effects are contained within the bioregion.
Moderate	Loss or alteration to ecological value that is readily detectible with respect to natural variability, and/or loss of a moderate proportion of the known population or range of the value with limited overall reduction in the viability of the value. The effects are contained within the project site.
Low	Minor effect from existing baseline conditions. Effects unlikely to reduce the overall viability of the ecological value. The effects contained within the construction disturbance area and operational footprint.
Very low	Effects likely to be very low or barely detectable and reduction in the viability of the ecological value is highly unlikely. The effects are limited to areas within the construction disturbance area and operational footprint.

Vegetation loss (from clearance, earthworks and physical disturbance)

The primary impact pathway resulting in the direct loss and/or degradation of native vegetation is from vegetation clearance, earthworks and physical disturbance. Physical disturbance will primarily occur during construction, although a small amount of disturbance is also expected during decommissioning of the project.

Native vegetation

As the project has been developed in accordance with the 'avoid' and 'minimise' principles, most native vegetation has been avoided and would be retained. Depending on the selected transport route, construction of the project will result in impacts to 8.238 hectares (Geelong Transport Route option), 8.423 hectares (Portland Transport Route option), or 8.533 hectares (Combined Transport Route option) of native vegetation, including scattered trees, and up to nine large trees in patches. Impacts to native vegetation have been assessed as low, with direct impacts to approximately 10% of all mapped native vegetation and 1.4% of the construction disturbance area. Within the project site, this will occur as small occurrences across 16,104-hectares, with direct and indirect impacts will be contained within the project construction disturbance area. The average conditions score of native vegetation to be impacted is 21 out of 100.

Table 8.18 Proposed impacts to native vegetation (by project component)

Project component	Native vegetation patches (hectares)			Large trees in patches			Scattered trees			Total including scattered trees as vegetation (hectares)		
Project site	6.466			4			4 large and 2 small trees (comprising of 0.343 hectares)			6.809		
Road widening	1.180 m			0 m			0 m			1.180		
Transport route	*Geelong*	*Portland*	*Combined*	*Geelong*	*Portland*	*Combined*	*Geelong*	*Portland*	*Combined*	*Geelong*	*Portland*	*Combined*
	0.249	0.432	0.542	0	5	5	0	0	0	0.249	0.432	0.542
Total										**8.238**	**8.423**	**8.533**
									Approx. % within construction disturbance area		**1.4%**	
									Approx. % of all mapped native vegetation		**10%**	

Threatened ecological communities

Three threatened ecological communities occur in the investigation area and have the potential to be impacted. These are:

- Natural Temperate Grassland of the Victorian Volcanic Plain (EPBC Act: Critically endangered)
- Grassy Eucalypt Woodland of the Victorian Volcanic Plain (EPBC Act: Critically endangered)
- Western (Basalt) Plains Grassland Community (FFG Act: Listed).

The proposed impacts of project construction on these ecological communities are summarised in Table 8.19, with the location of these impacts shown in Figure 2-1 through Figure 2-57 of Appendix D – ***Flora and Fauna Assessment.***

While a portion of the patch of each threatened ecological community may be impacted, with the implementation of proposed management controls these are unlikely to affect the overall viability of each habitat patch. Direct and indirect impacts will be contained within the construction disturbance area. The predicted impacts to Grassy Eucalypt Woodland of the Victorian Volcanic Plain, Natural Temperate Grassland of the Victorian Volcanic Plain and Western (Basalt) Plains Grassland Community associated with direct loss from clearance, earthworks and physical disturbance have been assessed as low.

Table 8.19 Proposed impacts to threatened ecological communities (by project component)

	Ecological community impacts (hectares)											
Project component	**NTGVVP**			**GEWVVP**			**W(B)PGC**			**WBPGW**		
Project site	0			0			0			0		
Road widening	0.570 m			0.247 m			0.723 m			0 m		
Transport route	*Geelong*	*Portland*	*Combined*	*Geelong*	*Portland*	*Combined*	*Geelong*	*Portland*	*Combined*	*Geelong*	*Portland*	*Combined*
	0.016	0.021	0.025	0	0	0	0.020	0.083	0.095	0	0.007	0.007
Total (hectares)	**0.586**	**0.595**	0.605	**0.247**	**0.247**	**0.247**	**0.743**	**0.0.806**	**0.818**	**0**	**0.007**	**0.007**
Approx. % of all mapped area	**2.8%**	**2.9%**	**2.9%**	**2.2%**	**2.2%**	**2.2%**	**2.2%**	**2.4%**	**2.5%**	**0%**	**2.7%**	**2.7%**

Key to ecological community names:

- NTGVVP: Natural Temperate Grassland of the Victorian Volcanic Plain
- GEWVVP: Grassy Eucalypt Woodland of the Victorian Volcanic Plain
- W(B)PGC: Western (Basalt) Plains Grassland Community
- WBPGW: Western Basalt Plain (River Red-gum) Grassy Woodland

Threatened flora

Purple Blown-grass (FFG Act: Endangered) was recorded during the site surveys and the following impacts are anticipated:

- one individual along the Geelong Transport Route option, equating to 3.7% of recorded Purple Blown-grass individuals
- five individuals along the Portland Transport Route option, equating to 18.5% of recorded Purple Blown-grass individuals
- six individuals along the Combined Transport Route option, equating to 22.2% of recorded Purple Blown-grass individuals.

The predicted impacts to Purple Blown-grass associated with direct loss from clearance, earthworks and physical disturbance have been assessed as low (for the Geelong Transport Route option) or moderate (for the Portland Transport Route and Combined Transport Route options).

The project has avoided all recorded individuals of Spiny Rice-flower, and this species is therefore not anticipated to be impacted. The individual Dianella recorded, unable to be identified at the species-level but with the potential to be a Matted-flax Lily or Glaucous Flax Lily, is located outside the construction disturbance area and operational footprint, and will not be impacted.

With the implementation of design measures and management controls, residual impacts to other listed flora species from direct loss are not anticipated and considered very low.

Habitat and vegetation degradation from indirect impacts

The project has the potential to indirectly degrade native vegetation and ecological communities through various pathways, including via the introduction or spread of weeds and pathogens, changes to surface water hydrology and groundwater availability, and deposition of eroded sediments.

Weeds and pathogens may be spread by construction plant and equipment, which could negatively impact the quality of remnant vegetation. During construction, activities such as clearing native vegetation, stockpiling materials and exposing bare ground create disturbed areas that are more susceptible to invasion by weeds and pathogens. To minimise this risk, biodiversity and biosecurity management measures will be incorporated within the Construction Environmental Management Plan, including the requirement for decontamination bays and protection zones [EMM BH01].

Operation of the proposed on-site quarry would require groundwater dewatering. Excavations for wind turbine foundations also have the potential to intercept shallow groundwater and require dewatering for a short period. These activities may temporarily reduce groundwater levels and affect groundwater availability at these locations. A Water Management Plan would be developed and implemented to minimise impacts to groundwater discharge, recharge and flow [EMM GW05].

Where project activities are close to watercourses or watercourses are downslope of earthworks and construction activities, erosion may cause sediment-laden runoff to enter watercourses and reduce water quality, affecting riparian habitats. A 100-metre buffer was placed around all DEECA mapped wetlands to exclude all project infrastructure as a means of avoiding physical disturbance to wetlands and their fringes and to limit the likelihood of poor-quality surface water runoff from construction works zones reaching these areas. To further minimise these impacts, sediment control measures would be also applied and watercourse crossings avoided during high flow periods, where possible [EMM SW04].

Native vegetation, threatened ecological communities and flora

Proposed management controls (e.g., vegetation protection zones and waterway protection measures [EMMs BH02 and SW04]) will minimise indirect impacts to native vegetation, threatened ecological communities and flora species during project construction, operation and decommissioning. The significance of the residual impact is considered very low.

Groundwater Dependent Ecosystems

An assessment of impacts to potential GDEs in the three different aquifers that may occur within the project site was undertaken as part of the Surface Water and Groundwater Impact Assessment (Appendix B).

Groundwater extraction would be limited to locations where a perched or very shallow aquifer is encountered during construction. If shallow groundwater is intercepted during construction, localised groundwater from the uppermost zones may seep into the excavated area. Under this scenario, groundwater abstraction via pumping (termed 'dewatering' of the excavation) may be required to create a safe work area. Dewatering may temporarily lower the water table until the concrete foundations are laid.

Buffers from aquatic and terrestrial systems were incorporated into the design of the project to minimise the potential for impacts on GDEs, and management measures have also been proposed for the construction, operation and decommissioning phases of the project to further reduce impacts.

With any impacts to GDEs likely to be temporary, and with the implementation of management controls proposed to manage potential impacts to groundwater (detailed in Chapter 11 – ***Groundwater***), the residual impacts to GDEs are likely to be low. Impacts to GDEs from drawdown associated with turbine and infrastructure foundation construction and excavations are considered low to very low, only expected to occur briefly during winter and spring when watertables are typically higher, and the risk of accidentally released, fuels and chemicals stored within the project site impacting GDEs are considered low.

Refer to Chapter 11 – ***Groundwater*** for further assessment of potential impacts to GDEs.

Fauna habitat loss or alteration (direct and indirect impacts)

During construction, there is the potential for direct habitat loss from vegetation clearance and physical disturbance associated with construction earthworks, as well as habitat degradation from indirect effects such as hydrological changes and reduced water quality from deposition of eroded sediments. The potential direct and indirect impacts of the project on fauna habitat are discussed below.

The current construction disturbance area and operation footprint will not have a significant impact on any habitat for any rare or threatened species. Most creek crossings have been designed to utilise existing crossing points. Where necessary these will be upgraded, however impacts to waterways will be temporary and localised. Targeted surveys did not record listed fish species, and despite the age of these surveys, no impacts to these species are anticipated.

Threatened birds

The Australasian Shoveler, Blue-billed Duck, Freckled Duck and Musk Duck prefer well-vegetated and deep-water wetland habitats and are considered susceptible to impacts from changes to or disturbance or loss of wetland habitat. The project proposes to remove up to 6.122 hectares of wetland vegetation within the project site and 0.008 hectares within the Geelong Transport Route or Combined Transport Route options. However, most of the wetland vegetation patches impacted do not hold water of a depth and extent suitable for these

species in most years. With the implementation of proposed management controls, including establishment of waterway protection measures [EMM SW04], the residual impact to these species from habitat loss from direct or indirect impacts to wetland habitat is anticipated to be very low to low.

While the project site falls within the breeding range of Blue-winged Parrot, this species has not been recorded in surveys undertaken for the project during the breeding season. Avoiding removal of all hollow-bearing trees within the project site and along the transport route is recommended to avoid loss of breeding sites for this species. However, where potential nesting habitat is identified during pre-clearance surveys and removed, impacts would be mitigated through the installation of nest boxes [EMM BH06]. The significance of the residual impact is considered low to moderate, depending on whether Blue-winged Parrot is confirmed to breed on site and the type and extent of habitat removed.

Up to five large scattered trees may be removed along the Portland Transport Route option that are considered suitable foraging habitat for the Gang Gang Cockatoo. However, given the small extent of potential impacts, the significance of these impacts in relation to habitat loss for the Gang Gang Cockatoo are considered very low.

Migratory shorebirds and waterbirds

Due to the ephemeral nature of most waterbodies and the lack of muddy shorelines within the project site there is little suitable habitat for most species of migratory shorebird. However, habitat for Latham's Snipe is found along Mustons Creek and some of the muddy margins of the large lake (unnamed) and large dams within the project site. Given the lack of habitat for most migratory shorebirds and the results of surveys undertaken for the project, it is considered that migratory shorebirds would only be present in small numbers that do not meet significant population thresholds at the international (1 % of flyway population) or national (0.1% of the flyway population) levels.

Up to 6.122 hectares of wetland vegetation within the project site and 0.008 hectares within the Geelong Transport Route or Combined Transport Route options is proposed to be removed for the project, with the majority of this removal (five hectares) comprising two Plains Grassy Wetland EVC locations around turbines 57, 108 and 109. These areas are characterised by dense grassy vegetation, which does not provide suitable or high-quality habitat for most migratory shorebirds. The exception is Latham's Snipe, which may use such areas opportunistically when shallowly inundated, noting that these sites are highly ephemeral. The Sharp-tailed Sandpiper may also utilise open grassy wetlands on occasion, however in small numbers, with the species likely to stick to large, semi-permanent water bodies which are not located within the construction disturbance area. This removal is approximately 16% of the wetland habitat mapped within the investigation areas and larger areas of suitable habitat are available to these species including in DEECA mapped wetlands which are largely avoided, and along Mustons Creek and Drysdale Creek.

Significant impacts associated with the direct removal of wetland habitat are considered low to moderate depending on the frequency and timing of wetland inundation, with inundation during spring and summer of greater concern due to presence of migratory shorebirds during these seasons, and the depth and extent of water when flooded, with shallow extensive wetlands preferred by migratory shorebirds.

Proposed design measures and management controls, including waterway protection measures [EMMs SW01 and EMM SW02] and project design minimise impacts to surface water flow paths [EMM SW01], will minimise indirect impacts to suitable wetland habitat. The significance of the residual impact from habitat loss through indirect impacts to wetlands is considered very low. Moving turbines 57, 108 and 109, which require the majority of vegetation removal, is not considered practical as it would compromise turbine spacing, impacting turbine efficiency, and necessitate substantial redesign of access tracks and electrical cabling. This was considered disproportionate given the assessed residual risk to shorebirds.

Growling Grass Frog

Based on survey results, it is assumed that Growling Grass Frog use the Mustons Creek for most parts of the year in the sections that retain sizable water pools. Mustons Creek connects to the Hopkins River to the east of the project site and therefore provide continuous habitat for Growling Grass Frog. Several other smaller tributaries of Mustons Creek within the project site could provide habitat for Growling Grass Frog during the wet season and form a continuous network of wetland habitat. While some permanent dams in the project site and along the transport route may contribute to distribution of Growling Grass Frog, most dams lack proper habitat and are of low value for the species.

Wind turbines have been set back 100 metres from potential habitat along Mustons Creek, Hopkins River and other suitable wetland habitat. Where essential wind farm infrastructure (e.g. access tracks) intersects a creek line or potential wetland habitat, disturbance of banks, channels and nearby vegetation shall be kept to a minimum and, if feasible, restored or enhanced to at least its pre-construction condition [EMM SW03]. Waterway protection measures will be included in the Construction Environmental Management Plan, including sediment fencing if works are to be undertaken within 30 metres of waterways [EMM SW01 and EMM SW04]. These measures, described in Chapter 12 – ***Surface water***, are also relevant to minimising impacts to the Growling Grass Frog.

Provided the known sites for Growling Grass Frog are avoided, alteration of habitat at creek crossings is minimised and construction at these locations is undertaken when the species is mostly in the water and active [EMM BH08], impacts on the local population of Growling Grass Frog are likely to be minimal and the significance of residual impacts associated with direct removal of habitat are expected to be very low to low (depending on whether Growling Grass Frog are present in habitats within impacted areas).

Proposed design measures and management controls are expected to avoid and minimise indirect impacts to Growling Grass Frog habitat, and the significance of residual impacts is considered very low.

Hairy Burrowing Crayfish

The preferred habitat for Hairy Burrowing Crayfish includes waterways and wetlands but can be found some distance from water itself on floodplains and in wet areas. This species may be susceptible to impacts from habitat loss due to construction in or around waterways, such as crossing points of Mustons Creek, and in low-lying areas near waterways during the wetter months.

To avoid and minimise impacts to Hairy Burrowing Crayfish, earthworks, creek crossings and vegetation removal in areas of suitable habitat for Hairy Burrowing Crayfish would be scheduled to occur during drier months when the species retreats closer to permanent water bodies and impacts would be expected to be lower, and disturbance within 30 metres from wetlands and waterways considered as potential Hairy Burrowing Crayfish habitat would be avoided, where possible [EMM BH09]. As noted for the Growling Grass Frog, a 100-metre wind turbine buffer has been set around potential habitat along Mustons Creek, Hopkins River and other suitable wetland habitat for the Hairy Burrowing Crayfish.

The significance of the residual impact on Hairy Burrowing Crayfish associated with direct removal of habitat is considered low to moderate, depending on its presence in potential habitats within the construction disturbance area.

Proposed design measures and management controls are anticipated to avoid and minimise indirect impacts to Hairy Burrowing Crayfish habitat, and the significance of the residual impact is considered very low.

Fat-tailed Dunnart

Removal of grassland EVC, considered to provide habitat for Fat-tailed Dunnart, is proposed, including up to 0.3 hectares within the project site, 1.175 hectares due to local road upgrades, as well as 0.241 hectares associated with the Geelong Transport Route option, 0.432 hectares associated with Portland Transport Route option, 0.534 hectares associated with the Combined Transport Route option. Management measures would be implemented during construction to avoid and minimise impacts to this species, including establishment of tree protection zones [EMM BH02]. Within identified habitat areas proposed to be removed, salvage and relocation of Fat-tailed Dunnart would be undertaken, where practicable, prior to the commencement of construction activities [EMM BH03].

If Fat-tailed Dunnart is found to occur in most roadside grasslands, the significance of the impact from habitat loss would be considered moderate due to the historical range contraction the species has experienced in Victoria. Indirect impacts to Fat-tailed Dunnart habitat are not anticipated.

Striped Legless Lizard and Tussock Skink

Striped Legless Lizard and Tussock Skink are susceptible to impacts from the removal of suitable grassland habitat within road reserves and patches of Plains Grassy Woodland and Plains Grassland EVCs within the project site. Removal of up to 1.91 hectares of Plains Grassy Woodland and Plains Grassland EVCs are proposed within the project site (associated with the wind turbines and access tracks) and road reserves

(associated with local road upgrades and the transport route). Their occurrence may also extend into areas of non-native grassland vegetation, which support less than 25% native vegetation cover.

A number of management controls are proposed to minimise potential impacts to the Striped Legless Lizard and Tussock Skink, including a salvage and translocation protocol if either species is discovered during construction works [EMM BH03] and scheduling project activities in areas of suitable habitat in warmer months when Striped Legless Lizard and Tussock Skink are most active and able to move out of construction area [EMM BH10]. Prior to removal of habitat, grasslands will also be modified to facilitate dispersal of these species [EMM BH10].

If Striped Legless Lizard occur in roadside grasslands, the significance of the residual impact, following the implementation of management controls, would be low to moderate (depending on the actual occurrence) given the historical range contraction in Victoria. However, the residual impacts would be low for Tussock Skink as their habitat requirements mean they are able to survive in exotic pastures with appropriate shelters (e.g., rocks). Indirect impacts to Striped Legless Lizard and Tussock Skink habitat are not anticipated.

Golden Sun Moth

If present, the Golden Sun Moth may be susceptible to impacts through the removal of suitable grassland habitat which largely occurs within road reserves, which may be subject to road upgrades in some areas. On a precautionary basis, the total impact to grassland EVCs has been considered, including up to 0.300 hectares within the project site, 1.175 hectares due to local road upgrades, as well as 0.241 hectares associated with the Geelong Transport Route option, 0.432 hectares associated with Portland Transport Route option, 0.534 hectares associated with the Combined Transport Route option.

Given the Golden Sun Moth has not been recorded during project surveys and low number of records in the area, the implementation of proposed management controls (e.g., vegetation protection zones and habitat restoration following construction [EMMs BH01 and BH02]), would result in the significance of the residual impacts of Golden Sun Moth habitat loss being considered low. Additional avoidance and minimisation measures will also be included in the Construction Environmental Management Plan should this potential presence of this species be confirmed through habitat suitability surveys undertaken prior to vegetation removal [BH03].

Indirect disturbance to fauna (including due to noise)

Vehicle movements, human activity and noise will increase significantly during construction, and may be focused at specific locations within the project site where turbine or infrastructure construction is occurring. Almost weekly blasting from the on-site quarry is anticipated to occur during the project construction phase. These activities have the potential to disturb native fauna. In particular, increased noise can cause a wide range of behavioural changes in some fauna species, which can in turn effect breeding and foraging success (Jakob-Hoff et al., 2019; Shannon et al., 2016). However, as construction is temporary and intermittent (estimated to last for short periods at any one site during construction), long-term exclusion of fauna from these disturbed areas is not anticipated.

During operation, there would be a lower level of vehicle traffic, human activity in the project area. Noise from wind turbines is usually continuous and does not vary suddenly. As the project is within an agricultural landscape with various sources of human-made noise, it is considered unlikely that fauna in adjacent habitats will be persistently disturbed by project operation and associated maintenance works.

Wedge-tailed Eagle

Wedge-tailed Eagles are highly vulnerable to disturbance during sensitive phases of the breeding cycle (Olsen, 2005; Rowe et al., 2018), and human activity can lead to Wedge-tailed Eagles deserting the nest. There is evidence that Wedge-tailed Eagles can become habituated to routine traffic and farming activity, however research has also identified failed nesting when visually exposed to busy roads within 400 metres (Rowe et al., 2018).

During the project design process, a 500-metre wind turbine and overhead transmission line exclusion buffer

was applied to all known Wedge-tailed Eagle nests based on previous research and observations by Nature Advisory of Wedge-tailed Eagles successfully breeding at this distance from wind turbines. Temporary daytime curtailment of wind turbine(s) will also be undertaken within a 300-metre buffer of active Wedge-tailed Eagle breeding nests identified during operation [BA01-1] .

Collision with turbines

During operation of the project there would be expected to be some bird deaths from collisions with wind turbines. The impact of wind turbine collisions is discussed in the following section.

Threatened birds

As a raptor species, the foraging behaviour of Black Falcon and Little Eagle means they are considered a higher risk for turbine collisions than other bird groups. However, the presence of these species in the project site is likely to be low given the low number of observations during project surveys and collisions are expected to be highly infrequent. Black Falcon occurrences in southwest Victoria are less frequent than other regions such as the wheatbelt, however wetlands within the project site the species could attract them for foraging or even breeding. However, as site has been extensively surveyed over multiple years, with only one record, it is unlikely to host territorial pairs on an ongoing basis. Specific management measures have been included to limit construction within 200 metres of active breeding nests [EMM BH11], and temporarily curtail wind turbines within 300-meter of active breeding nests during daytime operations [EMM BA01-1]. The wind farm operator will also liaise with relevant landowners to minimise the occurrence of stubble burning and tractor activity near turbines that could potentially attract Black Falcon to the area due to displacing small birds and providing a hunting opportunity [EMM BA01-7].

Australasian Shoveler, Blue-billed Duck, Freckled Duck and Musk Duck are also considered susceptible to collisions with operating wind turbines. However, habitat for these species has been avoided and they are unlikely to fly at the Rotor Swept Area height and collide with turbines.

With the development and implementation of Attachment V - ***Bat and Avifauna Management Plan*** [EMM BA01], the significance of the residual impact to the above species from collisions is considered low.

The Blue-winged Parrot is known to fly at Rotor Swept Area heights and there are records of turbine collisions involving this species on occasion in southern-east Australia. However, it is unlikely to be disturbed by operating turbines as the species is often observed foraging in their vicinity. Given the low number of individuals observed and the irregularity of records during the surveys conducted at the project site, it is considered unlikely that the species breeds within the project site due to the lack of mature woodlands and records within the breeding season (Spring/Summer). As such, while the species is considered potentially susceptible to impacts due to collisions with wind turbines, these events are considered unlikely to occur within the project site. With the implementation of Attachment V - ***Bat and Avifauna Management Plan*** [EMM BA01], including species-specific management strategies for species of concern, the significance of the residual impact is considered low to moderate.

Migratory shorebirds and waterbirds

Based on previous research of flight altitudes during migration (Piersma et al., 1990; Tulp et al., 1994), shorebirds migrating across the project site will be at a height well above the Rotor Swept Area (i.e., above 260 metres) and therefore not at risk of collision.

While Latham's Snipe will fly at height after dusk, it is unknown whether flights occur at the Rotor Swept Area height. As with most shorebirds, Latham Snipe flights are direct, have a direct, powered flight pattern that puts

them at lesser risk of collision compared to soaring birds, which spend lengthy periods at the Rotor Swept Area height and have repeated circling trajectories, as well as less manoeuvrability (Schuster et al., 2015). Studies in operational wind farms in Europe show that similar migratory shorebirds avoid collision by flying above operating turbines, or if flying within Rotor Swept Area, avoiding the operating turbine (Krijgsveld et al., 2011). As such, this species could occasionally collide with wind turbines; however an important population (18 individuals or more) is not expected to occur within the project site. As such, it is considered unlikely that the project development would significantly impact Latham's Snipe or their habitat.

All moderate to high-quality habitat for migratory shorebirds and waterbirds has been avoided through the wind turbine design layout process. Migratory shorebirds would be able to reach heights above the Rotor Swept Area before interacting with wind turbines. However, three wind turbines are located within seasonal wetland areas, which migratory shorebirds may use seasonally or in wet years. With the implementation of Attachment V - ***Bat and Avifauna Management Plan*** [EMM BA01], the significance of the residual impact to migratory shorebird and waterbird species likely, possible or known to occur within the project site is considered low to moderate.

Migratory birds

White-throated Needletail collisions with wind turbines have been recorded by Nature Advisory at other wind farms in small numbers. However, this species was not observed in the project site during the project surveys undertaken at the time of year when they are known to occur in southern Australia, and the closest records of this species are approximately 30 to 40 kilometres from the project site. As such, White-throated Needletail is unlikely to use the area in or around the project site frequently or in large numbers. Although this species is potentially susceptible to collision, the significance of the residual impact associated with wind turbine collisions is considered very low.

The Fork-tailed Swift often flies at Rotor Swept Area heights and may be susceptible to collision with operating wind turbines. However, given the relatively high population numbers of this species (previously estimated as high as 100,000 in Victoria (DoE, 2015a)) and low number of collisions recorded at other wind farms, significance of the residual impact associated with wind turbine collisions is considered very low.

Species-specific management strategies for the White-throated Needletail and the Fork-tailed Swift will be implemented through Attachment V - ***Bat and Avifauna Management Plan*** [BA01].

Non-threatened birds of interest

Spotted Harrier has been recorded on one occasion in the northern portion of the project site, suggesting a relative low occurrence within the project site given the number of fieldwork survey days. As a medium sized raptor, flights at Rotor Swept Area heights are common. Though susceptible to collisions with wind turbines, the likelihood of collision in any given year is considered very low due to the low occurrence of the species at the project site. The significance of the residual impact is considered low.

Direct mortality during construction

Growling Grass Frog and Hairy Burrowing Crayfish

To minimise mortality of Growling Grass Frog and Hairy Burrowing Crayfish due to collision with construction traffic and/or construction activities, project construction works in areas of suitable habitat for these species would be timed occur in seasons when Growling Grass Frog are mostly in the water and active (and able to avoid machinery) and when Hairy Burrowing Crayfish retreats to permanent waterbodies [EMMs BH08 and BH09].

With the implementation of proposed management controls, the significance of the residual impact from direct mortality during construction is considered very low for Growling Grass Frog and low for Hairy Burrowing Crayfish.

Fat-tailed Dunnart, Striped Legless Lizard and Tussock Skink

During construction, Fat-tailed Dunnart, Striped Legless Lizard and Tussock Skink are likely to move away from construction areas. With the implementation of recommended management controls, residual impacts associated with direct mortality of these species are considered low.

8.7.6 Cumulative impacts

The direct and indirect impacts of the project on biodiversity, including the removal and potential degradation of native vegetation, threatened ecological communities and habitat, may result in additive cumulative effects to biodiversity values. Potential cumulative impacts were assessed considering 12 existing and planned renewable energy developments within 25 kilometres of the project site, detailed in Chapter 26 – ***Cumulative effects***. Most of these were wind farm projects, with six currently operational and four either approved or proposed. Mortlake Power Station Battery Energy Storage System and Mortlake Energy Hub (both approved) were also considered in the cumulative impact assessment.

Construction of the project has been identified as contributing to cumulative impacts to the EPBC Act listed Natural Temperate Grasslands of the Victorian Volcanic Plain and Striped Legless Lizard, which are also anticipated to be impacted due to construction of this project, Salt Creek Wind Farm, Dundonnell Wind Farm, and Mt Fyans Wind Farm.

Operational cumulative impacts are difficult to quantity due to limited data on the extent of impacts of operational wind farms on biodiversity, and uncertainty regarding the future impacts arising from each wind farm. Wind farm operation that can result in cumulative effects associated with barrier effects and collision with wind turbine blades. However, significant cumulative impacts to species of concern including the White-throated Needletail and Black Falcon are considered unlikely due to their limited presence within the project site.

Potential cumulative impacts to other biodiversity values and species-specific assessments are provided in Chapter 26 – ***Cumulative effects***.

8.7.7 Impact assessment summary

A summary of the biodiversity impact assessment is shown in Table 8.20 below, with the full assessment presented in Appendix D – ***Flora and Fauna Assessment***. This is intended for summary purposes and is not intended to capture the assessment in its entirety, which is detailed in the preceding sections.

Table 8.20 Biodiversity impact assessment summary

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Native vegetation	Direct vegetation and habitat loss from clearance, earthworks and physical disturbance	Construction	• Avoidance of native vegetation through design • Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02].	Removal of up to 8.405 hectares of native vegetation.	Approximately 10% of all mapped native vegetation will be impacted. This removal will occur as small occurrences across the 16,104 hectares project site, with direct and indirect impacts to be contained within the project construction disturbance area. The significance of the residual impact is considered **low**.
	Habitat and vegetation degradation from indirect impacts	Construction, operation and decommissioning	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02] • Waterway protection measures documented in the Construction Environmental Management Plan, including sediment fencing if works are to be undertaken within 30 metres of waterways [EMM SW04] • Design of access tracks, bridges and culverts to minimise impacts to surface water flow paths [EMM SW01] • Excavations and trenches will be backfilling using excavated material where possible to minimise groundwater recharge and flow related impacts [EMM GW04-1].	None anticipated.	Mitigation and management measures will protect native vegetation from indirect impacts. The significance of the residual impact is considered **very low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Threatened ecological communities					
Grassy Eucalypt Woodland of the Victorian Volcanic Plain Natural Temperate Grasslands of the Victorian Volcanic Plain Western (Basalt) Plains Grassland Community	Direct loss from clearance, earthworks and physical disturbance	Construction	• Avoidance of Natural Temperate Grasslands of the Victorian Volcanic Plain and Western (Basalt) Plains Grassland Community through design • Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02].	Proposed removal of: • 0.247 hectares of Grassy Eucalypt Woodland of the Victorian Volcanic Plain • Up to 0.605 hectares of Natural Temperate Grasslands of the Victorian Volcanic Plain • Up to 0.818 hectares of Western (Basalt) Plains Grassland Community • Up to 0.007 hectares of Western Basalt Plain (River Red-gum) Grassy Woodland.	Proposed impacts to these threatened ecological communities within the investigation areas equate to: • 2.2% of Grassy Eucalypt Woodland of the Victorian Volcanic Plain • Up to 2.9% of Natural Temperate Grasslands of the Victorian Volcanic Plain • Up to 2.5% of Western (Basalt) Plains Grassland Community • Up to 2.7% of Western Basalt Plain (River Red-gum) Grassy Woodland. While a portion of the patches may be impacted, with the implementation of proposed management controls this is unlikely to affect the overall viability of each habitat patch. Direct and indirect impacts will be contained within the project construction disturbance area. The significance of the residual impact is considered **low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
	Degradation from indirect impacts	Construction, operation and decommissioning	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02] • Excavations and trenches will be backfilling using excavated material where possible to minimise groundwater recharge and flow related impacts [EMM GW04-1].	None anticipated.	Proposed management controls will minimise indirect impacts to listed ecological communities. The significance of the residual impact is considered **very low**.
	Degradation from indirect impacts	Construction, operation and decommissioning	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02] • Waterway protection measures documented in the Construction Environmental Management Plan, including sediment fencing if works are to be undertaken within 30 metres of waterways [EMM SW04] • Design of access tracks, bridges and culverts to minimise impacts to surface water flow paths [EMM SW01] • Excavations and trenches will be backfilling using excavated material where possible to minimise groundwater recharge and flow related impacts [EMM GW04-1].	None anticipated.	Proposed management controls will minimise indirect impacts to listed ecological communities. The significance of the residual impact is considered **very low**.
Threatened flora					
Purple Blown-grass	Direct loss from clearance, earthworks and physical disturbance	Construction	• Avoidance of Purple Blown-grass through design • Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02].	Removal of up to six Purple Blown-grass individuals.	The significance of the residual impact to Purple Blown-grass is considered **low** (Geelong Transport Route option) to **moderate** (Portland Transport Route option) given the small number of individuals to be impacted and the remaining suitable habitat.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Other listed flora species	Habitat and vegetation degradation from indirect impacts	Construction, operation and decommissioning	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02] • Waterway protection measures documented in the Construction Environmental Management Plan, including sediment fencing if works are to be undertaken within 30 metres of waterways [EMM SW04] • Design of access tracks, bridges and culverts to minimise impacts to surface water flow paths [EMM SW01] • Excavations and trenches will be backfilling using excavated material where possible to minimise groundwater recharge and flow related impacts [EMM GW04-1].	None anticipated.	Proposed management controls will minimise indirect impacts to listed flora species. The significance of the residual impact is considered **very low**.
Threatened birds					
Australasian Shoveler Blue-billed Duck Freckled Duck Musk Duck	Habitat loss through direct removal of wetland habitat	Construction	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02].	Impacts to 6.122 hectares of wetland vegetation (Plains Grassy Wetland, Plains Sedgy Wetland, Aquatic Herbland) within the project site. Geelong Transport Route or Combined Transport Route options would impact 0.008 hectares of wetland vegetation. No impacts to this habitat associated with the Portland Transport Route option.	Most of the wetland vegetation patches impacted do not hold water of a depth and extent suitable for these species in most years. Due to requirements for Growling Grass Frog crossings, many of the impacted wetlands will be rehabilitated. Suitable habitat will remain within the project site. The significance of the residual impact is considered l**ow**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
	Habitat loss through indirect impacts to wetlands	Construction, operation and decommissioning	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02] • Waterway protection measures documented in the Construction Environmental Management Plan, including sediment fencing if works are to be undertaken within 30 metres of waterways [EMM SW04] • Design of access tracks, bridges and culverts to minimise impacts to surface water flow paths [EMM SW01] • Excavations and trenches will be backfilling using excavated material where possible to minimise groundwater recharge and flow related impacts [EMM GW04-1].	None anticipated.	Proposed management controls will minimise indirect impacts to suitable wetland habitat. The significance of the residual impact is considered **very low**.
	Collision with wind turbine blades	Operation	• Development and implementation of Attachment V - Bat and Avifauna Management Plan [EMM BA01].	Minor as these species are unlikely to occur in significant numbers and habitat has been avoided. They are unlikely to fly at Rotor Swept Area height and collide with turbines.	Habitat has been avoided, and insignificant numbers of these species within the project site that are unlikely to fly at the Rotor Swept Area height (i.e., between 40 and 260 metres above ground level). The significance of the residual impact is considered **low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Black Falcon	Collision with wind turbine blades	Operation	• Development and implementation of Attachment V - ***Bat and Avifauna Management Plan***, including species-specific management strategies for the Black Falcon [EMM BA01] • Limitations on construction activities to be conducted within 200 metres of confirmed nest sites until fledging or confirmed failure [EMM BH11] • Temporary daytime curtailment of turbine(s) within a 300-metre buffer of active Black Falcon nests identified during operation [EMM BA01-1]] • Minimisation of farming activities that may attract Black Falcon, such as tractor activity in cropped paddocks and stubble burns, close to turbines and establishment of communication procedures with relevant landowners [EMM BA01-7].	Unknown.	The significance of the residual impact is considered **low** to **moderate**, given: • Black Falcon are expected to occur irregularly, however they are known to fly at heights within the Rotor Swept Area and forage near turbines. • Collisions with wind turbines have been reported in southeast Australia. • Agricultural activities that may attract Black Falcon will be managed. • Construction and operation will be managed within set buffers of active Black Falcon nests.
Little Eagle Spotted Harrier[1]	Collision with wind turbine blades	Operation	• Development and implementation of Attachment V - ***Bat and Avifauna Management Plan*** [EMM BA01].	Unknown.	Species do not regularly occur in the project site. The significance of the residual impact is considered **low**.

1 Non-threatened bird of interest

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Blue-winged Parrot	Habitat loss through direct removal of hollow-bearing trees and hollow-bearing fence posts	Construction	• Pre-clearance surveys of potential mature treed habitat to be removed during the breeding season [EMM BH06] • Installation of compensatory nest boxes if potential breeding habitat are removed [EMM BH06].	Unknown.	The significance of the residual impact is considered **low** to **moderate**, given: • Potential losses of breeding habitat if Blue-winged Parrot is confirmed to breed on site, and depending on the type and extent of habitat removed. Habitat includes tree hollows (native or planted) and hollows in old fence stumps. • Habitat restoration and improvement (revegetation and nest boxes) will mitigate impacts from removal.
	Collision with wind turbine blades	Operation	• Development and implementation of Attachment V - ***Bat and Avifauna Management Plan***, including species-specific management strategies for the Blue-winged Parrot [EMM BA01].	Unknown.	Blue-winged Parrot is known to fly at Rotor Swept Area height and forage near wind turbines. The significance of the residual impact is considered **low** to **moderate**
Gang Gang Cockatoo	Habitat loss through direct removal of foraging trees	Construction	• Minimisation of removal of tree and woody understorey along Portland Transport Route option, and revegetation following construction [EMM BH07] • Revegetation of removed trees and woody understory after impact ceases [EMM BH07].	Removal of up to five foraging trees along the Portland Transport Route option. These are all at one location in Cavendish.	**Very low** given the small extent of potential impacts, which have been assessed on a precautionary basis.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Migratory shorebirds & waterbirds					
Australian Gull-billed Tern Common Greenshank Common Sandpiper Curlew Sandpiper Double-banded Plover Eastern Great Egret Latham's Snipe Marsh Sandpiper Red-necked Stint Sharp-tailed Sandpiper	Habitat loss through direct removal of wetland habitat	Construction	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02]	Impacts to 6.122 hectares of wetland vegetation (Plains Grassy Wetland, Plains Sedgy Wetland, Aquatic Herbland) within the project site. Geelong Transport Route or Combined Transport Route options would impact 0.008 hectares of wetland vegetation. No impacts to this habitat associated with the Portland Transport Route option.. Three wind turbines (turbines 57, 108 and 109) are proposed to impact two shallow ephemeral grassy wetlands that are likely used by migratory shorebirds and some waterbirds seasonally or in wet years.	The significance of the residual impact is considered **low** to **moderate** depending on: • the frequency and timing of wetland inundation, with inundation during spring and summer of greater concern due to presence of migratory shorebirds during these seasons • the depth and extent of water when flooded, with shallow extensive wetlands preferred by migratory shorebirds.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
	Habitat loss through indirect impacts to wetlands	Construction, operation and decommissioning	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02] • Waterway protection measures documented in the Construction Environmental Management Plan, including sediment fencing if works are to be undertaken within 30 metres of waterways [EMM SW04] • Design of access tracks, bridges and culverts to minimise impacts to surface water flow paths [EMM SW01] • Excavations and trenches will be backfilling using excavated material where possible to minimise groundwater recharge and flow related impacts [EMM GW04-1].	None anticipated.	Proposed management controls will minimise indirect impacts to suitable wetland habitat. The significance of the residual impact is considered **very low**.
	Collision with wind turbine blades	Operation	• Development and implementation Attachment V - ***Bat and Avifauna Management Plan*** [EMM BA01]	Minor given these species are unlikely to occur in significant numbers and habitat has been avoided. Unlikely to fly at Rotor Swept Area height for extended periods of time.	All moderate to high-quality habitat has been avoided. Migratory shorebirds would be able to reach heights above the Rotor Swept Area (i.e., above 260 metres above ground level) before interacting with wind turbines. Three wind turbines are located within seasonal wetland areas. Migratory shorebirds may use these wetlands seasonally or in wet years The significance of the residual impact is considered **low** to **moderate**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Migratory birds					
White-throated Needletail	Collision with wind turbine blades	Operation	• Development and implementation of Attachment V - ***Bat and Avifauna Management Plan***, including species-specific management strategies for the White-throated Needletail [EMM BA01]	Minimal as species has not been recorded in the project site.	White-throated Needletail has not been recorded at the project site. The significance of the residual impact is considered **very low**.
Fork-tailed Swift	Collision with wind turbine blades	Operation	• Development and implementation of Attachment V - ***Bat and Avifauna Management Plan***, including species-specific management strategies for the Fork-tailed Swift [EMM BA01]	Unknown.	**Very low** given the relatively high population numbers and low number of collisions recorded at other wind farms.
Mammals					
Fat-tailed Dunnart	Direct mortality during construction	Construction	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02] • Salvage and translocation Fat-tailed Dunnart is found during construction works [EMM BH03]	Minimal as species is unlikely to occur in significant numbers and is likely to move away from construction areas.	The significance of the residual impact is considered **low**, given: • The implementation of management controls during construction • The small amount of proposed habitat loss within the project site • The remaining available habitat.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
	Direct habitat loss	Construction	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02] • Salvage and translocation if Fat-tailed Dunnart is found during construction works [EMM BH03] • Habitat restoration, where applicable, once impacts cease [EMM BH01]	• Impacts to 0.300 hectares of grassland EVCs within the project site and 1.175 hectares associated with local road upgrades. • Geelong Transport Route option would impact 0.241 hectares of grassland EVCs. • Portland Transport Route option would impact 0.432 hectares of grassland EVCs. • Combined Transport Route option would impact 0.534 hectares of grassland EVCs. • Potential non-native vegetation (supporting less than 25% of native cover) that may provide habitat for this species has not been quantified, but will be managed through pre-clearance mitigations [EMM BH02].	If Fat-tailed Dunnart occurs in roadside grasslands the impact would be moderate given the historical range contraction in Victoria, with the species surviving in small grassland remnants such as roadsides. The significance of the residual impact is considered **low** to **moderate**, depending on the occurrence of the species.
	Habitat loss through indirect impacts to habitat	Construction, operation and decommissioning	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02]	None anticipated.	Proposed management controls will minimise indirect impacts to suitable grassland habitat. The significance of the residual impact is considered **very low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Frogs					
Growling Grass Frog	Direct mortality during construction	Construction	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02] • Salvage and translocation if Growling Grass Frog is found during construction works [EMM BH03] • Habitat restoration, where applicable, once impacts cease [EMM BH01] • Seasonally appropriate works to enable movement from the construction disturbance area [EMM BH08]	Minimal as construction management controls would be in place.	With the implementation of proposed management controls, the significance of the residual impact is considered **very low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
	Habitat loss through direct removal of habitat	Construction	• Establish vegetation / tree protection zones prior to construction [EMM BH02] • Salvage and translocation if Growling Grass Frog is found during construction works [EMM BH03] • Habitat restoration, where applicable, once impacts cease [EMM BH01]	Impacts to 6.122 hectares of wetland vegetation (Plains Grassy Wetland, Plains Sedgy Wetland, Aquatic Herbland) within the project site. Up to 3.5 hectares of waterway to be temporarily disturbed across the project site due to waterway crossings. Geelong Transport Route or Combined Transport Route options would impact 0.008 hectares of wetland vegetation, including some potential impacts to roadside terrestrial vegetation adjacent a small wetland. No impacts to this habitat associated with the Portland transport route.	The significance of the residual impact is considered **very low** to **low** depending on the presence of Growling Grass Frog in potential habitats within impacted areas.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
	Habitat loss through indirect impacts to habitat	Construction, operation and decommissioning	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • 100-metre buffer of all wetlands mapped in the Victorian Wetland Inventory and watercourses (including confirmed Growling Grass Frog habitat) • 30-metre buffer around ephemeral drainage lines (identified as potential waterbird and/or Growling Grass Frog habitat • Minimise disturbance of banks, channels and nearby vegetation where wind farm infrastructure crosses a creek line or wetland identified as potential habitat for Growling Grass Frog, and restore or enhance habitat where feasible [EMM SW03] • Seasonally appropriate works to enable movement from the construction disturbance area [EMM BH08] • Waterway protection measures documented in the Construction Environmental Management Plan, including sediment fencing if works are to be undertaken within 30 metres of waterways [EMM SW04]	None anticipated.	Proposed design measures and management controls will avoid and minimise indirect impacts to Growling Grass Frog habitat. The significance of the residual impact is considered **very low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Invertebrates					
Golden Sun Moth	Direct habitat loss and mortality	Construction	• Establish vegetation / tree protection zones prior to construction [EMM BH02] • Habitat restoration, where applicable, once impacts cease [EMM BH01]	Impacts consider the removal of all grassy EVCs, however within the project site some patches are likely too isolated from potential core population on road reserves. Impacts to 0.3 hectares of grassland EVCs within the project site and 1.175 hectares associated with local road upgrades. Geelong Transport Route option would impact 0.241 hectares of grassland EVCs. • Portland Transport Route option would impact 0.432 hectares of grassland EVCs. • Combined Transport Route option would impact 0.534 hectares of grassland EVCs. • Potential non-native vegetation (supporting less than 25% of native cover) that may provide habitat for this species has not been quantified, but will be managed through pre-clearance mitigations [EMM BH02].	Golden Sun Moth has not been recorded during surveys (EHP, 2014) and there are low number of records in the area. Some populations may occur in roadside vegetation proposed to be removed. The significance of the residual impact is considered **low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
Hairy Burrowing Crayfish	Direct mortality during construction	Construction	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02] • Salvage and translocation if Hairy Burrowing Crayfish is found during construction works [EMM BH03] • Seasonally appropriate works when species retreats to permanent waterbodies [EMM BH09]	Minimal as construction management controls would be in place.	With the implementation of proposed management controls, the significance of the residual impact is considered **low**.
	Habitat loss through direct removal of habitat	Construction	• Establish vegetation / tree protection zones prior to construction [EMM BH02] • Salvage and translocation if Hairy Burrowing Crayfish is found during construction works [EMM BH03] • Habitat restoration, where applicable, once impacts cease [EMM BH01]	Impacts to 6.122 hectares of wetland vegetation (Plains Grassy Wetland, Plains Sedgy Wetland, Aquatic Herbland) within the project site. Up to 3.5 hectares of waterway to be temporarily disturbed across the project site due to waterway crossings. Geelong Transport Route or Combined Transport Route options would impact 0.008 hectares of wetland vegetation. No impacts to this habitat associated with the Portland Transport Route option. Some potential impacts to terrestrial vegetation surrounding small wetlands.	The significance of the residual impact is considered l**ow** to **moderate**, depending on presence in potential habitats within the construction disturbance area.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
	Habitat loss through indirect impacts to habitat	Construction, operation and decommissioning	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • 100-metre buffer of all wetlands mapped in the Victorian Wetland Inventory and watercourses • 30-metre buffer around ephemeral drainage lines • Minimise impacts to waterways and wetlands (e.g., where feasible, undertake works when creek line or wetland is dry and restore or enhance waterway/wetland condition to at least pre-construction state) [EMM BH06] • Waterway protection measures documented in the Construction Environmental Management Plan, including sediment fencing if works are to be undertaken within 30 metres of waterways [EMM SW04]	None anticipated with the implementation of proposed management controls.	Proposed design measures and management controls will avoid and minimise indirect impacts to Hairy Burrowing Crayfish habitat. The significance of the residual impact is considered **very low**.
Reptiles					
Striped Legless Lizard and Tussock Skink	Direct mortality during construction	Construction	• Preparation and implementation of a Construction Environmental Management Plan EMM [BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02] • Salvage and translocation if Striped Legless Lizard and / or Tussock Skink is found during construction works [EMM BH03] • Seasonally appropriate works to enable movement from the construction disturbance area [EMM BH10] • Habitat modification prior to removal to facilitate dispersal [EMM BH10].	Minimal as species is unlikely to occur in significant numbers and is likely to move away from construction areas if construction occurs during active periods.	With the implementation of proposed management controls, the significance of the residual impact is considered **low**.

Biodiversity value	Impact pathway	Project phase	Mitigation and management	Likely impact (considering magnitude, extent and duration)	Impact rating and justification
	Habitat loss through direct removal of habitat	Construction	• Establish vegetation / tree protection zones prior to construction [EMM BH02] • Salvage and translocation if Striped Legless Lizard and / or Tussock Skink is found during construction works [EMM BH03] • Habitat restoration, where applicable, once impacts cease [EMM BH01] • Offsets to compensate for unavoidable impacts to habitat for Striped Legless Lizard [EMM BH04]	• Impacts to 0.300 hectares of grassland EVCs within the project site and 1.175 hectares associated with local road upgrades. • Geelong Transport Route option would impact 0.241 hectares of grassland EVCs. • Portland Transport Route option would impact 0.432 hectares of grassland EVCs. Combined Transport Route option would impact 0.534 hectares of grassland EVCs. • Potential non-native vegetation (supporting less than 25% of native cover) that may provide habitat for this species has not been quantified, but will be managed through pre-clearance mitigations [EMM BH02].	If Striped Legless Lizard occurs in roadside grasslands the impact would be moderate given the historical range contraction in Victoria, with the species surviving in small grassland remnants such as roadsides. The significance of the residual impact for Striped Legless Lizard is considered **low** to **moderate**, depending on the occurrence of the species. For Tussock Skink the significance of the residual impact is considered **low** as its habitat requirements mean they can survive in exotic pasture provided there are appropriate shelters.
	Habitat loss through indirect impacts to habitat	Construction, operation and decommissioning	• Preparation and implementation of a Construction Environmental Management Plan [EMM BH01] • Establish vegetation / tree protection zones prior to construction [EMM BH02]	None anticipated.	Proposed management controls will minimise indirect impacts to suitable grassland habitat. The significance of the residual impact is considered **very low**.

8.8 Conclusions

The project site and surrounding area have undergone widespread historical clearing to support agriculture, including dryland cropping and sheep and cattle grazing. As a result, most areas have been highly modified and remnant native vegetation is now largely confined to roadside reserves and watercourses.

From the earliest point in the project design, ecological considerations have incorporated in project development as constraints to ensure that potential impacts could be either avoided or minimised at the outset. To support this, extensive vegetation, flora and fauna surveys have been conducted over more than a decade. These surveys have included concentrated efforts to characterise the presence of threatened ecological communities and flora, and the use of the site by threatened fauna and protected migratory birds.

The entirety of the project, including facilitating the transport of project infrastructure along the transport route, will result in between 8.238 and 8.533 hectares of native vegetation being removed, including four to nine large trees in patches and six scattered trees. Depending on the transport route option chosen, road widening and transport route works will also require the removal of the following threatened ecological communities, resulting in a low level of impact:

- 0.585 to 0.605 hectares of Natural Temperate Grassland of the Victorian Volcanic Plain, listed as Critically Endangered under the EPBC Act
- 0.247 hectares of Grassy Eucalypt Woodland of the Victorian Volcanic Plain, listed as Critically Endangered under the EPBC Act
- 0.743 to 0.818 hectares of Western (Basalt) Plains Grassland Community, listed under the FFG Act
- Up to 0.007 hectares of Western Basalt Plain (River Red-gum) Grassy Woodland, listed under the FFG Act.

Vegetation removal will also impact one listed flora species, Purple Blown-grass, listed as Endangered under the FFG Act. Between one and six individuals will be impacted (depending on the preferred transport route option), resulting in a low to moderate impact to the species. Impacts to all other listed flora species are anticipated to be very low. Regardless of which transport route is chosen, native vegetation removal represents approximately 10% of all mapped native vegetation, and only 1.4% of the total area within the project construction disturbance area. Native vegetation to be retained will be included on site maps, marked, and protected during construction.

A range of fauna species listed as threatened or migratory under the EPBC Act and/or FFG Act are either known to reside within or are likely to use the project site, roadside upgrade and transport route investigation areas. This includes 13 bird species, and one species each of reptile, amphibian, and invertebrate. Depending on the species, impacts are assessed as being very low to moderate following the application of design mitigations (such as habitat buffers) and both general and species-specific management measures, including seasonal scheduling of specific construction activities, protection zones, and the establishment of nest boxes where breeding locations cannot be avoided.

Some bird species are susceptible to collision with turbine blades based on their flying behaviour and others may avoid the area. A range of management measures have been proposed in Attachment V - ***Bat and Avifauna Management Plan,*** which is being exhibited alongside this EES. With the implementation of this plan, residual risks of collision to bird species are assessed as very low to moderate (depending on the species). Potential impacts to Brolga and bat species (including the Southern Bent-wing Bat, Grey-headed Flying-fox and Yellow-bellied Sheath-tailed Bat) have been presented separately in Chapter 10 – ***Brolga*** and Chapter 9 – ***Bats***, respectively.

Offset requirements have been calculated and will be secured via DEECA's Native Vegetation Credit Register prior to vegetation removal, including habitat units with specific biodiversity value thresholds and protection of large trees.